

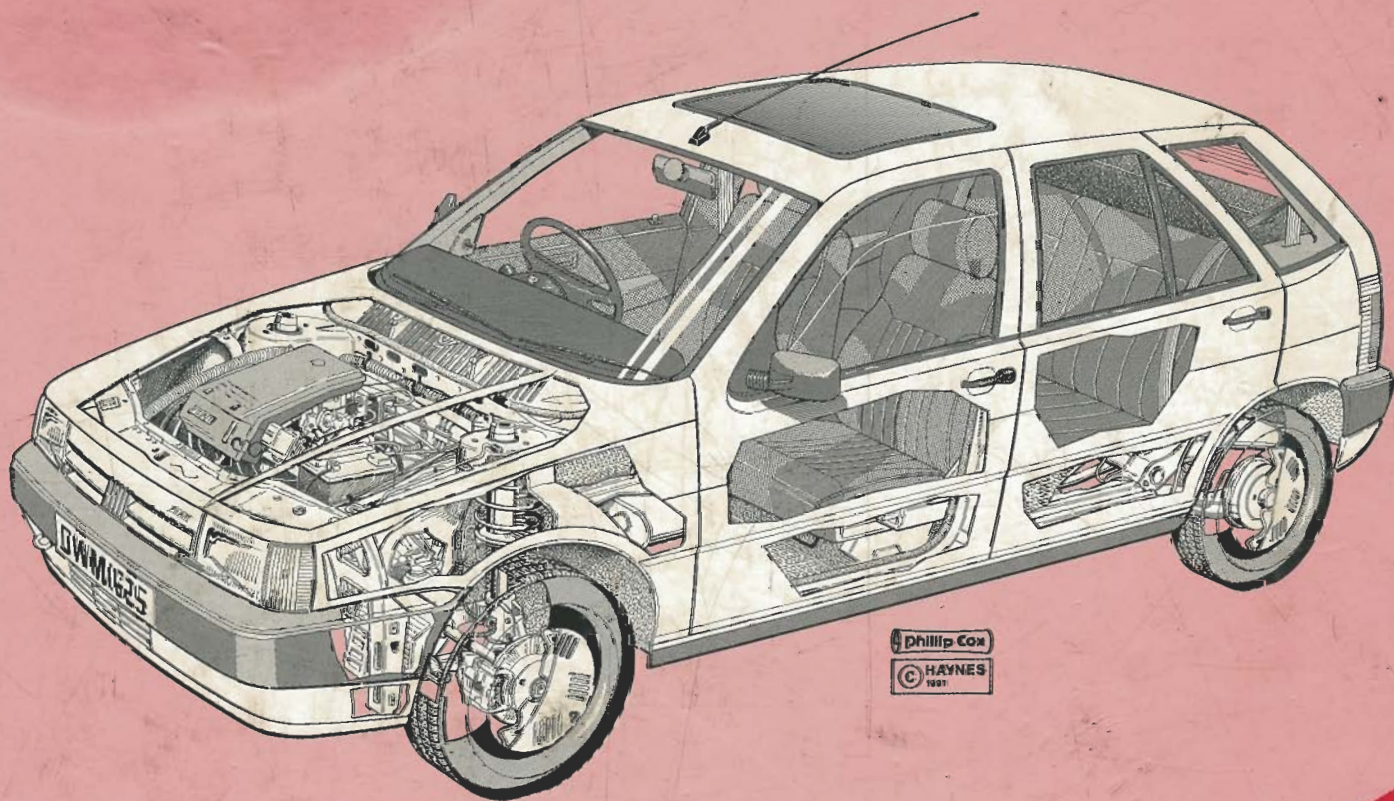
# FIAT TIPO (petrol)

1988 to 1991  
1372 cc □ 1580 cc



THE  
BOOK

## Owners Workshop Manual

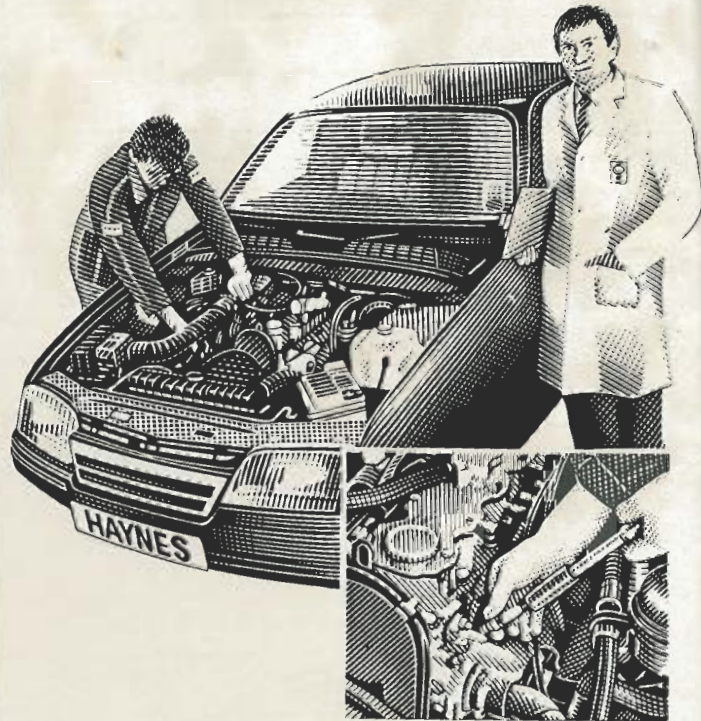


Phillip Cox  
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1987

EVERY MANUAL BASED ON  
A STRIPDOWN AND  
REBUILD



**“We fit  
Champion - so  
should you”**



#### **Acknowledgements**

Thanks are due to the Champion Sparking Plug Company Limited who supplied the illustrations showing spark plug conditions, to Holt Lloyd Limited who supplied the illustrations showing bodywork repair, and to Duckhams Oils who provided lubrication data. Certain other illustrations are the copyright of the FIAT Motor Company (UK) Limited and are used with their permission. Thanks are also due to Sykes-Pickavant Limited who supplied some of the workshop tools, and all those people at Sparkford who assisted in the production of this Manual.

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A book in the Haynes Owners Workshop Manual Series

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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.

Many of the cars we strip for our manuals are from our own fleet of vehicles or loaned by garages. Often they are cars with many thousands of miles on the clock.

As a matter of course we always fit new plugs when reassembling the engine, and these days, it has to be Champion Double Copper.

The extra performance, ease of starting, anti-fouling and longer trouble-free life, due to the copper earth and centre core electrodes, means you cannot fit a better plug.

We also fit Champion oil, air and fuel filters and, when necessary, Champion wiper blades because, as they say, "You can't beat a Champion".

**Jim Scott, Managing Director - Haynes**



**Go by the book. Fit Champion.**



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**FIAT Tipo DGT**



**FIAT Tipo DGT/SX**



## About this manual

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### *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 eleven 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 main project vehicle used in the preparation of this manual, and appearing in the majority of the photographic sequences, was a 1989 Fiat Tipo 1.6 DGT SX. Additional work was carried out and photographed on a 1989 Fiat Tipo 1.4 Formula, and a 1989 Fiat Tipo 1.6 DGT.

## Introduction to the FIAT Tipo

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The FIAT Tipo was first introduced to the UK market in July 1988 with the option of three engine sizes and three trim levels. This manual covers the petrol engines, but other models in the range are fitted with Diesel engines.

The Tipo was introduced by FIAT as the successor to the Strada. However, the Tipo was conceived as a totally fresh design, and shares very little with its predecessor. The controversial styling incorporates an unusually long wheelbase for a car of this class, together with a high roof line, which allows maximum use of interior space.

All models share the same 5-door Hatchback body style and a five-

speed manual gearbox. 1.4 and 1.6 litre engines are available. All-round independent suspension is fitted, and the suspension and drivetrain components are mounted on subframes to reduce the transmission of road noise to the passenger compartment, and to preserve the alignment of the components in the event of minor impact.

The standard equipment fitment is comprehensive across the range, and as a result, few options are available.

For the home mechanic, the Tipo is a straightforward vehicle to maintain, and most of the items requiring frequent attention are easily accessible.



# General dimensions, weights and capacities

## Dimensions

Overall length .....	3958 mm (156.0 in)
Overall width (excluding door mirrors) .....	1700 mm (67.0 in)
Overall height .....	1445 mm (57.0 in)
Wheelbase .....	2540 mm (100.0 in)
Front track .....	1429 mm (56.3 in)
Rear track .....	1415 mm (55.8 in)
Turning circle.....	10.3 m (33.8 ft)

## Weights

Kerb weight:*	
1.4 litre models .....	945 to 965 kg (2084 to 2128 lbs)
1.6 litre models .....	970 kg (2139 lbs)
Maximum gross vehicle weight .....	Refer to VIN plate
Maximum towing weight:	
Braked trailer:	
1.4 litre models.....	1100 kg (2426 lbs)
1.6 litre models.....	1200 kg (2646 lbs)
Unbraked trailer:	
1.4 litre models.....	525 kg (1158 lbs)
1.6 litre models.....	550 kg (1213 lbs)
Maximum towing hitch downward load:	
1.4 litre models .....	77 kg (170 lbs)
1.6 litre models .....	84 kg (185 lbs)

\*Exact kerb weights depend upon model and specification

## Capacities

Engine oil (including filter):	
Drain and refill .....	3.30 litres (5.80 pints)
From dry (after major overhaul) .....	3.75 litres (6.60 pints)
Cooling system .....	6.5 litres (11.4 pints)
Fuel tank .....	55.0 litres (12.1 gals)
Manual gearbox .....	1.4 litres (2.5 pints)



# Jacking, towing and wheel changing

## Jacking and wheel changing

**Note:** A "space-saver" spare wheel is provided on all Tipo models. The tyre fitted to this wheel is smaller than the standard tyres, and the wheel should only be used to travel the distance necessary to reach a suitable tyre repair specialist where the damaged tyre can be repaired. Do not exceed a speed of 50 mph (80 kmh) when using the spare wheel. The spare tyre has a maximum life of 1800 miles (3000 km)

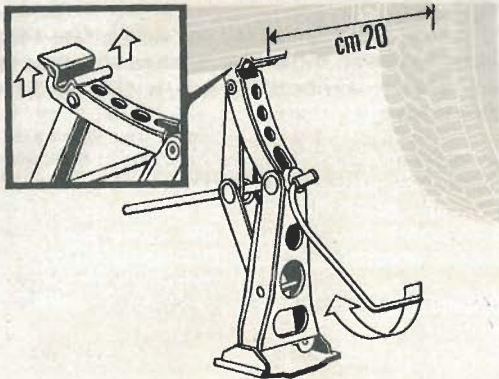
The jack supplied with the vehicle tool kit should only be used for changing roadwheels. When carrying out any other kind of work, raise the vehicle using a hydraulic jack, and always supplement the jack with axle stands positioned under the vehicle jacking points.

To change a roadwheel, first remove the spare wheel and jack from their stowage position with the spare wheel under the luggage compartment floor. Firmly apply the handbrake and engage first gear. Place chocks at the front and rear of the wheel diagonally opposite the one to be changed.

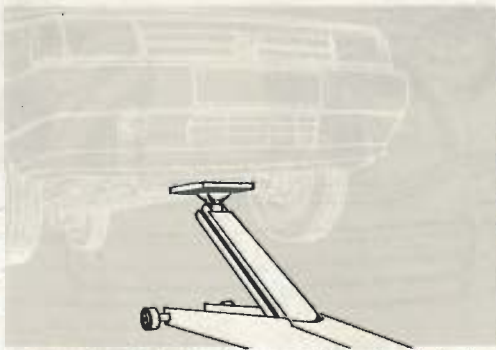
Remove the wheel trim and loosen the roadwheel bolts using the wheel brace provided in the tool kit. Position the jack head under the jacking point nearest the wheel to be changed. Raise the jack until the

wheel is clear of the ground. Note that as the car is raised, it will tend to move horizontally due to the geometry of the front suspension; the curved base of the jack is designed to compensate for this. Remove the wheel bolts and the wheel. Fit the spare wheel and secure it with the wheel bolts, noting that the locating peg on the brake disc or drum must locate in one of the four holes in the wheel rim. Lower the jack until the wheel is just touching the ground, and tighten the wheel bolts moderately tight. Now lower the jack fully and tighten the wheel bolts securely in a diagonal sequence. Refit the wheel trim, then withdraw the jack and stow the wheel, jack and wheel brace in their respective locations.

When jacking up the vehicle with a hydraulic jack, position the jack head under one of the relevant jacking points. If the rear of the vehicle is to be jacked up, a block of wood should be positioned under the rear crossmember between the jack and the vehicle, as shown in the accompanying illustration. If the front of the vehicle is to be jacked up, a block of wood should be placed between the gearbox casing and the jack. **Do not** jack the vehicle under the sump or any of the steering or suspension components. Supplement the jack with axle stands. The jacking points and axle stand positions are shown in the accompanying illustrations. **Never work under, around, or near a raised vehicle, unless it is adequately supported in at least two places.**

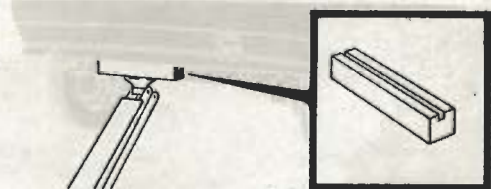


Jacking point for use with vehicle jack



Front jacking point for use with hydraulic jack

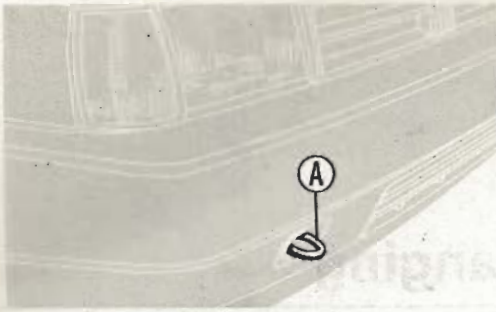
Position jack head under gearbox casing with interposed block of wood



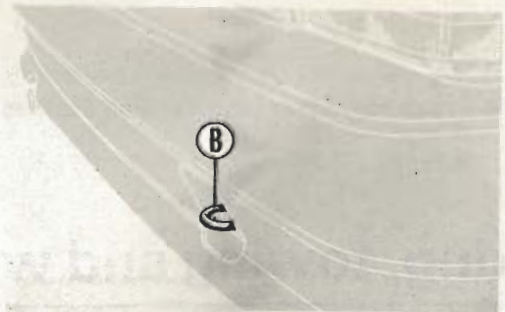
Rear jacking point for use with hydraulic jack

Dimensions of wooden block – 400 x 70 x 70 mm (16 x 3 x 3 in) with groove 10 mm (0.4 in) wide and 25 mm (1.0 in) deep





Front towing eye (A)



Rear towing eye (B)

### Towing

Towing eyes are fitted to the front and rear of the vehicle for attachment of a tow rope. Always turn the ignition key to the "MAR" position when the vehicle is being towed, so that the steering lock is released and the direction indicator and brake lamps are operational.

Before being towed, release the handbrake and place the gear lever in neutral. Note that greater than usual pedal pressure will be required to operate the brakes, since the vacuum servo unit is only operational with the engine running. Similarly, on models with power steering, greater than usual steering effort will be required.



# Buying spare parts and vehicle identification numbers

## Buying spare parts

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

**Officially appointed FIAT garages** - This is the best source for parts which are peculiar to your car, and are 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 the vehicle is still under warranty. To be sure of obtaining the correct parts, it will be necessary to give the storeman your car's vehicle identification number, and if possible, take the old part along for positive identification. Many parts are available under a factory exchange scheme - any parts returned should always be clean. It obviously makes good sense to go straight to the specialists on your car for this type of part, as they are best equipped to supply you.

**Other garages and accessory shops** - These are often very good places to buy materials 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 general accessories, usually have convenient opening hours, charge lower prices and can often be found not far from home.

**Motor factors** - Good factors will stock all the more important

components which wear out comparatively quickly (eg exhaust systems, brake pads, seals and hydraulic parts, clutch components, bearing shells, pistons, valves 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

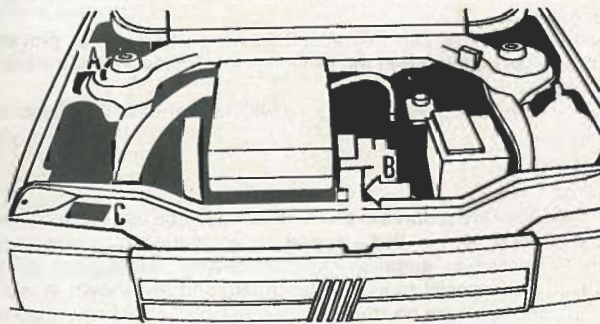
Modifications are a continuing and unpublicised process in vehicle manufacture, quite apart from major model changes. Spare parts manuals and lists are compiled upon a numerical basis, the individual vehicle identification numbers being essential to correct identification of the component concerned.

When ordering spare parts, always give as much information as possible. Quote the car model, year of manufacture, body and engine numbers as appropriate.

The **vehicle identification number (VIN)** is located on a plate in the engine compartment on the right-hand side of the body front panel (photo).

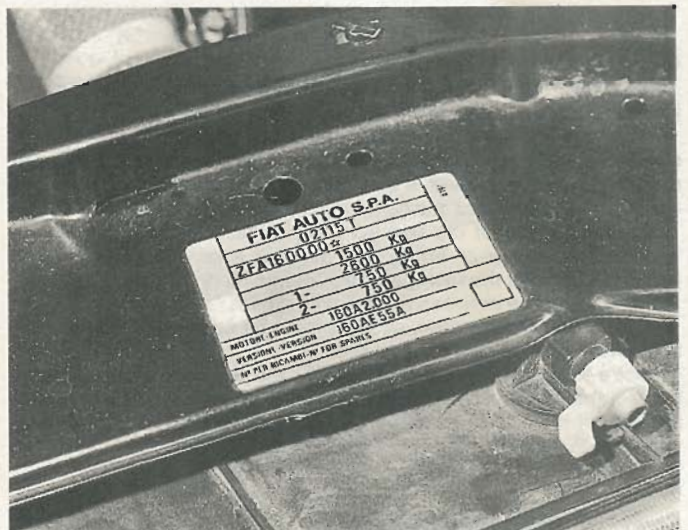
The **body (chassis) number** is stamped into the right-hand suspension turret.

The **engine number** is stamped into the flywheel end of the cylinder block casting, just below the cylinder head.



Identification number locations

- A Vehicle type code and chassis number
- B Engine number (on end-face of cylinder block)
- C VIN plate



VIN plate location



## 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.

### *Threads and fastenings*

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 will last for many years and prove an extremely worthwhile investment.

To help the average owner to decide which tools are needed to carry out the various tasks detailed in this manual, we have compiled three lists of tools under the following headings: *Maintenance and minor repair*, *Repair and overhaul*, and *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

- 1/8, 1/4, 3/8, 1/2, 5/8 & 3/4 in AF

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 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

Oil can

Oil filter removal tool

Fine emery cloth

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)*

*Self-locking grips*

*Ball pein hammer*

*Soft-faced mallet (plastic/aluminium, or rubber)*

*Screwdriver - 6 in long x 3/8 in dia (flat blade)*

*Screwdriver - 2 in long x 1/8 in dia (flat blade)*

*Screwdriver - 1 1/2 in long x 1/4 in dia (cross blade)*

*Screwdriver - 3 in long x 1/2 in dia (electrician's)*

*Pliers - electrician's side cutters*

*Pliers - needle-nosed*

*Pliers - circlip (internal and external)*

*Cold chisel - 1/2 inch*

*Scriber*

*Scraper*

*Centre punch*

*Pin punch*

*Hacksaw*

*Brake hose clamp*

*Brake bleeding kit*

*Selection of twist drills*

*Steel rule/straight edge*

*Allen keys*

*Selection of files*

*Wire brush*

*Axle-stands*

*Jack (strong trolley or hydraulic type)*

*Light with extension lead*

## 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  
Coil spring compressors  
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 electric multi-meter  
Cylinder compression gauge  
Lifting tackle  
Trolley jack

### 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  $\frac{7}{8}$  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	$\frac{1}{4}$ in AF
0.275	7 mm
0.312	$\frac{1}{8}$ in AF
0.315	8 mm
0.343	$\frac{1}{2}$ in AF; $\frac{1}{2}$ in Whitworth
0.354	9 mm
0.375	$\frac{3}{8}$ in AF
0.394	10 mm
0.433	11 mm
0.437	$\frac{7}{16}$ in AF
0.445	$\frac{7}{16}$ in Whitworth; $\frac{1}{2}$ in BSF
0.472	12 mm
0.500	$\frac{1}{2}$ in AF
0.512	13 mm
0.525	$\frac{1}{2}$ in Whitworth; $\frac{5}{8}$ in BSF
0.551	14 mm
0.562	$\frac{1}{8}$ in AF
0.591	15 mm
0.600	$\frac{1}{8}$ in Whitworth; $\frac{3}{4}$ in BSF
0.625	$\frac{3}{8}$ in AF
0.630	16 mm
0.669	17 mm
0.687	$\frac{1}{4}$ in AF
0.709	18 mm
0.710	$\frac{3}{8}$ in Whitworth; $\frac{7}{16}$ in BSF
0.748	19 mm
0.750	$\frac{3}{8}$ in AF
0.812	$\frac{1}{2}$ in AF
0.866	22 mm
0.875	$\frac{1}{2}$ in AF
0.920	$\frac{1}{2}$ in Whitworth; $\frac{9}{16}$ in BSF
0.937	$\frac{1}{2}$ in AF
0.945	24 mm
1.000	1 in AF
1.010	$\frac{9}{16}$ in Whitworth; $\frac{3}{4}$ in BSF
1.024	26 mm
1.062	$1\frac{1}{16}$ in AF; 27 mm
1.063	27 mm
1.125	$1\frac{1}{8}$ in AF
1.182	30 mm
1.200	$\frac{1}{2}$ in Whitworth; $\frac{7}{8}$ in BSF
1.250	$1\frac{1}{2}$ in AF
1.260	32 mm
1.312	$1\frac{1}{8}$ in AF
1.375	$1\frac{3}{8}$ in AF
1.418	36 mm
1.437	$1\frac{1}{4}$ in AF
1.480	$\frac{3}{4}$ in Whitworth; 1 in BSF
1.500	$1\frac{1}{2}$ in AF
1.575	40 mm; $1\frac{1}{2}$ in Whitworth
1.615	41 mm
1.625	$1\frac{5}{8}$ in AF
1.670	1 in Whitworth; $1\frac{1}{2}$ in BSF
1.688	$1\frac{1}{2}$ in AF
1.811	46 mm
1.813	$1\frac{3}{4}$ in AF
1.860	$1\frac{1}{2}$ in Whitworth; $1\frac{1}{4}$ in BSF
1.875	$1\frac{5}{8}$ in AF
1.969	50 mm
2.000	2 in AF
2.050	$1\frac{1}{2}$ in Whitworth; $1\frac{3}{4}$ in BSF
2.165	55 mm
2.362	60 mm



# 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.



# Routine maintenance

Maintenance is essential for ensuring safety, and desirable for the purpose of getting the best in terms of performance and economy from your 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 examination as comprehensively as possible, in order to spot any potential defects at an early stage before they develop into major expensive repairs.

The following service schedules are a list of the maintenance requirements, and the intervals at which they should be carried out based on the manufacturer's recommendations. Where applicable, these procedures are covered in greater detail throughout this manual, near the beginning of each Chapter.

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## Every 250 miles (400 km) or weekly - whichever occurs first

---

### Engine, cooling system and braking system

- Check the engine oil level and top up if necessary
- Check the coolant level and top up if necessary
- Check the brake fluid level in the reservoir and top up if necessary

### Steering

- Check the power steering fluid level and top up if necessary (where applicable)

### Lamps and wipers

- Check the operation of all lamps, wipers and washers
- Check the washer fluid level and top up if necessary

### Tyres

- Check the tyre pressures (including the spare)
- Visually examine the tyres for wear or damage

---

## Every 9000 miles (15 000 km) or 12 months - whichever occurs first

---

### Engine (Chapter 1)

- Change the engine oil and renew the oil filter
- Check for oil leaks and rectify as necessary

### Cooling system (Chapter 2)

- Check the coolant level and top up if necessary
- Check for coolant leaks and rectify as necessary
- Inspect the radiator matrix for blockage (eg dead insects), and clean as necessary

### Fuel and exhaust systems (Chapter 3)

- Inspect the air cleaner element for blockage and clean or renew as necessary
- Check for fuel leaks and rectify as necessary
- Check the operation of the throttle linkage and lubricate if necessary
- Check the exhaust system for corrosion, leaks and security
- Check all vacuum hoses for condition and security
- Check the operation of the air cleaner air temperature control

### Ignition system (Chapter 4)

- Check the condition of the spark plugs
- Check all wiring and vacuum hoses for condition and security

### Manual gearbox (Chapter 6)

- Check for oil leaks and rectify as necessary

### Driveshafts (Chapter 7)

- Check the driveshafts for damage or distortion and check the condition of the joint gaiters

### Braking system (Chapter 8)

- Check the brake fluid level in the reservoir and top up if necessary
- Check the front brake pad friction material for wear and renew if necessary
- Check the brake fluid leaks and rectify as necessary
- Check brake fluid level warning lamp operation
- Check the condition and adjustment of the handbrake cable and check the handbrake mechanism for satisfactory operation

### Suspension and steering (Chapter 9)

- Check the tightness of the roadwheel bolts
- Check the tyre pressures
- Check the condition and tension of the power steering fluid pump drivebelt (where applicable)

### Electrical system (Chapter 11)

- Check the operation of all interior and exterior lamps and all electrical systems
- Check all exposed wiring for condition and security
- Check the washer fluid level and top up if necessary
- Check the battery electrolyte level and top up if necessary

---

## Every 12 000 miles (20 000 km) or 12 months - whichever occurs first

---

In addition to all the items in the 9000 mile (15 000 km) service, carry out the following:

### Engine (Chapter 1)

- Check and if necessary adjust the valve clearances
- Inspect the crankcase ventilation system for condition and security

### Cooling system (Chapter 2)

- Check the operation of the cooling fan
- Check the condition and tension of the coolant pump/alternator drivebelt

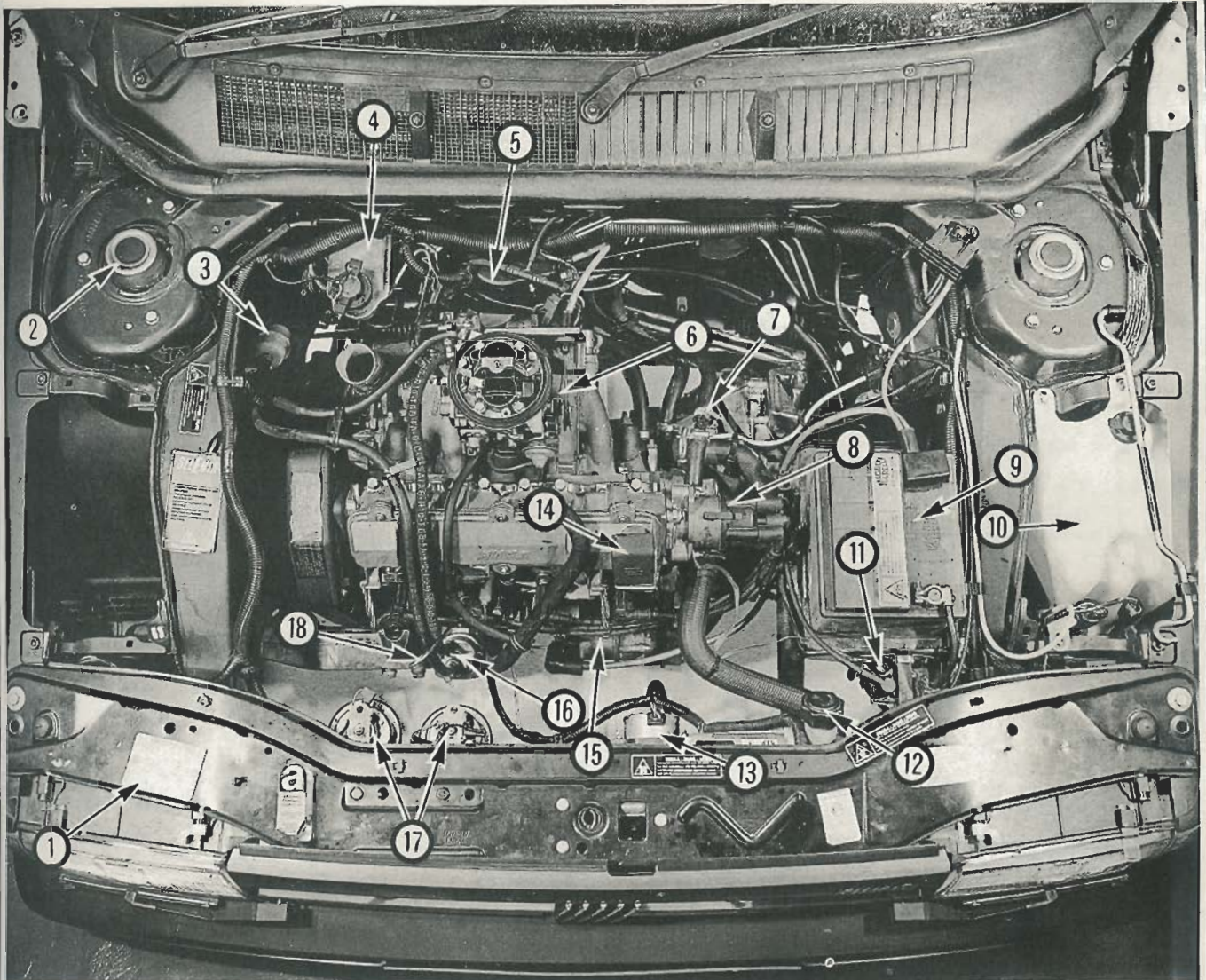
### Fuel and exhaust systems (Chapter 3)

- Renew the air cleaner element
- Renew the fuel filter
- Check and if necessary adjust the idle speed and mixture

### Ignition system (Chapter 4)

- Renew the spark plugs
- Inspect and clean the distributor cap and HT leads

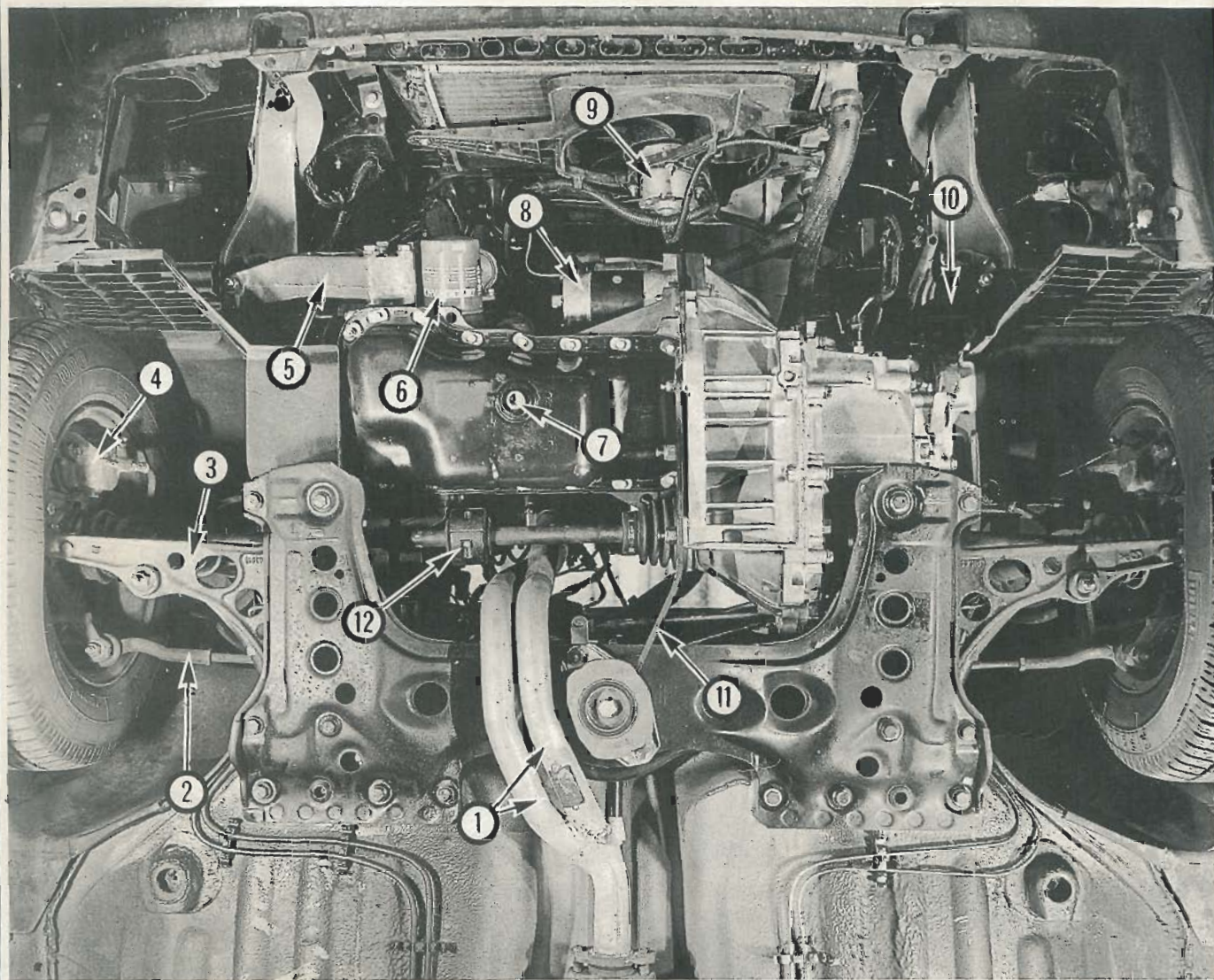




Underbonnet view of a 1989 1.6 DGT SX model (air cleaner removed)

- |                                  |                                   |                                      |                       |
|----------------------------------|-----------------------------------|--------------------------------------|-----------------------|
| 1 VIN plate                      | 6 Carburettor                     | 10 Washer fluid reservoir            | 14 Oil filler cap     |
| 2 Suspension strut top           | 7 Heater hose coolant bleed screw | 11 Ignition coil                     | 15 Starter motor      |
| 3 Fuel filter                    | 8 Distributor cap                 | 12 Coolant expansion tank filler cap | 16 Fuel pump          |
| 4 Brake fluid reservoir          | 9 Battery                         | 13 Cooling fan motor                 | 17 Horns              |
| 5 Cable bellcrank assembly cover |                                   |                                      | 18 Oil level dipstick |

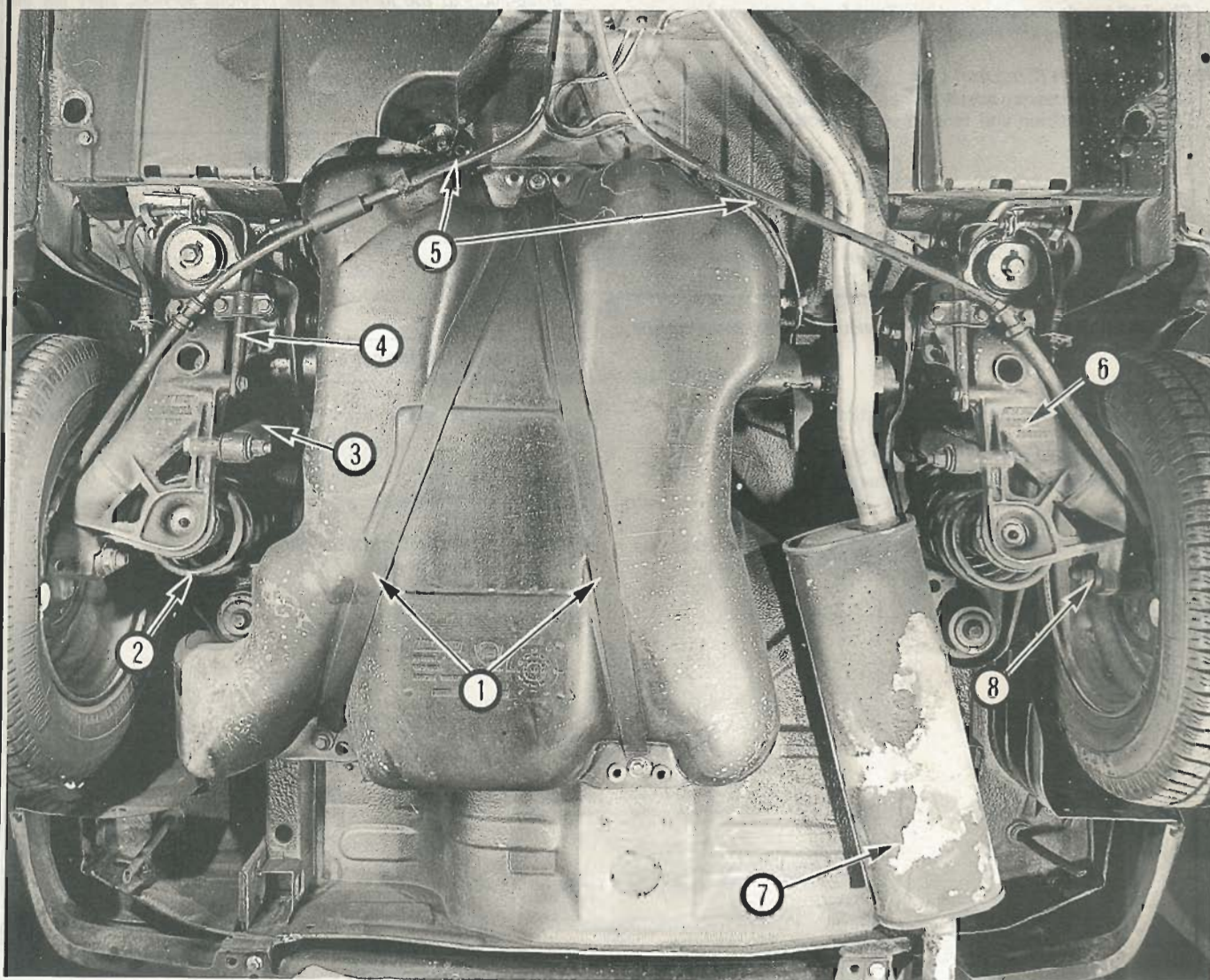




**Front underbody view of a 1989 1.6 DGT SX model**

- |                        |                              |                               |   |
|------------------------|------------------------------|-------------------------------|---|
| 1 Exhaust downpipes    | 5 Right-hand engine mounting | 8 Starter motor               | 11 Centre engine/gearbox mounting bracket |
| 2 Track rod end        | 6 Oil filter                 | 9 Cooling fan motor           | 12 Driveshaft damper weight               |
| 3 Suspension lower arm | 7 Sump drain plug            | 10 Left-hand gearbox mounting |   |
| 4 Brake caliper        |                              |                               |   |





**Rear underbody view of a 1989 1.6 DGT SX model**

1 Fuel tank securing straps  
2 Coil spring

3 Shock absorber  
4 Anti-roll bar

5 Handbrake cables  
6 Suspension trailing arm

7 Exhaust rear box  
8 Rear hub nut



**Clutch (Chapter 5)**

Check the condition and adjustment of the clutch cable

**Manual gearbox (Chapter 6)**

Check the oil level and top up if necessary

**Suspension and steering (Chapter 9)**

Check all components for wear and damage

**Bodywork (Chapter 10)**

Check all panels and structural members for corrosion and damage  
Lubricate all locks and hinges

**Electrical system (Chapter 11)**

Check and if necessary adjust the headlamp alignment  
Check the condition and tension of the coolant pump/alternator drivebelt

---

**Every 24 000 miles (40 000 km) or 24 months - whichever occurs first**

---

*In addition to all the items in the previous services, carry out the following:*

**Engine (Chapter 1)**

Check the condition and tension of the timing belt

**Fuel and exhaust system (Chapter 3)**

Clean the carburettor exterior, float chambers and jets

**Ignition system (Chapter 4)**

Check and if necessary adjust the ignition timing, and check the operation of the vacuum advance unit (1.4 litre models only)

**Braking system (Chapter 8)**

Check the rear brake shoe friction material for wear, and renew if necessary  
Check the operation of the rear brake wheel cylinders

---

**Every 36 000 miles (60 000 km) or 24 months - whichever occurs first**

---

*In addition to the items in the previous services, carry out the following:*

**Cooling system (Chapter 2)**

Renew the coolant

---

**Every 24 months - regardless of mileage**

---

*In addition to the items in the previous services, carry out the following:*

**Braking system (Chapter 8)**

Renew the brake fluid

---

**Every 60 000 miles (100 000 km)**

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*In addition to all the items in the previous services, carry out the following:*

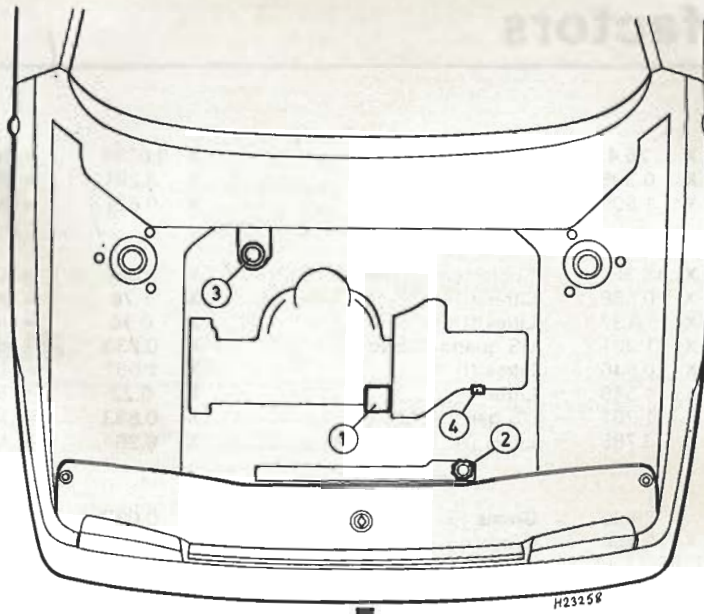
**Engine (Chapter 1)**

Renew the timing belt

**Manual gearbox (Chapter 6)**

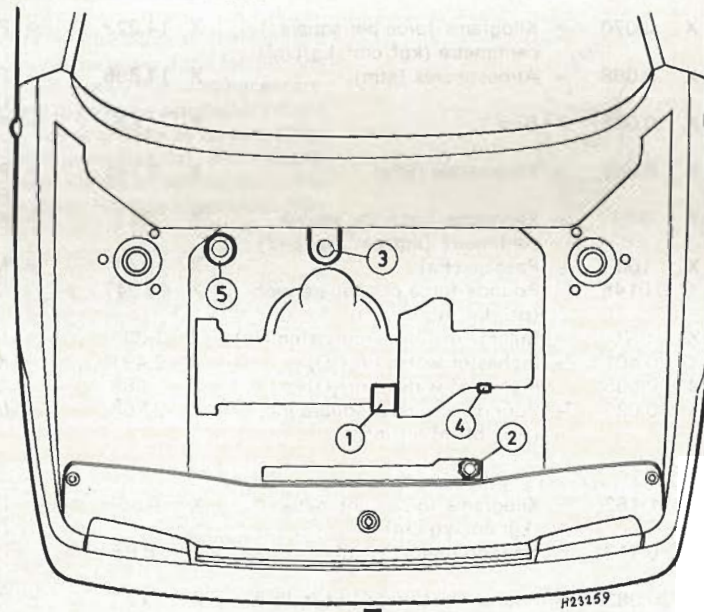
Renew the gearbox oil





FRONT

Models with manual steering



FRONT

Models with power steering

## Recommended lubricants and fluids

Component or system	Lubricant type/specification	Duckhams recommendation
1 Engine	Multigrade engine oil, viscosity range SAE 15W/40, to API SF/CC or better	Duckhams QXR or Hypergrade
2 Cooling system	Soft water and ethylene glycol based antifreeze	Duckhams Universal Antifreeze and Summer Coolant
3 Brake hydraulic system	Hydraulic fluid to SAE J1703	Duckhams Universal Brake and Clutch Fluid
4 Manual gearbox	Gear oil, viscosity SAE 80 to API GL4	Duckhams Hypoid 80
5 Power steering	Dexron II type ATF	Duckhams D-Matic



# 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 <sup>3</sup> )	X 16.387	= Cubic centimetres (cc; cm <sup>3</sup> )	X 0.061	= Cubic inches (cu in; in <sup>3</sup> )
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 <sup>2</sup> ; lb/in <sup>2</sup> )	X 0.070	= Kilograms-force per square centimetre (kgf/cm <sup>2</sup> ; kg/cm <sup>2</sup> )	X 14.223	= Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )
Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )	X 0.068	= Atmospheres (atm)	X 14.696	= Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )
Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )	X 0.069	= Bars	X 14.5	= Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )
Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )	X 6.895	= Kilopascals (kPa)	X 0.145	= Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )
Kilopascals (kPa)	X 0.01	= Kilograms-force per square centimetre (kgf/cm <sup>2</sup> ; kg/cm <sup>2</sup> )	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 <sup>2</sup> ; lb/in <sup>2</sup> )	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 <sub>2</sub> O)	X 2.491	= Millibar (mbar)
Millimetres of mercury (mmHg)	X 0.535	= Inches of water (inH <sub>2</sub> O)	X 1.868	= Millimetres of mercury (mmHg)
Inches of water (inH <sub>2</sub> O)	X 0.036	= Pounds-force per square inch (psi; lbf/in <sup>2</sup> ; lb/in <sup>2</sup> )	X 27.68	= Inches of water (inH <sub>2</sub> O)

## 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)
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## 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



# 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.

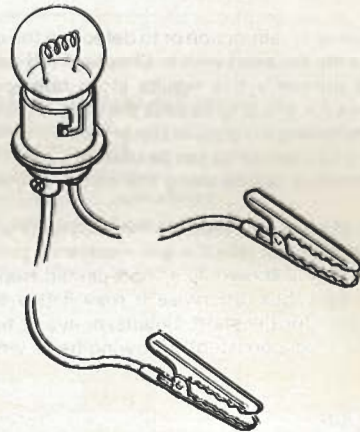
**Don't take anything for granted.** Particularly, don't forget that a 'new' component may itself be defective (especially if it's been rattling round in the boot for months), and don't leave components out of a fault diagnosis sequence just because they are new or recently fitted. When you do finally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

## Electrical faults

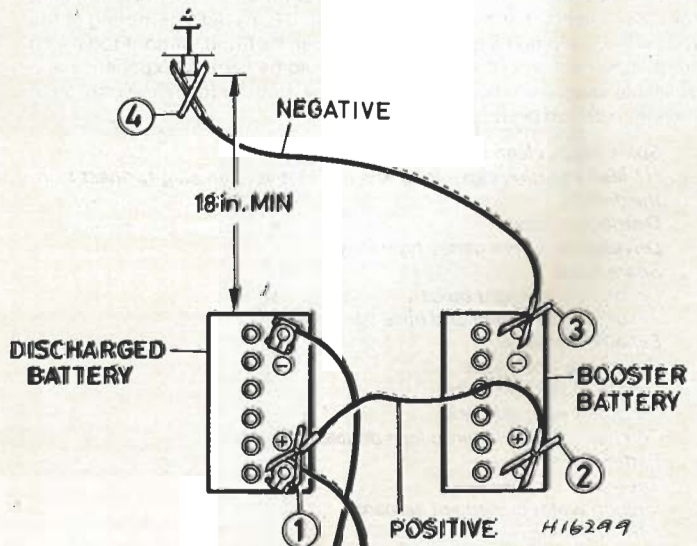
Electrical faults can be more puzzling than straightforward mechanical failures, but they are no less susceptible to logical analysis if the basic principles of operation are understood. Vehicle electrical wiring exists in extremely unfavourable conditions – heat, vibration and chemical attack – and 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, alternator and ignition trouble may result.

Assuming the earth return to be satisfactory, electrical faults will be



A simple test lamp is useful for tracing electrical faults



Jump start lead locations for negative earth – connect leads in order shown







**Engine turns normally but fails to start**

- Damp or dirty HT leads and distributor cap (crank engine and check for spark) - try moisture dispersant such as Holts Wet Start
- No fuel in tank
- Excessive choke (hot engine) or insufficient choke (cold engine)
- Fouled or incorrectly gapped spark plugs (remove, renew and regap)
- Other ignition system fault (see Chapter 4)
- Other fuel system fault (see Chapter 3)
- Poor compression
- 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)
- Ignition system fault (see Chapter 4)
- Other fuel system fault (see Chapter 3)

**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 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 3)

**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 - re-tension or renew (see Chapter 2)

**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 coolant passages 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

**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 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 belt
- Broken piston ring (ticking noise)

**Knocking or thumping**

- Unintentional mechanical contact (eg fan blades)
- Worn drivebelt
- Peripheral component fault (alternator, coolant 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

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## Specifications

### General

Engine type .....	Four-cylinder, in-line, single overhead camshaft
Firing order .....	1 – 3 – 4 – 2 (No 1 cylinder at timing belt end of engine)
Direction of crankshaft rotation .....	Clockwise
Engine codes:	
1.4 litre engines .....	160 A1.000 (early models) or 159 A2.000 (later models)
1.6 litre engines .....	160 A2.000 (early models) or 159 A3.000 (later models)
Bore:	
1.4 litre engines .....	80.5 mm (3.17 in)
1.6 litre engines .....	86.4 mm (3.40 in)
Stroke .....	67.4 mm (2.66 in)
Cubic capacity:	
1.4 litre engines .....	1372 cc (83.7 cu in)
1.6 litre engines .....	1580 cc (96.4 cu in)
Compression ratio .....	9.2:1
Maximum power output (DIN):	
1.4 litre engines:	
Engine code 160 A1.000 .....	52 kW (68 bhp) at 6000 rpm
Engine code 159 A2.000 .....	56 kW (73 bhp) at 6000 rpm
1.6 litre engines:	
Engine code 160 A2.000 .....	60 kW (78 bhp) at 6000 rpm
Engine code 159 A3.000 .....	62 kW (81 bhp) at 5800 rpm
Maximum torque (DIN):	
1.4 litre engines .....	106 Nm (78 lbf ft) at 2900 rpm
1.6 litre engines .....	130 Nm (96 lbf ft) at 2900 rpm



**Cylinder block**

Material .....	Cast iron
Cylinder bore diameter:	
1.4 litre engines:	
Standard .....	80.500 to 80.550 mm according to class
Oversize .....	0.4 mm
1.6 litre engines:	
Standard .....	86.400 to 86.450 mm according to class
Oversize .....	0.4 mm
Maximum cylinder bore ovality .....	0.005 mm
Maximum cylinder bore taper .....	0.005 mm
Maximum gasket face distortion (at cylinder head face) .....	0.1 mm
Auxiliary shaft bearing bore diameter:	
Front .....	35.664 to 35.684 mm
Rear .....	32.000 to 32.020 mm

**Crankshaft**

Number of main bearings .....	Five
Main bearing journal diameter:	
Standard .....	50.780 to 50.800 mm according to class
1st undersize .....	0.254 mm
2nd undersize .....	0.508 mm
Main bearing journal running clearance .....	0.019 to 0.050 mm
Crankpin journal diameter:	
Standard .....	45.503 to 45.523 mm according to class
1st undersize .....	0.254 mm
2nd undersize .....	0.508 mm
Crankpin journal running clearance .....	0.025 to 0.063 mm
Crankshaft endfloat .....	0.055 to 0.265 mm
Thrustwasher thickness:	
Standard .....	2.310 to 2.360 mm
Oversize .....	0.127 mm
Maximum main bearing and crankpin journal ovality .....	0.005 mm

**Pistons and piston rings**

Piston diameter:	
1.4 litre engines:	
Standard .....	80.460 to 80.510 mm according to class
Oversize .....	0.4 mm
1.6 litre engines:	
Standard .....	86.360 to 86.410 mm according to class
Oversize .....	0.4 mm
Piston-to-bore clearance .....	0.030 to 0.050 mm
Piston ring end gaps (fitted in bore):	
Top compression ring .....	0.30 to 0.50 mm
Second compression ring .....	0.30 to 0.50 mm
Oil control ring .....	0.25 to 0.50 mm
Piston ring-to-groove clearance:	
Top compression ring .....	0.045 to 0.077 mm
Second compression ring .....	0.040 to 0.072 mm
Oil control ring .....	0.030 to 0.065 mm

**Gudgeon pins**

Diameter .....	21.991 to 21.997 mm according to class
Clearance in piston .....	0.002 to 0.008 mm
Clearance in connecting rod .....	0.010 to 0.016 mm

**Connecting rods**

Small end bush diameter .....	22.004 to 22.010 mm according to class
-------------------------------	--

**Cylinder head**

Material .....	Light alloy
Valve seat angle .....	45° ± 5°
Valve seat width .....	2.0 mm approximately
Camshaft bearing bore diameter:	
No 1 (front/timing sprocket end) .....	29.989 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 (rear/flywheel end) .....	48.580 to 48.605 mm



**Camshaft**

Drive .....	Toothed belt
Number of bearings .....	Five
Bearing journal diameter:	
No 1 (front/timing sprocket 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 (rear/flywheel end) .....	48.535 to 48.550 mm
Bearing journal running clearance .....	0.030 to 0.070 mm
Cam lift .....	8.8 mm

**Auxiliary shaft**

Bearing journal diameter:	
Front .....	35.593 to 35.618 mm
Rear .....	31.940 to 31.960 mm

**Valves**

Operation .....	From camshaft via bucket and shim type cam followers
Seat angle .....	45° 30' ± 5'
Seat width .....	2.0 mm approximately
Head diameter (inlet):	
1.4 litre engines .....	37.35 to 37.65 mm
1.6 litre engines:	
Engine code 160 A2.000 .....	37.35 to 37.65 mm
Engine code 159 A3.000 .....	39.20 to 39.70 mm
Head diameter (exhaust):	
1.4 litre engines .....	30.85 to 31.15 mm
1.6 litre engines:	
Engine code 160 A2.000 .....	32.85 to 33.45 mm
Engine code 159 A3.000 .....	30.85 to 31.15 mm
Stem diameter (inlet and exhaust) .....	7.974 to 7.992 mm
Stem-to-guide clearance (inlet and exhaust) .....	0.030 to 0.066 mm
Valve clearance (cold):	
Inlet .....	0.40 ± 0.05 mm (0.016 ± 0.002 in)
Exhaust .....	0.50 ± 0.05 mm (0.020 ± 0.002 in)
Valve spring length (under a compressive load of 43.6 to 46.5 N/ 9.8 to 10.5 lbf) .....	22.5 mm
Valve guide internal diameter (inlet and exhaust) .....	8.022 to 8.040 mm

**Valve timing**

1.4 litre engines:	
Engine code 160 A1.000:	
Inlet opens .....	7° BTDC
Inlet closes .....	35° ABDC
Exhaust opens .....	37° BBDC
Exhaust closes .....	5° ATDC
Engine code 159 A2.000:	
Inlet opens .....	6° BTDC
Inlet closes .....	46° ABDC
Exhaust opens .....	47° BBDC
Exhaust closes .....	7° ATDC
1.6 litre engines:	
Inlet opens .....	7° BTDC
Inlet closes .....	35° ABDC
Exhaust opens .....	37° BBDC
Exhaust closes .....	5° ATDC

**Lubrication system**

System pressure (at temperature of 100°C) .....	3.43 to 4.90 bar (49.7 to 71.1 lbf/in <sup>2</sup> )
Engine oil type/specification .....	Multigrade engine oil, viscosity SAE 15W/40, to API SF/CC or better (Duckhams QXR or Hypergrade)
Engine oil capacity:	
Drain and refill (including filter) .....	3.30 litres (5.80 pints)
From dry (after major overhaul) .....	3.75 litres (6.60 pints)
Difference between MAX and MIN marks on dipstick .....	1.00 litre (1.76 pints)
Oil pump type .....	Gear type, mounted in sump
Oil pump clearances:	
Gear endfloat .....	0.020 to 0.105 mm
Gear-to-housing side clearance .....	0.110 to 0.180 mm
Gear backlash .....	0.31 mm
Oil filter:	
Application .....	Champion C106



**Torque wrench settings**

	Nm	lbf ft
Main bearing cap bolts.....	80	59
Big-end bearing cap bolts.....	51	37
Cylinder head bolts (M10 - 10 off)*:		
Stage 1.....	20	15
Stage 2.....	40	29
Stage 3.....	Angle tighten a further 90°	
Stage 4.....	Angle tighten a further 90°	
Cylinder head bolts (M8 - 4 off).....	30	22
Camshaft housing bolts.....	20	15
Crankcase ventilation oil separator securing bolt.....	23	17
Flywheel bolts.....	83	61
Camshaft sprocket bolt.....	83	61
Crankshaft pulley nut.....	137	101
Timing belt tensioner pulley nut.....	44	32
Auxiliary shaft sprocket bolt.....	83	61
Temperature gauge sender.....	49	36
Manifold nuts.....	28	21
Alternator bracket-to-cylinder block bolts.....	49	36
Right-hand engine mounting-to-cylinder block bolts.....	49	36
Right-hand engine mounting-to-body bolts.....	40	30
Right-hand engine mounting rubber through-bolt nyloc nut.....	49	36
Left-hand gearbox mounting-to-gearbox bolts.....	49	36
Left-hand gearbox mounting-to-body bolts.....	40	30
Left-hand gearbox mounting rubber through-bolt nyloc nut.....	49	36
Centre engine/gearbox mounting-to-gearbox nuts (M12).....	88	65
Centre engine/gearbox mounting-to-gearbox nut (M8).....	24	18
Centre engine/gearbox mounting-to-subframe bolts.....	28	21
Centre engine/gearbox mounting rubber-to-bracket bolt.....	88	65

\*Note: FIAT specify that the main cylinder head bolts should be renewed after they have been used (ie tightened) four times - if in any doubt as to the number of times the bolts have been used, renew them in any case as a precaution against possible failure

**1 General description**

The engine is of four-cylinder, in-line, overhead camshaft type, mounted transversely at the front of the vehicle, and available in 1.4 and 1.6 litre versions.

The crankshaft runs in five main bearings. Thrustwashers are fitted to the rear (flywheel end) main bearing in order to control crankshaft endfloat.

The connecting rods are attached to the crankshaft by horizontally-split shell-type big-end bearings. The piston are attached to the connecting rods by fully-floating gudgeon pins which are secured by circlips. The aluminium alloy pistons are fitted with three piston rings: two compression rings and an oil control ring.

The camshaft is driven by a toothed belt and operates the angled valves via bucket and shim type cam followers. The camshaft is located in a separate housing on top of the cylinder head. On 1.6 litre models, the distributor is driven from the rear end of the camshaft.

The inlet and exhaust valves are each closed by double valve springs, and operate in guides pressed into the cylinder head.

The auxiliary shaft, which is also driven by the toothed belt, drives the oil pump, fuel pump, and on 1.4 litre models the distributor.

Lubrication is by means of a gear type pump which draws oil through a strainer located in the sump, and forces it through a full-flow filter into the engine oil galleries from where it is distributed to the crankshaft, camshaft and auxiliary shaft. The big-end bearings are supplied with oil via internal drillings in the crankshaft. On 1.6 litre engines, the undersides of the pistons are cooled by oil jets located in each main bearing location in the crankcase.

A crankcase ventilation system is employed, whereby piston blow-by gases are drawn via an oil separator into the air cleaner, from where they are drawn into the inlet manifold and re-burnt with fresh air/fuel mixture.

**2 Routine maintenance**

1 At the intervals specified in the *Routine maintenance* Section at the

beginning of this manual, carry out the following tasks.

- 2 Check the engine oil level as follows. With the vehicle parked on level ground, and with the engine having been stopped for a few minutes, withdraw the oil level dipstick, wipe it on a clean rag, and re-insert it fully. Withdraw the dipstick again and read off the oil level relative to the MAX and MIN marks. The oil level should be between the marks. If the level is at or below the MIN mark, top up through the filler on the camshaft cover without delay (photo). The quantity of oil required to raise the level from MIN to MAX on the dipstick is approximately 1.0 litre (1.8 pints). Do not overfill.
- 3 Renew the engine oil and filter as described in Section 3.
- 4 Check and if necessary adjust the valve clearances as described in Section 4.
- 5 Inspect the engine for signs of oil, coolant or fuel leaks and rectify as necessary.
- 6 Inspect the crankcase ventilation hose for blockage or damage. Clean or renew as necessary.
- 7 Check the condition and tension of the timing belt as described in Section 16.
- 8 Renew the timing belt as described in Section 15.

**3 Engine oil and filter - renewal**

- 1 The oil should be drained when the engine is hot, immediately after a run.
- 2 Park the vehicle on level ground and position a container of suitable capacity under the sump.
- 3 Remove the oil filler cap from the camshaft cover, and withdraw the dipstick, then unscrew the sump drain plug using a suitable hexagonal key (photo). Oil will be released before the drain plug is withdrawn, so take precautions against scalding, as the oil will be hot. Allow the oil to drain for at least 10 minutes.
- 4 When the oil has finished draining, clean the drain plug threads and the mating face of the sump, then refit and tighten the drain plug.
- 5 Place a suitable container under the oil filter, and remove the filter. If



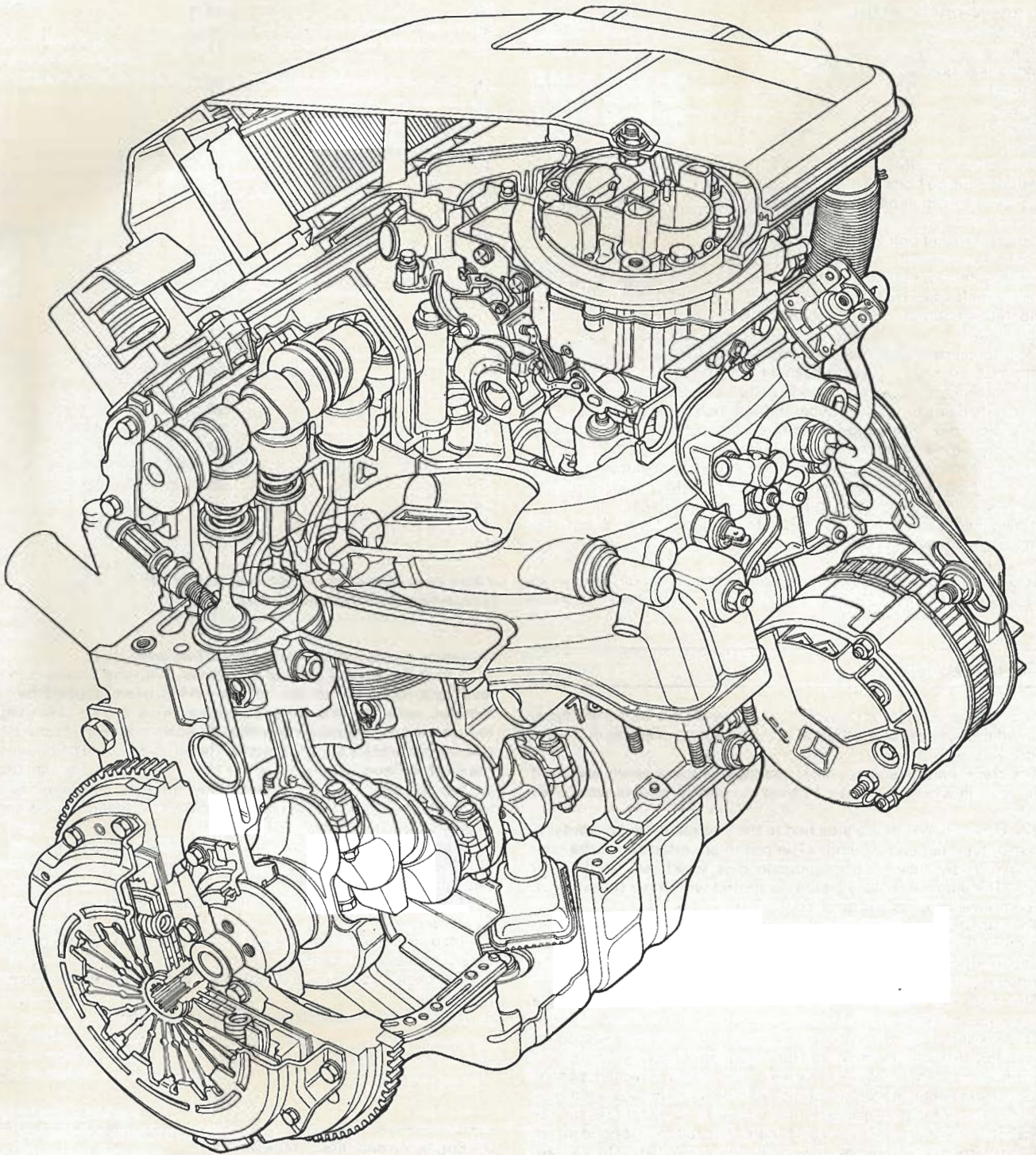


Fig. 1.1 Sectional view of 1.4 litre engine (Sec 1)

necessary use a strap wrench to slacken the filter, then unscrew it by hand. If a strap wrench is not available, drive a large screwdriver through the filter and use the screwdriver as a lever to unscrew the filter. Be prepared for the spillage of hot oil.

6 Wipe clean the filter mounting face on the cylinder block.

7 Smear a little clean engine oil on the sealing ring of the new filter, then screw the filter onto the threaded tube in the cylinder block and

tighten it *by hand only* (photo). If there are no specific instructions included with the new filter, tighten it until the sealing ring contacts the mounting face on the cylinder block, then tighten a further three-quarters of a turn.

8 Fill the engine with the correct grade and quantity of oil through the oil filler on the camshaft cover. Ensure that the filler cap and the dipstick are refitted on completion.



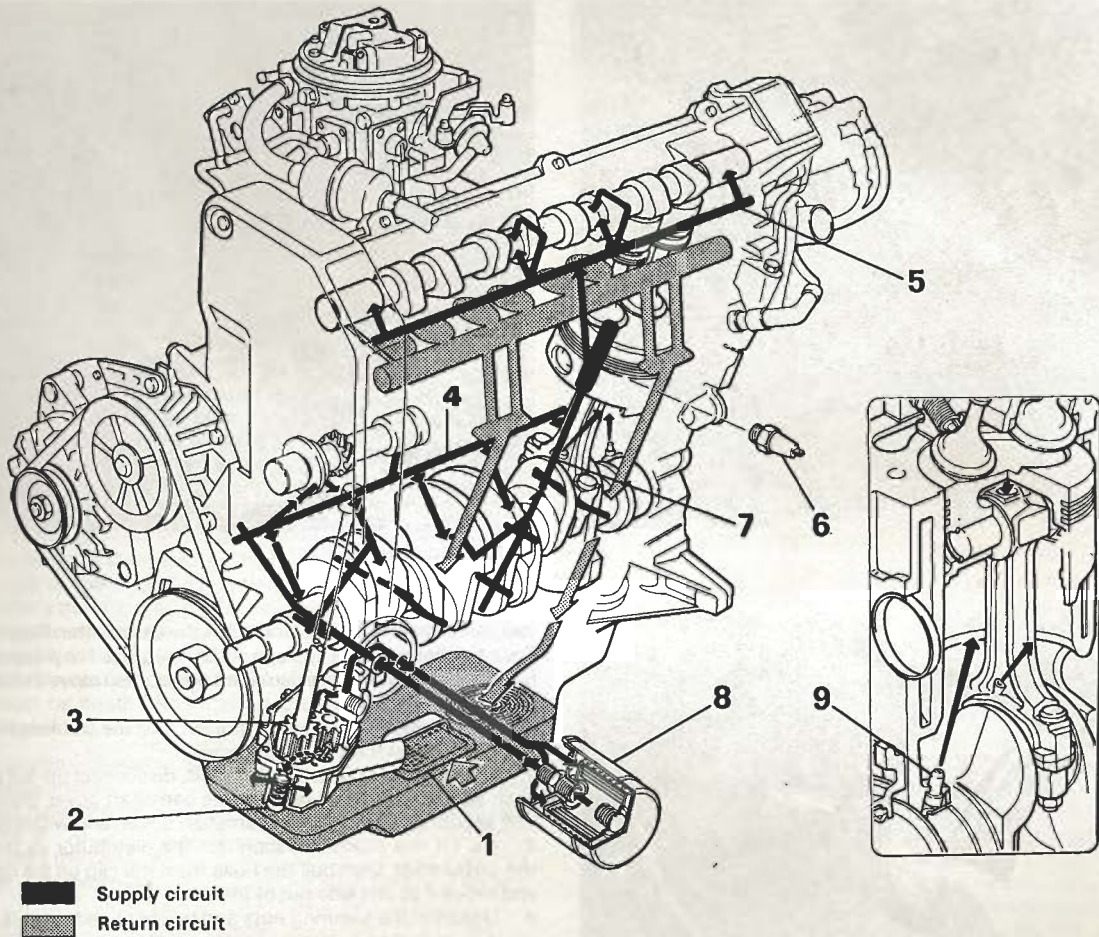


Fig. 1.2 Engine lubrication system (Sec 1)

- |                                      |                                    |  |  |
|--------------------------------------|------------------------------------|--|--|
| 1 Oil pump pick-up with gauze filter | 4 Main oil gallery                 | 6 Low oil pressure warning lamp switch | 8 Full flow oil filter                           |
| 2 Oil pressure relief valve          | 5 Camshaft bearing oil supply duct | 7 Cylinder head oil supply duct        | 9 Piston cooling oil jet (1.6 litre engine only) |
| 3 Oil pump gears                     |                                    |  |  |

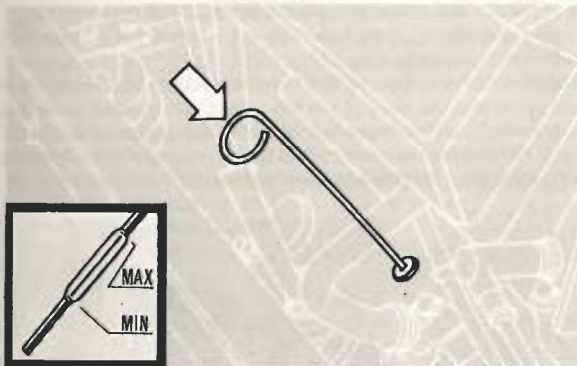


Fig. 1.3 Engine oil level dipstick location and markings (Sec 2)

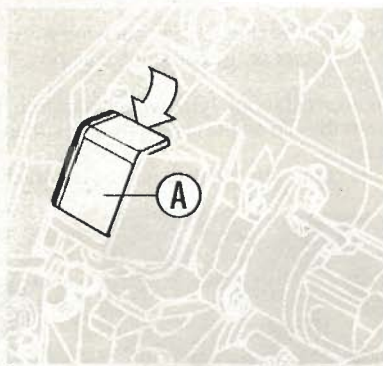


Fig. 1.4 Engine oil filler cap location (A) on camshaft cover (Sec 2)

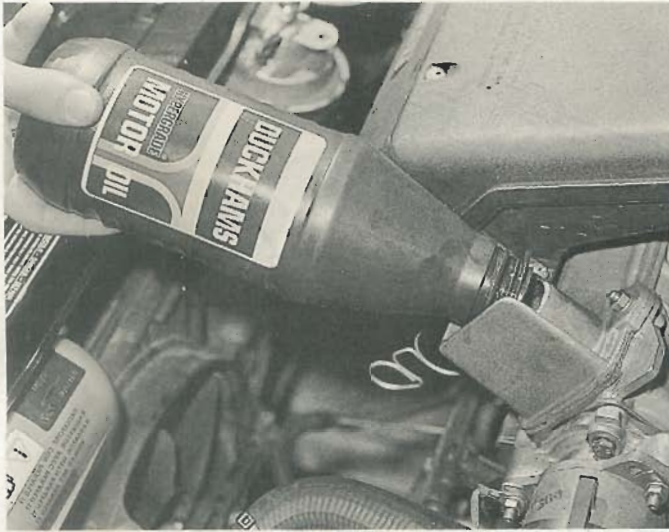
9: When the engine is started, there may be a delay in the extinguishing of the oil pressure warning lamp while the new filter fills with oil. Run the engine and check for leaks from the filter and drain plug, then stop the engine and check the oil level, with reference to Section 2, paragraph 2. Top up the level if necessary.

10 Dispose of the old engine oil safely. **Do not** pour it down a drain - this is illegal and causes pollution. Your dealer or Local Authority may be able to dispose of it safely.

#### 4 Valve clearances - checking and adjustment

1 It is important to ensure that the valve clearances are set correctly, as incorrect clearances will result in incorrect valve timing, thus affecting engine performance.





2.2 Topping-up the engine oil level



3.3 Sump drain plug



3.7 Fitting a new oil filter

- 2 The clearances must be checked and adjusted with the engine cold.
- 3 Remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- 4 Pull the fuel pump fuel supply hose (which runs from the fuel filter to the fuel pump) from the clip on the camshaft cover, then move it to one side out of the way.
- 5 Disconnect the carburettor fuel supply hose (which runs from the

fuel pump to the carburettor) from the carburettor. Plug the end of the hose to minimise fuel spillage. Take adequate fire precautions. Pull the hose from the clip on the camshaft cover, then move it to one side out of the way.

6 Where applicable on later models, pull the crankcase breather hose from the clip on the camshaft cover.

7 Where applicable on later models, disconnect the hot air hoses from each end of the hot air pipe on the camshaft cover, then unscrew the bolt securing the pipe to the camshaft cover, and withdraw the pipe.

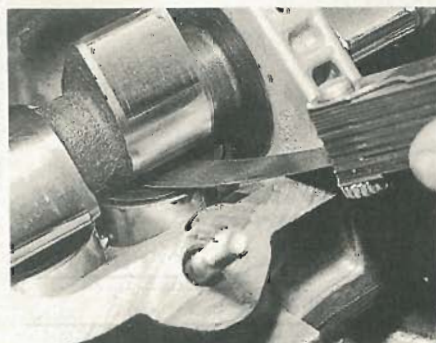
8 On 1.4 litre models, disconnect the distributor vacuum hose from the carburettor, then pull the hose from the clip on the camshaft cover and move it to one side out of the way.

9 Unscrew the securing nuts and washers and remove the camshaft cover, noting that on later models two of the nuts also secure the hose clip assembly. Recover the gasket.

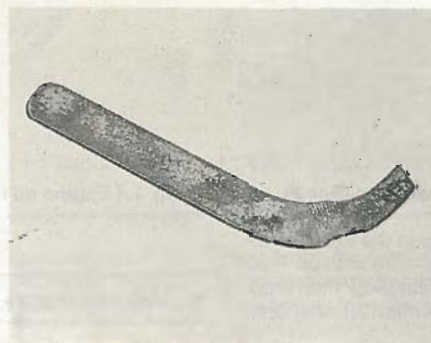
10 Numbering from the front (timing belt) end of the engine, the exhaust valves are 1, 4, 5 and 8, and the inlet valves are 2, 3, 6 and 7.

11 Turn the engine clockwise using a suitable socket on the crankshaft pulley bolt, until the exhaust valve of No 1 cylinder (valve No 1) is fully closed; ie the cam lobe is pointing directly upwards. Alternatively, the engine can be turned by jacking up one front corner of the vehicle and supporting securely on an axle stand (apply the handbrake and chock the diagonally-opposite rear wheel before jacking), engaging top gear and turning the raised roadwheel in the forward direction of travel. In both cases, it will be easier to turn the engine if the spark plugs are removed, but if this is done, take care not to allow dirt or other foreign matter to enter the spark plug holes.

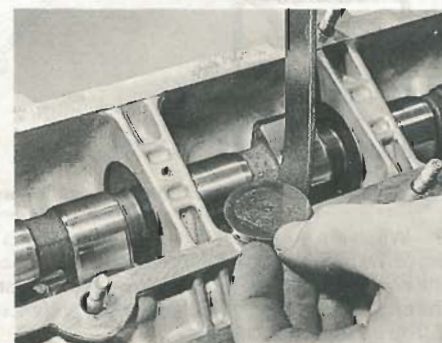
12 Insert a feeler gauge of the correct thickness between the cam follower shim and the heel of the No 1 cam lobe (photo). If necessary, increase or reduce the thickness of the feeler gauge until it is a firm sliding fit. Record the thickness of the feeler gauge, which will represent the valve clearance for this particular valve.



4.12 Measuring a valve clearance - No 2 valve shown



4.16 Special tool for retaining cam follower in depressed position



4.17 Removing a shim from a cam follower



13 Turn the crankshaft, and repeat the procedure for the remaining valves, recording their respective clearances. Note that the clearance for inlet and exhaust valves differs.

14 If a clearance is incorrect, the relevant cam follower shim must be removed, and a thicker or thinner shim must be fitted to achieve the correct clearance. To remove a shim proceed as follows.

15 Turn the crankshaft until the relevant cam lobe is pointing directly upwards.

16 The cam follower must now be depressed in order to extract the shim. FIAT special tool No 1860642000 is available for this purpose, but alternatively a suitable tool can be improvised (photo). The tool should locate on the rim of the cam follower, leaving enough room for the shim to be prised out by means of the cut-outs provided in the cam follower rim. Depress the cam follower by turning the crankshaft as described previously until the relevant cam lobe is pointing directly downwards, then fit the tool between the camshaft and the edge of the cam follower to retain the cam follower in the depressed position.

17 Ensure that the tool is securely located, as there is a risk of personal injury if the tool is dislodged whilst the cam follower is depressed, then turn the crankshaft until the relevant cam lobe is pointing directly upwards, leaving sufficient room to extract the shim (photo). A pair of angle-nosed pliers will greatly ease removal of the shim.

18 Once the shim has been extracted, establish its thickness. The thickness in mm should be stamped into the face of the shim, although it is possible for wear to obliterate the number, in which case the use of a metric micrometer is the only way to accurately establish the thickness.

19 Refer to the clearance recorded for the valve concerned. If the clearance recorded was larger than that specified, a thicker shim must be fitted, and if the clearance recorded was smaller than that specified, a thinner shim must be fitted. The required thickness of shim can be calculated as follows:

*Sample calculation - clearance too large:*

Desired clearance (A).....	0.40 mm
Measured clearance (B) .....	0.45 mm
Difference (B - A) .....	+ 0.05 mm
Original shim thickness.....	3.40 mm
Required shim thickness .....	3.40 + 0.05 = 3.45 mm

*Sample calculation - clearance too small:*

Desired clearance (A).....	0.50 mm
Measured clearance (B) .....	0.35 mm
Difference (B - A) .....	-0.15 mm
Original shim thickness.....	4.55 mm
Required shim thickness .....	4.55 - 0.15 = 4.40 mm

20 Shims are available in thicknesses from 3.20 to 4.70 mm, in steps of 0.05 mm. Note that if several shims have to be changed, they can often be interchanged, thus avoiding the need to buy more new shims than are necessary.

21 The shims should be fitted to the cam followers with the stamped thickness marking against the face of the cam follower.

22 After fitting a shim, rotate the crankshaft as described previously until the relevant cam lobe is pointing directly downwards (resting on the shim), then carefully remove the tool used to retain the follower in the depressed position.

23 Re-check each relevant valve clearance after fitting the shim.

24 On completion, where applicable lower the vehicle to the ground.

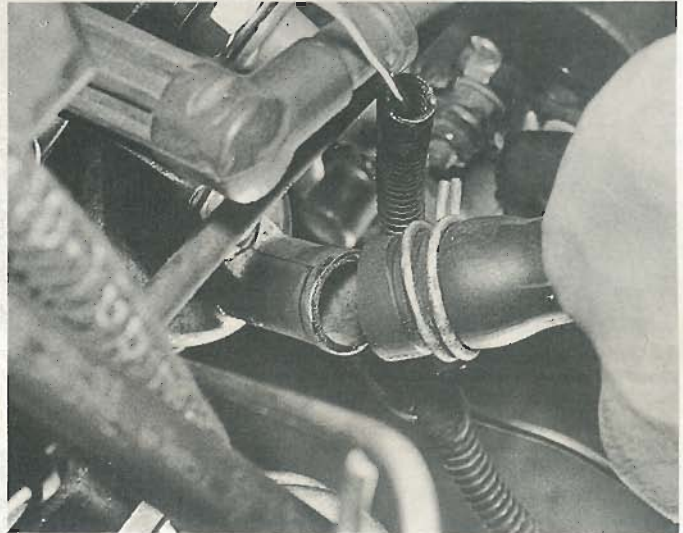
25 Refit the camshaft cover, using a new gasket. Where applicable, ensure that the hose clip is in place before refitting the relevant camshaft cover securing nuts.

26 On 1.4 litre models, reconnect the distributor vacuum hose to the carburettor, and refit the hose to the clip on the camshaft cover.

27 Where applicable, refit the hot air pipe to the camshaft cover, and reconnect the hot air hoses.

28 Reconnect the fuel hoses, and refit them to the clip on the camshaft cover.

29 Refit the air cleaner, or the carburettor air box, as applicable.



5.4 Disconnecting the crankshaft ventilation hose from the oil separator

2 Regularly inspect the hose for blockage or damage, and clean or renew as necessary. A blocked hose can cause a build-up of crankcase pressure, which in turn can cause oil leaks.

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

4 Disconnect the crankcase ventilation hose from the air cleaner or the carburettor air box, as applicable, and from the oil separator on the cylinder block, and inspect it for damage and blockage (photo). If the vehicle has covered a high mileage, it is likely that a jelly-like deposit will have built up inside the hose. If this is evident, the hose should be cleaned thoroughly before refitting. If the hose shows any evidence of splits or deterioration of the rubber, it should be renewed.

5 With the crankcase ventilation hose disconnected, unscrew the through-bolt securing the crankcase oil separator to the cylinder block and withdraw the oil separator. Inspect the oil separator for blockage, as for the ventilation hose, and clean if necessary.

6 On completion, refit the oil separator and the hose, ensuring that all connections are secure.

## 6 Major operations possible with the engine in the vehicle

The following operations can be carried out without removing the engine from the vehicle:

- (a) Removal and overhaul of the cylinder head
- (b) Removal of the camshaft (with housing)
- (c) Removal of the timing belt and sprockets
- (d) Removal of the sump
- (e) Removal of the oil pump
- (f) Removal of the pistons and connecting rods
- (g) Removal of the big-end bearings
- (h) Removal of the engine mountings
- (i) Removal of the clutch and flywheel (gearbox must be removed)
- (j) Renewal of the crankshaft front oil seal
- (k) Renewal of the crankshaft rear oil seal (gearbox must be removed)
- (l) Removal of the auxiliary shaft

## 7 Major operations requiring engine removal

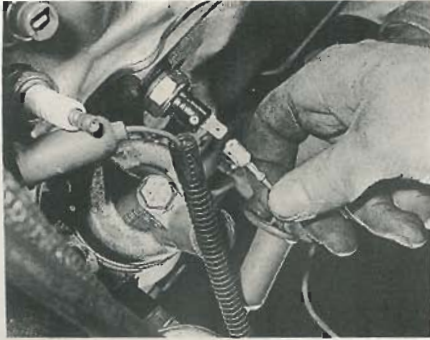
The following operations can only be carried out after removing the engine from the vehicle:

- (a) Removal of the crankshaft main bearings
- (b) Removal of the crankshaft

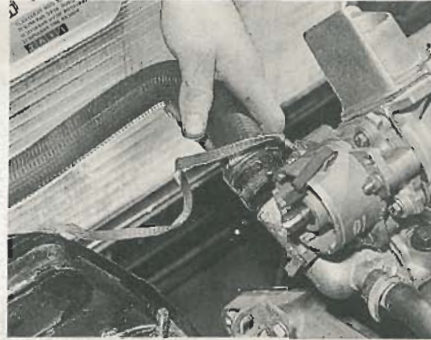
## 5 Crankcase ventilation system - description and maintenance

1 The purpose of the crankcase ventilation system is to draw oil vapour and piston blow-by gases (which have passed the piston rings) from the crankcase and pass them to the air cleaner, from where they are drawn into the engine together with the air/fuel mixture.

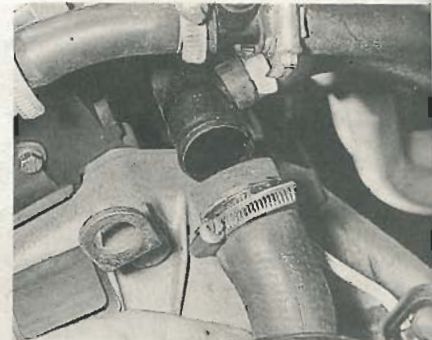




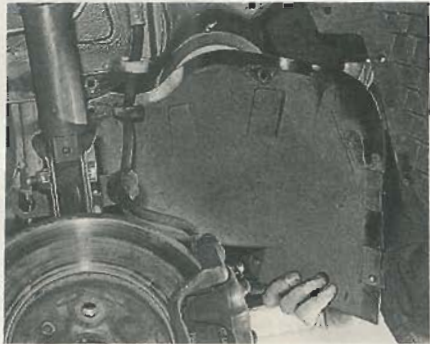
9.8 Disconnecting the wiring from the oil pressure warning lamp switch (crankcase ventilation hose removed)



9.11A Disconnect the radiator top hose from the thermostat cover ...



9.11B ... and the bottom hose from the plastic coolant gallery



9.18 Removing the engine splash shield



9.19 Withdrawing the clutch bellhousing cover plate



9.25 Withdrawing the right-hand engine mounting assembly

## 8 Method of engine removal

The engine may be lifted out on its own, or it may be removed together with the gearbox. In either case, the engine or engine/gearbox assembly is lifted out through the top of the engine compartment. Unless work is to be carried out on the gearbox, it is recommended that the engine is removed on its own. In either case, a suitable engine hoist and lifting tackle will be required.

## 9 Engine - removal leaving manual gearbox in vehicle

**Note:** A suitable hoist and lifting tackle will be required for this operation

- 1 Disconnect the battery leads.
- 2 Remove the bonnet as described in Chapter 10.
- 3 Remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- 4 Where applicable on later models, disconnect the air cleaner hot air hose from the hot air pipe on the camshaft cover.
- 5 Drain the cooling system as described in Chapter 2.
- 6 Drain the engine oil as described in Section 3 of this Chapter.
- 7 Disconnect the throttle cable and the choke cable from the carburettor as described in Chapter 3.
- 8 Disconnect the wiring from the following components, as applicable depending on model, with reference to the relevant Chapters if necessary. It is advisable to identify the wires for location to assist with reconnection:

*Alternator  
Starter motor  
Distributor and spark plugs*

*Oil pressure warning lamp switch (photo).*

*Temperature gauge sender*

*Carburettor fuel cut-off valve and "throttle closed" switch*

*Crankshaft speed/position sensor (1.6 litre models only)*

*Inlet manifold heater*

*Inlet manifold heater switch (mounted in rear of inlet manifold)*

- 9 Taking adequate fire precautions, disconnect the fuel return hose from the carburettor, and disconnect the fuel supply hose (which runs from the fuel filter to the fuel pump) from the fuel pump. Plug the ends of the hoses to minimise fuel spillage.
- 10 Disconnect the brake servo vacuum hose from the rear of the inlet manifold.
- 11 Disconnect the radiator top hose from the thermostat cover, and the radiator bottom hose from the plastic coolant gallery at the rear of the cylinder block (photos).
- 12 Disconnect the heater coolant hoses from the plastic coolant gallery, and from the thermostat cover.
- 13 Unbolt the engine earth strap from the left-hand end of the cylinder head.
- 14 Remove the alternator as described in Chapter 11.
- 15 Where applicable, remove the power steering pump and its mounting bracket as described in Chapter 9.
- 16 Prise back the ends of the locktabs from the exhaust downpipe-to-manifold nuts, then unscrew the four nuts, and disconnect the downpipes. Recover the locktabs.
- 17 Apply the handbrake, then remove the wheel trim and loosen the right-hand front roadwheel bolts. Jack up the front of the vehicle and support securely on axle stands. Remove the roadwheel.
- 18 Working under the right-hand side of the vehicle, release the clips securing the engine splash shield to the wheel arch liner and the body. To release the clips, carefully tap out the pins from the centre of the clips using a suitable pin punch, the clips can then be pulled from their locations. Manipulate the splash shield out from under the engine compartment (photo).
- 19 Unscrew the single nut and two bolts securing the clutch bellhousing cover plate to the bellhousing, and withdraw the plate (photo).

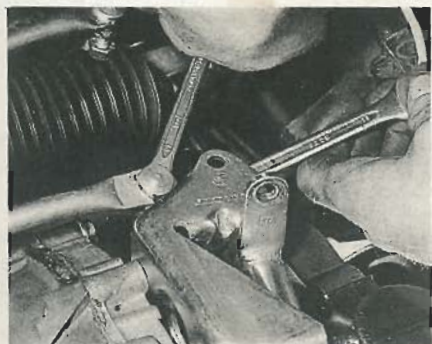


- 20 Unbolt and remove the starter motor, noting that the top securing bolt also secures a wiring harness bracket.
- 21 Make a final check to ensure that all relevant hoses and wires have been disconnected to facilitate engine removal.
- 22 Suitable lifting tackle must now be attached to the engine. No lifting brackets are provided, so care must be taken when deciding on engine lifting points. In the workshop, two right-angled brackets were made up by bending two suitable pieces of steel plate. The brackets were then bolted to the engine using the rear left and right-hand camshaft housing securing bolts with suitable packing washers.
- 23 Attach the lifting tackle to the brackets, and just take the weight of the engine.
- 24 Support the gearbox using a trolley jack and interposed block of wood.
- 25 Unscrew and remove the three bolts securing the right-hand engine mounting bracket to the body, and the four bolts securing the mounting to the cylinder block. Withdraw the complete engine mounting assembly (photo).
- 26 Unscrew and remove the three engine-to-gearbox bolts which fit from the gearbox side, and the single nut which fits from the engine side. Take note of the positions of any brackets which may be secured by the engine-to-gearbox bolts.
- 27 Carefully pull the engine away from the gearbox, taking care not to strain the gearbox input shaft.
- 28 Raise the hoist and carefully manipulate the engine from the engine compartment, taking care not to damage the surrounding components.

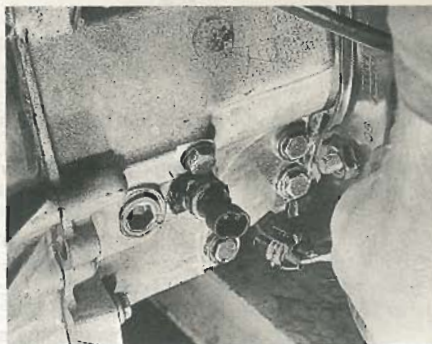
## 10 Engine/manual gearbox assembly – removal and separation

*Note: A suitable hoist and lifting tackle will be required for this operation*

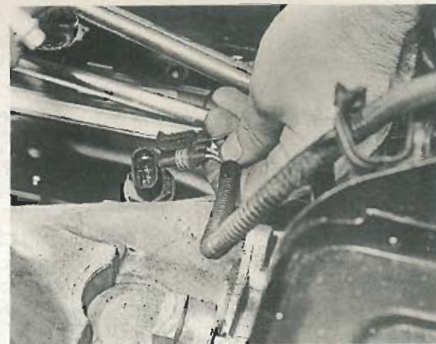
- 1 Proceed as described in Section 9, paragraphs 1 to 18 inclusive, but remove both front roadwheels, and remove the gearbox splash shield from the left-hand side of the vehicle in a similar manner to that described for the engine splash shield in Section 9, paragraph 18. Note that it will be necessary to disconnect the brake pad wear sensor wire, which passes through a hole in the splash shield.
- 2 Working in the engine compartment, disconnect the three gear selector rods from the gearbox, identifying the rods for location. Counterhold the selector rod balljoints using a second spanner on the flats provided in order to unscrew the rod securing nuts (photo).
- 3 Note the length of exposed thread on the threaded rod at the release arm end of the clutch cable, then unscrew the adjuster nut and locknut from the threaded rod, and withdraw the plastic block which locates in the release arm. Slide the end of the clutch cable from the release arm, and pull the cable sheath rubber grommet from the lugs on the gearbox casing. Move the cable to one side out of the way, taking note of its routing.
- 4 Disconnect the wiring from the reversing lamp switch, which is located at the front of the gearbox casing (photo). Identify the wiring for location.
- 5 On models with an analogue instrument panel, unscrew the securing sleeve and disconnect the speedometer cable from the gearbox. Move the cable to one side out of the way, taking note of its routing.
- 6 On models with digital instruments, disconnect the wiring from the speedometer sender unit (photo).
- 7 Unbolt the earth lead from the gearbox casing (photo). Refit the securing bolt when the lead has been disconnected.
- 8 Unscrew the clamp bolt and remove the battery.
- 9 Disconnect the wiring from the ignition coil, which is mounted on the front of the battery tray.
- 10 On models with digital instruments, disconnect the wiring and the vacuum hose from the economy gauge sender unit which is mounted on the rear of the battery tray.
- 11 Pull the plastic drip tray, complete with drain tube, from the battery tray (photo).
- 12 Remove the three upper securing bolts and the single lower



10.2 Disconnecting a gear selector rod from the gearbox



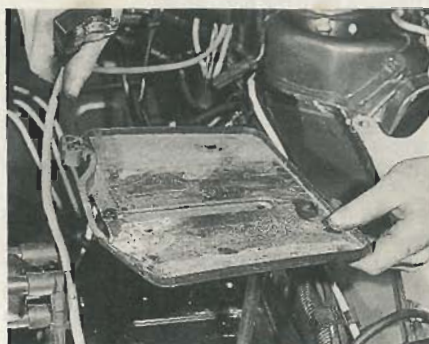
10.4 Disconnecting the wiring from the reversing lamp switch



10.6 Disconnecting the wiring from the speedometer sender unit – model with digital instruments



10.7 Disconnecting the earth strap from the gearbox casing

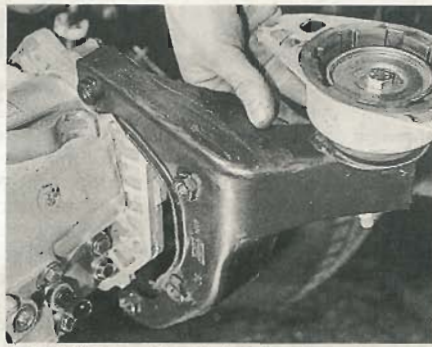


10.11 Removing the plastic drip tray from the battery tray

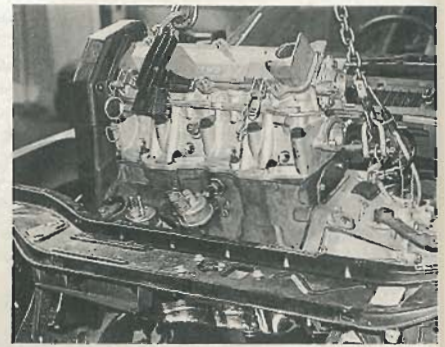




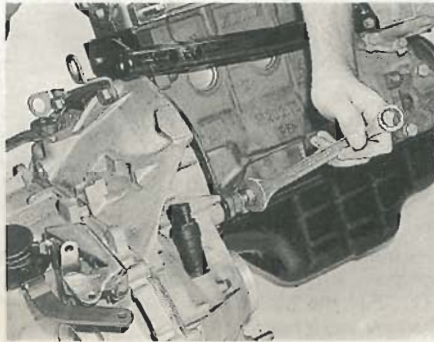
10.12 Removing an upper securing bolt from the battery tray



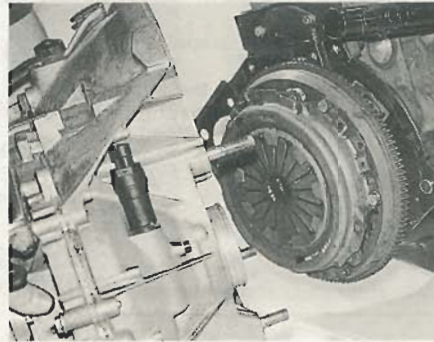
10.25 Withdrawing the left-hand gearbox mounting assembly



10.28 Lifting the engine/gearbox assembly from the engine compartment (radiator and headlamp removed)



10.32 Unscrewing the engine-to-gearbox nut



10.33 Separating the gearbox from the engine

securing bolt, and withdraw the battery tray from the engine compartment (photo).

13 Make a final check to ensure that all relevant hoses and wires have been disconnected to facilitate removal of the engine/gearbox assembly.

14 Drain the gearbox oil with reference to Chapter 6, Section 2.

15 Working on one side of the vehicle, unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush, noting that the convex side of the washer lies against the bush.

16 Unscrew the nut and the pinch-bolt securing the lower arm balljoint to the hub carrier.

17 Working at the inboard end of the driveshaft, remove the clip securing the driveshaft joint rubber gaiter to the differential casing.

18 Using a suitable bar to lever against the subframe, lever the lower arm down to separate the balljoint from the hub carrier.

19 Place a suitable container under the inboard end of the driveshaft to catch any remaining gearbox oil which may be released as the driveshaft is withdrawn from the differential.

20 Pull the inboard end of the driveshaft from the differential (be prepared for possible oil spillage). The inboard end of the driveshaft must be supported, for example by suspending with wire or string from the vehicle underbody. **Do not allow a driveshaft to hang down under its own weight.**

21 Repeat the procedure given in paragraphs 15 to 20 inclusive on the remaining side of the vehicle.

22 Suitable lifting tackle must now be attached to the engine/gearbox assembly. A lifting bracket is provided on the gearbox, but no lifting bracket is provided on the engine, so care must be taken when deciding on an engine lifting point. In the workshop, a right-angled bracket was made up by bending a suitable piece of steel plate. The bracket was then bolted to the engine using the rear right-hand camshaft housing securing bolt with suitable packing pieces.

23 Attach the lifting tackle to the brackets on the engine and gearbox,

and just take the weight of the assembly.

24 Unscrew and remove the three bolts securing the right-hand engine mounting bracket to the body, and the four bolts securing the mounting to the cylinder block. Withdraw the complete engine mounting assembly.

25 Unscrew and remove the three bolts securing the left-hand gearbox mounting bracket to the body, and the four bolts securing the mounting to the gearbox. Withdraw the complete gearbox mounting assembly (photo).

26 Unscrew the single nut (which also secures the engine/gearbox mounting to the gearbox) and two bolts securing the clutch bellhousing cover plate to the bellhousing, and withdraw the plate.

27 Unscrew the two remaining nuts securing the engine/gearbox centre mounting to the gearbox.

28 Carefully manipulate the engine/gearbox assembly in the engine compartment, to allow the assembly to be lifted vertically from the vehicle by raising the hoist (photo). Take care not to damage any of the surrounding components in the engine compartment.

29 With the engine/gearbox assembly removed, support the assembly on suitable blocks of wood positioned on a workbench, or failing that, on a clean area of the workshop floor.

30 Clean away any external dirt using paraffin or a water-soluble solvent and a stiff brush.

31 Unscrew the three securing bolts and withdraw the starter motor. Note that the top bolt also secures a wiring harness bracket.

32 Ensure that the engine and gearbox are adequately supported, then unscrew the three engine-to-gearbox bolts, which fit from the gearbox side, and the single nut, which fits from the engine side (photo). Take note of the positions of any brackets which may be secured by the engine-to-gearbox bolts.

33 Carefully separate the gearbox from the engine, ensuring that the weight of the gearbox is not allowed to hang on the input shaft while it is engaged with the clutch friction disc (photo). Note that the gearbox locates on dowels positioned in the cylinder block.



## 11 Engine – refitting (manual gearbox in vehicle)

**Note:** A suitable hoist and lifting tackle will be required for this operation. New locktabs will be required for the exhaust downpipe-to-manifold nuts, and suitable exhaust assembly paste will be required when reconnecting the downpipes to the exhaust manifold

- 1 Before attempting to reconnect the engine to the gearbox, check that the clutch friction disc is centralised as described in Chapter 5, Section 8. This is necessary to ensure that the gearbox input shaft splines will pass through the splines in the centre of the friction disc.
- 2 Check that the clutch release arm and bearing are correctly fitted, and lightly grease the input shaft splines.
- 3 With the front of the vehicle raised and supported on axle stands, support the engine with the hoist and lifting tackle, and gently lower it into position in the engine compartment.
- 4 Mate the engine and gearbox together, ensuring that the engine adapter plate is correctly located, and that the gearbox locates on the dowels in the cylinder block, then refit the three engine-to-gearbox bolts and the single nut, but do not fully tighten them at this stage. Ensure that any brackets noted during removal are in place under the engine-to-gearbox bolts.
- 5 Fit the right-hand engine mounting bracket to the cylinder block, and tighten the securing bolts to the specified torque.
- 6 Manipulate the engine and gearbox as necessary to enable the right-hand engine mounting-to-body bolts to be fitted, then fit the bolts and tighten them to the specified torque.
- 7 Tighten the engine-to-gearbox bolts and nut to the specified torque, then disconnect the lifting tackle and hoist from the engine, and unbolt the lifting brackets from the camshaft housing.
- 8 Refit the starter motor, ensuring that the wiring harness bracket is in place on the top securing bolt.
- 9 Refit the clutch bellhousing cover plate.
- 10 Refit the engine splash shield.
- 11 Refit the roadwheel and lower the vehicle to the ground. Fully tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trim.
- 12 Clean the mating faces of the exhaust manifold and the downpipes, then coat the mating faces with exhaust assembly paste. Fit new locktabs, and tighten the downpipe-to-manifold nuts, then bend over the ends of the locktabs to secure the nuts.
- 13 Where applicable, refit the power steering pump and its bracket, and adjust the drivebelt tension as described in Chapter 9.
- 14 Refit the alternator, and adjust the coolant pump/alternator drivebelt tension as described in Chapter 2.
- 15 Reconnect the engine earth strap to the left-hand end of the cylinder head.
- 16 Reconnect the radiator top hose to the thermostat cover, and reconnect the bottom hose to the coolant gallery.
- 17 Reconnect the heater coolant hoses to the thermostat cover and the coolant gallery.
- 18 Reconnect the brake servo vacuum hose to the inlet manifold.
- 19 Reconnect the fuel hoses to the fuel pump and the carburettor.
- 20 Reconnect the wiring to the components listed in Section 9, paragraph 8.
- 21 Reconnect the throttle cable and the choke cable to the carburettor, and adjust the cables as described in Chapter 3.
- 22 Fill the engine with oil, and fit a new oil filter as described in Section 3.
- 23 Refill the cooling system as described in Chapter 2.
- 24 Where applicable, reconnect the air cleaner hot air hose to the hot air pipe on the camshaft cover.
- 25 Refit the air cleaner or the carburettor hot air box, as applicable, as described in Chapter 3.
- 26 Refit the bonnet as described in Chapter 10.
- 27 Reconnect the battery leads.

## 12 Engine/manual gearbox assembly – reconnection and refitting

**Note:** A suitable hoist and lifting tackle will be required for this operation. New locktabs will be required for the exhaust downpipe-to-manifold nuts, and suitable exhaust assembly paste will be required when recon-

necting the downpipes to the exhaust manifold

- 1 Before attempting to reconnect the engine to the gearbox, check that the clutch friction disc is centralised as described in Chapter 5, Section 8. This is necessary to ensure that the gearbox input shaft splines will pass through the splines in the centre of the friction disc.
- 2 Check that the clutch release arm and bearing are correctly fitted, and lightly grease the input shaft splines.
- 3 Carefully offer the gearbox to the engine, ensuring that the engine adapter plate is correctly positioned, until the bellhousing is located on the dowels in the cylinder block, then refit the engine-to-gearbox bolts and nut, and tighten them to the specified torque. Make sure that any brackets noted during removal are in place under the engine-to-gearbox bolts. Ensure that the weight of the gearbox is not allowed to hang on the input shaft as it is engaged with the clutch friction disc.
- 4 Refit the starter motor, ensuring that the wiring harness bracket is in position on the top bolt.
- 5 With the front of the vehicle raised and supported on axle stands, support the engine/gearbox assembly with the hoist and lifting tackle, then gently lower it into position in the engine compartment.
- 6 Reconnect the engine/gearbox centre mounting to the gearbox, and fit the two larger securing nuts (the smaller nut also secures the clutch bellhousing cover plate), but do not fully tighten them at this stage.
- 7 Fit the left-hand gearbox mounting bracket to the gearbox, and tighten the securing bolts to the specified torque.
- 8 Fit the left-hand gearbox mounting-to-body bolts, but do not fully tighten them at this stage.
- 9 Fit the right-hand engine mounting bracket to the engine, and tighten the securing bolts to the specified torque.
- 10 Fit the right-hand engine mounting-to-body bolts, and tighten them to the specified torque.
- 11 Tighten the left-hand engine mounting-to-body bolts and the two engine/gearbox centre mounting-to-gearbox nuts to their specified torques, then disconnect the lifting tackle and hoist from the engine.
- 12 Refit the clutch bellhousing cover plate.
- 13 Working on one side of the vehicle, remove the wire or string supporting the driveshaft, then manipulate the driveshaft as necessary to engage the inboard end with the differential.
- 14 Lever the lower arm down, as during removal, to engage the balljoint with the hub carrier.
- 15 Refit the nut and pinch-bolt securing the lower arm balljoint to the hub carrier, and tighten to the specified torque.
- 16 Refit the rubber bush and the washer to the end of the anti-roll bar vertical link (the convex side of the washer should lie against the bush), then fit the securing nut and tighten it to the specified torque.
- 17 Repeat the procedure given in paragraphs 13 to 16 inclusive on the remaining side of the vehicle.
- 18 Refit the battery tray, and its plastic drip tray.
- 19 On models with digital instruments, reconnect the wiring and the vacuum hose to the economy gauge sender unit on the rear of the battery tray.
- 20 Reconnect the ignition coil wiring.
- 21 Refit the battery and secure with the clamp bolt.
- 22 Reconnect the earth strap to the gearbox casing and tighten the securing bolt.
- 23 On models with digital instruments, reconnect the wiring to the speedometer sender unit.
- 24 On models with analogue instruments reconnect the speedometer cable to the gearbox, and tighten the securing sleeve. Ensure that the cable is routed as noted previously.
- 25 Reconnect the wiring to the reversing lamp switch.
- 26 Reconnect the clutch cable to the release arm, ensuring that it is routed as noted previously. Refit the plastic block, adjuster nut and locknut to the threaded rod at the end of the cable, and locate the cable sheath rubber grommet in the lugs on the gearbox casing. Screw the adjuster nut and locknut onto the threaded rod to leave the approximate amount of exposed thread noted before removal, then adjust the cable as described in Chapter 5.
- 27 Reconnect the three gear selector rods to the gearbox, in their previously noted positions, and tighten the securing nuts.
- 28 Refit the engine and gearbox splash shields, and reconnect the brake pad wear sensor wire.
- 29 Refit the roadwheels and lower the vehicle to the ground. Fully tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trims.
- 30 Clean the mating faces of the exhaust manifold and the down-



pipes, then coat the mating faces with exhaust assembly paste. Fit new locktabs, and tighten the downpipe-to-manifold nuts, then bend over the ends of the locktabs to secure the nuts.

31 Proceed as described in Section 11, paragraph 13 onwards, but in addition, refill the gearbox with oil with reference to Chapter 6, Section 2.

### 13 Engine/gearbox mountings – renewal

1 The engine/gearbox assembly is suspended in the engine compartment on three mountings, two of which are attached to the gearbox, and one to the engine.

#### Right-hand mounting

2 Apply the handbrake, then jack up the front of the vehicle and support securely on axle stands.

3 Suitable lifting tackle must now be attached to the engine in order to support it as the engine mounting is removed. No lifting brackets are provided, so care must be taken when deciding on an engine lifting point. In the workshop, a right-angled bracket was made up by bending a suitable piece of steel plate. The bracket was then bolted to the engine using the rear right-hand camshaft housing securing bolt with suitable packing washers.

4 Attach the lifting tackle to the bracket on the engine and just take the weight of the assembly.

5 Working under the vehicle, unbolt the engine mounting bracket from the cylinder block, and unbolt the mounting from the body, then withdraw the bracket/mounting assembly (photo).

6 Unscrew the nut and through-bolt, counterholding the bolt with a second spanner or socket, and separate the mounting from the bracket.

7 Fit the new mounting to the bracket, and tighten the nut to the specified torque, while counterholding the through-bolt using a suitable spanner or socket.

8 Refit the mounting bracket to the cylinder block, and tighten the securing bolts to the specified torque.

9 Refit the mounting to the body and tighten the securing bolts to the specified torque.

10 Disconnect the lifting tackle from the engine, and remove the engine lifting bracket.

11 Lower the vehicle to the ground.

#### Left-hand mounting

12 Apply the handbrake, then jack up the front of the vehicle and support securely on axle stands.

13 Suitable lifting tackle must now be attached to the gearbox lifting bracket in order to support the weight of the assembly as the mounting is removed.

14 Attach the lifting tackle to the bracket on the gearbox, and just take the weight of the assembly.

15 Working under the vehicle, unbolt the mounting bracket from the gearbox, and unbolt the mounting from the body, then withdraw the bracket/mounting assembly (photo).

16 Proceed as described in paragraphs 6 and 7.

17 Refit the mounting bracket to the gearbox, and tighten the securing bolts to the specified torque.

18 Refit the mounting to the body and tighten the mounting bolts to the specified torque.

19 Disconnect the lifting tackle from the engine.

20 Lower the vehicle to the ground.

#### Centre mounting

21 Proceed as described in paragraphs 12 to 20 inclusive, but note that the clutch bellhousing cover plate must be removed before the mounting bracket can be removed from the gearbox – the smaller mounting bracket securing nut also secures the clutch bellhousing cover plate (photo). Note also that the mounting is bolted to the subframe, not the body.

22 On some later models, the mounting bracket incorporates an additional bracing strut which bolts to the top of the gearbox.

23 Refit the bellhousing cover plate on completion.

### 14 Engine dismantling – general

1 It is preferable to mount the engine on a dismantling stand, but if this is not possible, stand the engine on a strong bench at a comfortable working height. Failing this, it will have to be stripped down on the floor.

2 Cleanliness is most important, and if the engine is dirty, it should be cleaned with paraffin.

3 Avoid working with the engine directly on a concrete floor, as grit presents a real source of trouble.

4 If the engine oil appears extremely dirty or contaminated, avoid inverting the engine until the sump has been removed. This will prevent any contaminated sludge from entering the oilways.

5 As components are removed, clean them in a paraffin bath. However, do not immerse components with internal oilways in paraffin, as it is difficult to remove, usually requiring a high pressure hose. Clean oilways with nylon pipe cleaners.

6 It is advisable to have suitable containers available to hold small items according to their use, as this will help when reassembling the engine and will also prevent possible losses.

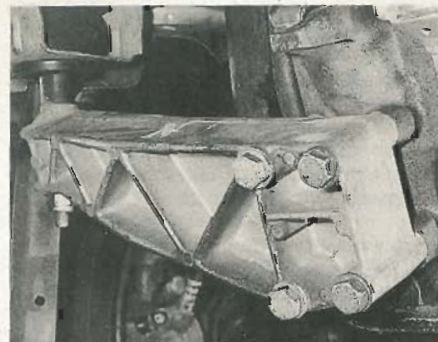
7 Always obtain a complete set of new gaskets for use during engine reassembly, but retain the old gaskets with a view to using them as a pattern to make a replacement if a suitable new one is not available.

8 Where possible, refit securing nuts, bolts and washers to their locations after removing the relevant components. This will help to protect the threads and will also prevent possible losses.

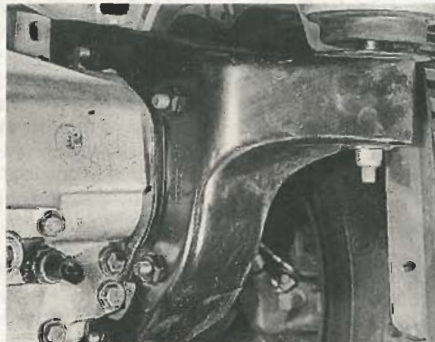
9 Retain unserviceable components in order to compare them with the new components supplied.

10 Read through the relevant Section of this Chapter carefully before commencing work, to ensure that any special tools which may be required are available. Many components (particularly gaskets and oil seals) must be renewed on reassembly; where applicable, obtain the required new components before starting work.

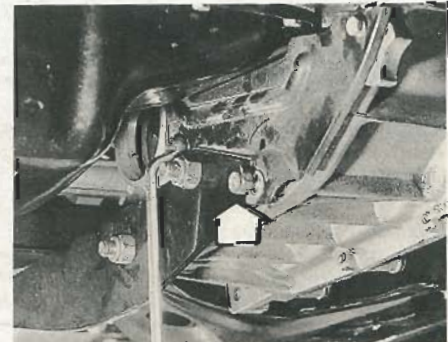
11 Before dismantling the main engine components, the following



13.5 Right-hand engine mounting bracket



13.15 Left-hand gearbox mounting bracket

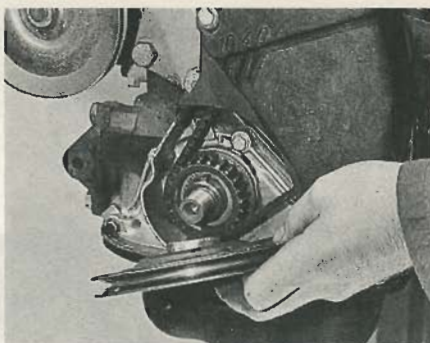


13.21 Unscrewing a clutch bellhousing cover plate securing bolt. Nut (arrowed) secures both cover plate and engine/gearbox mounting bracket

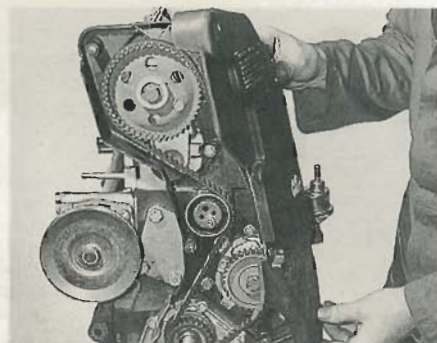




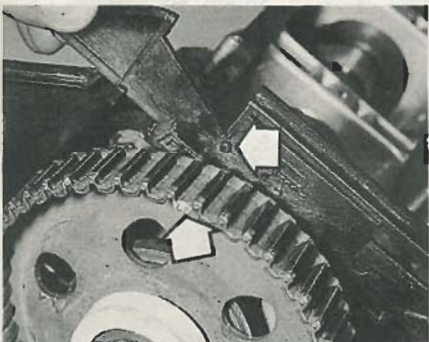
15.3A Removing the crankshaft pulley nut ...



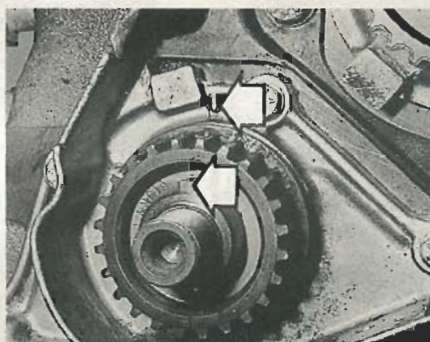
15.3B ... and the pulley



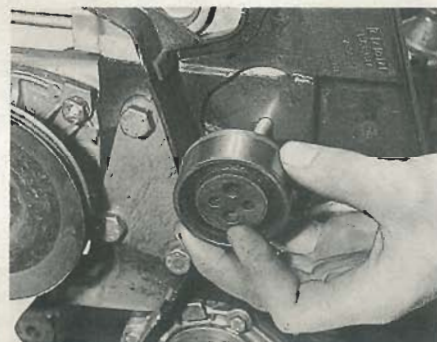
15.4 Removing the outer timing belt cover



15.5A Timing mark on camshaft sprocket aligned with reference pip on rear timing belt cover



15.5B Crankshaft Woodruff key aligned with reference mark on crankshaft front oil seal housing (arrows)



15.6A Withdraw the timing belt tensioner pulley assembly ...

externally-mounted ancillary components can be removed, with reference to the relevant Chapters where applicable:

- Inlet manifold and carburettor, and exhaust manifold – see Chapter 3*
- Dipstick*
- Crankcase ventilation system oil separator and hose – see Section 5 of this Chapter*
- Clutch – see Chapter 5*
- Engine mounting bracket*
- Alternator mounting bracket*
- Power steering pump bracket (where applicable)*
- HT lead bracket*
- Distributor, HT leads and spark plugs – see Chapter 4*
- Coolant pump – see Chapter 2*
- Oil pressure switch*
- Coolant temperature sender*
- Crankshaft speed/position sensor – see Chapter 4*
- Fuel pump – see Chapter 3*
- Thermostat/cover assembly – see Chapter 2*
- Oil filter*
- Camshaft cover-mounted hot air pipe (where applicable)*

## 15 Timing belt and sprockets – removal and refitting

**Note:** The timing belt must be renewed after removal: never refit a used belt

- 1 If the engine is in the vehicle, disconnect the battery negative lead, and remove the coolant pump/alternator drivebelt as described in Chapter 2.
- 2 Slacken the crankshaft pulley nut. If the engine is in the vehicle, prevent the crankshaft from turning by engaging top gear and having an assistant apply the brake pedal hard, or alternatively remove the starter motor and jam the flywheel ring gear teeth with a lever. If the engine has been removed from the vehicle, an improvised tool can be bolted into

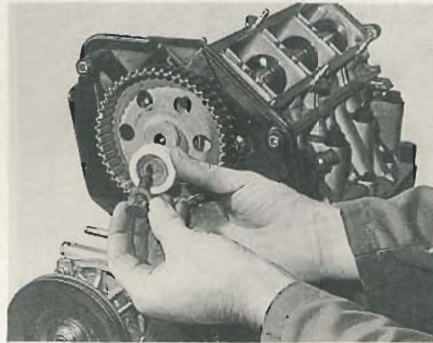
place using one of the engine-to-gearbox mounting bolt holes to prevent the crankshaft from turning by locking the flywheel.

- 3 Remove the nut, noting that the stepped end of the nut fits against the pulley, and withdraw the pulley (photos). Temporarily refit the pulley nut to the end of the crankshaft.
- 4 Unscrew the four securing bolts and washers, and remove the outer timing belt cover (photo).
- 5 Turn the crankshaft, using a suitable socket or spanner on the crankshaft pulley nut, until the timing mark on the camshaft sprocket is aligned with the fixed reference pip on the upper section of the rear timing belt cover, and the Woodruff key in the end of the crankshaft is aligned with the reference mark on the crankshaft front oil seal housing (photos).
- 6 Unscrew the securing nut and withdraw the timing belt tensioner pulley assembly, noting that it is in three sections (photo).
- 7 Slide the timing belt from the sprockets, and remove it from the engine.
- 8 If desired, the sprockets and the rear timing belt cover can be removed as follows, otherwise proceed to paragraph 18.
- 9 To remove the camshaft sprocket, a suitable tool must be used to hold the camshaft stationary as the sprocket bolt is loosened. A suitable tool can be improvised as shown in photo 15.17, using two pieces of steel bar joined together by a pivot bolt, with suitable bolts through the ends of the steel bars to engage with the holes in the sprocket.
- 10 Unscrew the sprocket bolt, and recover the plain washer, and the thrustwasher which is bonded into a plastic sleeve (photo).
- 11 The sprocket can now be withdrawn from the end of the camshaft. If the sprocket is tight, carefully lever it from the camshaft using two screwdrivers, but take care not to damage the rear timing belt cover.
- 12 The crankshaft sprocket can be removed by simply pulling it from the end of the crankshaft after the pulley securing nut has been removed. Recover the Woodruff key from the end of the crankshaft if it is loose (photo).
- 13 To remove the auxiliary shaft sprocket, a suitable tool must be used to hold the sprocket stationary as the securing bolt is loosened (the bolt is extremely tight). In the workshop, a "scissors" style tool was improvised, using two pieces of steel bar joined together by a pivot bolt, with their ends bent through a right-angle to engage securely between

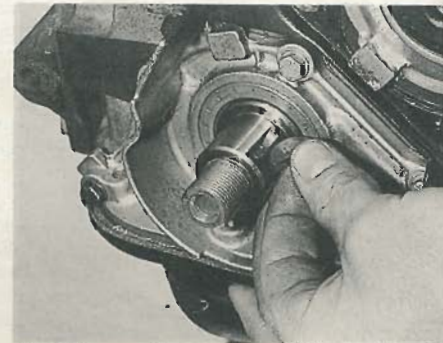




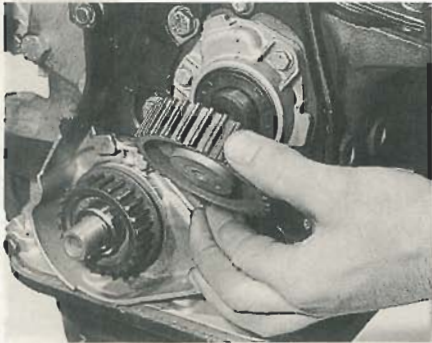
15.6B ... noting that it is in three sections



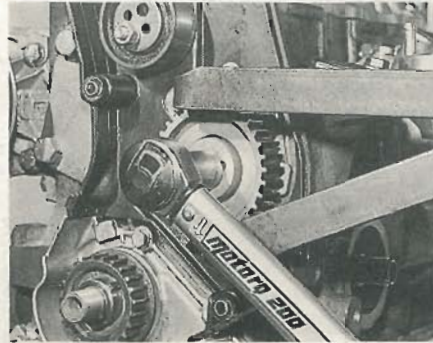
15.10 Removing the camshaft sprocket bolt, plane washer and thrustwasher



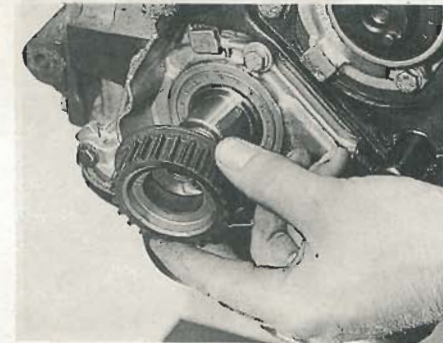
15.12 Recover the crankshaft Woodruff key if it is loose



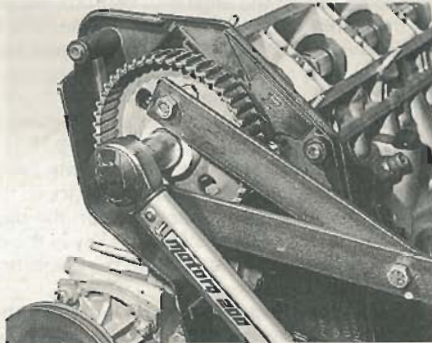
15.14 Withdrawing the auxiliary shaft sprocket



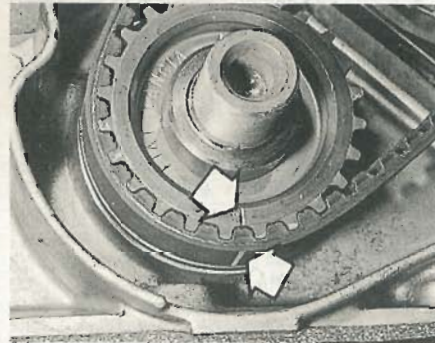
15.15 Tightening the auxiliary shaft sprocket bolt



15.16 Refitting the crankshaft sprocket



15.17 Tightening the camshaft sprocket bolt



15.21 Mark on timing belt aligned with scribed mark on crankshaft sprocket (arrows)

the teeth on the sprocket - see photo 15.15.

14 Unscrew the sprocket bolt, and recover the washer, then withdraw the sprocket from the end of the auxiliary shaft (photo). If the sprocket is tight, carefully lever it from the shaft using two screwdrivers. 15 Refit the auxiliary shaft sprocket, making sure that the lug on the end of the shaft engages with the hole in the sprocket, then tighten the securing bolt to the specified torque (ensure that the washer is in place under the bolt head). Prevent the sprocket from turning as during removal (photo).

16 Where applicable, refit the Woodruff key to the end of the crankshaft, then refit the crankshaft sprocket with the flanged side against the oil seal housing (photo).

17 Refit the camshaft sprocket to the end of the camshaft, making sure that the lug on the end of the shaft engages with the hole in the sprocket, then refit the thrustwasher, plain washer, and bolt, and tighten the bolt to the specified torque. Prevent the camshaft from turning as during removal (photo).

18 Refit the belt tensioner pulley assembly, ensuring that the washer

is in place under the securing nut, but do not fully tighten the nut at this stage.

19 Make sure that the crankshaft and camshaft sprocket timing marks are still aligned as described in paragraph 5.

20 The new timing belt should have two alignment marks on its outside edge, which must align with corresponding marks on the crankshaft and camshaft sprockets as the belt is refitted.

21 Refit the timing belt around the sprockets and the tensioner pulley, starting at the crankshaft sprocket. One of the alignment marks on the belt must be aligned with the scribed mark on the lower edge of the crankshaft sprocket (opposite the Woodruff key), and the remaining mark on the belt should then align with the timing marks on the camshaft sprocket and rear timing belt cover (photo).

22 Ensure that the marks on the belt and sprockets are correctly aligned as described in the previous paragraph, then temporarily refit the crankshaft pulley nut, and adjust the timing belt tension as described in Section 16.

23 Turn the crankshaft through two complete turns clockwise, and



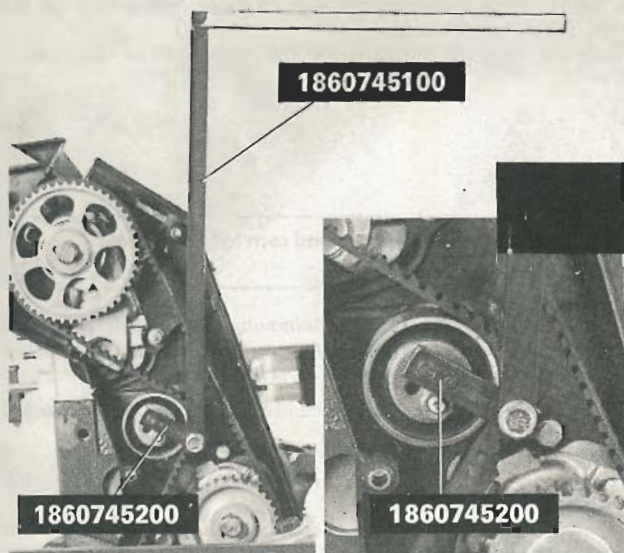
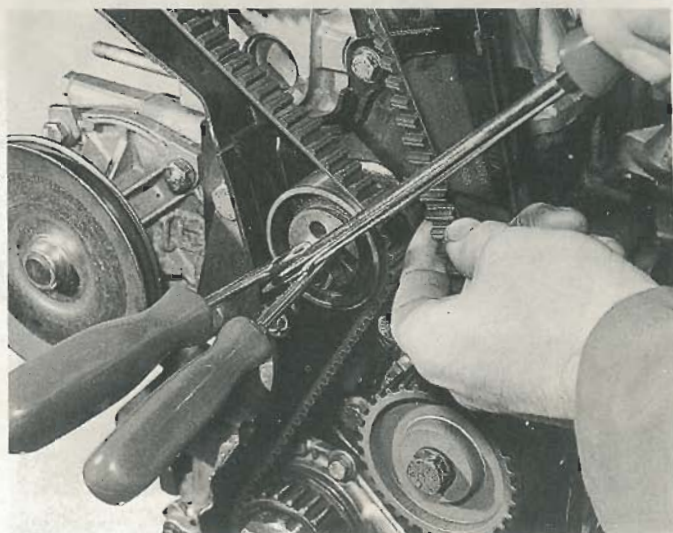


Fig. 1.5 FIAT special tools for timing belt adjustment assembled on tensioner pulley (Sec 16)



16.7 Levering the timing belt tensioner pulley for approximate adjustment of belt tension

check that the crankshaft and camshaft sprocket timing marks are still aligned as described in paragraph 5 (note that the marks on the timing belt will no longer be aligned with the relevant marks on the crankshaft and camshaft sprockets). Remove the crankshaft pulley nut.

24 Refit the crankshaft pulley and its securing nut (the stepped side of the nut should face the pulley), and tighten the nut to the specified torque. Prevent the crankshaft from turning as during removal.

25 Refit the outer timing belt cover.

26 Where applicable, refit the coolant pump/alternator drivebelt and adjust its tension as described in Chapter 2, and reconnect the battery negative lead.

## 16 Timing belt tension - checking and adjustment

**Note:** The manufacturers specify the use of special tools (FIAT tool nos 18607452000 and 18607451000) for checking the timing belt tension. If access to suitable tools cannot be obtained, it is strongly recommended that the vehicle is taken to a FIAT dealer to have the belt tension checked at the earliest opportunity

### Approximate adjustment

1 The timing belt tension should be checked at the intervals specified in the *Routine maintenance* Section at the beginning of this manual.

2 Where applicable on later models, remove the air cleaner trunking and the hot air hose for improved access.

3 Unscrew the four securing bolts and washers, and remove the outer timing belt cover.

4 The timing belt tension can be checked approximately by twisting the belt between the thumb and forefinger, at the centre of the run between the auxiliary shaft sprocket and the camshaft sprocket. It should just be possible to twist the belt through 90° using moderate pressure.

5 If adjustment is necessary, slacken the tensioner pulley securing nut, and proceed as follows.

6 Insert two suitable rods (such as two small screwdrivers) into the holes in the tensioner pulley, and insert a lever between them.

7 Gently lever the tensioner pulley against the belt, until the belt can be twisted as described in paragraph 4, then lock the tensioner pulley by tightening the securing nut (photo).

8 Remove the tools from the tensioner pulley, then finally tighten the securing nut to the specified torque.

9 Turn the crankshaft through two complete turns clockwise, using a suitable socket or spanner on the crankshaft pulley nut, then re-check the belt tension as described in paragraph 4.

10 If further adjustment is required, repeat paragraphs 5 to 9 inclusive until the desired tension is obtained. If in doubt, err on the tight side when adjusting the tension, as if the belt is too slack, it may jump on the sprockets, which could result in serious engine damage.

11 Refit the outer timing belt cover.

12 Have the belt tension checked by a FIAT dealer at the earliest opportunity.

### Adjustment using FIAT special tools

13 Proceed as described in paragraphs 1 to 3 inclusive.

14 Slacken the tensioner pulley securing nut.

15 Assemble the special tools and fit them to the belt tensioner pulley as shown in Fig. 1.5.

16 Turn the crankshaft through two full turns clockwise, using a suitable socket or spanner on the crankshaft pulley nut, then lock the belt tensioner pulley by tightening the securing bolt.

17 Remove the special tools, and finally tighten the tensioner pulley bolt to the specified torque.

18 Refit the outer timing belt cover.

19 Where applicable, refit the air trunking and the hot air hose.

## 17 Timing belt covers - removal and refitting

### Outer cover

1 The outer cover is moulded as a single piece, and can be removed after unscrewing the four securing bolts.

2 Refitting is a reversal of removal.

### Rear cover - upper section

3 Remove the timing belt and the camshaft sprocket as described in Section 15.

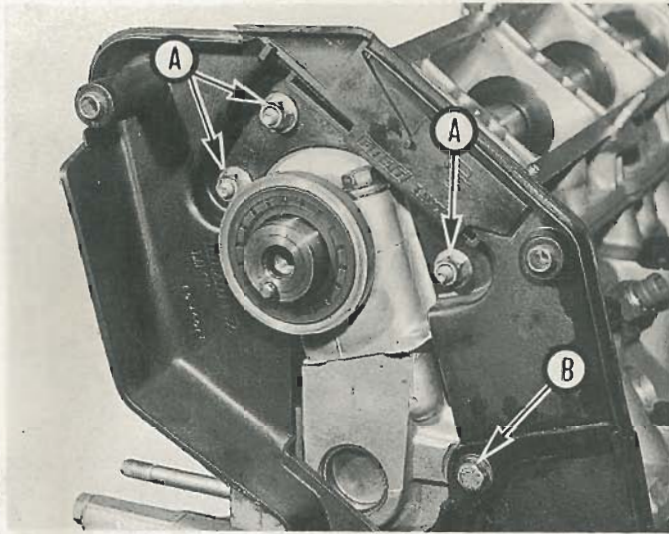
4 Remove the three securing nuts and the single securing bolt, and withdraw the upper section of the rear cover (photo).

5 Refitting is a reversal of removal.

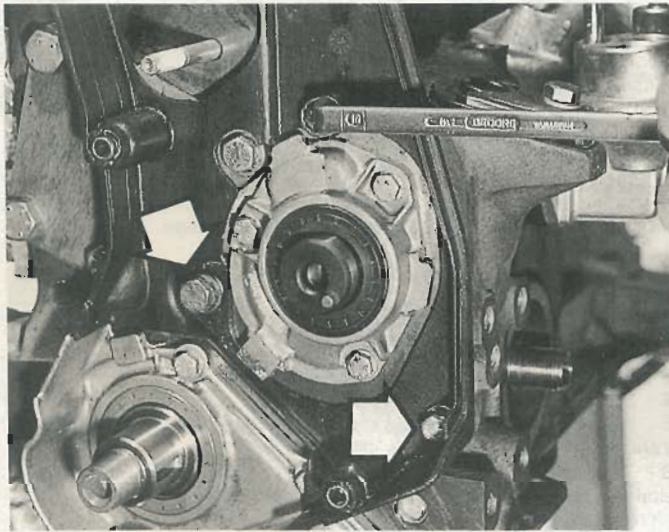
### Rear cover - lower section

6 Remove the timing belt and the timing belt tensioner pulley as described in Section 15.





17.4 Rear timing belt cover upper section securing nuts (A) and bolt (B)



17.7 Unscrewing a rear timing belt cover lower section securing bolt (two of the remaining bolts arrowed)

7 Remove the four securing bolts (there are two different sizes of bolt), noting that the top bolt also secures the upper section of the rear timing belt cover, and withdraw the lower section of the rear cover (photo).

8 Refitting is a reversal of removal.

### 18 Camshaft front oil seal - renewal

1 The camshaft front oil seal may be renewed with the engine in the vehicle, and the camshaft *in situ*, as follows.

2 Remove the timing belt and the camshaft sprocket as described in Section 15.

3 Punch or drill a small hole in the centre of the exposed oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal.

4 Clean the oil seal seat with a wooden or plastic scraper.

5 Lubricate the lips of the new seal with clean engine oil, and drive it into position until it is flush with the housing, using a suitable socket or

tube. Take care not to damage the seal lips during fitting. Note that the seal lips should face inwards.

6 Refit the camshaft sprocket and the timing belt as described in Section 15.

### 19 Camshaft housing, camshaft and cam followers - removal and refitting

**Note:** The engine must be cold when removing the camshaft housing. Do not remove the camshaft housing from a hot engine. New camshaft housing and camshaft cover gaskets must be used on refitting

1 If the engine is in the vehicle, proceed as follows, otherwise proceed to paragraph 6.

2 Disconnect the battery negative lead.

3 Remove the air cleaner or the carburettor hot air box, as applicable, as described in Chapter 3.

4 Disconnect the fuel pump fuel supply hose (which runs from the fuel filter to the fuel pump) from the fuel pump. Plug the end of the hose to minimise fuel spillage, and take adequate fire precautions. Pull the hose from the clip on the camshaft cover, then move it to one side out of the way.

5 Repeat the procedure given in paragraph 4 for the carburettor fuel supply hose (which runs from the fuel pump to the carburettor).

6 On 1.4 litre models, disconnect the distributor vacuum hose from the carburettor, then pull the hose from the clip on the camshaft cover and move it to one side out of the way.

7 Where applicable on later models, pull the crankcase breather hose from the clip on the camshaft cover.

8 Where applicable on later models, disconnect the hot air hoses from each end of the hot air pipe on the camshaft cover, then unscrew the bolt securing the pipe to the camshaft cover, and withdraw the pipe.

9 On 1.6 litre models, remove the distributor, as described in Chapter 4.

10 Where applicable, remove the power steering pump and its bracket as described in Chapter 9.

11 Unscrew the six securing nuts and washers, and lift off the camshaft cover, noting that on later models two of the nuts also secure the hose clip assembly. Recover the gasket.

12 Remove the timing belt and the camshaft sprocket as described in Section 15.

13 Remove the three securing nuts and the single securing bolt, and withdraw the upper section of the rear timing belt cover.

14 Unscrew the camshaft housing securing bolts. There are seven

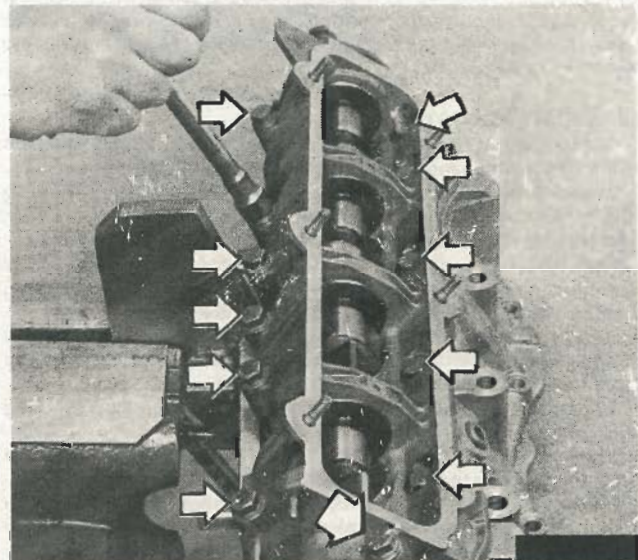
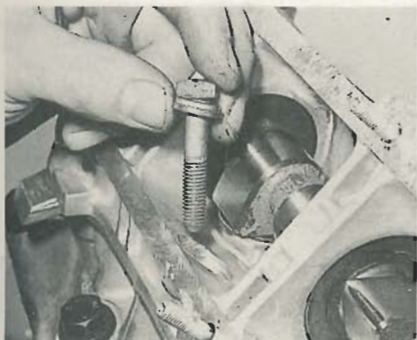
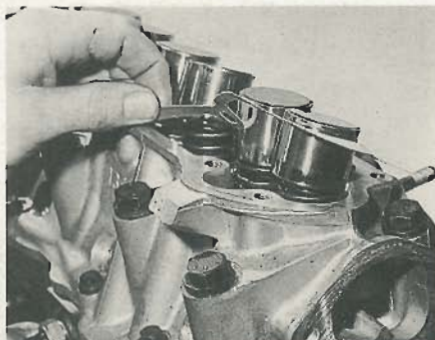


Fig. 1.6 Camshaft housing securing bolts (arrowed) [Sec 19]

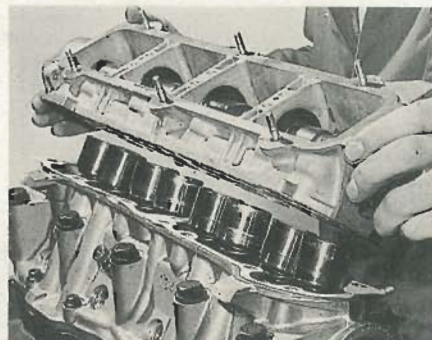




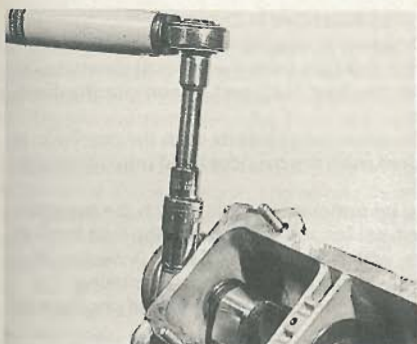
19.14 Removing one of the shorter camshaft housing securing bolts



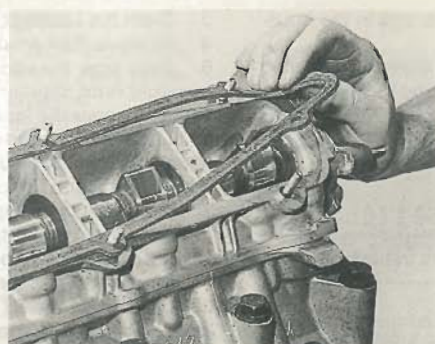
19.19 Locating a new camshaft housing gasket on the cylinder head



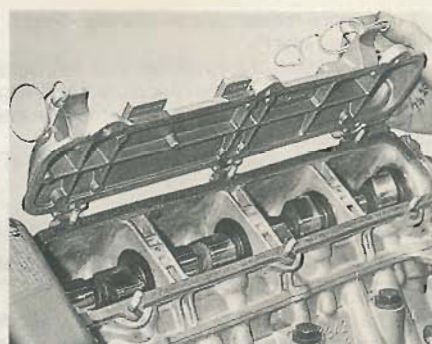
19.21 Lowering the camshaft housing onto the cylinder head



19.22 Tightening a camshaft housing securing bolt



19.26A Locate a new gasket on the camshaft housing ...



19.26B ... and refit the camshaft cover

bolts which are accessible from outside the camshaft housing, and five shorter bolts which are accessible from inside the housing (these bolts are normally covered by the camshaft cover). Note that each bolt is fitted with two washers (photo).

15 Carefully lift the camshaft housing from the cylinder head. Be prepared for the cam followers to drop from their bores in the camshaft housing as the camshaft housing is lifted, and ensure that the cam followers are identified for position so that they can be refitted in their original positions (this can be achieved by placing each cam follower over its relevant valve in the cylinder head).

16 Recover the gasket.

17 Removal of the camshaft from the housing, and inspection of the components is described in Section 20.

18 Commence refitting by cleaning the gasket mating surfaces of the camshaft housing and cylinder head.

19 Locate a new gasket on the cylinder head, making sure that it is correctly positioned over the dowels (photo).

20 Ensure that the cam followers are correctly located over their relevant valves.

21 Liberally oil the cam follower bores in the camshaft housing, then carefully lower the housing over the cam followers, and onto the cylinder head (photo). Some manipulation will be required to engage the cam followers with their relevant bores in the camshaft housing.

22 Loosely refit all the camshaft housing securing bolts, ensuring that the washers are in place under their heads, then tighten them progressively to the specified torque, starting at the centre of the housing and working outwards in a spiral pattern (photo).

23 Refit the upper section of the rear timing belt cover.

24 Refit the camshaft sprocket and the timing belt as described in Section 15.

25 Check the valve clearances as described in Section 4.

26 Refit the camshaft cover using a new gasket, and tighten the securing nuts, ensuring that the washers are in place (photos). Where applicable, ensure that the hose clip is in place before refitting the relevant camshaft cover securing nuts.

27 Where applicable, refit the power steering pump and its bracket, and tension the drivebelt as described in Chapter 9.

28 Where applicable, refit the hot air pipe to the camshaft cover, and reconnect the hot air hoses.

29 On 1.6 litre models, refit the distributor as described in Chapter 4.

30 On 1.4 litre models, reconnect the distributor vacuum hose to the carburettor, and refit the hose to the clip on the camshaft cover.

31 Reconnect the fuel hose(s), and refit it/them (as applicable) to the clip on the camshaft cover.

32 If the engine is in the vehicle, refit the air cleaner or the carburettor air box, as applicable, and reconnect the battery negative lead.

## 20 Camshaft housing, camshaft and cam followers – dismantling, inspection and reassembly

1 With the camshaft housing removed from the cylinder head as described in Section 19, proceed as follows.

2 Unscrew the three securing bolts, and withdraw the blanking plate (1.4 litre models), or the distributor intermediate housing (1.6 litre models) from the end of the camshaft housing. Recover the gasket.

3 The camshaft can now be carefully withdrawn from the blanking plate/distributor end of the camshaft housing, taking care not to damage the bearing journals (photo).

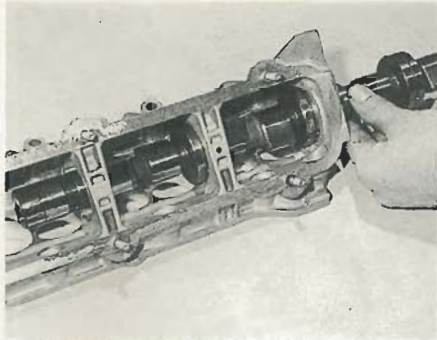
4 With the camshaft removed, examine the bearings in the camshaft housing, and the cam follower bores for signs of obvious wear or pitting. If evident, a new camshaft housing will probably be required.

5 The camshaft itself should show no signs of marks or scoring on the journal or cam lobe surfaces. If evident, renew the camshaft.

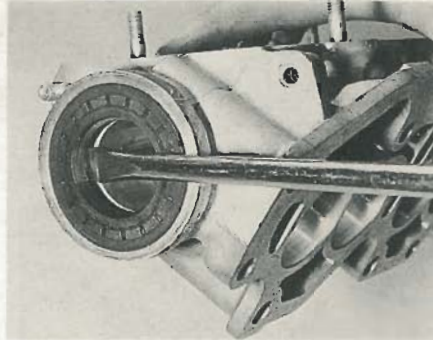
6 Examine the cam followers for signs of obvious wear, and for ovality, and renew if necessary.

7 It is advisable to renew the camshaft front oil seal as a matter of course if the camshaft has been removed. Prise out the old seal using a screwdriver, and drive in the new seal until it is flush with the housing, using a suitable socket or tube (photos).

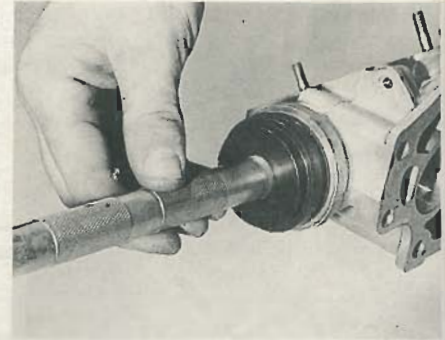




20.3 Withdrawing the camshaft from its housing



20.7A Prise out the camshaft front oil seal using a screwdriver ...



20.7B ... and drive in the new seal using a tool of suitable diameter

- 8 Commence reassembly by liberally oiling the bearings in the housing, and the oil seal lip.
- 9 Carefully insert the camshaft into the housing from the blanking plate/distributor end, taking care to avoid damage to the bearings.
- 10 Refit the blanking plate or distributor intermediate housing (as applicable), using a new gasket.
- 11 Refit the camshaft housing as described in Section 19.

## 21 Cylinder head – removal and refitting (engine in vehicle)

**Note:** The engine must be cold when the cylinder head is removed. Do not remove the cylinder head from a hot engine. New cylinder head, camshaft housing and camshaft cover gaskets and new exhaust downpipe-to-manifold nut locktabs must be used on refitting, and suitable exhaust assembly paste will be required when reconnecting the downpipes to the exhaust manifold. FIAT specify that the main cylinder head bolts should be renewed after they have been used (ie tightened) four times – if in any doubt as to the number of times the bolts have been used, renew them in any case as a precaution against possible failure

- 1 Disconnect the battery negative lead.
- 2 Remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.

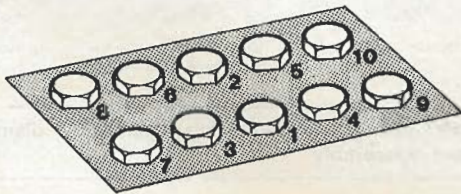
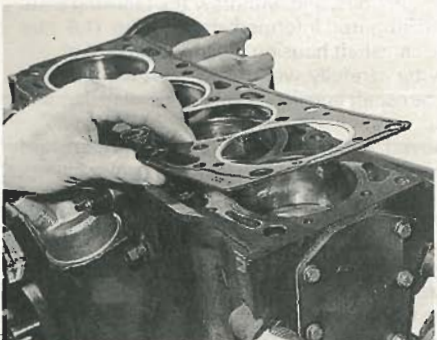
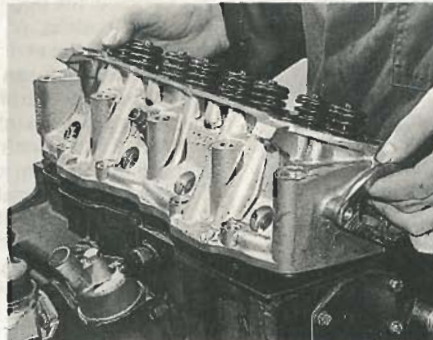


Fig. 1.7 Cylinder head bolt tightening sequence (Sec 21)



21.16 Locating a new cylinder head gasket on the cylinder block (engine shown on dismantling stand)



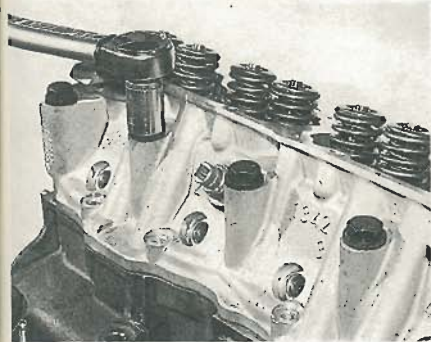
21.17A Locate the cylinder head on the block ...



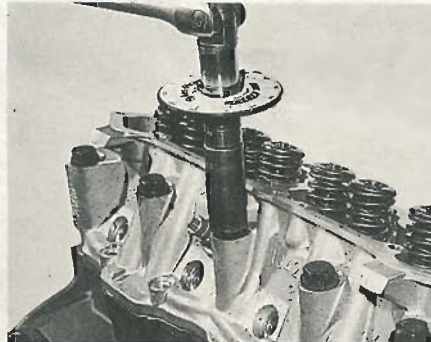
21.17B ... so that the positioning dowels engage in their holes

- 3 Drain the cooling system as described in Chapter 2.
- 4 Remove the camshaft housing as described in Section 19.
- 5 Prise back the ends of the locktabs from the exhaust downpipe-to-manifold nuts, then unscrew the four nuts, and disconnect the downpipes. Recover the locktabs.
- 6 The cylinder head can be removed complete with the manifolds, or the manifolds can be detached from the cylinder head prior to removal, with reference to Chapter 3.
- 7 If the cylinder head is to be removed complete with the manifolds, disconnect all relevant hoses, cables and wiring from the inlet manifold and associated components, with reference to Chapter 3, Section 28.
- 8 Disconnect the coolant hoses from the thermostat housing.
- 9 Disconnect the HT leads from the spark plugs, identifying them for location if necessary to aid refitting.
- 10 Loosen the ten main cylinder head bolts progressively, working from the outside inwards in a spiral pattern, in the reverse sequence to that shown in Fig. 1.7, then loosen the four smaller bolts located adjacent to the spark plug holes.
- 11 Remove the cylinder head bolts and recover the washers.
- 12 Lift the cylinder head from the cylinder block. If necessary, tap the cylinder head gently with a soft-faced mallet to free it from the block, but do not lever at the mating faces. Note that the cylinder head is located on dowels.
- 13 Recover the cylinder head gasket and discard it.
- 14 Clean the cylinder head and block mating faces by careful scraping. Take care not to damage the cylinder head, which is made from light alloy, and is easily scored. Cover the coolant passages and other openings with masking tape or rag to prevent dirt and carbon falling in. Mop out all the oil from the bolt holes – if oil is left in the holes, hydraulic pressure could crack the block when the bolts are refitted.
- 15 If desired, the cylinder head can be dismantled and inspected as described in Sections 23 and 24 respectively.
- 16 Commence refitting by locating a new gasket on the block so that the world "ALTO" can be read from above (photo). Note that the gasket should be kept in its original sealed packaging until shortly before fitting. Take care to avoid any oil or grease coming into contact with the gasket.
- 17 With the mating faces scrupulously clean, locate the cylinder head on the block so that the positioning dowels engage in their holes (photos).

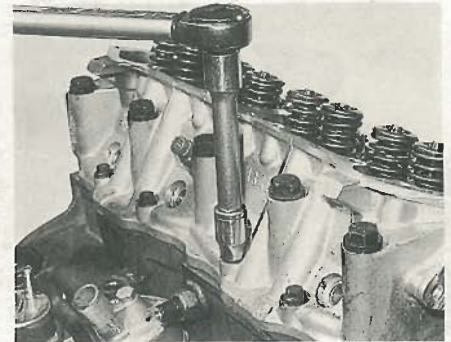




21.19A Tighten the main cylinder head bolts to the specified torque ...



21.19B ... and then through the specified angle



21.20 Tighten the smaller cylinder head bolts to the specified torque

18 Refer to the note at the beginning of this Section, then refit the ten main cylinder head bolts, ensuring that the washers are in place under their heads, and screw the bolts in by hand as far as possible.

19 Tighten the bolts working from the inside outwards in a spiral pattern as shown in Fig. 1.7. Tighten the bolts in the four stages given in the Specifications – ie tighten all bolts to the Stage 1 torque, then tighten all bolts to the Stage 2 torque, and so on (photos).

20 Refit the four smaller cylinder head bolts adjacent to the spark plug holes, ensuring that the washers are in place under their heads, then tighten them to the specified torque (photo).

21 Refit the HT leads to the spark plugs, ensuring that they are refitted to their correct cylinders.

22 Reconnect the coolant hoses to the thermostat housing.

23 Refit the manifolds and/or reconnect all relevant hoses, cables and wiring to the inlet manifold (as applicable), with reference to Chapter 3.

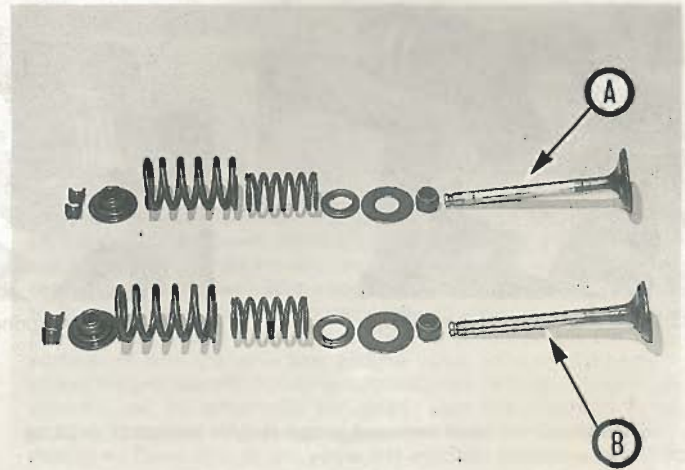
24 Clean the mating faces of the exhaust manifolds and the downpipes, then coat the mating faces with exhaust assembly paste. Fit new locktabs, and tighten the downpipe-to-manifold nuts, then bend over the ends of the locktabs to secure the nuts.

25 Refit the camshaft housing as described in Section 19.

26 Refill the cooling system as described in Chapter 2.

27 Refit the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.

28 Reconnect the battery negative lead.



23.7 Inlet (A) and exhaust (B) valve components

4 Where applicable, refit the manifolds with reference to Chapter 3.

5 Refit the camshaft housing as described in Section 19.

## 22 Cylinder head – removal and refitting (engine removed)

*Note: Refer to the note at the beginning of Section 21*

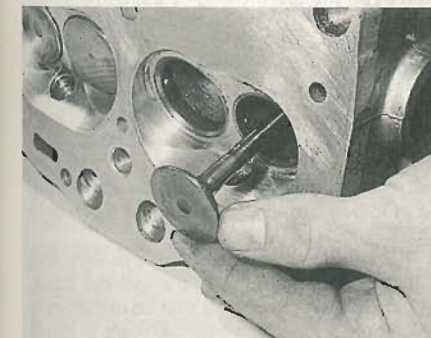
1 Remove the camshaft housing as described in Section 19.

2 The cylinder head can be removed complete with the manifolds, or the manifolds can be detached from the cylinder head prior to removal, with reference to Chapter 3.

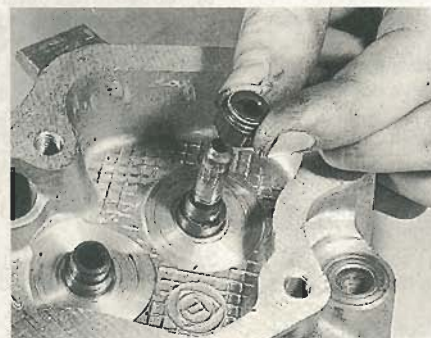
3 Proceed as described in Section 21, paragraphs 10 to 20 inclusive, then proceed as follows.

## 23 Cylinder head – dismantling and reassembly

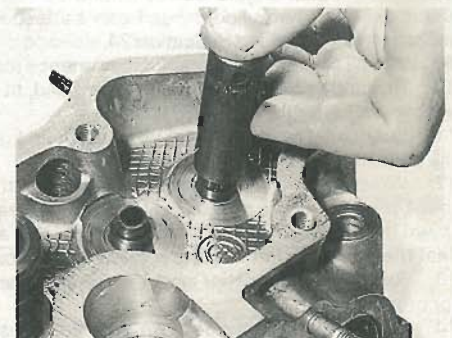
*Note: A valve spring compressor tool will be required for this operation. New valve stem oil seals must be used on reassembly*



23.11 Inserting an exhaust valve into its guide

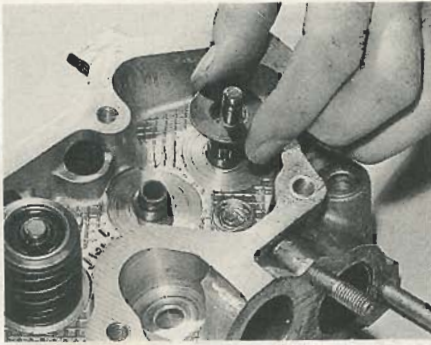


23.12A Fit the valve stem oil seal ...

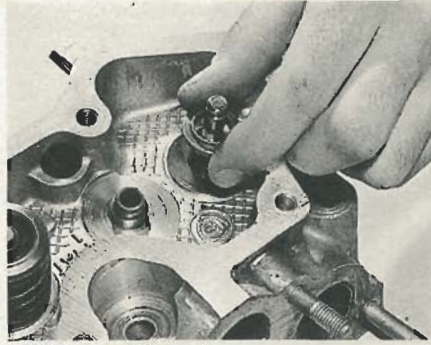


23.12B ... and seat it using a suitable metal tube





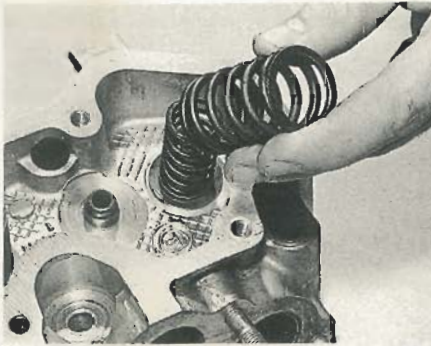
23.13A Refit the flat washer ...



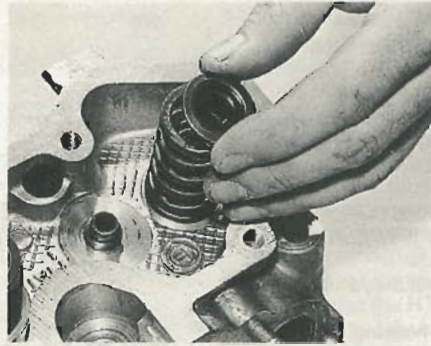
23.13B ... and the spring seat



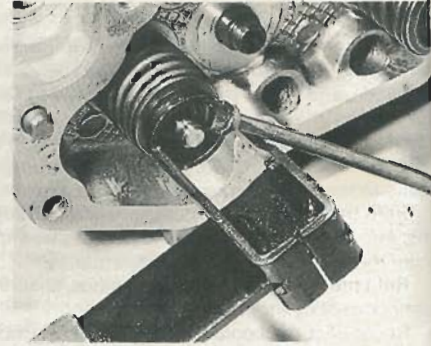
23.14A Refit the inner ...



23.14B ... and outer valve springs, ...



23.14C ... and the spring clip



23.14D Refitting split collets with valve spring compressor in position

- 1 With the cylinder head removed as described in Section 21 or 22, as applicable, proceed as follows.
- 2 If desired and if not already done, unscrew the two securing bolts and remove the thermostat cover. Recover the gasket.
- 3 Similarly, where applicable remove the manifolds with reference to the relevant Sections of Chapter 3.
- 4 Using a valve spring compressor, compress the valve springs of one of the valves (each valve has double valve springs, one inside the other) until the split collets can be removed from the groove in the valve stem. Release the compressor and remove the cap and springs, identifying them for location. If the cap is difficult to release, do not continue to tighten the compressor, but gently tap the top of the tool with a hammer. Always make sure that the compressor is firmly located on the valve head and the cap.
- 5 Remove the spring seat and the flat washer, then prise the oil seal from the valve stem.
- 6 Withdraw the valve.
- 7 Repeat the procedure given in paragraphs 4 to 6 for the remaining valves, keeping all components identified for location so that they can be refitted in their original positions (photo).
- 8 If desired, the cylinder head can be inspected and if necessary renovated as described in Section 24.
- 9 With all components cleaned, commence reassembly as follows.
- 10 Starting at one end of the cylinder head, fit the valve components as follows.
  - 11 Lubricate the appropriate valve stem and guide with clean engine oil, then insert the valve into its guide (photo).
  - 12 Wrap a thin layer of adhesive tape over the collet groove of the valve, then smear the new oil seal with a little clean engine oil and slide it down the valve stem onto the valve guide. Use a suitable metal tube to seat the seal, then remove the adhesive tape from the valve (photos).
  - 13 Refit the flat washer and the spring seat over the valve stem (photos).
  - 14 Fit the valve springs and cap, then compress the springs using the compressor tool and fit the split collets to the groove in the valve stem. Apply a little grease to the collet groove to assist fitting of the collets (photos). Release the compressor and tap the end of the valve stem with a soft-faced mallet to settle the components.

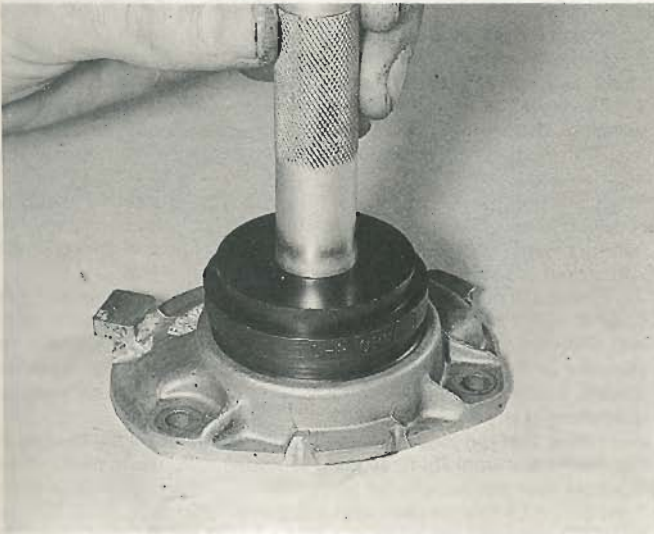
- 15 Repeat the procedure for the remaining valves, ensuring that all components are refitted in their original locations, where applicable.
- 16 Where applicable, refit the manifolds with reference to Chapter 3, and refit the thermostat cover using a new gasket.
- 17 Refit the cylinder head as described in Section 21, or 22, as applicable.

## 24 Cylinder head - inspection and renovation

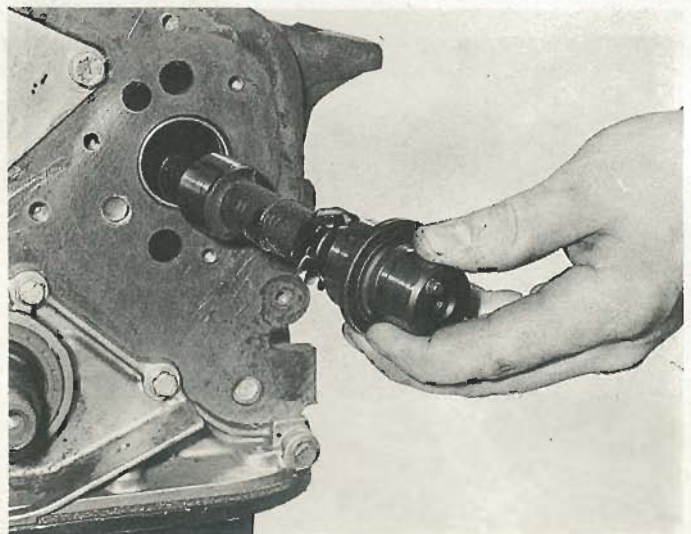
**Note:** Refer to a dealer for advice before attempting to carry out valve grinding or valve seat recutting operations, as these operations may not be possible for the DIY mechanic, due to the fitment of hardened valve seats for use with unleaded petrol

- 1 This operation will normally only be required at comparatively high mileages. However, if persistent pre-ignition ('pinking') occurs and performance has deteriorated even though the engine adjustments are correct, de-carbonising and valve grinding may be required.
- 2 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 chambers and the ports. The valve stems and the valve guides should also be freed from any carbon deposits. Wash the combustion chambers and ports down with paraffin, and scrape the cylinder head surface free of any foreign matter with the side of a steel rule, or similar article. Remove all traces of gasket from the cylinder head lower surface, then wash it thoroughly with paraffin.
- 3 If the engine is still in the vehicle, clean the piston crowns and cylinder bore upper edges. If the pistons are still in the cylinder 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 pistons and rings. To ensure that this does not happen, first turn the crankshaft so that two of the pistons are at the top of their bores. Push rag into the other two bores or seal them off with paper and masking tape. The waterways should also be covered with small pieces

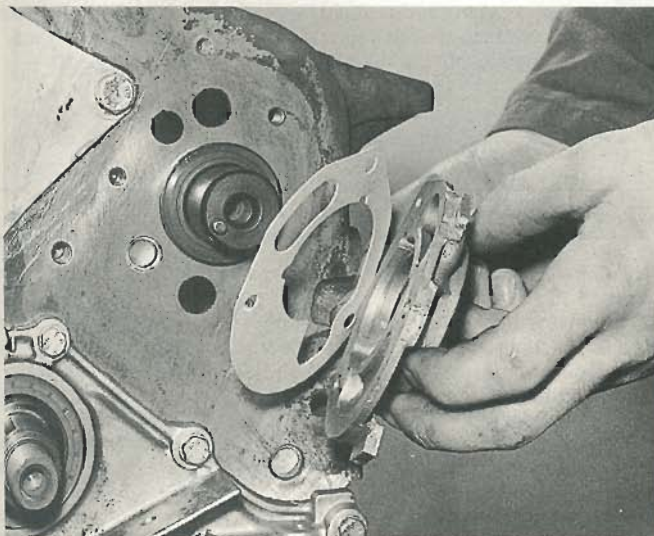




25.8 Driving a new auxiliary shaft oil seal into position in the cover



25.9 Inserting the auxiliary shaft into the cylinder block (rear timing belt cover removed)



25.10A Refit the auxiliary shaft cover using a new gasket ...

of masking tape, to prevent particles of carbon entering the cooling system and damaging the coolant pump.

4 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 great 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 crowns can be polished with 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. Seal off the cylinders which have been decarbonised with a rag or masking tape, and proceed as just described.

5 Examine the heads of the valves for pitting and burning, especially the heads of the exhaust valves. The valve seats 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.

6 Where excessive 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 a local dealer, or suitably-equipped 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.

7 Valve grinding is carried out as follows. Place the cylinder head upside down on a bench on blocks of wood. Smear a trace of coarse carborundum paste on the valve seat face and press a suction grinding tool onto the valve head. With a semi-rotary action, 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 the mating surfaces of both the valve seat and the valve, wipe off the paste and repeat the process with fine carborundum 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 the mating surfaces of both the valve and seat, the grinding operation is complete.

8 Carefully clean away every trace of grinding compound, taking great care to leave none in the ports or in the valve guides. Clean the valves and 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.

9 If the valve guides are worn (evident from perceptible side-to-side rock of valve in guide), new inserts will have to be fitted. This is a job for a dealer, as a special tool is required to ensure the correct installation depth, and the cylinder head must be heated before fitting the guides.

10 Check that all valve springs are intact. If any one is broken, all the springs should be renewed. Check the free height of the springs against new ones. If any spring appears short, indicating wear, all should be renewed. Do not renew individual springs – if any of the springs are worn or damaged, renew all the springs as a set. Springs suffer from fatigue and it is a good idea to renew them if they look serviceable.

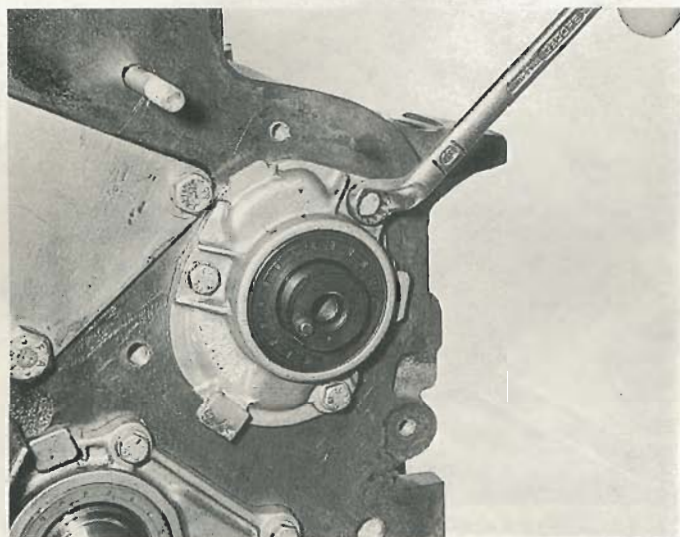
11 The cylinder head can be checked by warping either by placing it on a piece of plate glass or using a straight edge and feeler blades. If there is any doubt or if the block mating face is corroded, check with a local dealer to see if it is possible to have the cylinder head refaced – if not, renewal is the only course of action available.

## 25 Auxiliary shaft – removal, inspection and refitting

**Note:** A new auxiliary shaft cover gasket must be used on refitting

- 1 Remove the timing belt and auxiliary shaft sprocket as described in Section 15.
- 2 On 1.4 litre models, remove the distributor and its drivegear as described in Chapter 4.
- 3 Remove the fuel pump as described in Chapter 3.



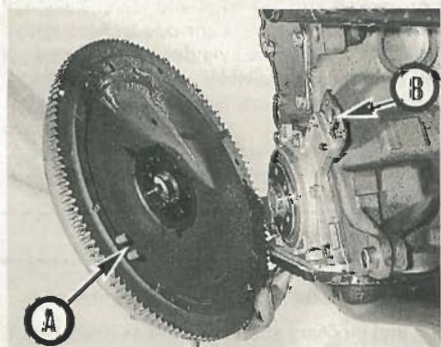


25.10B ... and tighten the securing bolts (rear timing belt cover removed)

- 4 Unscrew the three securing bolts and withdraw the auxiliary shaft cover. Recover the gasket.
- 5 The auxiliary shaft can now be withdrawn from the cylinder block.
- 6 Examine the shaft for wear and damage and renew if necessary.
- 7 If desired, the oil seal in the cover can be renewed as follows.
- 8 Support the cover on blocks of wood and drive out the old seal using a suitable drift inserted in the cut-out in the back of the cover. Clean the seal location in the housing. Drive the new seal into place using a suitable metal tube or socket (photo). The sealing lip must face towards the cylinder block. Smear the sealing lips with clean engine oil before installation.
- 9 Commence refitting by lubricating the auxiliary shaft journals with clean engine oil, then insert the shaft into the cylinder block (photo).
- 10 Refit the auxiliary shaft cover, using a new gasket, and tighten the securing bolts (photos).
- 11 Refit the fuel pump as described in Chapter 3.
- 12 On 1.4 litre models, refit the distributor and its drive gear as described in Chapter 4.
- 13 Refit the timing belt and auxiliary shaft sprocket as described in Section 15.

## 26 Flywheel – removal, inspection and refitting

- 1 If not already done, remove the clutch as described in Chapter 5.



26.8 The two TDC indicating studs on the flywheel (A) should align with the crankshaft speed/position sensor bracket (B)



26.9A Fit the washer plate and the flywheel securing bolts ...



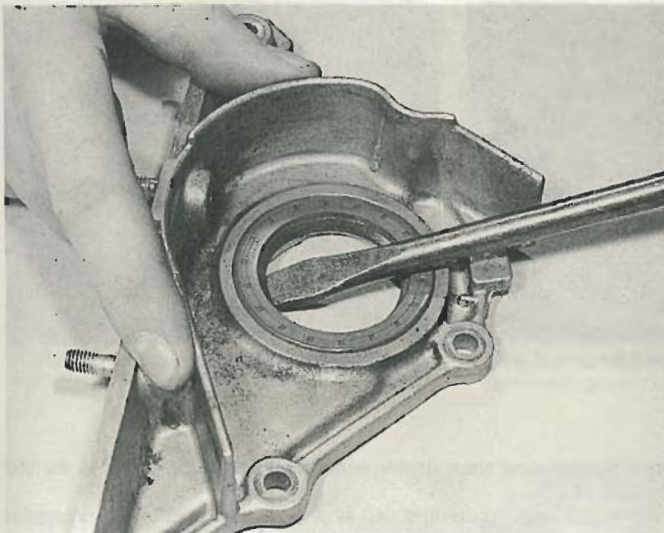
26.9B ... and tighten the bolts to the specified torque. Note tool used to prevent flywheel turning

- 2 Prevent the flywheel from turning by jamming the ring gear teeth by bolting a strap between the flywheel and the cylinder block.
- 3 Make alignment marks on the flywheel and the end of the crankshaft, so that the flywheel can be refitted in its original position.
- 4 Unscrew the securing bolts and remove the washer plate, then withdraw the flywheel. **Do not drop it, it is very heavy.**
- 5 With the flywheel removed, the ring gear can be examined for wear and damage.
- 6 If the ring gear is badly worn or has missing teeth it should be renewed. The old ring gear can be removed from the flywheel by cutting a notch between two teeth with a hacksaw and then splitting it with a cold chisel. Wear eye protection when doing this.
- 7 Fitting of a new ring gear requires heating the ring to a temperature of 80°C (176°F). Do not overheat, or the hard-wearing properties will be lost. The gear has a chamfered inner edge which should fit against the shoulder on the flywheel. When hot enough, place the gear in position quickly, tapping it home if necessary, and let it cool naturally without quenching in any way.
- 8 Ensure that the mating faces are clean, then locate the flywheel on the rear of the crankshaft, aligning the previously made marks on the flywheel and crankshaft. As an additional aid to orientation of the flywheel on 1.6 litre models, with the crankshaft positioned at TDC, the two TDC-indicating studs on the rear edge of the flywheel should be aligned with the crankshaft speed/position sensor bracket on the side of the cylinder block (photo).
- 9 Fit the washer plate, and insert the securing bolts, then prevent the flywheel from turning as described in paragraph 2, and tighten the bolts progressively to the specified torque in a diagonal sequence (photos).
- 10 If applicable, refit the clutch as described in Chapter 5.

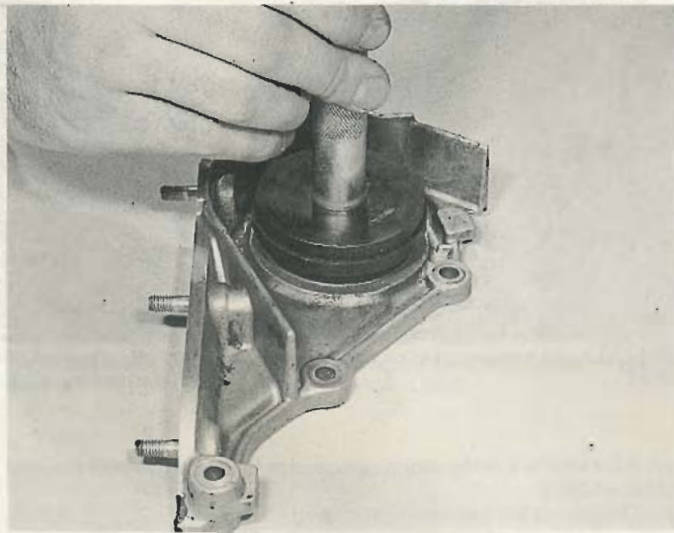
## 27 Crankshaft front oil seal – renewal

- 1 Remove the timing belt and the crankshaft sprocket as described in Section 15.
- 2 Punch or drill a small hole in the centre of the exposed oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal. If necessary, use two screws at opposite sides of the seal.
- 3 If the oil seal cannot be removed as described in paragraph 2, proceed as follows.
- 4 Remove the sump as described in Section 29, then unbolt the oil seal housing. Recover the gasket. Prise out the old seal using a suitable screwdriver (photo).
- 5 Clean the oil seal location in the housing. Drive the new seal into place using a suitable metal tube or socket (photo). The sealing lip must face towards the cylinder block. Smear the sealing lips with clean engine oil before installation.
- 6 Where applicable, refit the oil seal housing using a new gasket, and use a straight edge to ensure that the face of the oil seal housing is flush with the face of the cylinder block before tightening the securing bolts (photos).
- 7 Where applicable, refit the sump as described in Section 29.

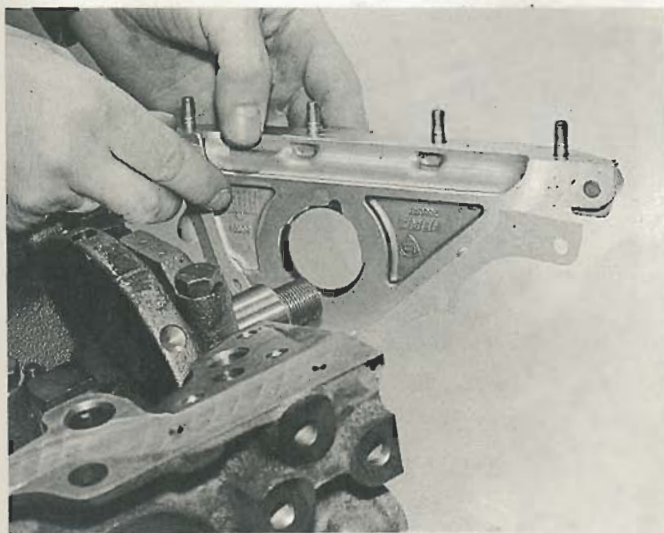




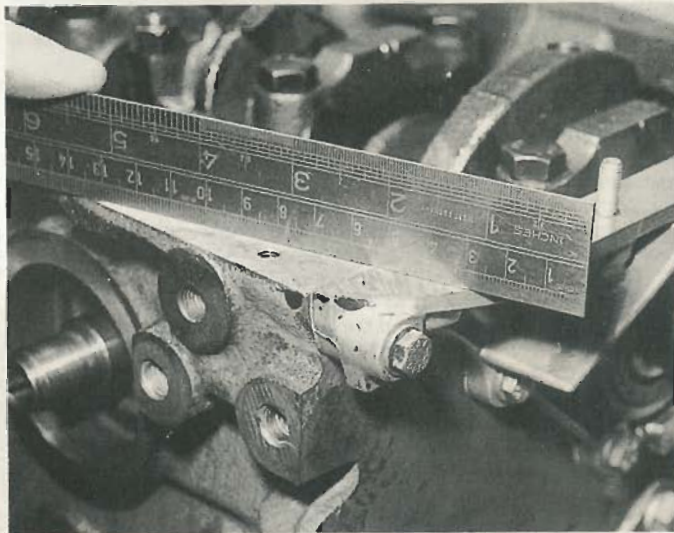
27.4 Prise out the crankshaft front oil seal using a screwdriver ...



27.5 ... and drive in the new seal using a tool of suitable diameter



27.6A Refit the crankshaft front oil seal housing ...



27.6B ... and use a straight edge to check that it is flush with the face of the cylinder block

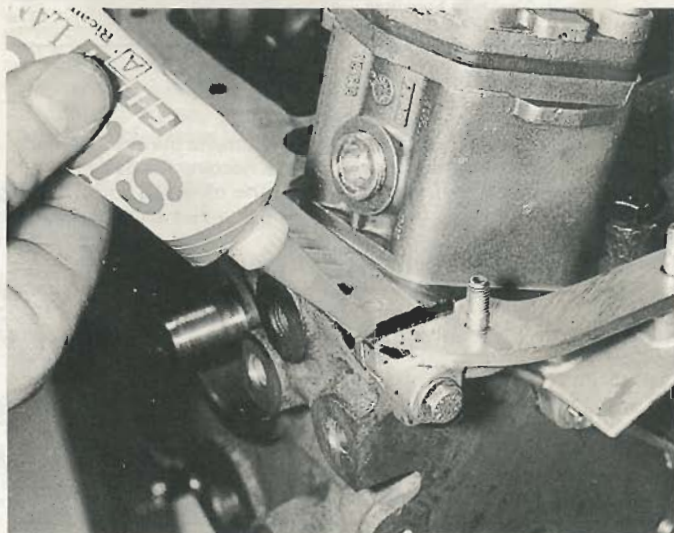
8 Refit the crankshaft sprocket and the timing belt as described in Section 15.

## 28 Crankshaft rear oil seal – renewal

- 1 If the engine is still in the vehicle, disconnect the battery negative lead, then disconnect the wiring from the crankshaft speed/position sensor, which is located in the crankshaft rear oil seal housing.
- 2 Remove the flywheel as described in Section 26.
- 3 Proceed as described in Section 27, paragraphs 2 to 7 inclusive.
- 4 Refit the flywheel as described in Section 26.
- 5 If the engine is still in the vehicle, reconnect the wiring to the crankshaft speed/position sensor, then reconnect the battery negative lead.

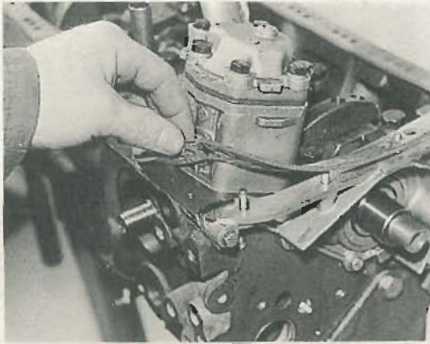
## 29 Sump – removal and refitting

**Note:** A new sump gasket must be used on refitting, and suitable sealer will be required for use on the crankshaft oil seal housing-to-cylinder block joints

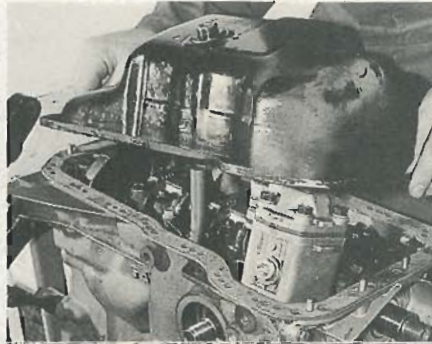


29.9 Applying sealing compound to the joint between the front crankshaft oil seal housing and the cylinder block





29.10A Locate a new gasket on the cylinder block ...



29.10B ... then refit the sump (engine shown on dismantling stand)



29.10C Refitting a sump securing bolt and washer plate

- 1 If the engine is in the vehicle, proceed as follows, otherwise proceed to paragraph 6.
- 2 Disconnect the battery negative lead.
- 3 Apply the handbrake, jack up the front of the vehicle and support securely on axle stands.
- 4 Drain the engine oil into a suitable container, with reference to Section 3 if necessary, then refit and tighten the drain plug.
- 5 Unscrew the nut and bolts securing the clutch bellhousing cover plate to the bellhousing, and withdraw the plate.
- 6 Progressively unscrew the sump securing bolts and nuts, noting that with the engine in the vehicle, access to the flywheel end sump securing nuts is extremely limited, requiring the use of an open-ended spanner to unscrew the nuts one flat at a time. Recover the washer plates which fit under the bolts and nuts.
- 7 Withdraw the sump and recover the gasket.
- 8 Clean all traces of old gasket and sealing compound from the mating faces of the cylinder block, oil seal housings and sump.
- 9 Commence reassembly by applying sealing compound (FIAT part no 5882442, or equivalent) to the joints between the front and rear crankshaft oil seal housings and the cylinder block (photo).
- 10 Locate a new gasket on the cylinder block, then refit the sump and progressively tighten the securing bolts and nuts. Ensure that the washer plates are in position under the bolts and nuts (photos).
- 11 If the engine is in the vehicle, further refitting is a reversal of the removal procedure, but on completion refill the engine with oil as described in Section 3 of this Chapter.

### 30 Oil pump - removal and refitting

**Note:** A new oil pump gasket must be used on refitting

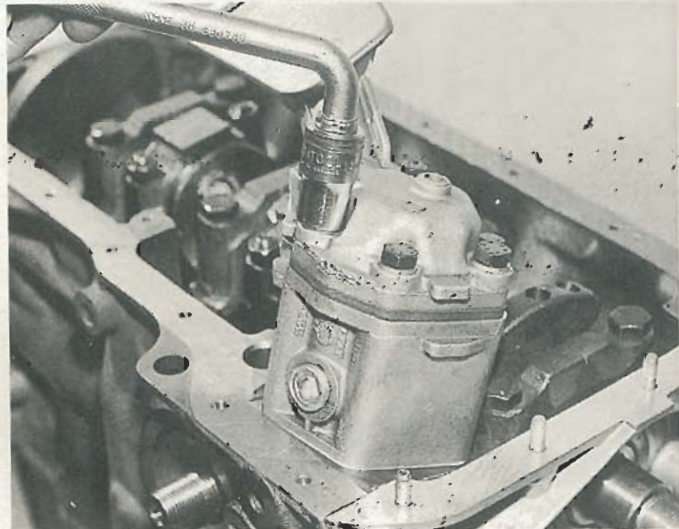
- 1 Remove the sump as described in Section 29.
- 2 Unscrew the three bolts securing the oil pump to the cylinder block, and carefully withdraw the oil pump (photo). Recover the gasket.
- 3 Thoroughly clean the mating faces of the oil pump and cylinder block. If desired the pump can be dismantled and inspected as described in Section 31.
- 4 Prime the pump by injecting oil into it and turning it by hand.
- 5 Fit the pump using a new gasket, then insert the securing bolts, and tighten them (photo).
- 6 Refit the sump as described in Section 29.

### 31 Oil pump - dismantling, inspection and reassembly

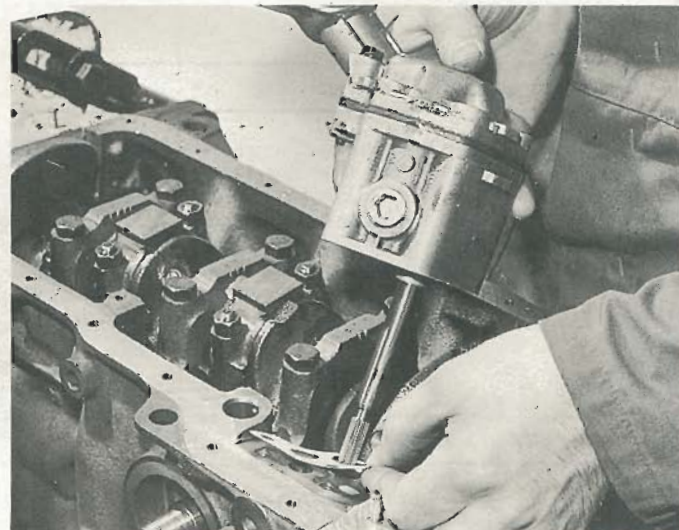
- 1 If oil pump wear is suspected, check the cost and availability of new parts and the cost of a new pump. Examine the pump as described in

this Section and then decide whether renewal or repair is the best course of action.

- 2 With the oil pump removed as described in Section 30, proceed as follows.
- 3 Unscrew the three securing bolts and remove the oil pump cover

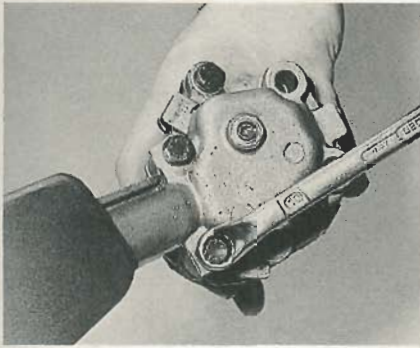


30.2 Unscrewing an oil pump securing bolt

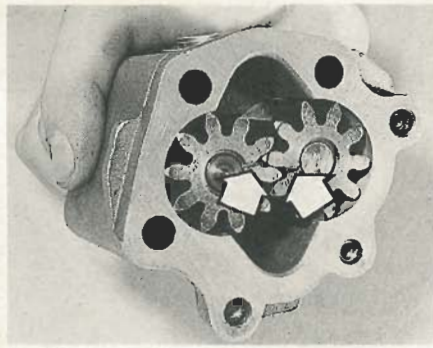


30.5 Refit the oil pump using a new gasket

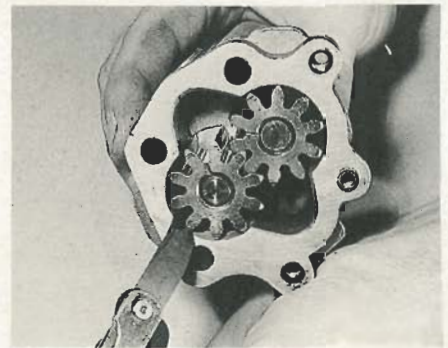




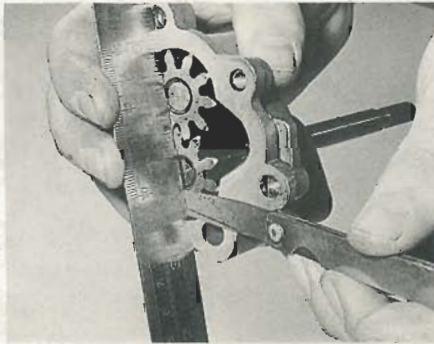
31.3 Unscrewing an oil pump cover securing bolt



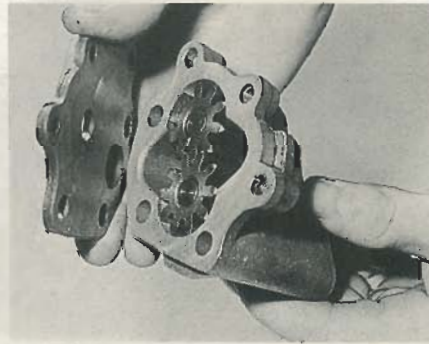
31.8 Correct alignment of scribed marks (arrowed) on oil pump gears



31.9 Checking the clearance between the oil pump gears and body



31.10 Checking the oil pump gear endfloat



31.12 Refitting the oil pump intermediate plate

(photo). Note that as the cover is removed, the oil pressure relief valve components will be released.

- 4 Recover the oil pressure relief valve, spring and spring seat.
- 5 Lift the intermediate plate from the oil pump body.
- 6 The gears can now be removed from the oil pump body.
- 7 Inspect the gears for obvious signs of wear or damage, and renew if necessary.
- 8 Commence reassembly by lubricating the gears with clean engine oil, and refitting them to the casing. Note that the scribed marks on the top faces of the gears should face each other with the gears installed (photo).
- 9 Using a feeler gauge, check that the clearance between the gears and the pump body is within the limits given in the Specifications (photo).
- 10 Using a straight edge placed across the top of the pump body and the gears, and a feeler gauge, check that the gear endfloat is within the limits given in the Specifications (photo).
- 11 If either the gear-to-body clearance, or the gear endfloat is outside

the specified limits, both gears should be renewed.

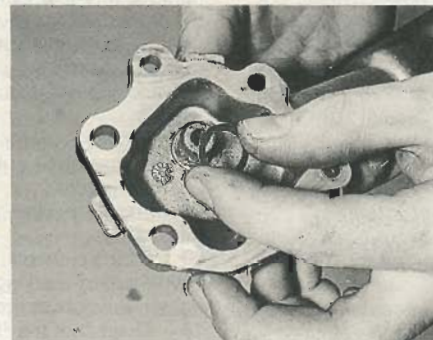
- 12 Locate the intermediate plate on the pump body (photo).
- 13 Place the pressure relief valve and spring over the pressure relief hole in the intermediate plate, and locate the spring seat over the boss in the pump cover, then refit the pump cover, ensuring that the pressure relief valve components seat correctly (photos).
- 14 Refit and tighten the pump cover securing bolts.
- 15 Refit the pump as described in Section 30.

### 32 Pistons and connecting rods - removal and refitting

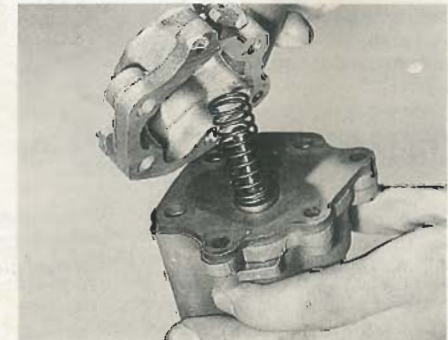
- 1 Remove the sump as described in Section 29, and the cylinder head as described in Section 21 or 22, as applicable.
- 2 The big-end caps and connecting rods normally have identification marks stamped into their sides, facing the coolant pump side of the



31.13A Locate the pressure relief valve and spring on the intermediate plate

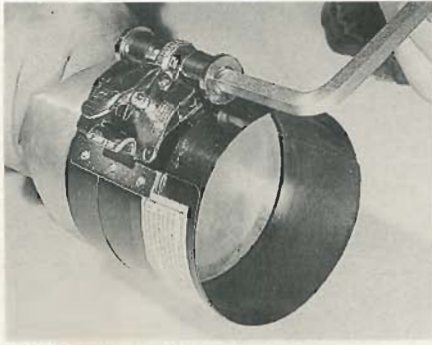


31.13B Locate the spring seat over the boss in the pump cover ...

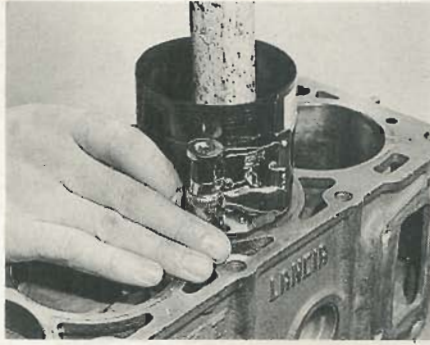


31.13C ... then refit the cover

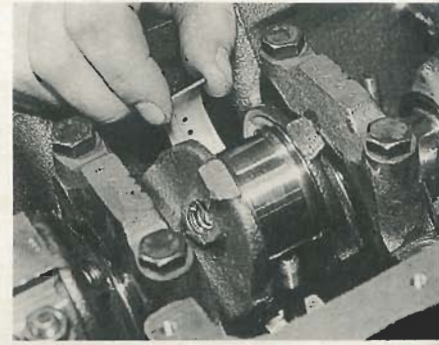




32.10A Fitting a ring compressor to a piston



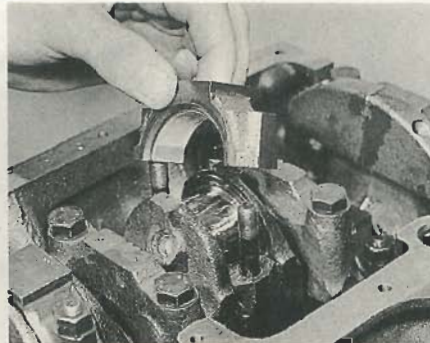
32.10B Tapping a piston into its bore (No 3 cylinder shown)



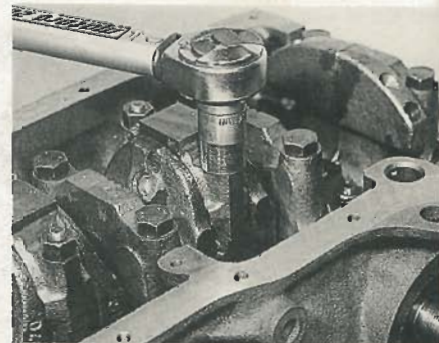
32.11 Sliding the bearing shell into position in a connecting rod big-end



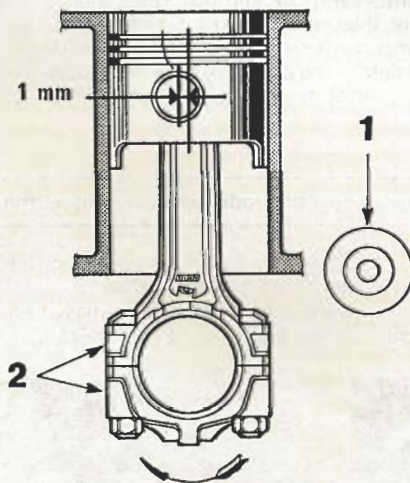
32.12 Fitting the bearing shell to a big-end bearing cap



32.13A Fit the big-end bearing cap ...



32.13B ... and tighten the nuts to the specified torque



**Fig. 1.8 Correct orientation of piston and connecting rod in engine (Sec 32)**

- 1 Auxiliary shaft
- 2 Cylinder identification markings on connecting rod and big-end cap

Arrow denotes direction of engine rotation. Note offset gudgeon pin

cylinder block. If no marks are present, use a centre-punch to identify the bearing caps and the connecting rods for location.

- 3 Turn the crankshaft so that No 1 crankpin is at its lowest point, then

unscrew the nuts and tap off the bearing cap. Keeping the bearing shells in the cap and the connecting rod if they are to be re-used, taping them in position if necessary to avoid loss.

- 4 Using the handle of a hammer, push the piston and connecting rod up the bore and withdraw it from the top of the cylinder block. Loosely refit the cap to the connecting rod.

- 5 Repeat the procedure given in paragraphs 3 and 4 on No 4 piston and connecting rod, then turn the crankshaft through half a turn and repeat the procedure on Nos 2 and 3 pistons and connecting rods.

- 6 The pistons and connecting rods and the big-end bearings can be examined and if necessary renovated as described in Sections 33 and 35 respectively.

- 7 Commence refitting as follows.

- 8 Clean the backs of the bearing shells and the recesses in the connecting rods and big-end caps.

- 9 Lubricate the cylinder bores with engine oil.

- 10 Fit a ring compressor to No 1 piston, then insert the piston and connecting rod into No 1 cylinder. With No 1 crankpin at its lowest point, drive the piston carefully into the cylinder with the wooden handle of a hammer (photos). Leave enough space between the connecting rod and the crankshaft to allow the bearing shell to be fitted. The piston must be fitted with the cut-out in the piston crown on the auxiliary shaft side of the engine, and the cylinder identification marking on the connecting rod and big-end cap on the coolant pump side of the engine – see Fig. 1.8.

- 11 Slide the appropriate bearing shell into position in the connecting rod big-end, then pull the connecting rod firmly into position on the crankpin (photo).

- 12 Press the appropriate bearing shell into position in the big-end cap (photo).

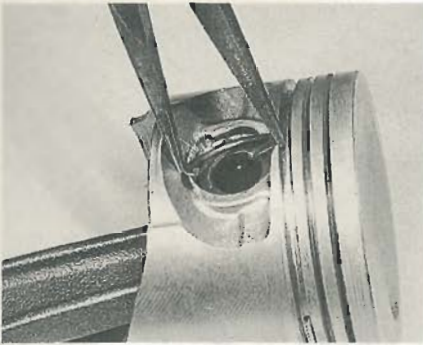
- 13 Oil the crankpin, then fit the big-end bearing cap with the cylinder identification marking on the coolant pump side of the engine, and tighten the nuts to the specified torque (photos).

- 14 Check that the crankshaft turns freely.

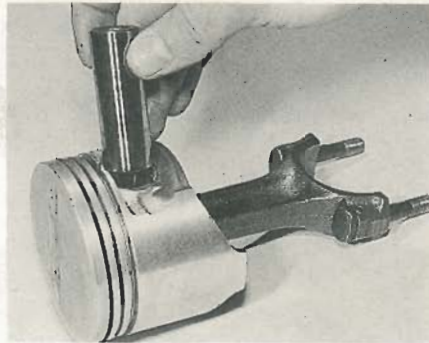
- 15 Repeat the procedure in paragraphs 10 to 14 inclusive on the remaining pistons.

- 16 Refit the cylinder head as described in Section 21 or 22, as applicable, and the sump as described in Section 29.

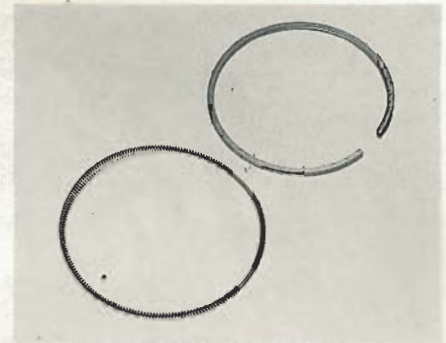




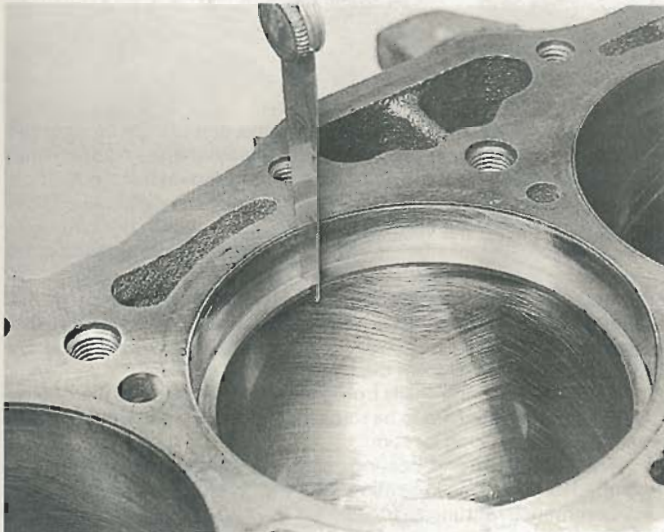
33.2A Remove one of the circlips ...



33.2B ... to enable removal of the gudgeon pin



33.6 The oil control ring is in two sections



33.7A Measuring a piston ring end gap



33.7B Measuring a piston ring-to-groove clearance

### 33 Pistons and connecting rods – examination and renovation

1 Examine the pistons for ovality, scoring and scratches. Check the connecting rods for wear and damage. If distortion of the connecting rods is suspected, have them checked by a dealer or engine reconditioning specialist.

2 The gudgeon pins are fully floating, and are located by circlips (photos). The gudgeon pins run in bushes in the small-ends of the connecting rods. If new pistons are being fitted, the gudgeon pins and connecting rod small-end bushes should also be renewed. The use of a suitable press will be required to renew the small-end bush.

3 When renewing a gudgeon pin, first check the fit in the piston. It should be possible to fit the gudgeon pin using hand pressure, but the pin should be a tight enough fit that it does not drop out under its own weight. Oversize gudgeon pins are available as spares if necessary. Use new circlips when refitting the pistons to the connecting rods.

4 Before fitting the pistons to their connecting rods, weigh each piston and check that their weights are all within 2.5 g of each other. If not, the heavier pistons must be lightened by machining metal from the underside of the small-end bosses. This operation must be entrusted to a dealer or engine reconditioning specialist.

5 The pistons should be fitted to the connecting rods so that the higher, flat side of the piston crown is on the side of the connecting rod with the stamped cylinder identification number, ie the gudgeon pin is offset towards the cylinder identification number – see Fig. 1.8.

6 New pistons are normally supplied complete with rings. If new rings are being fitted to the existing pistons, expand the old rings over the top of the pistons. The use of two or three old feeler gauges will be helpful in

preventing the rings dropping into empty grooves. Note that the oil control ring is in two sections, and note which way up each ring is fitted for use when reassembling (photo).

7 Before fitting the new rings to the pistons, insert them into the cylinder bore and use a feeler gauge to check that the end caps are within the specified limits. Check the end gaps at the upper and lower limits of the piston travel in the bores. Adjustment of the gap can be made by careful grinding to bring it within the specified tolerance, but this is best carried out by a suitably-equipped specialist. Also check the piston ring-to-groove clearance, again using a feeler gauge. If the ring grooves in the pistons are worn, new pistons may be required (photos).

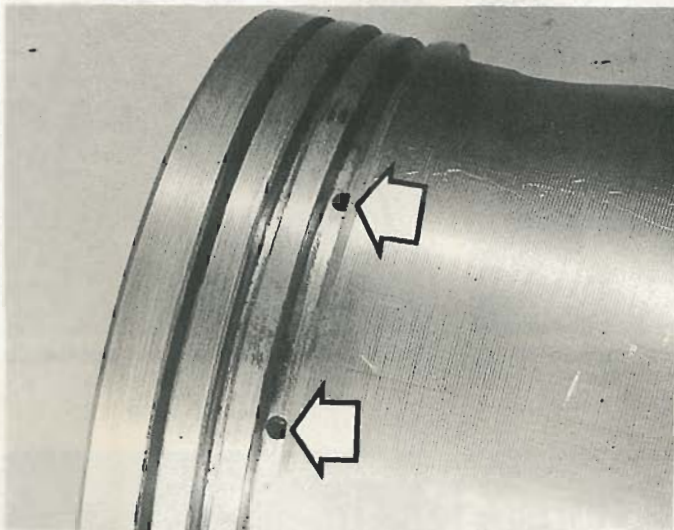
8 Clean out the piston ring grooves using a piece of old piston ring as a scraper. Be careful not to scratch the surface of the pistons and protect your fingers – piston ring edges are sharp. Also probe the groove oil return holes in the pistons, and the oil holes in the connecting rod big-ends (photos).

9 Check the cylinder bores for signs of wear ridges towards the top of the bores. If wear ridges are evident, and new piston rings are being fitted, the top ring must be stepped in order to clear the wear ridge, or the bore must be de-ridged using a suitable scraper.

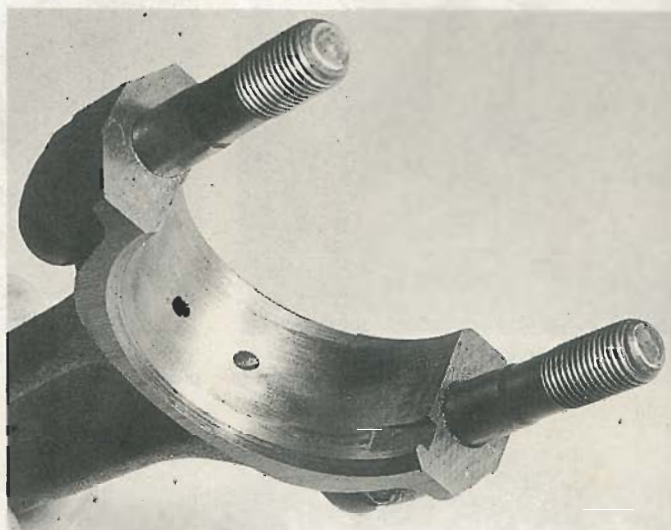
10 The piston rings should be fitted with the word "TOP" on each ring facing uppermost, or if no marks are visible, as noted during removal. If a stepped top compression ring is being fitted, fit the ring with the smaller diameter of the step uppermost. The ring endgaps should be offset 120° from each other. Use two or three old feeler gauges to assist fitting, as during removal. Note that the compression rings are brittle, and will snap if expanded too far.

11 If new pistons are to be fitted, they must be selected from the grades available, after measuring the cylinder bores as described in Section 36. Normally, the appropriate oversize pistons are supplied by





33.8A Piston ring groove oil return holes (arrowed)



33.8B Connecting rod big-end oil holes

the dealer when the block is rebored.

12 Whenever new piston rings are being installed, the glaze on the original cylinder bores should be removed using either abrasive paper or a glaze-removing tool in an electric drill. If abrasive paper is used, use strokes at 60° to the bore centre-line, to create a cross-hatching effect.

#### 34 Crankshaft and main bearings – removal and refitting

**Note:** *New front and rear crankshaft oil seal housing gaskets must be used on refitting*

- 1 With the engine removed from the vehicle, remove the timing belt and crankshaft sprocket as described in Section 15.
- 2 Remove the flywheel as described in Section 26.
- 3 Remove the pistons and connecting rods as described in Section 32. If no work is to be done on the pistons and connecting rods, there is no need to push the pistons out of the cylinder bores.
- 4 Unscrew the securing bolt and remove the crankcase breather tube (photos).
- 5 Remove the oil pump as described in Section 30.
- 6 Unscrew the securing bolts and remove the front and rear crankshaft oil seal housings. Recover the gaskets.
- 7 Check the main bearing caps for identification marks and if necessary use a centre-punch to identify them. Normally the caps have identifying notches cut into their top face nearest the timing end of the engine, with the exception of No 5 cap (flywheel end) which has no marking (photo).
- 8 Before removing the crankshaft, check that the endfloat is within the specified limits. Ideally a dial gauge should be used, but alternatively feeler gauges can be used as follows. Push the crankshaft as far as

possible towards the timing end of the engine, and using a feeler gauge, measure the gap between the rear face of the flywheel mounting flange on the crankshaft, and the outer face of the thrustwasher (photo). Now push the crankshaft as far as possible in the opposite direction and take the same measurement again. The difference between the two measurements is the crankshaft endfloat. If the endfloat is outside the specified limits, new thrustwashers will be required.

9 Unscrew the bolts and tap off the main bearing caps complete with bearing shells. If the bearing shells are to be re-used, tape them to their respective caps.

10 Lift the crankshaft from the crankcase.

11 Extract the bearing shells from the crankcase, keeping them identified for location if they are to be re-used, and recover the thrustwashers from No 5 main bearing location.

12 The crankshaft and bearings can be examined and if necessary renovated as described in Section 35.

13 Commence refitting as follows.

14 Ensure that the crankcase and crankshaft are thoroughly clean, and that the oilways are clear. If possible, blow through the oil drillings with compressed air, and inject clean engine oil into them.

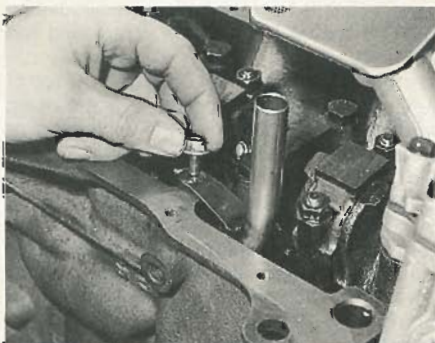
15 Unless they are virtually new, the old main bearing shells should be renewed. Not to do so is a false economy.

16 If new bearing shells are being fitted, wipe away all traces of protective grease.

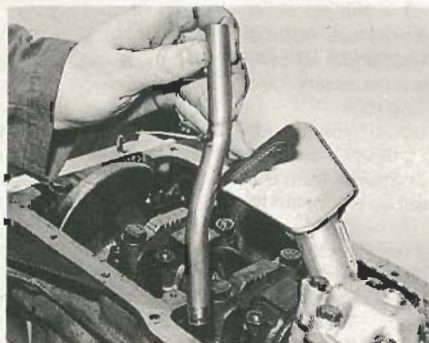
17 Note that there is a tag on the back of each bearing shell, which engages with a groove in the relevant seat in the crankcase or bearing cap.

18 Wipe clean the bearing shell locations in the crankcase with a non-fluffy rag, then lubricate them and fit the five upper halves of the bearing shells to their seats. Note that the centre (No 3) bearing shell is plain, whereas all the other shells have oil grooves (photos).

19 Fit the thrustwashers to the No 5 main bearing shell location, with the grooved side of each washer facing away from the face of the new



34.4A Unscrew the securing bolt ...

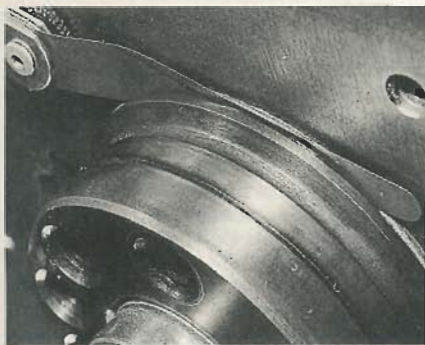


34.4B ... and remove the crankcase breather tube

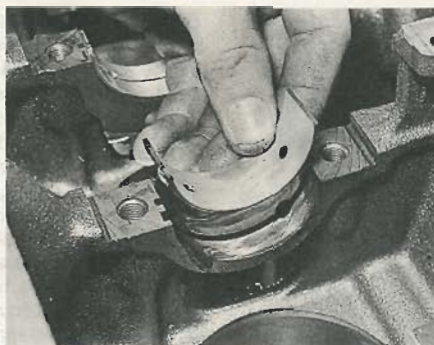


34.7 Identification notches on No 3 main bearing cap

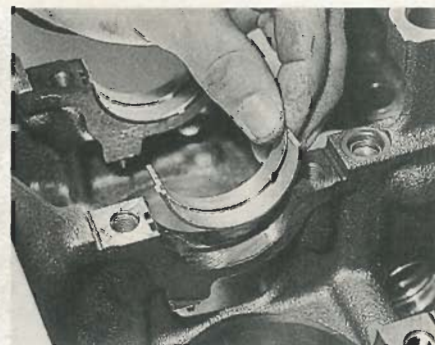




34.8 Measuring crankshaft endfloat using a feeler gauge



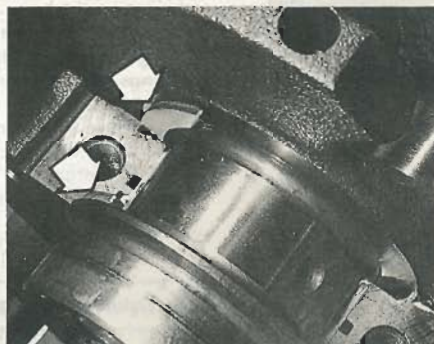
34.18A No 3 main bearing shell is plain ...



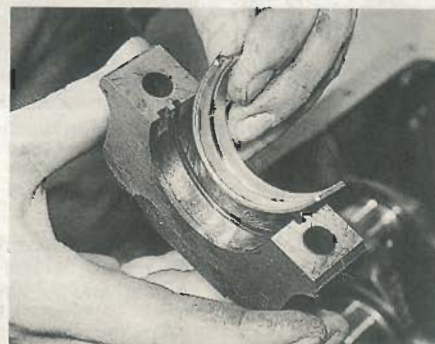
34.18B ... whereas all others have oil grooves



34.19A Fit the thrustwashers ...



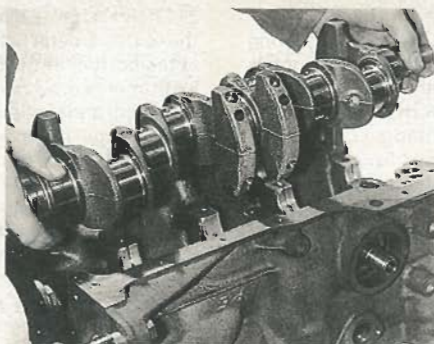
34.19B ... and slide them into position in the No 5 main bearing shell location – washers (arrowed) shown slightly proud of location



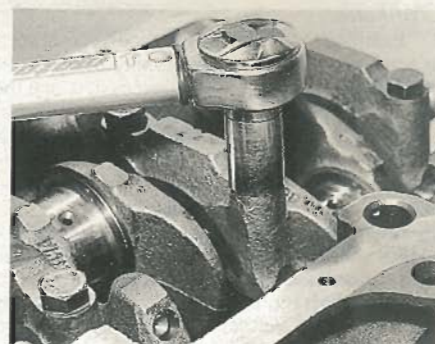
34.20 Fit the bearing shells to the main bearing caps ...



34.21 ... then lubricate the bearing shells



34.22 Lowering the crankshaft into the crankcase (engine shown on dismantling stand)



34.26 Tightening a main bearing cap bolt

cylinder block – ie towards the thrust face of the crankshaft (photos).

20 Wipe the bearing shell locations in the bearing caps with a soft non-fluffy rag, then fit the lower halves of the bearing shells to their seats. Again, note that the centre (No 3) bearing shell is plain, whereas all the other shells have oil grooves (photo).

21 Lubricate the crankshaft journals and the upper and lower main bearing shells with clean engine oil (photo).

22 Carefully lower the crankshaft into the crankcase (photo). If necessary, seat the crankshaft using light taps with a rubber-faced hammer on the crankshaft balance webs.

23 Lubricate the crankshaft main bearing journals again, then fit No 1 bearing cap. Fit the two securing bolts, and tighten them as far as possible by hand.

24 Fit No 5 bearing cap, and as before tighten the bolts as far as possible by hand.

25 Fit the centre and then the intermediate bearing caps, and again tighten the bolts as far as possible by hand.

26 Check that the markings on the bearing caps are correctly orientated as noted during dismantling – ie the identification grooves should face towards the timing side of the engine, then working from the centre cap outwards in a progressive sequence, finally tighten the bolts to the specified torque (photo).

27 Check that the crankshaft rotates freely. Some stiffness is to be expected with new components, but there should be no tight spots or binding.

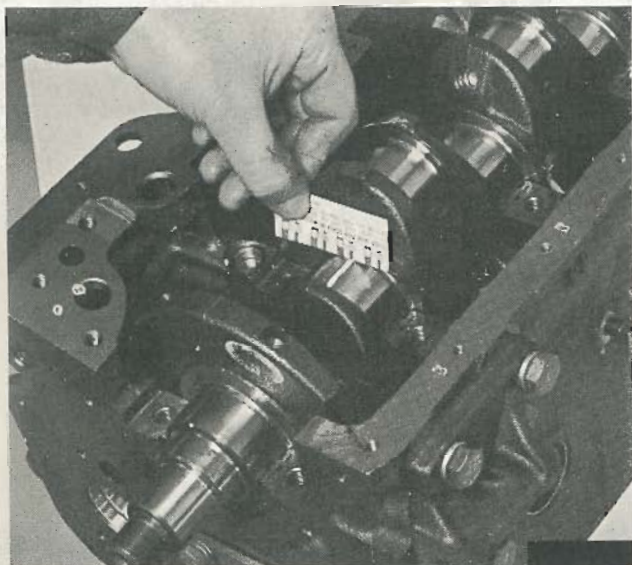
28 Check that the crankshaft endfloat is within the specified limits, as described in paragraph 8.

29 Examine the condition of the front and rear crankshaft oil seals and renew if necessary with reference to Sections 27 and 28 respectively. It is advisable to renew the oil seals as a matter of course unless they are in perfect condition.

30 Lubricate the oil seal lips with clean engine oil, then carefully fit the front and rear oil seal housings using new gaskets.

31 Refit the oil pump with reference to Section 30.





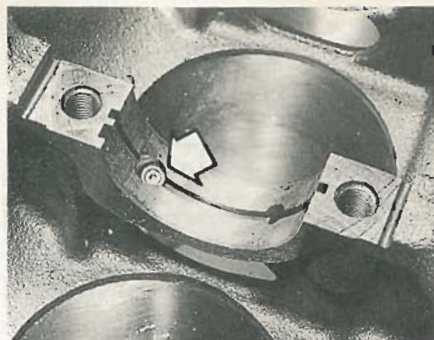
**Fig. 1.9** Measuring a main bearing running clearance using Plastigage filament (Sec 35)

- 32 Refit the crankcase breather tube.
- 33 Refit the pistons and connecting rods as described in Section 32.
- 34 Refit the flywheel as described in Section 26.
- 35 Refit the crankshaft sprocket and the timing belt as described in Section 15.

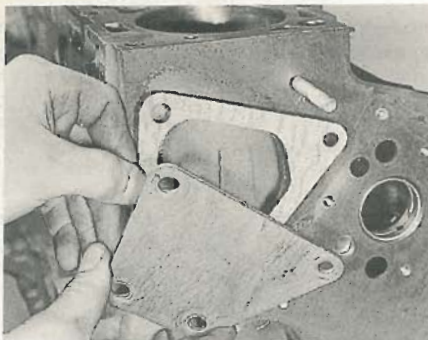
### 35 Crankshaft and bearings – examination and renovation

#### *Crankshaft*

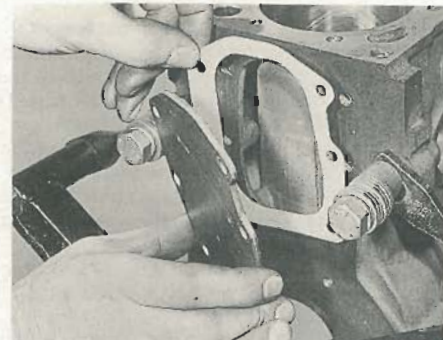
- 1 Examine the crankpin and main journal surfaces for signs of scoring or scratches, and check the ovality of the crankpins and main journals using a micrometer. If wear is excessive, or if the bearing surface ovality is outside the specified limits, the crankpins and/or main journals will have to be reground, and undersize bearing shells fitted.
- 2 Big-end and crankpin wear is accompanied by distinct metallic knocking, particularly noticeable when the engine is pulling from low revs, and some loss of oil pressure.
- 3 Main bearing and main journal wear is accompanied by severe engine vibration rumble – getting progressively worse as engine revs increase, and again by loss of oil pressure.
- 4 Crankshaft regrinding should be carried out by a suitable engineering works, who will normally supply the matching undersize bearing shells.
- 5 Note that undersize bearing shells may already have been fitted, either in production or by a previous repairer. Check the markings on the backs of the old bearing shells, and if in doubt take them along when buying new ones.



**36.6** Piston cooling oil jet location (arrowed) in crankcase – 1.6 litre engine



**36.8A** Renew the front ...



**36.8B** ... and rear coolant passage sealing plate gaskets – 1.6 litre engine (engine shown on dismantling stand)

- 6 If the crankshaft endfloat is more than the maximum specified amount, new thrustwashers should be fitted to No 5 main bearing. These are usually supplied together with the main and big-end bearing shells on a reground crankshaft.

#### *Big-end and main bearing shells*

- 7 Inspect the big-end and main bearing shells for signs of general wear, scoring, pitting and scratches. The bearings should be matt grey in colour. With lead-indium bearings, should a trace of copper colour be noticed, the bearings are badly worn, as the lead bearing material has worn away to expose the indium underlay. Renew the bearings if they are in this condition, or if there are any signs of scoring or pitting. **You are strongly advised to renew the bearings regardless of their condition at time of major overhaul. Refitting used bearings is a false economy.**
- 8 The undersizes available are designed to correspond with crankshaft regrind sizes. The bearings are in fact, slightly more than the stated undersize, as running clearances have to be allowed for during their manufacture.
- 9 Main and big-end bearing shells can be identified as to size by the marking on the back of the shell. Refer to paragraph 5.
- 10 An accurate method of determining bearing wear is by the use of Plastigage. The crankshaft is located in the main bearings (and big-end bearings if necessary) and the Plastigage filament is located across the journal, which must be dry. The cap is then fitted and the bolts/nuts tightened to the specified torque. On removal of the cap, the width of the filaments is checked against a scale which shows the bearing running clearance – Fig. 1.9. This clearance is then compared with that given in the Specifications.

### 36 Cylinder block and bores – examination and renovation

- 1 The cylinder bores must be examined for taper, ovality, scoring and scratches. Start by examining the top of the bores – if these are worn, a slight ridge will be found on the thrust side, which marks the top of the piston ring travel. If the wear is excessive, the engine will have a high oil consumption rate accompanied by blue smoke from the exhaust.
- 2 If available, use an internal micrometer, or a dial gauge to measure the bore diameter just below the ridge and compare it with the diameter at the bottom of the bore, which is not subject to wear. If no measuring instruments are available, use a piston from which the rings have been removed, and measure the gap between it and the cylinder wall with a feeler gauge. If the difference in bore diameter is more than 0.005 mm, the cylinders will normally require reboring in order to fit new oversize pistons.
- 3 It may be possible to obtain proprietary oil control rings for fitting to the existing pistons if it is felt that the degree of wear does not justify a rebore. However, any improvement brought about by such rings may be short-lived.
- 4 Whenever new piston rings are being installed, the glaze on the original cylinder bores should be removed using either abrasive paper or a glaze-removing tool in an electric drill. If abrasive paper is used, use strokes at 60° to the bore centre-line, to create a cross-hatching effect.
- 5 Check the cylinder bores for signs of wear ridges towards the top of the bores. If wear ridges are evident, and new piston rings are being fitted, the top ring must be stepped in order to clear the wear ridge, or



the bore must be de-ridged using a suitable scraper.

6 Thoroughly examine the crankcase and cylinder block for cracks and damage and use a piece of wire to probe all oilways and waterways to ensure that they are all unobstructed. On 1.6 litre engines, examine the piston cooling oil jets in each main bearing location for blockages (photo). The jets contain a ball valve which opens against the pressure of a spring at a set pressure. If faulty, the valves can be renewed, but this work is best entrusted to a dealer.

7 Use a straight edge and feeler gauge to check that the cylinder head gasket face of the cylinder block is not distorted. If the distortion exceeds the specified limit, it may be possible to have the block refaced by a suitably-equipped engineering works, otherwise the block must be renewed.

8 On 1.6 litre engines, it is advisable to take the opportunity to renew the gaskets between the cylinder block and the coolant passage sealing plates. Unbolt the plates and clean all traces of old gasket from the mating faces of the cylinder block and the plates. Refit the plates using new gaskets and tighten the securing bolts (photos).

### 37 Examination and renovation – general

1 With the engine completely stripped, clean all the components and examine them for wear. Each part should be checked and where necessary renewed or renovated as described in the relevant Sections of this Chapter. Renew main and big-end bearing shells as a matter of course, unless it is known that they have had little wear and are in perfect condition.

2 If in doubt as to whether to renew a component which is still just serviceable, consider the time and effort which will be incurred should the component fail at an early date. Obviously the age and expected life of the vehicle must influence the standards applied.

3 Gaskets, oil seals and O-rings must all be renewed as a matter of routine. FIAT specify that the main cylinder head bolts should be renewed after they have been used (ie tightened) four times – if in any doubt as to the number of times the bolts have been used, renew them in any case as a precaution against possible failure.

4 Take the opportunity to renew the engine core plugs while they are easily accessible. Knock out the old plugs with a hammer and chisel or punch. Clean the plug seats, smear the new plugs with sealant and tap them squarely into position.

### 40 Fault diagnosis – engine

Symptom	Reason(s)
Engine fails to turn over when starter operated	Discharged or defective battery Dirty or loose battery leads Defective starter solenoid or switch Engine earth strap disconnected Defective starter motor
Engine turns over but will not start	Ignition system components damp or wet HT leads loose or disconnected Shorted or disconnected LT leads Coil LT leads connected wrong way round Defective ignition switch Faulty coil No fuel in fuel tank Vapour lock in fuel line (in hot conditions or at high altitude) Blocked carburettor float chamber needle valve Faulty fuel pump Fuel filter blocked Blocked carburettor jets
Engine stalls and will not start	Ignition failure (in severe rain or after traversing water splash) No fuel in fuel tank Fuel tank breather choked Sudden obstruction in carburettor Water in fuel system

### 38 Engine reassembly – general

1 To ensure maximum life with minimum trouble from a rebuilt engine, not only must everything be correctly assembled, but it must also be spotlessly clean. All oilways must be clear, and all washers must be fitted in their original positions. Oil all bearings and other working surfaces thoroughly with clean engine oil during reassembly.

2 Before assembly begins, renew any bolts or studs with damaged threads.

3 Gather together a torque wrench, an angle torque gauge, suitable sockets and bits, an oil can, clean lint-free rag and a set of engine gaskets and oil seals, together with a new oil filter. Also obtain a set of new main cylinder head bolts, where applicable – see Section 21.

4 After reassembling the main engine components, refer to Section 14 and refit the ancillary components listed, referring to the Chapters indicated where necessary. Delicate items such as the distributor may be left until after the engine has been refitted to the vehicle.

### 39 Initial start-up after overhaul or major repair

1 Make a final check to ensure that everything has been reconnected to the engine and that no tools or rags have been left in the engine compartment.

2 Check that oil and coolant levels are correct.

3 Start the engine. This may take a little longer than usual as fuel is pumped to the engine.

4 Check that the oil pressure light goes out when the engine starts. This too may take a little longer than usual as the oil filter fills with oil. If the warning lamp does not extinguish after a few seconds, stop the engine immediately and investigate the cause.

5 Run the engine at a fast tickover and check for leaks of oil, fuel or coolant. Some smoke and odd smells may be experienced as assembly lubricant burns off the hot components.

6 Bring the engine to normal operating temperature, then check the ignition timing as described in Chapter 4 (where applicable), and the idle speed and mixture as described in Chapter 3.

7 When the engine has completely cooled, re-check the oil and coolant levels, and check and if necessary adjust the valve clearances as described in Section 4.

8 If new bearings, pistons etc have been fitted, the engine should be run-in at reduced speeds and loads for the first 500 miles (800 km) or so. It is beneficial to change the engine oil and filter after this mileage.



Symptom	Reason(s)
Engine misfires or idles unevenly	<ul style="list-style-type: none"> <li>Ignition leads loose</li> <li>Battery leads loose on terminals</li> <li>Battery earth strap loose on body attachment point</li> <li>Engine earth lead loose</li> <li>Dirty or incorrectly gapped spark plugs</li> <li>Tracking across distributor cap (oily or cracked cap)</li> <li>Ignition timing too far retarded</li> <li>Faulty coil</li> <li>Fuel mixture too weak</li> <li>Sticking inlet or exhaust valve</li> <li>Incorrect valve clearance(s)</li> <li>Air leak at carburettor</li> <li>Air leak at inlet manifold-to-cylinder head or inlet manifold-to-carburettor joint</li> <li>Weak or broken valve spring(s)</li> <li>Worn valve guides or stems</li> <li>Worn pistons or piston rings</li> <li>Incorrect spark plug gap(s)</li> </ul>
Lack of power and poor compression	<ul style="list-style-type: none"> <li>Burnt exhaust valve(s)</li> <li>Sticking or leaking valve(s)</li> <li>Worn valve guides and stems</li> <li>Weak or broken valve spring(s)</li> <li>Blown cylinder head gasket (accompanied by increase in noise)</li> <li>Worn pistons or piston rings</li> <li>Worn or scored cylinder bores</li> <li>Ignition timing incorrect</li> <li>Incorrect valve clearances</li> <li>Incorrect spark plug gap(s)</li> <li>Incorrect fuel mixture</li> <li>Fuel filter partially blocked</li> <li>Distributor automatic advance weights or vacuum advance mechanism not functioning correctly (where applicable)</li> <li>Faulty fuel pump</li> </ul>
Excessive oil consumption	<ul style="list-style-type: none"> <li>Badly worn or missing valve stem oil seals</li> <li>Excessively worn valve stems and valve guides</li> <li>Worn piston rings</li> <li>Worn pistons and cylinder bores</li> </ul>
Oil being lost due to leaks	<ul style="list-style-type: none"> <li>Leaking oil filter seal</li> <li>Leaking camshaft cover gasket</li> <li>Leaking crankshaft oil seal</li> <li>Leaking sump gasket</li> </ul>
Unusual noises from engine	<ul style="list-style-type: none"> <li>Worn valve gear (noisy tapping from camshaft cover)</li> <li>Worn big-end bearings (regular heavy knocking)</li> <li>Worn main bearings (rumbling and vibration)</li> <li>Worn crankshaft (knocking, rumbling and vibration)</li> </ul>
Engine runs on after switching off	<ul style="list-style-type: none"> <li>Faulty carburettor anti-run-on valve</li> <li>Excessive carbon build-up in combustion chambers</li> </ul>

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice.



# Chapter 2 Cooling system

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Cooling system - flushing .....	4	Thermostat - testing .....	10

## Specifications

<b>System type</b> .....	Belt-driven coolant pump, crossflow radiator with integral expansion tank, electric cooling fan and thermostat	
<b>Thermostat</b>		
Type .....	Wax	
Start to open temperature:		
1.4 litre models .....	85 to 89°C (185 to 192°F)	
1.6 litre models .....	80 to 84°C (176 to 183°F)	
Fully open temperature (all models) .....	100°C (212°F)	
Lift height (minimum) .....	7.5 mm	
<b>Expansion tank cap opening pressure</b> .....	0.98 bar	
<b>Cooling fan operating temperature</b>		
Fan switches on .....	90 to 94°C (194 to 201°F)	
Fan switches off .....	85 to 89°C (185 to 192°F)	
<b>Coolant pump/alternator drivebelt tension</b>		
Models with manual steering .....	Approximately 10.0 mm (0.4 in) deflection midway between crankshaft and alternator pulleys under firm thumb pressure	
Models with power steering .....	Approximately 5.0 mm (0.2 in) deflection midway between crankshaft and coolant pump pulleys under firm thumb pressure	
<b>Coolant</b>		
Type/specification .....	Soft water and ethylene glycol based antifreeze (Duckhams Universal Antifreeze and Summer Coolant)	
System capacity .....	6.5 litres (11.4 pints)	
<b>Torque wrench settings</b>		
Coolant pump bolts .....	<b>Nm</b>	<b>lbf ft</b>
Coolant temperature sender .....	25	18
	49	36

### 1 General description

The cooling system consists of a front-mounted radiator with integral expansion tank, coolant pump, cooling fan and a wax type thermostat.

The radiator matrix is manufactured from honeycombed metal, and the end tanks and expansion tank are made of plastic.

The coolant pump is bolted to the front face of the cylinder block, and is driven by the alternator drivebelt. The pump is of the impeller type. On models with power steering, the power steering pump is driven by a second drivebelt running from the coolant pump pulley.

The cooling fan draws cold air over the radiator matrix to assist the cooling process when the forward speed of the vehicle is too low to provide sufficient cooling airflow, or the ambient temperature is unusually high. The electrically-operated fan is switched on when the



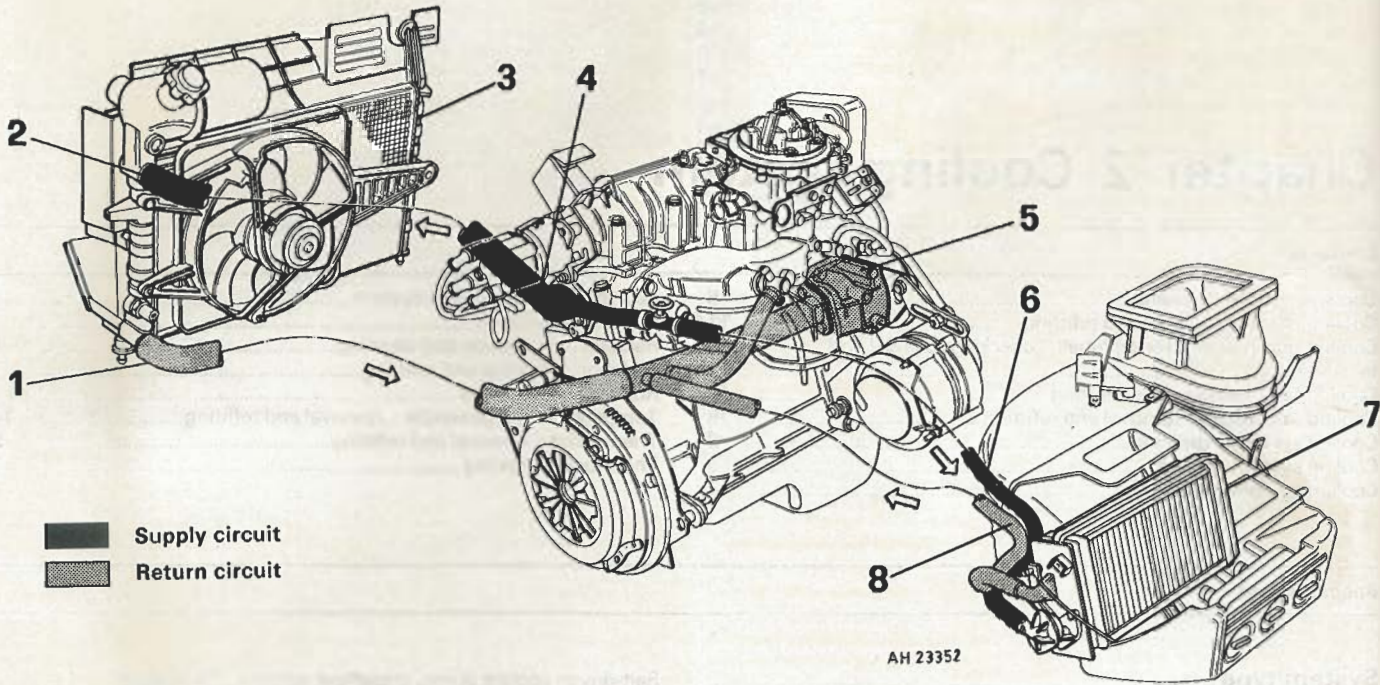


Fig. 2.1 Engine cooling system (Sec 1)

- |  |                    |                                     |                               |
|--|--------------------|-------------------------------------|-------------------------------|
| 1 Radiator-to-coolant pump hose (bottom hose)  | 3 Radiator         | 5 Coolant pump                      | 7 Heater matrix               |
| 2 Radiator-to-thermostat cover hose (top hose) | 4 Thermostat cover | 6 Thermostat housing-to-heater hose | 8 Heater-to-coolant pump hose |

temperature reaches a predetermined level by a temperature-sensitive switch mounted in the radiator. The fan is therefore only operating when required, and compared with direct-drive type fans represents a considerable improvement in fuel economy, drivebelt wear and fan noise.

The thermostat is located in a housing bolted to the rear of the cylinder head, and its purpose is to ensure rapid engine warm-up by restricting the flow of coolant to the engine when cold, and also to assist in regulating the normal operating temperature of the engine.

The system functions as follows. Cold coolant in the bottom of the radiator circulates through the bottom hose to the coolant pump where the pump impeller pushes the coolant through the passages within the cylinder block, cylinder head, inlet manifold, and, depending on the position of the heater temperature control coolant valve, the heater matrix. After cooling the cylinder bores, combustion chambers and valve seats, the coolant reaches the thermostat which is initially closed. The coolant is finally returned to the coolant pump, and the process is repeated. When the coolant reaches a predetermined temperature, the thermostat opens and hot coolant passes through the top hose to the top of the radiator. As the coolant circulates through the radiator, it is cooled by the flow of air due to the vehicle's forward motion, supplemented by the action of the cooling fan where necessary. When the coolant reaches the bottom of the radiator, it has cooled, and the cycle is repeated. Circulation of coolant to the heater matrix is controlled by the heater temperature control coolant valve which regulates the amount of coolant allowed to flow through the matrix, and thus the temperature of the air entering the vehicle interior (further details of the heater components can be found in Chapter 10).

## 2 Routine maintenance

**Warning:** *DO NOT attempt to remove the expansion tank cap when the engine is hot, as there is a very great risk of scalding*

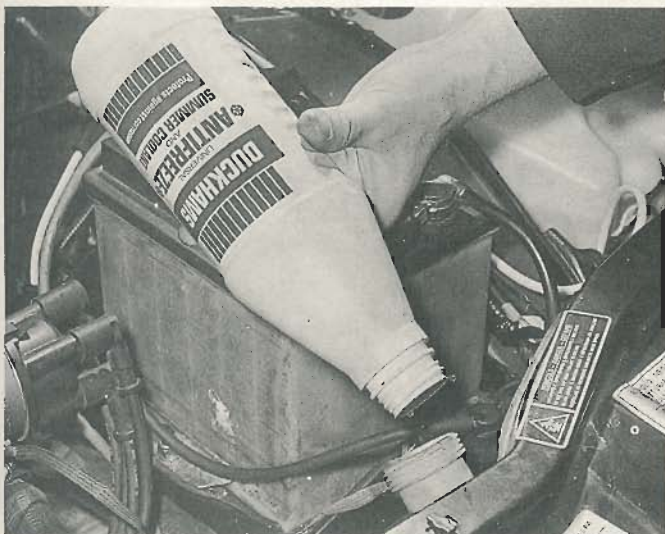
- 1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, carry out the following tasks.
- 2 Check the coolant level as described in paragraphs 3 to 6.



Fig. 2.2 Coolant expansion tank location and MIN level mark (Sec 2)

A Filler cap





2.5 Topping-up the coolant level

3 With the engine cold, observe the level of coolant through the translucent walls of the expansion tank. The level should be above the MIN mark.

4 If topping-up is necessary, ensure that the engine is cold, then carefully unscrew and remove the expansion tank cap. There is a risk of scalding if the cap is removed whilst the system is hot.

5 Top up the level with the specified coolant mixture – see Section 6 (photo). In an emergency, plain water can be used, but remember that it is diluting the proper coolant. Do not add cold water to an overheated engine which is still hot.

6 Refit the expansion tank cap securely when the level is correct. Check for leaks if there is a frequent need for topping-up.

7 Inspect the coolant pump/alternator drivebelt for wear or damage, and check the belt tension. Re-tension or renew the belt as necessary – see Section 12.

8 Check the operation of the cooling fan. Run the engine with the vehicle stationary and check that the fan cuts in as the temperature rises above normal operating temperature. If the fan does not operate, bridge the contacts of the cooling fan switch. If the fan now operates, the fault lies in the switch and renewal will be necessary.

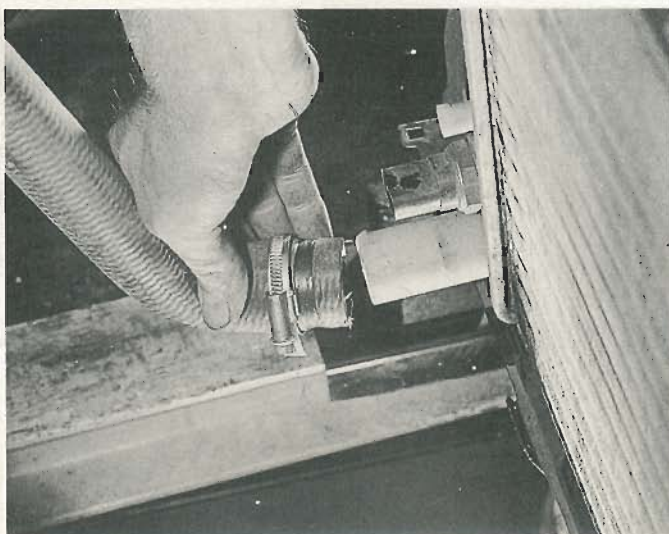
9 Renew the coolant as described in Sections 3 to 5. At the same time, inspect all the coolant hoses and clips for deterioration. It is worth renewing the hoses as a precautionary measure, rather than risking a burst hose on the road.

10 Occasionally, clean dead insects and road debris from the radiator matrix using an air jet or a soft brush.

### 3 Cooling system – draining

**Warning:** Wait until the engine is cold before starting this procedure. Do not allow antifreeze to come into contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Never leave antifreeze lying around in an open container or in a puddle in the driveway or on the garage floor. Children and pets are attracted by its sweet smell. Antifreeze is fatal if ingested

- 1 Disconnect the battery negative lead.
- 2 Working inside the vehicle, turn the heater temperature control knob fully to the right, which will fully open the heater coolant valve.
- 3 With the expansion tank cap removed, place a suitable container beneath the radiator bottom hose.
- 4 Loosen the clip and ease the bottom hose away from the radiator outlet (photo). Allow the coolant to drain into the container.
- 5 Reposition the container under the front of the cylinder block, and unscrew the cylinder block drain plug (photo). Allow the coolant to drain into the container.
- 6 Apply suitable sealant to the threads of the drain plug, then refit and tighten the plug.
- 7 Dispose of the drained coolant safely, or keep it in a covered container if it is to be re-used.



3.4 Disconnecting the bottom hose from the radiator outlet



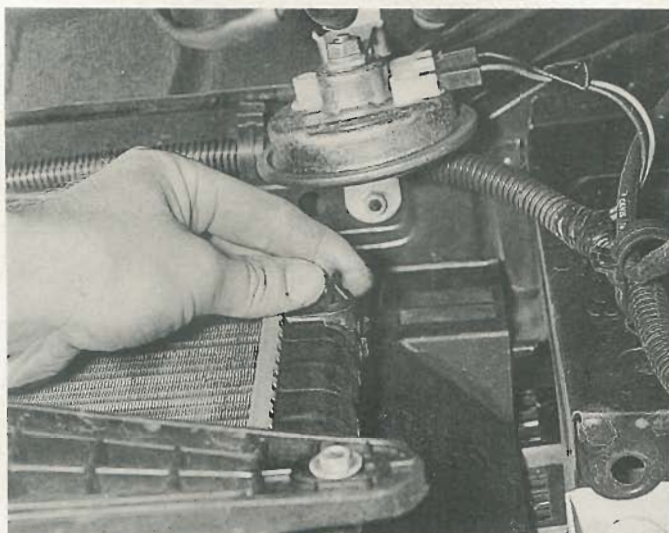
3.5 Unscrewing the cylinder block drain plug

### 4 Cooling system – flushing

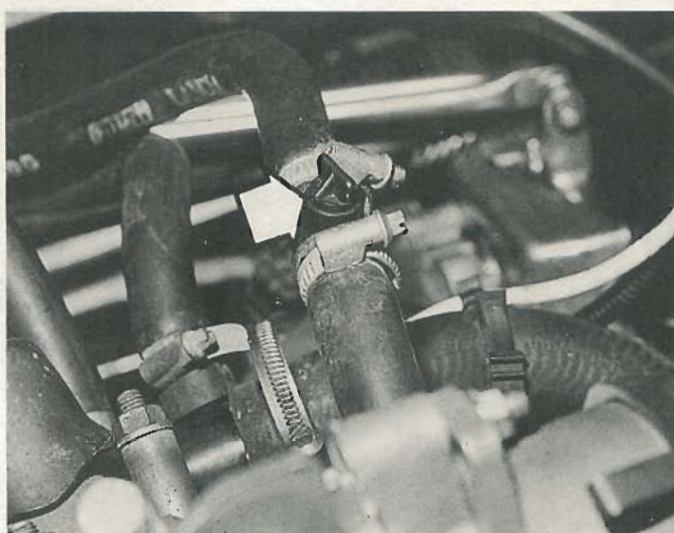
**Warning:** Refer to the warning note at the beginning of Section 3 before proceeding

- 1 After some time the radiator and engine coolant passages may become restricted or even blocked with scale or sediment, which reduces the efficiency of the cooling system. When this occurs, the coolant will appear rusty and dark in colour, and the system should then be flushed. Begin by draining the cooling system as described in Section 3.
- 2 The radiator should be flushed independently of the engine, to avoid unnecessary contamination.
- 3 To flush the radiator, disconnect the top hose from the radiator, then insert a garden hose and allow water to circulate through the radiator until it runs clear from the outlet (the bottom hose should have been disconnected to drain the system). If, after a reasonable period, the water still does not run clear, the radiator can be flushed with a good proprietary cleaning agent such as Holts Radflush or Holts Speedflush. If the contamination is particularly bad, insert the hose in the radiator bottom outlet, and flush the radiator in reverse. This should dislodge





5.2A Opening the bleed screw in the top of the radiator (viewed from underneath)



5.2B Heater hose bleed screw (arrowed) – 1.6 litre model

deposits which were not moved by conventional flushing.

- 4 To flush the engine, proceed as follows.
- 5 Remove the thermostat/cover assembly as described in Section 9.
- 6 With the radiator bottom hose disconnected from the radiator, insert a garden hose into the radiator bottom hose. Direct a clean flow of water through the engine, and continue flushing until clean water emerges from the thermostat housing. It is advisable to place a sheet of plastic under the thermostat housing to deflect water away from the engine and surrounding components during the flushing process.
- 7 On completion of flushing, refit the thermostat/cover assembly, reconnect the hoses and remove the sheet of plastic.

## 5 Cooling system – filling

**Warning:** Refer to the warning note at the beginning of Section 3 before proceeding

- 1 Before attempting to refill the cooling system, make sure that all hoses have been reconnected, that the hoses and clips are in good condition, and that the clips are tight. Also ensure that the cylinder block drain plug has been refitted and tightened. Note that an antifreeze mixture must be used all year round to prevent corrosion of the engine components – refer to Section 6.
- 2 Open the bleed screw in the top of the radiator, and on 1.6 litre models, in the heater hose which runs to the thermostat housing (photos).
- 3 Remove the expansion tank cap, and fill the system by slowly pouring the coolant into the expansion tank to prevent air locks from forming.
- 4 Top up the coolant until liquid free from air bubbles emerges from the radiator bleed screw orifice, then close the bleed screw.
- 5 On 1.6 litre models, continue topping-up until coolant free from air bubbles emerges from the heater hose bleed screw orifice, then close the bleed screw.
- 6 Top up the coolant until the level is approximately 30.0 mm (1.2 in) below the top edge of the expansion tank filler hole, then refit the expansion tank cap.
- 7 Start the engine and run it until it reaches normal operating temperature, then stop the engine and allow it to cool.
- 8 Check for leaks, particularly around disturbed components. Check the coolant level in the expansion tank, and top up if necessary. Note that the system must be cold before an accurate level is indicated. There is a risk of scalding if the expansion tank cap is removed whilst the system is hot.

## 6 Coolant mixture – general

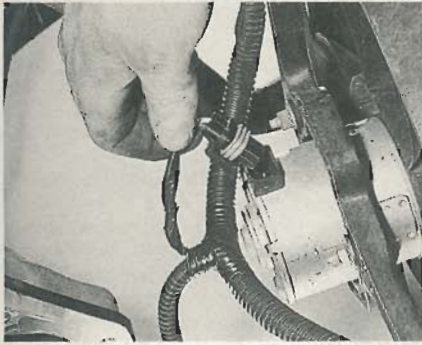
**Warning:** Refer to the warning note at the beginning of Section 3 before proceeding

- 1 The coolant (antifreeze/corrosion inhibitor) mixture should be renewed every 2 years or 36 000 miles (60 000 km), whichever comes first. This is necessary not only to maintain the antifreeze properties (although the antifreeze content does not deteriorate), but also to prevent corrosion which would otherwise occur as the properties of the inhibitors become progressively less effective.
- 2 Always use the specified type of antifreeze, and never use an antifreeze containing methanol, as the methanol evaporates.
- 3 Before filling the cooling system, the system should be completely drained and flushed, as described in Sections 4 and 5, and all hoses should be checked for security.
- 4 The specified coolant mixture is 50% antifreeze and 50% clean soft water (by volume). Mix the required quantity in a clean container and then fill the system as described in Section 5. Save any surplus mixture for topping-up purposes.

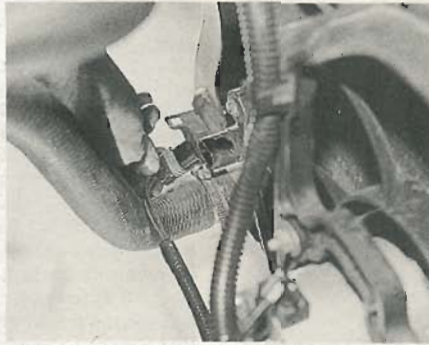
## 7 Radiator – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Drain the cooling system as described in Section 3, but note that there is no need to drain the cylinder block.
- 3 Disconnect the wiring plugs from the cooling fan, and the cooling fan switch which is located at the bottom left-hand corner of the radiator, and pull the wiring harness from the clips on the fan shroud (photos).
- 4 Disconnect the wiring plug(s) from the horn(s), then unscrew the securing nut(s) and remove the horn(s), complete with their mounting brackets, from the upper body panel.
- 5 If desired, remove the cooling fan/shroud assembly with reference to Section 13, to provide improved clearance when withdrawing the radiator.
- 6 Remove the front grille panel as described in Chapter 10.
- 7 Unscrew the two now-exposed radiator securing screws (photo).
- 8 Working in the engine compartment, pull the radiator back towards the engine, and lift it from the grommets in the lower body panel (photo).
- 9 Refitting is a reversal of removal, but on completion refill the cooling system as described in Section 5.

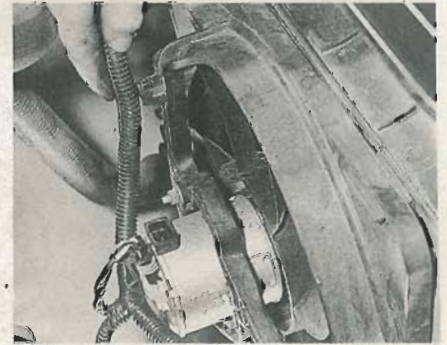




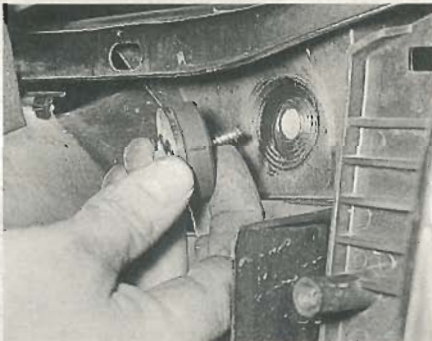
7.3A Disconnect the wiring plugs from the cooling fan ...



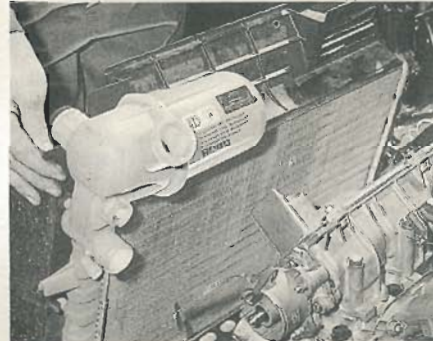
7.3B ... and the cooling fan switch ...



7.3C ... and pull the wiring harness from the clips on the fan shroud



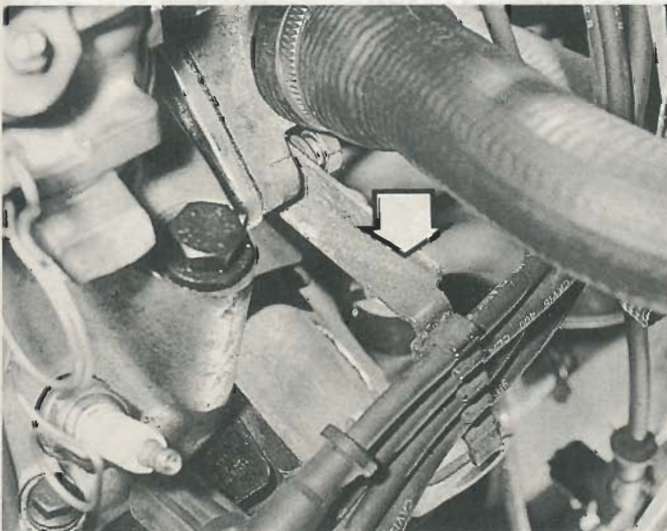
7.7 Removing a radiator securing screw



7.8 Withdrawing the radiator (cooling fan/shroud assembly removed)

## 8 Radiator – inspection and cleaning

- 1 If the radiator has been removed because of suspected blockage, reverse-flush it as described in Section 4.
- 2 Clean dirt and debris from the radiator fins, using an air jet or water and a soft brush. Be careful not to damage the fins or cut your fingers.
- 3 A radiator specialist can perform a "flow test" on the radiator to establish whether an internal blockage exists.
- 4 A leaking radiator must be referred to a specialist for permanent repair. Do not attempt to weld or solder a leaking radiator, as damage to the plastic parts may result.
- 5 In an emergency, minor leaks from the radiator can be cured by using radiator sealant such as Holts Radweld.



9.4A HT lead bracket (arrowed) is secured by thermostat cover bolt

## 9 Thermostat – removal and refitting

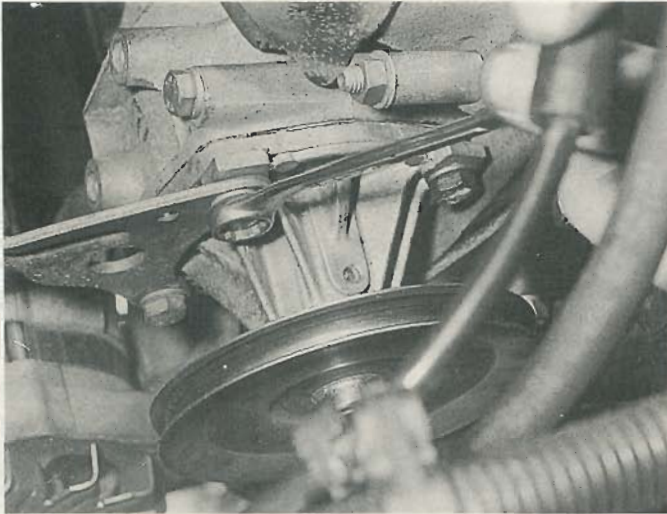
**Note:** A new thermostat cover gasket must be used on refitting

- 1 Disconnect the battery negative lead.
- 2 Drain the cooling system as described in Section 3, but note that there is no need to drain the cylinder block.
- 3 Disconnect the coolant hoses from the thermostat cover situated at the gearbox end of the cylinder head.
- 4 Unscrew the two thermostat cover securing bolts, noting that the left-hand bolt also secures the HT lead bracket, and remove the thermostat/cover assembly. Recover the gasket (photos).
- 5 If faulty, the thermostat must be renewed complete with the housing as an assembly.



9.4B Removing the thermostat/cover assembly and the gasket (1.6 litre engine shown with distributor removed)





11.5 Unscrewing a coolant pump/alternator adjuster bracket securing bolt - model with manual steering

- 6 If desired the thermostat can be tested as described in Section 10.
- 7 Refitting is a reversal of removal, bearing in mind the following points.
- 8 Clean the mating faces of the thermostat cover and cylinder head, and use a new gasket when refitting the cover.
- 9 Refill the cooling system as described in Section 5.

## 10 Thermostat - testing

- 1 To test the thermostat, suspend the thermostat/cover assembly by a piece of string in a container of water.
- 2 Gradually heat the water, and using a thermometer going up to at least 100°C (212°F), note the temperature at which the thermostat starts to open.
- 3 Remove the assembly from the water and check that the thermostat is fully closed when cold.
- 4 Renew the assembly if the thermostat opening temperature is not as given in the Specifications, or if the thermostat does not fully close when cold.

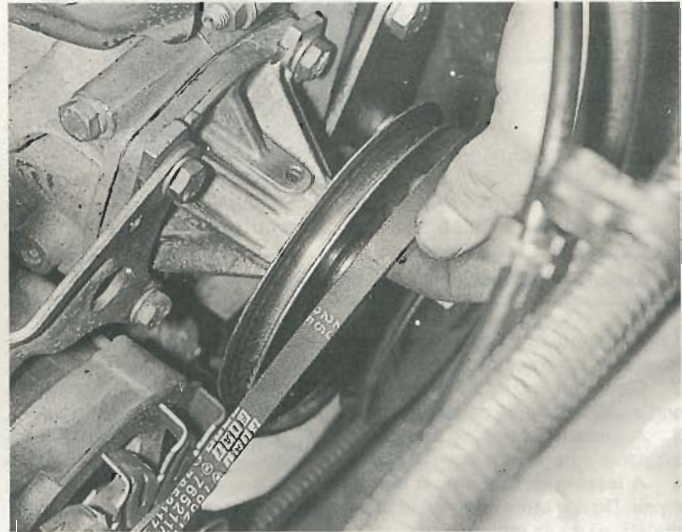
## 11 Coolant pump - removal and refitting

**Note:** A new coolant pump gasket must be used on refitting. If the pump is found to be worn it must be renewed as a complete unit, as dismantling and repair is not possible

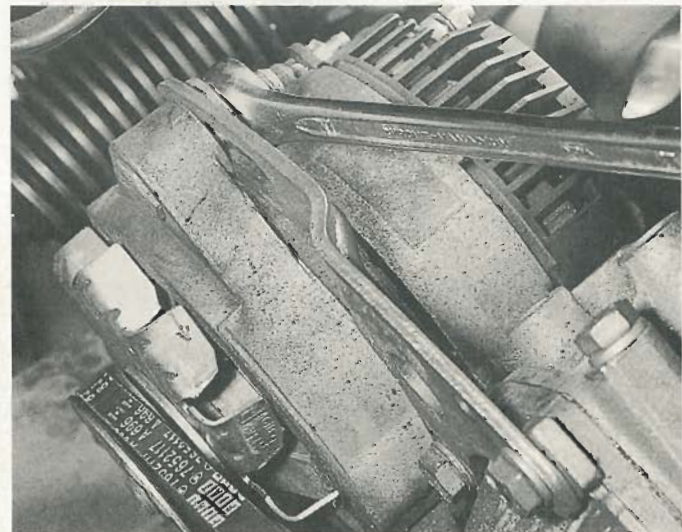
- 1 Disconnect the battery negative lead.
- 2 Drain the cooling system as described in Section 3.
- 3 Remove the coolant pump/alternator drivebelt, with reference to Section 12.
- 4 On models with power steering, remove the power steering pump drivebelt as described in Chapter 9.
- 5 Unscrew the four coolant pump securing bolts, noting that on models with manual steering, two of the bolts also secure the alternator adjuster bracket (photo), and withdraw the pump from the housing. Recover the gasket.
- 6 Refitting is a reversal of removal, bearing in mind the following points.
- 7 Use a new gasket between the pump and the housing.
- 8 On models with power steering, refit and tension the power steering pump drivebelt as described in Chapter 9.
- 9 Refit and tension the coolant pump/alternator drivebelt as described in Section 12.
- 10 On completion, refill the cooling system as described in Section 5.

## 12 Coolant pump/alternator drivebelt - checking, renewal and tensioning

- 1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the drivebelt should be checked and if necessary re-tensioned.
- 2 If desired, for improved access remove the air cleaner or the carburettor air box and air trunking, as applicable (see Chapter 3).
- 3 Check the full length of the drivebelt for cracks and deterioration. It will be necessary to turn the engine in order to check the portions of the drivebelt in contact with the pulleys. If a drivebelt is unserviceable, renew it as follows.
- 4 Loosen the alternator mounting and adjuster nuts and bolts, noting that the drivebelt idler pulley is fitted to the end of the mounting bolt on models with power steering, and pivot the alternator towards the cylinder block.
- 5 Slip the drivebelt from the alternator, coolant pump and crankshaft pulleys, and on models with power steering, from the idler pulley.
- 6 Fit the new drivebelt around the pulleys, then lever the alternator away from the cylinder block until the specified belt tension is achieved. Lever the alternator using a wooden or plastic lever at the pulley end to prevent damage. It is helpful to partially tighten the adjuster nut before tensioning the drivebelt (photos).
- 7 When the specified tension has been achieved, tighten the mounting and adjuster nuts and bolts.

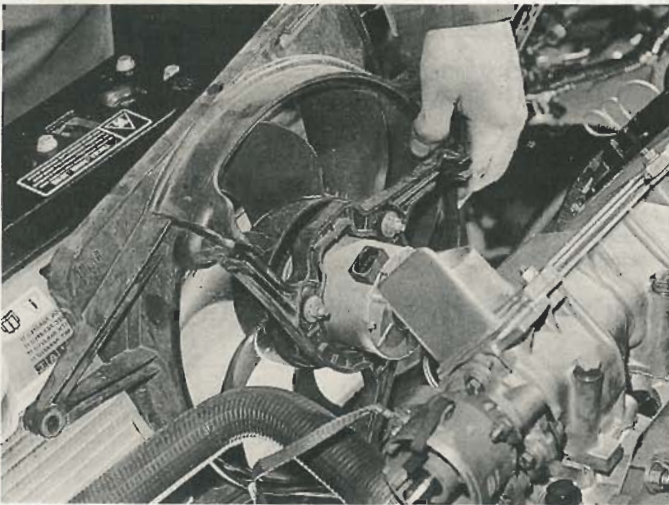


12.6A Fitting a new coolant pump/alternator drivebelt - model with manual steering

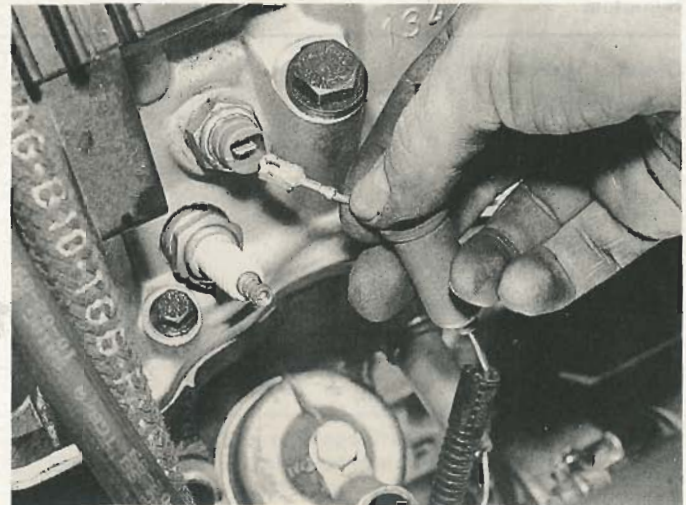


12.6B Tightening the alternator adjuster nut - model with manual steering





13.3 Withdrawing the cooling fan/shroud assembly



14.4 Disconnecting the wiring from the temperature gauge sender (crankcase ventilation hose removed)

8 The drivebelt tension should be rechecked and if necessary adjusted after the engine has been run for approximately 30 seconds, but note that the engine should be cold before rechecking or adjustment is carried out.

### 13 Cooling fan – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Disconnect the cooling fan wiring plug, and pull the wiring harness from the clips on the fan shroud.
- 3 Unscrew the three bolts securing the cooling fan shroud to the radiator, then withdraw the complete fan/shroud assembly (photo).
- 4 To remove the cooling fan motor from the shroud, first remove the fan blades by releasing the circlip from the end of the motor shaft and pulling the fan blades from the shaft, then unscrew the three securing nuts and withdraw the motor from the shroud. Recover the washers.
- 5 Refitting is a reversal of removal.

### 14 Temperature gauge sender – removal and refitting

**Note:** Suitable sealant will be required to coat the threads of the sender on refitting

- 1 The temperature gauge sender is located at the front of the cylinder block.
- 2 Disconnect the battery negative lead.
- 3 To minimise coolant spillage, it is recommended that the cooling

system is drained as described in Section 3, but this is not strictly necessary if a suitable plug can be found to plug the sender aperture.

4 Disconnect the wiring from the sender (photo), then unscrew the sender from its location. Be prepared for coolant spillage if the cooling system has not been drained, and where applicable plug the sender aperture.

5 Refitting is a reversal of removal, bearing in mind the following points.

6 Coat the threads of the sender with sealant before refitting.

7 Top up or refill the cooling system (as applicable) with reference to Section 5.

8 On completion, start the engine and check the operation of the temperature gauge. Also check for coolant leaks.

### 15 Cooling fan switch – removal and refitting

**Note:** A new cooling fan switch sealing ring must be used on refitting

- 1 The cooling fan switch is located in the lower left-hand side of the radiator.
- 2 Disconnect the battery negative lead.
- 3 Drain the cooling system as described in Section 3, but note that there is no need to drain the cylinder block.
- 4 Disconnect the wiring from the switch.
- 5 Unscrew the switch from the radiator and recover the sealing ring.
- 6 Refitting is a reversal of removal, but use a new sealing ring, and refill the cooling system as described in Section 5.

### 16 Fault diagnosis – cooling system

Symptom	Reason(s)
Overheating	Coolant level low Coolant pump/alternator drivebelt slipping or broken Radiator blocked or radiator grille restricted Collapsed or blocked coolant hose Ignition timing incorrect (accompanied by loss of power and possible misfiring) Fuel mixture too weak Exhaust system restricted Engine oil level low Blown cylinder head gasket Brakes binding Engine not yet run-in (new or reconditioned engine)



Symptom	Reason(s)
Overcooling/slow warm-up	Thermostat missing, jammed open, or of incorrect rating Cooling fan operating too early
Coolant loss	Damaged or deteriorated hose Leaking coolant pump or thermostat housing gasket Blown cylinder head gasket Leaking radiator Cracked cylinder head Leaking engine core plug

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice



# Chapter 3 Fuel and exhaust systems

## Contents

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## Specifications

### General

Fuel tank capacity.....	55.0 litres (12.1 gals)
Fuel octane rating.....	95 RON (Premium) unleaded or 97 RON (4-star) leaded
Carburettor type.....	Weber fixed jet, twin venturi sequential type with manually-operated choke

### Carburettor application and type:

1.4 litre models:	
Engine code 160 A1.000.....	Weber 32-34 TLDE 4/150
Engine code 159 A2.000.....	Weber 32-34 TLDE 21/151
1.6 litre models:	
Engine code 160 A2.000.....	Weber 32-34 TLDE 5/150
Engine code 159 A3.000.....	Weber 32-34 TLDE 23/151

### Fuel pump

Type.....	Mechanical, diaphragm type
Capacity.....	75 litres (16.5 gals) per hour

### Air filter

Application.....	Champion U533
------------------	---------------

### Fuel filter

Application.....	Champion L101
------------------	---------------

### Carburettor

Idle speed.....	800 to 850 rpm
Idle mixture (CO content).....	1.0 ± 0.5%
Fast idle speed (see Section 23).....	1300 ± 50 rpm
Float level (with gasket):	
1.4 litre models:	
Engine code 160 A1.000.....	29.5 to 30.5 mm (1.16 to 1.20 in)
Engine code 159 A2.000.....	29.0 to 31.0 mm (1.14 to 1.22 in)
1.6 litre models:	
Engine code 160 A2.000.....	29.5 to 30.5 mm (1.16 to 1.20 in)
Engine code 159 A3.000.....	29.0 to 31.0 mm (1.14 to 1.22 in)



**Carburettor (continued)**

Fast idle gap (see Section 25):

1.4 litre models:

Engine code 160 A1.000.....	0.95 to 1.05 mm (0.037 to 0.041 in)
Engine code 159 A2.000.....	1.10 mm (0.043 in)

1.6 litre models:

Engine code 160 A2.000.....	0.95 to 1.05 mm (0.037 to 0.041 in)
Engine code 159 A3.000.....	1.10 mm (0.043 in)

Choke vacuum pull-down gap:

1.4 litre models:

Engine code 160 A1.000.....	3.5 to 4.0 mm (0.14 to 0.16 in)
Engine code 159 A2.000.....	3.0 to 3.5 mm (0.12 to 0.14 in)

1.6 litre models:

Engine code 160 A2.000.....	3.5 to 4.0 mm (0.14 to 0.16 in)
Engine code 159 A3.000.....	3.0 to 3.5 mm (0.12 to 0.14 in)

Throttle barrel diameter.....

Primary	Secondary
32.0 mm	34.0 mm
Venturi diameter.....	24.0 mm

Venturi diameter.....

Idle fuel jet:

1.4 litre models:

Engine code 160 A1.000.....	0.47	0.40
Engine code 159 A2.000.....	0.47	0.40

1.6 litre models:

Engine code 160 A2.000.....	0.45	0.40
Engine code 159 A3.000.....	0.47	0.40

Idle air jet.....

1.40 1.00

Main jet:

1.4 litre models:

Engine code 160 A1.000.....	1.10	1.30
Engine code 159 A2.000.....	1.10	1.23

1.6 litre models:

Engine code 160 A2.000.....	1.10	1.30
Engine code 159 A3.000.....	1.07	1.23

**Torque wrench setting**

Manifold nuts.....

Nm	lbf ft
28	21

**1 General description**

The fuel system on all models comprises a fuel tank, a fuel pump, a fuel filter, a twin choke downdraught carburettor, an inlet manifold heater, and a thermostatically-controlled air cleaner.

The fuel tank is mounted under the rear of the vehicle, and is manufactured from plastic. The tank is ventilated and has a simple filler neck and a fuel gauge sender unit.

The fuel pump is a mechanical diaphragm type, actuated by a lever bearing on an eccentric cam on the auxiliary shaft.

The fuel filter is located in the fuel line which runs from the fuel tank to the fuel pump.

A Weber TLDE type carburettor is fitted, which is described in greater detail in Section 15.

The inlet manifold heater is described in greater detail in Section 27.

The operation of the air cleaner intake air temperature control is described in greater detail in Section 6.

All models in the Tipo range can be operated on unleaded petrol without any adjustments to the fuel or ignition systems.

**2 Fuel system - precautions**

**Warning:** Many of the procedures given in this Chapter involve the disconnection of fuel pipes and system components which may result in some fuel spillage. Before carrying out any operation on the fuel system, refer to the precautions given in the Safety first! Section at the beginning of this manual and follow them implicitly. Petrol is a highly dangerous and volatile substance, and the precautions necessary when handling it cannot be overstressed.

Certain adjustment points in the fuel system are protected by tamperproof caps, plugs or seals. In some territories, it is an offence to drive a vehicle with broken or missing tamperproof seals. Before

disturbing a tamperproof seal, check that no local or national laws will be broken by doing so, and fit a new tamperproof seal after adjustment is complete, where required by law. Do not break tamperproof seals on a vehicle which is still under warranty, as the warranty may be invalidated.

When working on fuel system components, scrupulous cleanliness must be observed, and care must be taken not to introduce any foreign matter into the fuel lines or components. Carburettors in particular are delicate instruments, and care must be taken not to disturb any components unnecessarily. Before attempting work on a carburettor, ensure that the relevant spares are available. Full overhaul procedures have not been given in this Chapter, as complete strip-down of a carburettor is unlikely to cure a fault which is not immediately obvious, without introducing new problems. If persistent problems are encountered, it is recommended that the advice of a FIAT dealer or carburettor specialist is sought. Most dealers will be able to provide carburettor re-jetting and servicing facilities, and if necessary it should be possible to purchase a reconditioned carburettor of the relevant type.

**3 Routine maintenance**

**Note:** Refer to Section 2 before proceeding.

- 1 At the intervals specified in the Routine maintenance Section at the beginning of this manual, carry out the following tasks.
- 2 Examine the rigid and flexible fuel pipes and hoses for leaks and damage. Bend the flexible hoses sharply with the fingers and examine them for signs of cracking or perishing of the rubber. Renew if evident.
- 3 Inspect the air cleaner element for blockage, and clean or renew as necessary.
- 4 Examine the fuel tank for signs of damage.
- 5 Check and if necessary adjust the engine idle speed and mixture settings as described in Section 17.
- 6 Check the operation of the throttle linkage and lubricate the linkage,



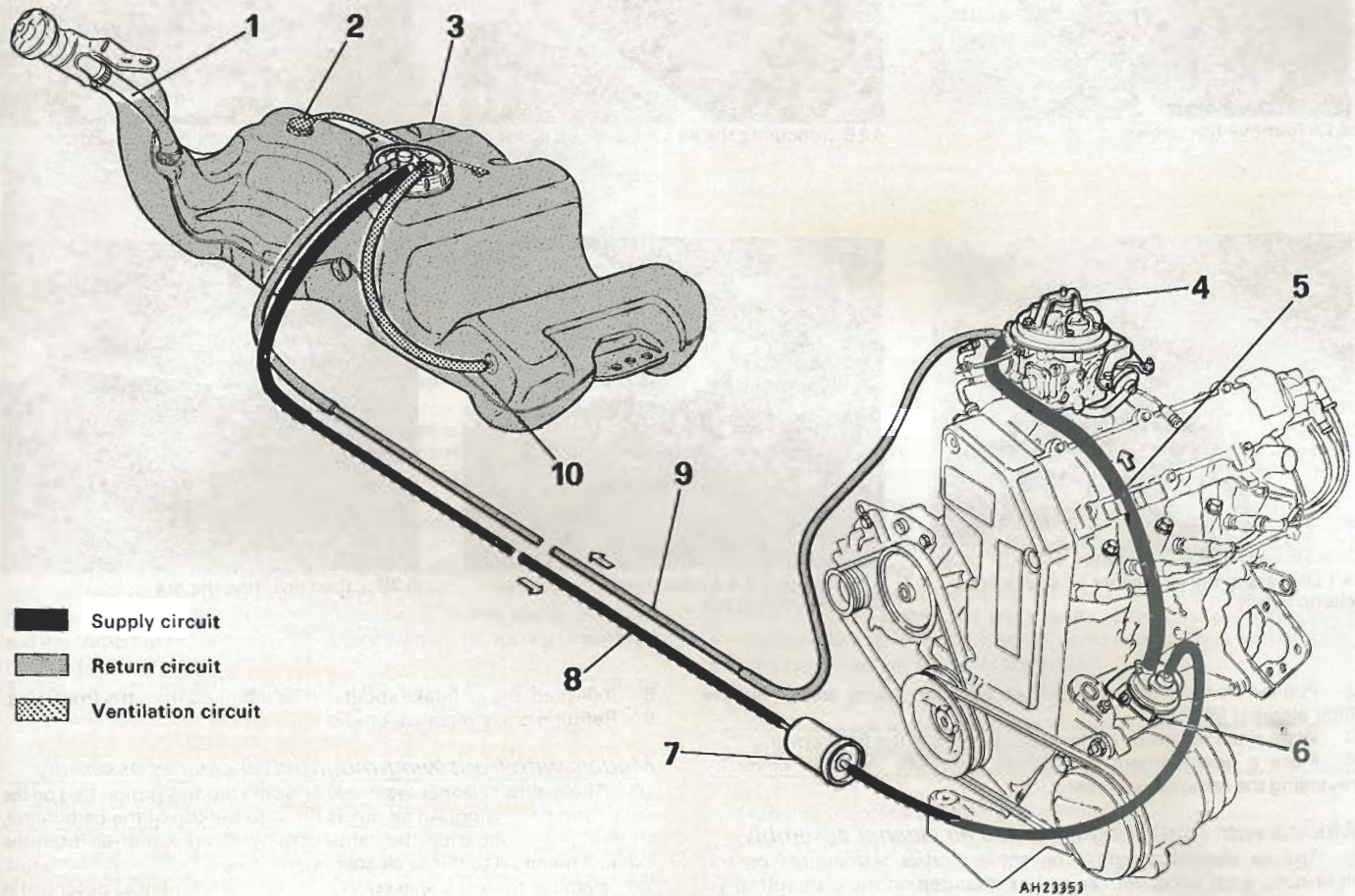


Fig. 3.1 Fuel system (Sec 1)

- |                          |   |   |   |
|--------------------------|---|---|---|
| 1 Fuel tank vent pipe    | 5 Fuel pump-to-carburettor fuel supply hose | 7 Fuel filter                             | 9 Carburettor-to-fuel tank fuel return hose |
| 2 Fuel tank safety valve | 6 Fuel pump                                 | 8 Fuel tank-to-fuel pump fuel supply hose | 10 Fuel tank breather pipe                  |
| 3 Fuel tank              |   |   |   |
| 4 Carburettor            |   |   |   |

cable, and pedal pivot with a few drops of engine oil.

- 7 Renew the air cleaner element as described in Section 4.
- 8 Check the operation of the air cleaner intake air temperature control as described in Section 6.
- 9 Examine the exhaust system for leaks, damage and security, as described in Section 29.
- 10 Clean the carburettor exterior, float chambers and jets, with reference to Section 18.

#### 4 Air cleaner element - renewal

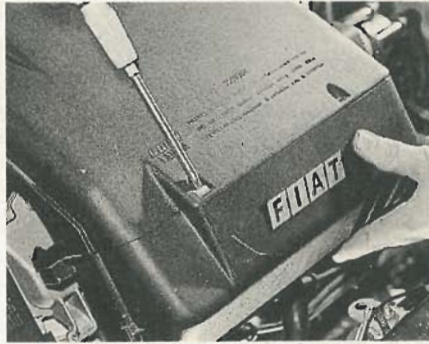
##### Models with carburettor-mounted air cleaner assembly

- 1 Remove the four screws securing the front cover to the main air cleaner casing, and release the two clips at the sides of the cover (photos).

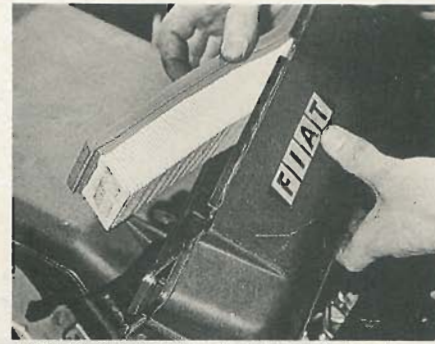




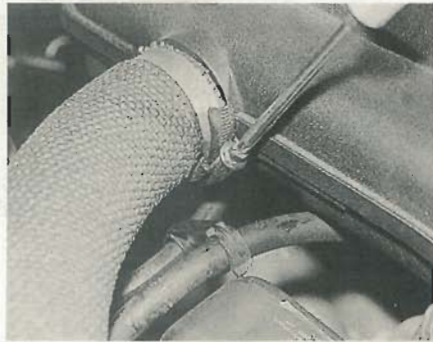
4.1A Remove the screws ...



4.1B ... securing the air cleaner front cover



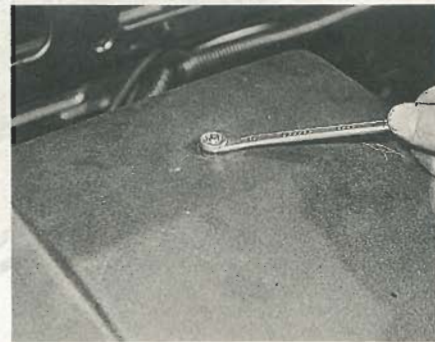
4.2 Withdrawing the air cleaner element



5.1 Loosening the air cleaner air intake hose clamp screw



5.3A Remove the rubber cover from the air cleaner securing nut ...



5.3B ... then unscrew the nut

- 2 Pull the front cover forwards from the main casing, and lift out the filter element (photo).
- 3 Wipe clean the inside of the main casing and the front cover.
- 4 Place a new element in position, then refit the front cover by reversing the removal operations.

#### *Models with front wing-mounted air cleaner assembly*

- 5 The air cleaner assembly on some models is mounted on the right-hand front wing, with an air box mounted on the carburettor. To renew the element, proceed as follows.
- 6 Disconnect the air trunking from the air cleaner cover.
- 7 Remove the securing screws, and lift off the cover to expose the filter element.
- 8 Lift out the element.
- 9 Refitting is a reversal of removal, noting that the element fits with the rubber locating flange uppermost.

- 8 If desired, the air intake spout can be unbolted from the front wing.
- 9 Refitting is a reversal of removal.

#### *Models with front wing-mounted air cleaner assembly*

- 10 The main air cleaner assembly on some models is mounted on the right-hand front wing. An air box is fitted to the top of the carburettor, and a pipe mounted on the camshaft cover carries hot air from the exhaust manifold to the air cleaner on the wing.
- 11 Remove the air cleaner cover and the filter element as described in Section 4.
- 12 Disconnect the hot air hose from the air cleaner casing.
- 13 Unscrew the two upper and the single lower securing bolt, and lift the air cleaner casing from the engine compartment, manipulating the air intake pipe from the front wing. Recover the mounting rubbers and spacers.
- 14 Refitting is a reversal of removal.

## 5 Air cleaner - removal and refitting

### *Models with carburettor-mounted air cleaner assembly*

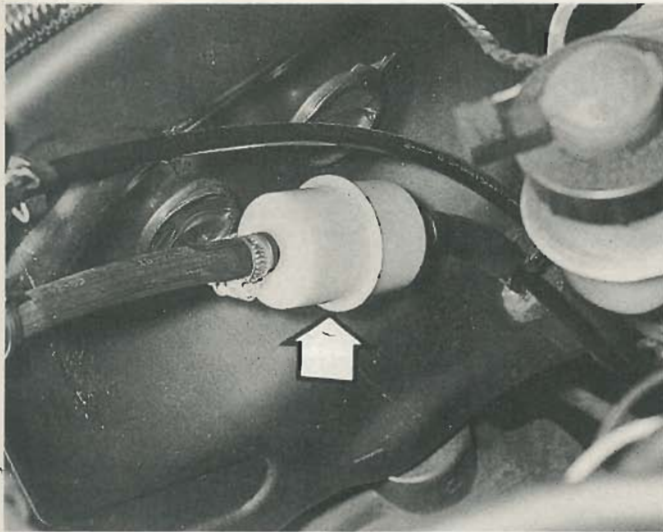
- 1 Loosen the clamp screw, and disconnect the air intake hose from the air cleaner casing (photo).
- 2 On models with power steering, loosen the clamp screw and disconnect the hot air hose from the rear of the air cleaner casing.
- 3 Prise the rubber cover from the top air cleaner securing nut, then unscrew the nut (photos).
- 4 Release the two clips securing the front of the air cleaner to the camshaft housing.
- 5 Lift the air cleaner assembly, pulling it from the hot air hose on models with manual steering, and disconnect the crankcase ventilation hose from the base of the air cleaner casing.
- 6 Withdraw the air cleaner assembly and recover the O-ring from the top of the carburettor.
- 7 Examine the condition of the O-ring and renew if necessary.

## 6 Air cleaner air temperature control - description and testing

**Note:** The description and testing procedure given in this Section applies to models fitted with a carburettor-mounted air cleaner assembly. At the time of writing, no information was available regarding the air temperature control fitted to models with a front wing-mounted air cleaner assembly, although the same basic principles apply equally to both air cleaner types

- 1 The air cleaner is thermostatically-controlled by a waxstat capsule to provide air at the most suitable temperature for combustion.
- 2 The optimum air temperature is achieved by drawing in cold air from an intake at the front of the vehicle, and blending it with hot air drawn from a shroud on the exhaust manifold. The proportion of hot and cold air is varied by the position of a flap valve in the air cleaner intake spout, which is controlled by a waxstat capsule.
- 3 When the engine is cold, the wax in the capsule contracts and the flap is pulled back to shut off the cold air intake. As the under-bonnet





7.1 Fuel filter location (arrowed)

temperature rises, the wax expands and the flap is opened to admit only cold air.

4 To test the unit, the engine **must initially be cold**.

5 Disconnect the cold air intake hose from the air cleaner and observe the position of the flap which should be fully closed to allow only hot air to enter.

6 Refit the hose and warm up the engine to normal operating temperature.

7 Disconnect the hose again and observe the position of the flap, which should be fully open to admit only cold air.

8 If the flap positions are not as described, the waxstat is defective and the complete air cleaner must be renewed as the waxstat cannot be renewed independently.

9 On completion of the checks, stop the engine and reconnect the air intake hose.

## 7 Fuel filter – renewal

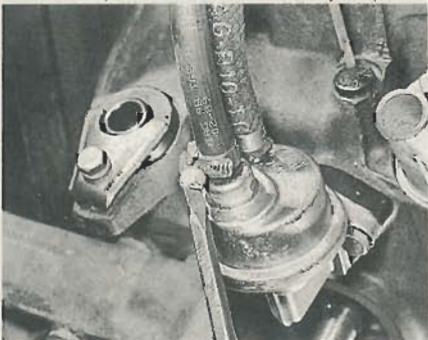
**Note:** Refer to Section 2 before proceeding

1 The fuel filter is located on the right-hand side of the engine compartment in the fuel feed line to the fuel pump (photo).

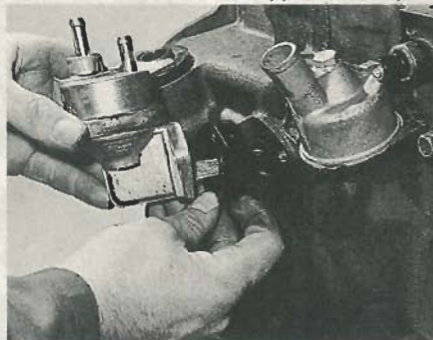
2 Disconnect the battery negative lead.

3 Loosen the clamp screws and disconnect the fuel hoses from the filter, then withdraw the filter. Be prepared for petrol spillage and take adequate fire precautions, and if the filter is not to be renewed immediately, plug the ends of the hoses to minimise fuel loss and prevent dirt ingress.

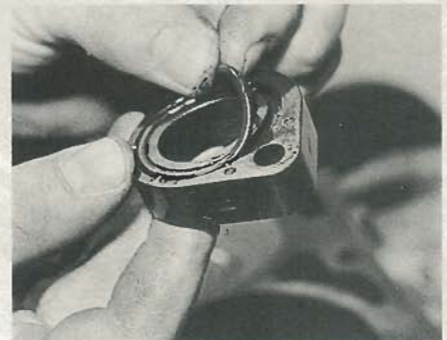
4 Refitting is a reversal of removal, but ensure that the fuel hoses are securely connected, and ensure that the flow direction arrow on the side of the filter points towards the fuel pump.



9.3 Disconnecting a hose from the fuel pump (oil filter removed)



9.4A Withdraw the fuel pump and the plastic insulator block ...



9.4B ... and recover the O-rings

## 8 Fuel pump – testing

**Note:** Refer to Section 2 before proceeding

1 The fuel pump is located on the cylinder block above the oil filter.

2 To test the pump, disconnect the ignition coil wiring plug to prevent the engine from firing.

3 Disconnect the outlet hose from the pump, and place a wad of rag next to the pump outlet. Take appropriate fire precautions.

4 Have an assistant crank the engine on the starter motor, and check that well-defined spurts of fuel are ejected from the fuel pump outlet. If not, the pump is faulty. Before condemning the pump, check that the fuel filter is not blocked, with reference to Section 7. Dispose of the petrol-soaked rag safely.

5 The pump is a sealed unit and if faulty, renewal will be necessary.

6 On completion of the test, reconnect the outlet hose to the pump, and reconnect the coil wiring plug.

## 9 Fuel pump – removal and refitting

**Note:** Refer to Section 2 before proceeding. New insulator block O-rings will be required when refitting

1 The fuel pump is located in the side of the cylinder block above the oil filter.

2 Disconnect the battery negative lead.

3 Identify the hose locations as an aid to refitting, then disconnect the hoses from the pump and plug them (photo). Be prepared for petrol spillage and take adequate fire precautions.

4 Unscrew the two securing bolts and withdraw the fuel pump from the cylinder block. Recover the plastic insulator block and the two O-rings which fit either side of the insulator block (photos).

5 Clean the exterior of the pump with paraffin and wipe dry.

6 The pump is a sealed unit, and if faulty, it must be renewed.

7 Refitting is a reversal of removal, using new O-rings, and ensuring that the fuel hoses are correctly connected.

## 10 Fuel tank – removal and refitting

**Note:** Refer to Section 2 before proceeding

1 Disconnect the battery negative lead.

2 Siphon out any remaining fuel in the tank through the filler pipe. Siphon the fuel into a clean metal container which can be sealed.

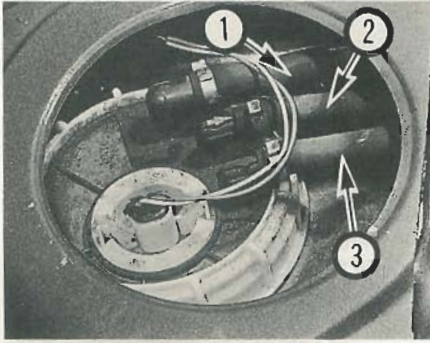
3 Working in the luggage compartment, lift the carpet and prise the plastic fuel pipe housing/fuel level sender unit cover from the floor panel.

4 Disconnect the fuel hoses from the now exposed fuel pipe housing (photo). Make a note of the hose positions to aid refitting. Be prepared for fuel spillage, and take adequate fire precautions. Plug the open ends of the hoses to prevent dirt ingress and further fuel loss.

5 Disconnect the wiring plug from the fuel level sender unit.

6 Chock the front wheels, then jack up the rear of the vehicle and support securely on axle stands.





10.4 Fuel pipe housing/fuel level sender unit viewed through aperture in luggage compartment

- 1 Breather pipe
- 2 Fuel supply pipe
- 3 Fuel return pipe

7 Working under the right-hand rear wheel arch, unscrew the fuel filler tube securing screw (photo). If desired, the roadwheel can be removed for improved access.

8 Open the fuel filler flap, and prise the fuel filler sleeve from its housing in the rear wing.

9 Release the handbrake cables and the brake pipes from their clips on the fuel tank.

10 Support the weight of the fuel tank on a jack with interposed block of wood.

11 Unscrew the securing bolts from the tank mounting straps (photo), then remove the straps and lower the tank, at the same time pulling the fuel filler tube from its location in the rear wing.

12 With the aid of an assistant, withdraw the tank from under the vehicle.

13 If the tank contains sediment or water, it may be cleaned out using two or three rinses with clean fuel. Shake vigorously using several changes of fuel, but before doing so, remove the fuel level sender unit with reference to Section 11. *This procedure should be carried out in a well-ventilated area, and it is vital to take adequate fire precautions – refer to the Safety first! Section at the beginning of this manual for further details.*

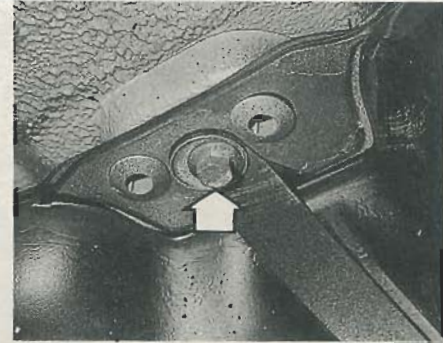
14 Any repairs to the fuel tank should be carried out by a professional, although as the fuel tank is manufactured from plastic, it is likely that renewal will be necessary if any damage is evident.

15 Refitting is a reversal of removal, ensuring that the fuel hoses are reconnected to their correct locations as noted during removal.

16 On completion, fill the fuel tank, then run the engine and check for leaks. If leakage is evident, stop the engine immediately and rectify the problem without delay. Note that the engine may take a longer time than usual to start after the fuel tank has been removed and refitted, as the fuel pump refills with fuel.



10.7 Fuel filler tube securing screw (arrowed)



10.11 Fuel tank securing bolt (arrowed)

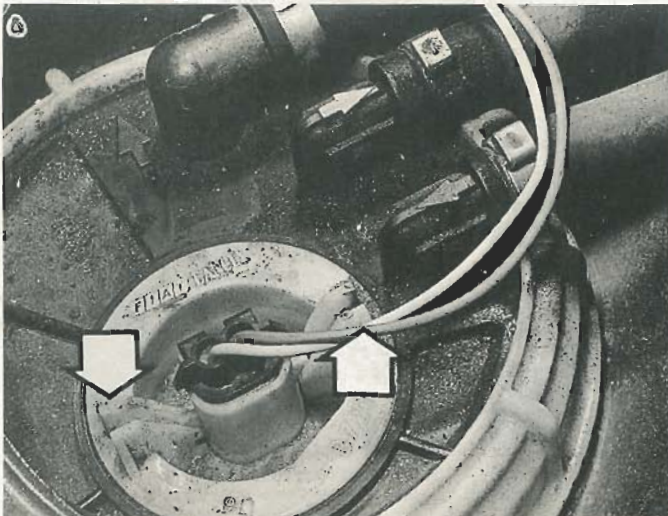
## 11 Fuel level sender unit – removal and refitting

**Note:** Refer to Section 2 before proceeding

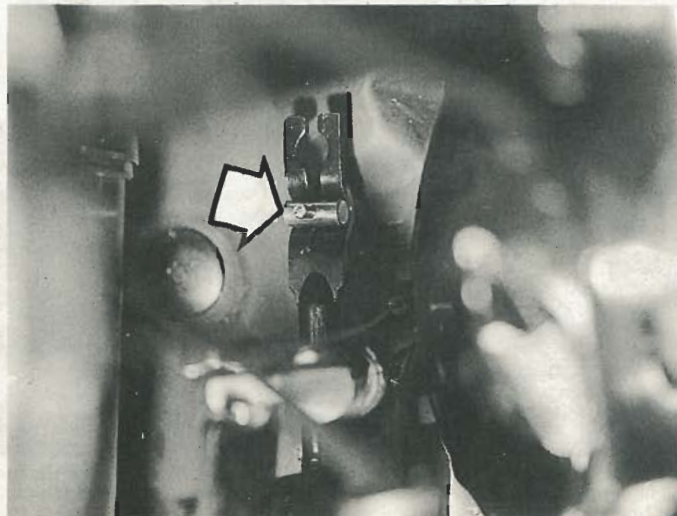
- 1 Run the fuel level as low as possible before removing the sender unit.
- 2 Disconnect the battery negative lead.
- 3 Working in the luggage compartment, lift the carpet and prise the plastic sender unit cover from the floor panel.
- 4 Disconnect the wiring plug from the now exposed sender unit.
- 5 Using a suitable pair of pliers, or two screwdrivers inserted into the lugs on either side of the sender unit, twist the sender unit anti-clockwise, and withdraw it from the fuel pipe housing in the top of the fuel tank (photo). Be prepared for fuel spillage, and take adequate fire precautions.
- 6 Check the condition of the sender unit sealing ring, and renew if necessary.
- 7 Refitting is a reversal of removal.
- 8 On completion, fill the fuel tank and check that the fuel gauge reads correctly. Also check for fuel leaks, and if evident rectify the problem without delay.

## 12 Throttle pedal – removal and refitting

- 1 Working in the driver's footwell, for improved access remove the lower facia trim panel, with reference to Chapter 10 if necessary.
- 2 Slide the end of the throttle cable from the pedal (photo).

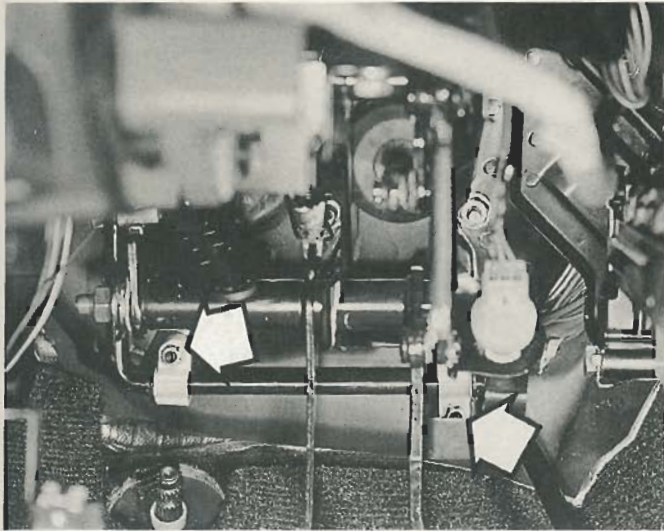


11.5 Twist the sender unit anti-clockwise using the lugs (arrowed)



12.2 Slide the throttle cable end fitting (arrowed) from the pedal





12.3 Throttle pedal clamp nuts (arrowed)

- 3 Unscrew the two clamp nuts, then lift the pedal complete with the pivot clamps from the footwell (photo).
- 4 Refitting is a reversal of removal, but on completion check the throttle mechanism for satisfactory operation, and check the throttle cable adjustment as described in Section 13.

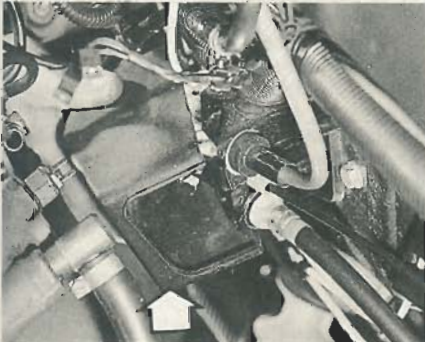
### 13 Throttle cable - removal, refitting and adjustment

#### Removal and refitting

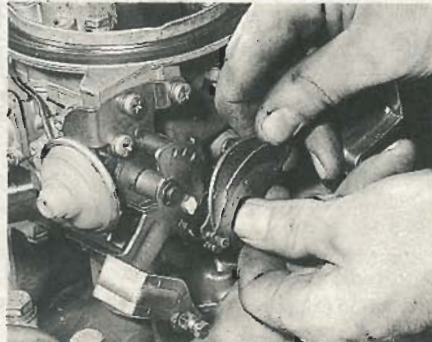
- 1 The throttle cable is in two sections. One section runs from the throttle pedal to the bellcrank assembly on the engine compartment bulkhead, and the remaining section runs from the bellcrank assembly to the throttle lever on the carburettor.

#### Throttle pedal-to-bellcrank cable

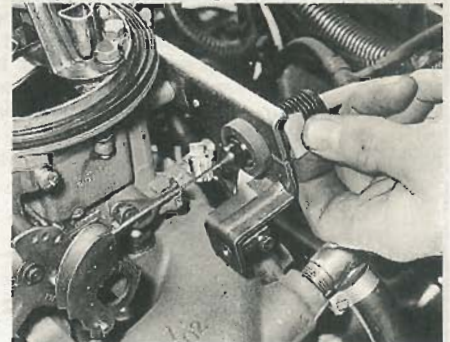
- 2 Working in the driver's footwell, for improved access remove the lower facia trim panel, with reference to Chapter 10 if necessary.
- 3 Slide the end of the throttle cable from the pedal.
- 4 Working in the engine compartment, for improved access remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 5 Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead (photo).
- 6 Turn the throttle cable bellcrank as necessary to allow the cable end to be slid free.
- 7 Withdraw the cable through the bulkhead grommet into the engine compartment.
- 8 Refitting is a reversal of removal, but ensure that the bulkhead grommet is correctly located.



13.5 Removing the plastic cover (arrowed) from the cable bellcrank assembly



13.11 Disconnecting the throttle cable from the carburettor throttle lever



13.16 Move the clip on the threaded sleeve to adjust the throttle cable free play

- 9 On completion, check the throttle mechanism for satisfactory operation, and if necessary adjust the cable as described in paragraph 16 onwards.

#### Bellcrank-to-carburettor throttle lever cable

- 10 Working in the engine compartment, for improved access remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 11 Turn the throttle lever on the carburettor to the fully open position, then unhook the end of the throttle cable from the lever (photo).
- 12 Pull the threaded sleeve on the end of the cable sheath from the rubber grommet in the carburettor cable support bracket.
- 13 Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead.
- 14 Slide the cable end from the throttle cable bellcrank, then slide the cable sheath from the bellcrank bracket. Withdraw the cable.
- 15 Refitting is a reversal of removal, but on completion, check the throttle mechanism for satisfactory operation, and if necessary adjust the cable as described in the following paragraphs.

#### Adjustment

- 16 A clip is located on the threaded sleeve at the end of the cable sheath in the carburettor cable support bracket, to adjust the cable free play (photo).
- 17 The cable should be adjusted so that when the throttle pedal is released, there is very slight free play in the cable at the carburettor end.
- 18 Check that when the throttle pedal is fully depressed, the primary throttle valve in the carburettor is fully open.
- 19 Adjust the position of the clip on the threaded sleeve to achieve the desired results.

### 14 Choke cable - removal, refitting and adjustment

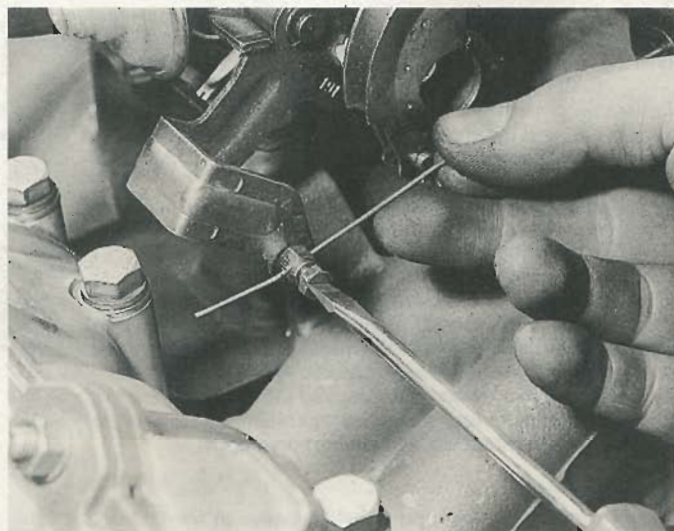
#### Removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Working in the engine compartment, for improved access, remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 3 Loosen the clamp screw and disconnect the end of the choke cable from the choke lever on the carburettor, then loosen the clamp screw which retains the cable sheath in the carburettor cable bracket (photos).
- 4 Working in the passenger compartment, remove the driver's side lower facia panel, with reference to Chapter 10 if necessary.
- 5 Remove the single screw securing the choke knob trim panel to the facia bracket, then carefully manipulate the trim panel from the bracket.
- 6 Disconnect the choke warning lamp switch wiring plug.
- 7 Pull the cable through the bulkhead into the passenger compartment, then withdraw the complete assembly.
- 8 Refitting is a reversal of removal, but ensure that the bulkhead grommet is correctly located.
- 9 On completion check the choke mechanism for satisfactory operation, and if necessary adjust the cable as described in the following paragraphs.

#### Adjustment

- 10 The cable free play is adjusted by altering the effective length of



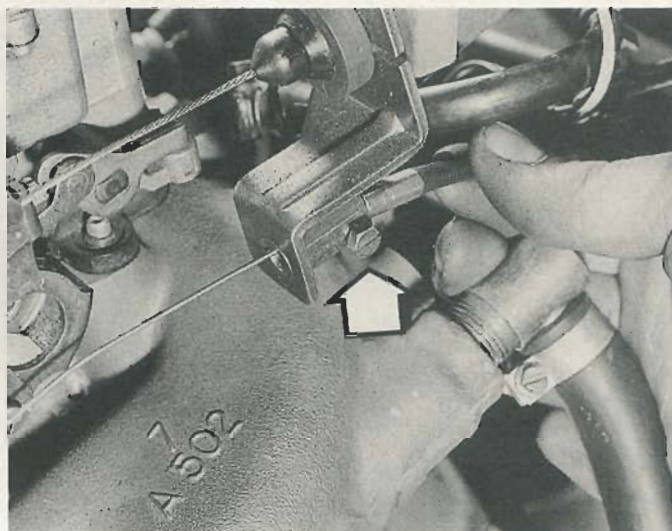


14.3A Disconnecting the end of the choke cable from the carburettor choke lever ...

the cable using the clamp screw at the cable end.

11 The cable should be adjusted so that when the choke knob is pushed fully home, there is very slight free play in the cable at the carburettor end.

12 Check that when the choke knob is pulled fully out, the choke lever rests against its stop, and that when the choke lever is pushed fully home, the choke valve is fully open.



14.3B ... and the cable bracket (clamp screw arrowed)

### 15 Carburettor (Weber TLDE type) - description

The Weber TLDE type carburettor is of fixed-jet, twin-venturi sequential throttle type, with a manually-operated choke. The primary throttle valve operates alone except at high engine speeds and loads when the secondary throttle valve is operated, until at full throttle both

are fully open. This arrangement allows good fuel economy during light acceleration and cruising, but also gives maximum power at full throttle. The secondary throttle valve is activated mechanically. The primary throttle barrel and venturi diameters are smaller than their secondary counterparts. The carburettor is a complicated instrument with various refinements and sub-systems added to achieve improved driveability, economy and exhaust emission levels.

A separate idle system operates independently from the main jet system, supplying fuel via the mixture control screw, and a fuel cut-off valve is incorporated in the idle circuit to shut off the fuel supply during engine overrun conditions and when the ignition is switched off.

The main jets are calibrated to suit engine requirements at mid-range throttle openings. To provide the necessary fuel enrichment at full throttle, a vacuum-operated power valve is used. The valve provides extra fuel under the low vacuum conditions associated with wide throttle openings.

To provide an enriched mixture during acceleration, an accelerator pump delivers extra fuel to the secondary main venturi. The accelerator

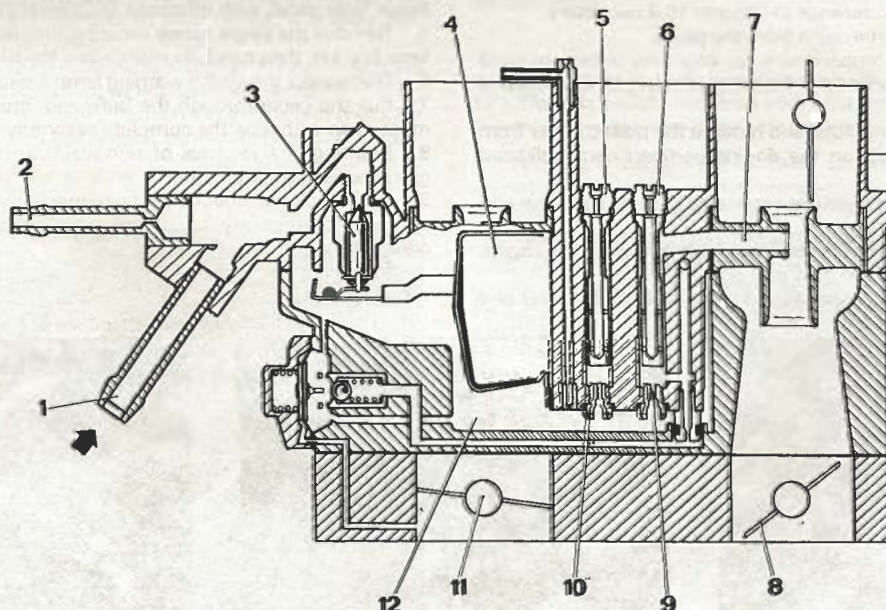


Fig. 3.2 Cross-section of Weber TLDE type carburettor (Sec 15)

1 Fuel supply from pump  
2 Fuel return to tank  
3 Needle valve

4 Float  
5 Secondary air jet  
6 Primary air jet

7 Primary venturi  
8 Primary throttle valve  
9 Primary main jet

10 Secondary main jet  
11 Secondary throttle valve  
12 Float chamber



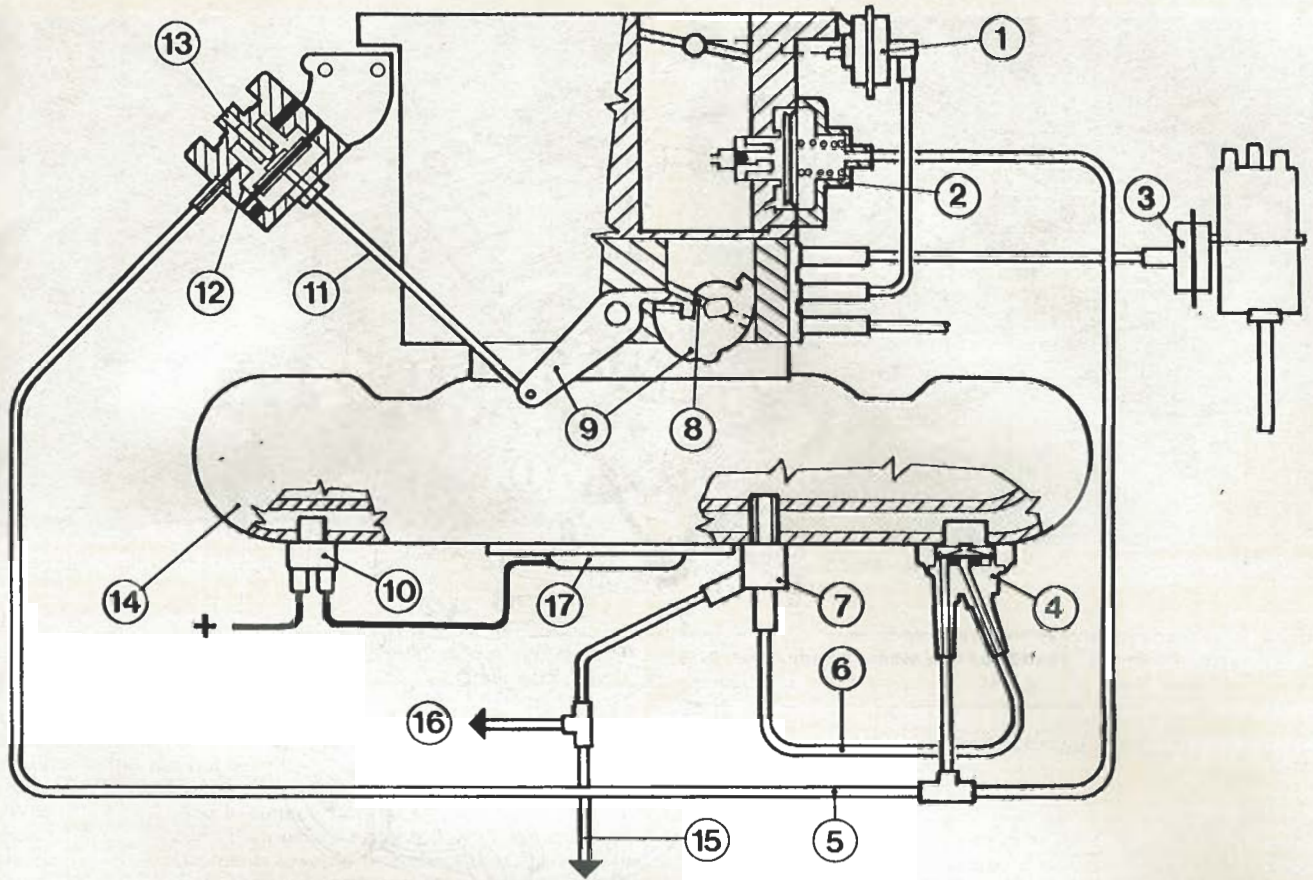


Fig. 3.3 Carburettor ancillary devices (Sec 15)

- |   |                               |   |                                   |
|---|-------------------------------|---|-----------------------------------|
| 1 Choke vacuum pull-down diaphragm                        | 4 Thermostatic vacuum valve   | 9 Fast idle device operating lever and throttle lever | 13 Fast idle speed adjuster screw |
| 2 Thermostatically-controlled accelerator pump diaphragm  | 5 Vacuum pipe                 | 10 Inlet manifold heater switch                       | 14 Inlet manifold                 |
| 3 Distributor vacuum advance unit - 1.4 litre models only | 6 Vacuum pipe                 | 11 Fast idle device operating rod                     | 15 Vacuum pipe to brake servo     |
|   | 7 Inlet manifold vacuum union | 12 Fast idle device                                   | 16 Vacuum pipe to economy gauge   |
|   | 8 Primary throttle valve      |   | 17 Inlet manifold heater          |

pump is operated mechanically by a cam on the throttle linkage.

An additional thermostatically-controlled accelerator pump is fitted to improve the running of the engine when cold and as it warms up. The pump is controlled by a thermostatic vacuum valve mounted in the inlet manifold. When the engine is warming up, during harsh acceleration, a large vacuum is created in the carburettor primary main venturi. With the thermostatic valve fully open, this vacuum is supplied to the accelerator pump, and extra fuel is delivered to the primary main venturi to enrich the mixture. When the temperature of the coolant reaches 25 to 45°C, the vacuum valve gradually shuts off the vacuum supply, and the accelerator pump ceases to operate.

A vacuum-operated fast idle device is fitted to prevent the engine from stalling when the coolant temperature is below 35°C and the choke is not in operation. The device increases the opening of the primary throttle valve via a vacuum diaphragm unit. The vacuum supply to the diaphragm unit is controlled by the same thermostatic vacuum valve which controls the thermostatically-controlled accelerator pump described previously. When the coolant temperature is below 35°C, the vacuum valve is open, and vacuum reaches the diaphragm unit, thus increasing the opening of the primary throttle valve. When the coolant temperature exceeds 45°C, the vacuum valve is completely closed, therefore no vacuum is supplied to the diaphragm unit, and the device ceases to operate.

A manually-operated choke is fitted, but a vacuum-operated pull-down system is employed, whereby, if the engine is under choke but is only cruising (ie not under heavy load) the choke plate is opened. The pull-down mechanism prevents an over-rich mixture, which reduces

fuel economy and may cause unnecessary engine wear when the engine is cold.

A fuel cut-off valve is fitted to shut off the fuel supply during engine overrun conditions and when the ignition is switched off. A "throttle closed" switch is fitted to the throttle lever and supplies a signal to the fuel cut-off control module on 1.4 litre models, or the Digiplex 2 module on 1.6 litre models. The fuel cut-off valve is operated by a solenoid, which is normally energised, thus pulling the cut-off valve from its seat, allowing fuel to flow. When the throttle is closed and the engine speed drops to around 1800 rpm, the solenoid is de-energised, thus cutting off the fuel supply. When the engine speed drops below 1800 rpm, the solenoid is re-energised, thus restoring the fuel supply, and ensuring that the engine does not cut out. This improves fuel economy and reduces exhaust gas emissions. The solenoid is also de-energised when the ignition is switched off, preventing dieselling or engine run-on. For further details of the fuel cut-off system components, refer to Chapter 4.

## 16 Carburettor - removal and refitting

**Note:** Refer to Section 2 before proceeding

- 1 Remove the inlet manifold as described in Section 28.
- 2 Disconnect the vacuum pipe, which runs from the inlet manifold to the carburettor vacuum T-piece, from the inlet manifold.



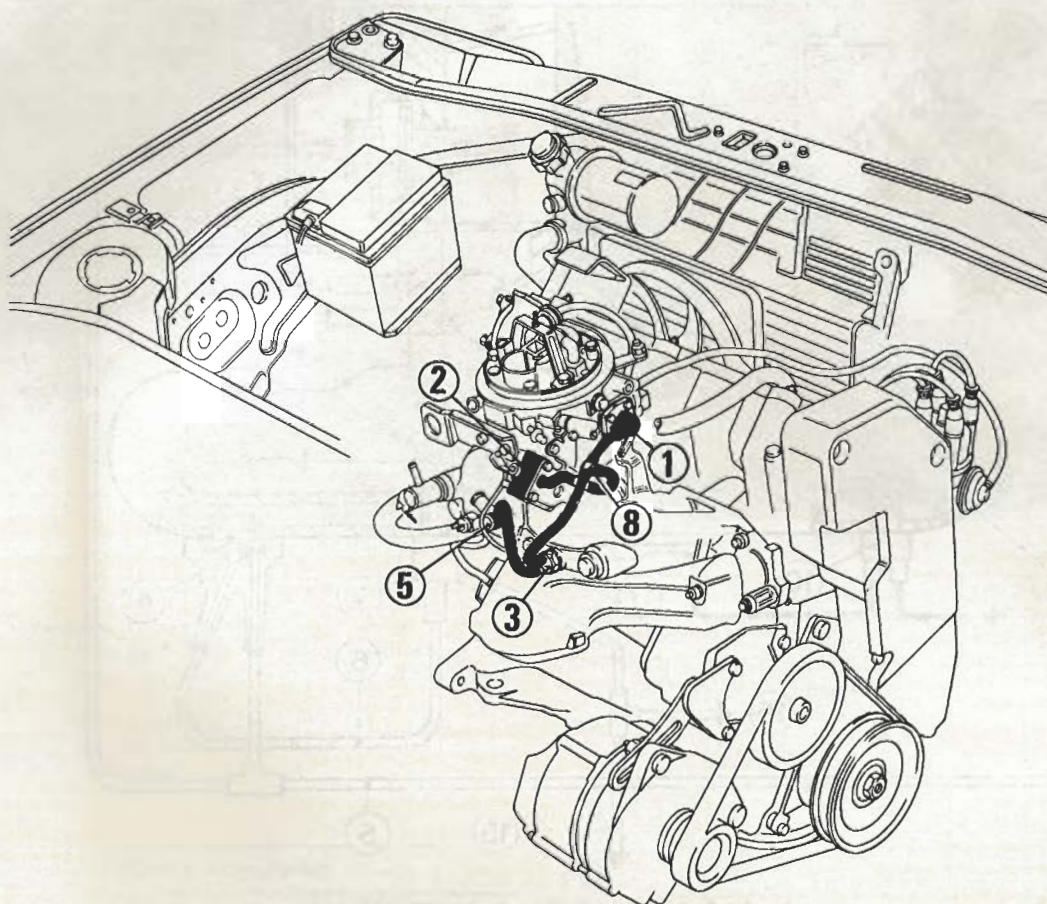
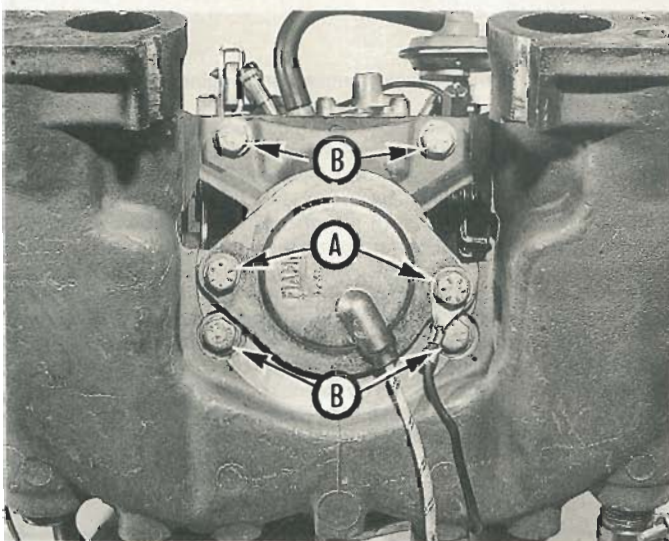


Fig. 3.4 Carburettor fast idle system components (Sec 15)

- |  |                                    |                             |                              |
|--|------------------------------------|-----------------------------|------------------------------|
| 1 Thermostatically-controlled accelerator pump | 2 Vacuum-operated fast idle device | 3 Thermostatic vacuum valve | 5 Inlet manifold vacuum port |
|  |                                    |                             | 8 Vacuum T-piece             |



16.4 Inlet manifold heater securing screws (A) and carburettor securing screws (B)

3 Working underneath the inlet manifold, remove the two securing screws and withdraw the heater from the manifold, noting that one of

the screws also secures an earth lead.

4 Unscrew the four carburettor securing screws (photo), and withdraw the carburettor from the manifold.

5 Thoroughly clean all external dirt from the carburettor.

6 Refitting is a reversal of removal, but refit the inlet manifold with reference to Section 28, and when the inlet manifold/carburettor assembly has been refitted, check and if necessary adjust the idle speed and mixture as described in Section 17.

### 17 Carburettor - idle speed and mixture adjustment

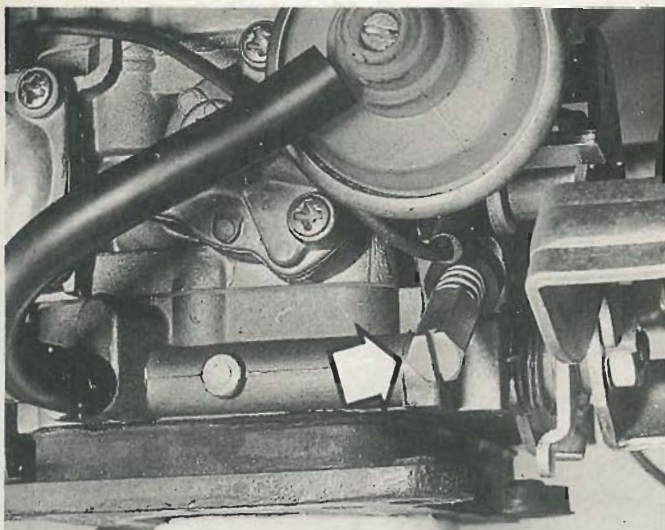
**Note:** Refer to Section 2 before proceeding. To carry out the adjustments an accurate tachometer and an exhaust gas analyser (CO meter) will be required

1 In order to check the idle speed and mixture, the following conditions must be met:

- The engine must be at normal operating temperature (the cooling fan should have cut in and out twice)
- All electrical consumers (cooling fan, heater blower, headlamps etc) must be switched off
- The ignition timing (where applicable) and spark plug gaps must be correctly adjusted - see Chapter 4
- The air cleaner or the carburettor air box, as applicable, must be fitted, and the air cleaner element must be clean

2 Connect a tachometer and an exhaust gas analyser in accordance





17.3 Carburettor throttle stop screw (arrowed)

with the manufacturer's instructions.

3 Start the engine and run it at 2000 rpm for approximately 30 seconds, then allow it to idle. Allow a few seconds for the readings on the instruments to settle. If the idle speed is outside the specified limits, adjust by means of the throttle stop screw (photo).

4 The adjustment should be completed within approximately 30 seconds. If this has not been possible, repeat paragraph 3, ignoring the reference to starting the engine.

5 When the idle speed is correct, run the engine at 2000 rpm for approximately 30 seconds, then allow it to idle. Allow a few seconds for the readings on the instruments to settle, then check the CO level in the exhaust gas. If it is outside the specified limits, adjust by means of the idle mixture adjustment screw (photo). In production, the screw is covered by a tamperproof plug – ensure that no local or international laws are being broken before removing the plug.

6 Again, the adjustment should be completed within approximately 30 seconds. If this has not been possible, repeat paragraph 5.

7 With the idle mixture correct, readjust the idle speed if necessary.

8 If the cooling fan cuts in during the adjustment procedure, stop the adjustments and proceed when the cooling fan stops.

9 When both idle speed and mixture are correctly set, stop the engine and disconnect the test equipment.

10 Fit a new tamperproof plug to the idle mixture adjustment screw, where this is required by law.

## 18 Carburettor – cleaning

1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the carburettor exterior, float chambers and jets should be cleaned as follows.

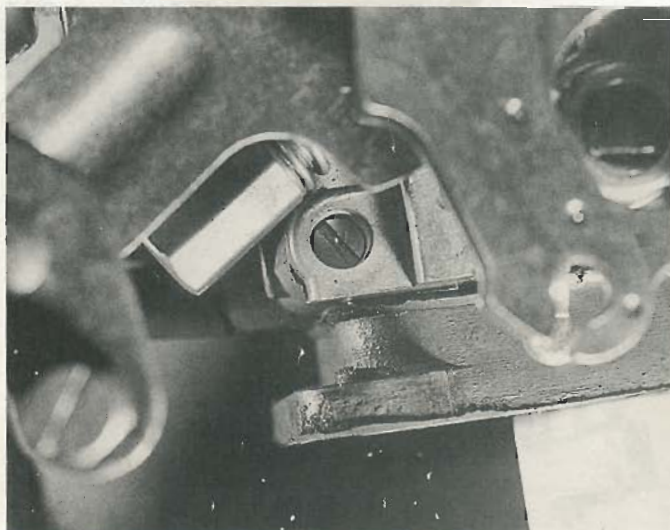
2 Proceed as described in Section 19, paragraphs 1 to 10 inclusive.

3 With the carburettor top cover removed, carefully mop out the float chambers using a lint-free cloth. If contamination is particularly bad, the surfaces of the chambers should be cleaned using proprietary carburettor cleaner.

4 If the carburettor has been neglected for a long period of time, it is possible that a sticky deposit may have formed on the internal surfaces, particularly in the main venturis and on the throttle valves. If this is the case, the carburettor should be removed as described in Section 16, and the contaminated areas should be cleaned using carburettor cleaner and a small brush, such as an old toothbrush. Take great care not to allow loose dirt to enter any of the passages or jets, as even the slightest amount of loose debris can cause serious running problems, and the source of trouble is normally very difficult to trace.

5 Clean the main jets in the top cover using air pressure – never probe them with wire, as the calibration could be ruined (photo).

6 On completion, refit the top cover with reference to Section 19, and where applicable, refit the carburettor as described in Section 16.



17.5 Carburettor idle mixture adjustment screw (tamperproof plug removed)

## 19 Carburettor needle valve and float – removal, refitting and adjustment

**Note:** Refer to Section 2 before proceeding. A new carburettor top cover gasket must be used on refitting

### Removal and refitting

1 The needle valve and float can be removed without removing the carburettor as follows. If the carburettor has been removed, proceed to paragraph 8.

2 Disconnect the battery negative lead.

3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.

4 Thoroughly clean all external dirt from the carburettor.

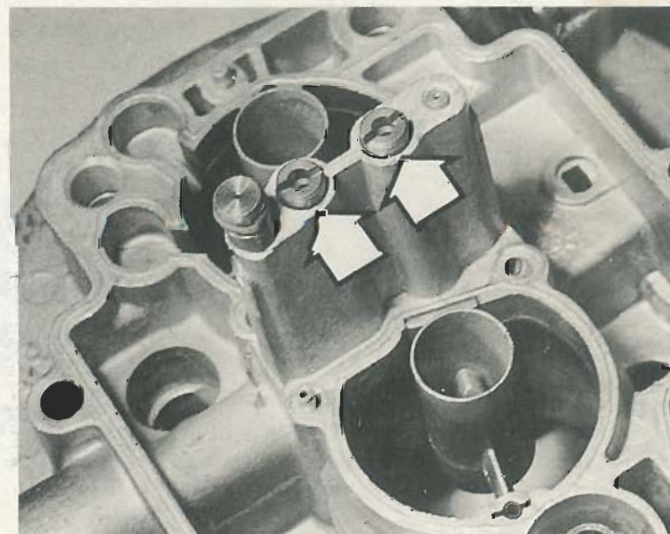
5 Disconnect the fuel supply and return hoses from the carburettor. Be prepared for fuel spillage and take adequate fire precautions. Plug the open ends of the hoses to prevent dirt ingress and to minimise fuel loss.

6 Loosen the clamp screw and disconnect the end of the choke cable from the choke lever on the carburettor.

7 Disconnect the wiring connector from the carburettor fuel cut-off valve.

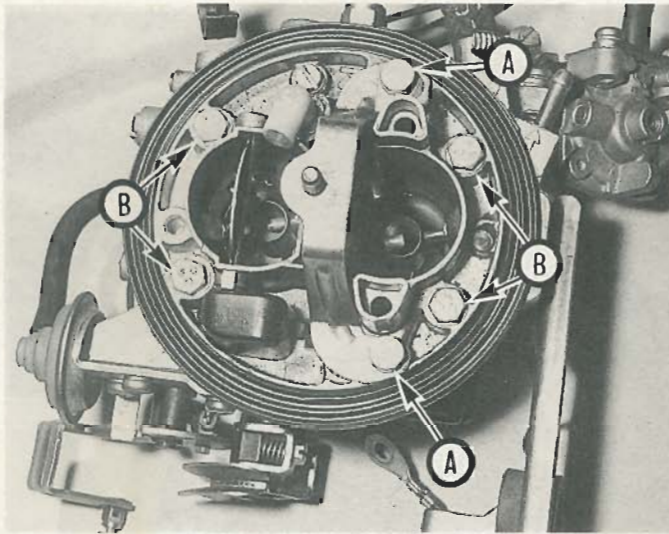
8 Pull the vacuum hose from the choke vacuum pull-down unit.

9 Extract the two securing screws and remove the air cleaner support

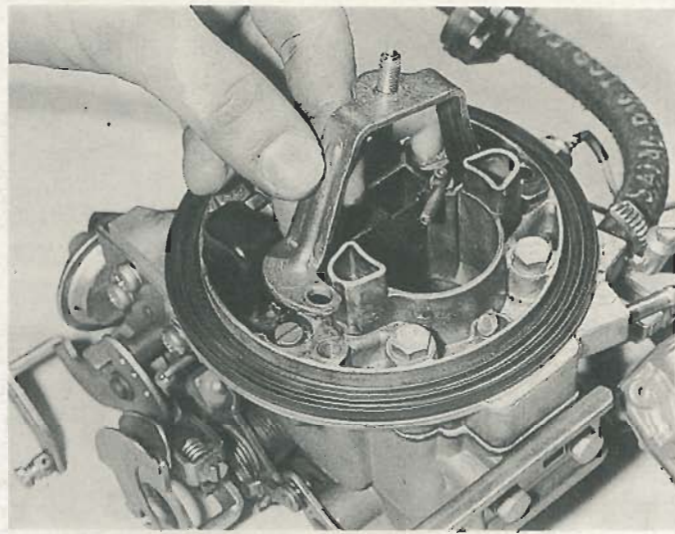


18.5 Carburettor main jets (arrowed) in top cover





19.9A Carburettor air cleaner support bracket securing screws (A) and top cover through-bolts (B)



19.9B Removing the air cleaner support bracket from the carburettor

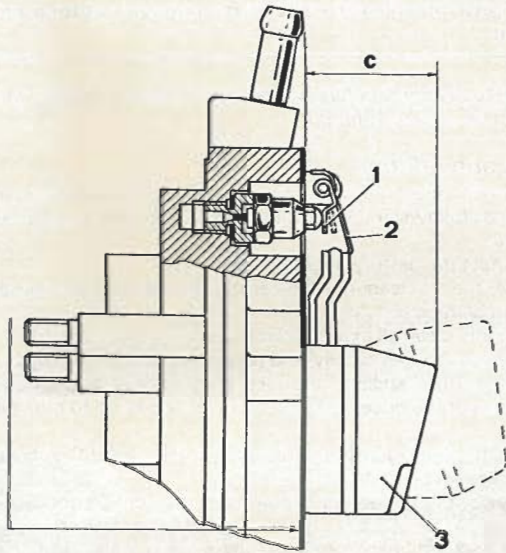


Fig. 3.5 Float level adjustment (Sec 19)

- |                              |   |
|------------------------------|---|
| 1 Needle valve operating tab | 3 Float   |
| 2 Float tab                  | $c = 30.0 \pm 0.25 \text{ mm}$ with gasket in place |

bracket from the top of the carburettor (photos).

10 Unscrew the four through-bolts and the two screws which secure the carburettor top cover, then withdraw the top cover (photos). Re-cover the gasket.

11 Invert the top cover for access to the float.

12 Using a suitable pin punch, tap the float retaining pin from the top cover and lift out the float and needle valve (photo).

13 Inspect the components for damage and wear, and renew as necessary. Check the needle valve for wear, and check the float for leaks by shaking it to see if it contains petrol.

14 Clean the mating faces of the carburettor body and top cover.

15 Refitting is a reversal of removal, bearing in mind the following points.

16 After refitting the needle valve and float to the top cover, check and if necessary adjust the float level as described in paragraphs 21 to 23 inclusive.

17 Where applicable, ensure that all hoses, pipes and wires are correctly reconnected.

18 Where applicable, on completion check and if necessary adjust the idle speed and mixture as described in Section 17.

#### Adjustment

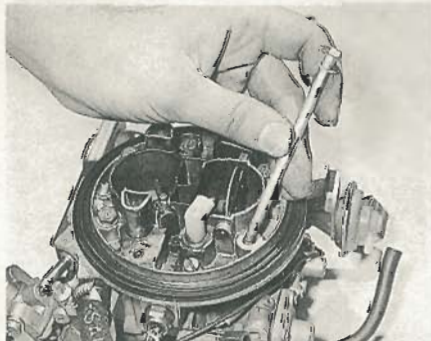
19 With the carburettor top cover removed as described previously, proceed as follows.

20 Ensure that the top cover gasket face is clean, then fit a new gasket to the top cover, ensuring that it seats correctly (photo).

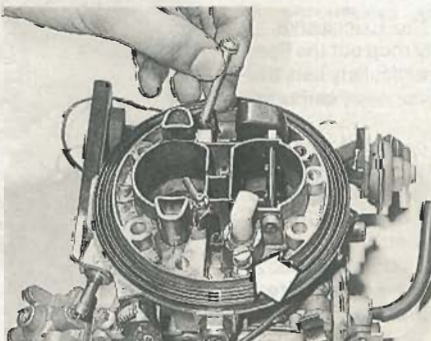
21 Hold the top cover in a vertical position, with the float tab just touching the needle valve ball, as shown in Fig. 3.5.

22 In this position, distance "C" between the bottom corner of the float and the face of the gasket should be as specified.

23 If adjustment is required, bend the float tab "2", using a suitable



19.10A Removing a carburettor top cover through-bolt ...

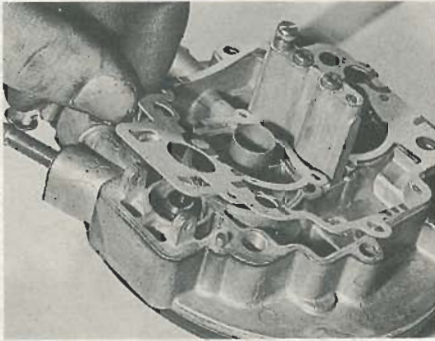


19.10B ... and screw (remaining screw arrowed)

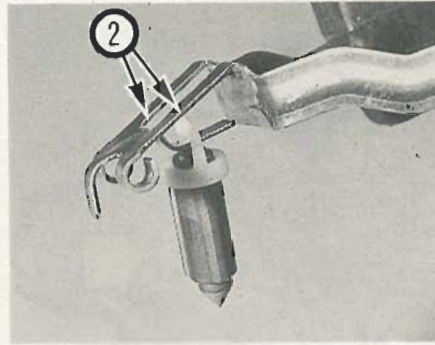


19.12 Removing the float pivot pin





19.20 Fitting a new gasket to the carburettor top cover



19.23 Bend float tab (2) to adjust float level

pair of pliers, until the float level is as specified (photo). **Do not bend the needle valve operating tab "1" under any circumstances.**

24 Refit the top cover as described previously.

## 20 Carburettor power valve diaphragm – renewal

**Note:** Refer to Section 2 before proceeding

1 The power valve diaphragm can be renewed without removing the carburettor as follows. If the carburettor has been removed, proceed to paragraph 4.

2 Disconnect the battery negative lead.

3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.

4 Thoroughly clean all external dirt from around the power valve housing.

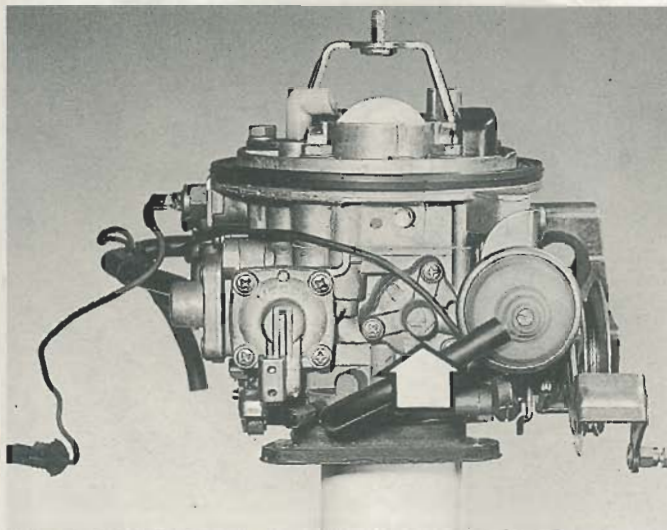
5 For improved access, disconnect the vacuum hose from the choke vacuum pull-down unit.

6 Remove the three securing screws, and lift off the power valve cover, spring and diaphragm assembly (photo).

7 Before refitting, first clean the mating faces of the cover and housing.

8 Locate the spring on the cover and diaphragm assembly, ensuring that it is correctly seated, then press the diaphragm assembly and cover together. Note that the vacuum hole in the diaphragm must align with the corresponding holes in the housing flange and cover.

9 Further refitting is a reversal of removal, but ensure that the diaphragm is correctly seated, and tighten the cover securing screws progressively to avoid distorting the diaphragm.



20.6 Carburettor power valve cover (arrowed)

## 21 Carburettor accelerator pump diaphragm – renewal

**Note:** Refer to Section 2 before proceeding

1 The accelerator pump diaphragm can be renewed without removing the carburettor as follows. If the carburettor has been removed, proceed to paragraph 4.

2 Disconnect the battery negative lead.

3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.

4 Thoroughly clean all external dirt from around the accelerator pump housing.

5 Remove the four securing screws and lift off the accelerator pump cover (photo). Recover the diaphragm, spring, and valve components. Note the orientation of the valve components.

6 Clean the diaphragm mating faces of the cover and housing.

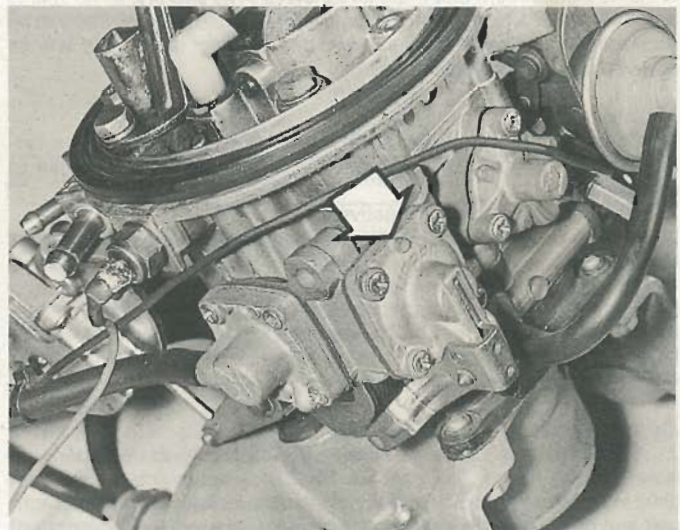
7 Commence refitting by locating the valve components and spring in the housing. Ensure that the valve components are orientated as noted during removal.

8 Locate the diaphragm on the housing, ensuring that the spring is correctly seated, and refit the cover. Tighten the cover securing screws progressively to avoid distorting the diaphragm.

9 Further refitting is a reversal of removal.

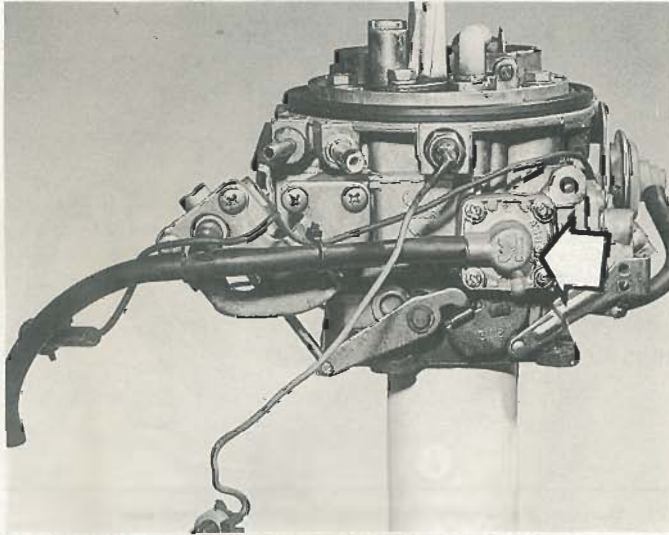
## 22 Carburettor thermostatically-controlled accelerator pump diaphragm – renewal

**Note:** Refer to Section 2 before proceeding



21.5 Carburettor accelerator pump cover (arrowed)





22.6 Carburettor thermostatically-controlled accelerator pump diaphragm cover (arrowed)

- 1 The accelerator pump diaphragm can be renewed without removing the carburettor as follows. If the carburettor has been removed, proceed to paragraph 4.
- 2 Disconnect the battery negative lead.
- 3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 4 Thoroughly clean all external dirt from around the accelerator pump housing.
- 5 Disconnect the vacuum hose from the pump cover.
- 6 Remove the four securing screws and lift off the accelerator pump cover, spring and diaphragm assembly (photo).
- 7 Before refitting, clean the diaphragm mating faces of the cover and housing.
- 8 Locate the spring on the cover and diaphragm assembly, ensuring that it is correctly seated, then press the diaphragm assembly and cover together.
- 9 Further refitting is a reversal of removal, but ensure that the diaphragm is correctly seated, and tighten the cover securing screws progressively to avoid distorting the diaphragm.

### 23 Carburettor fast idle device vacuum diaphragm - renewal and adjustment

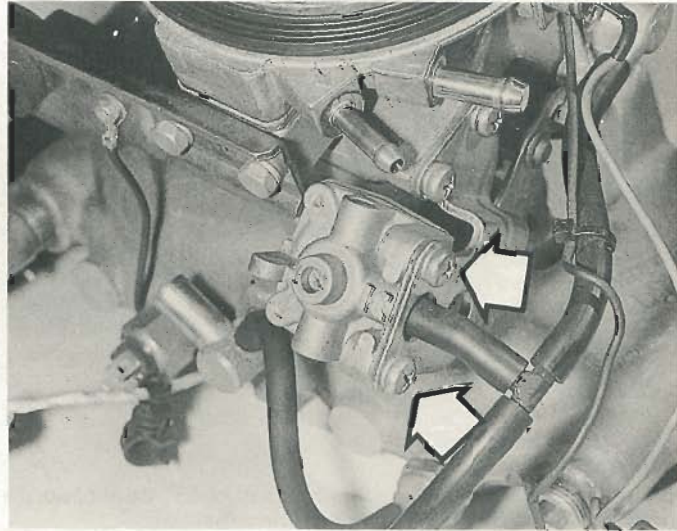
**Note:** The diaphragm unit must be renewed in its entirety, as no spares are available. Before adjusting the unit, refer to Section 2, and note that an accurate tachometer and an exhaust gas analyser (CO meter) will be required during this procedure

#### Renewal

- 1 The diaphragm unit can be renewed without removing the carburettor as follows. If the carburettor has been removed, proceed to paragraph 4.
- 2 Disconnect the battery negative lead.
- 3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 4 Disconnect the vacuum hose from the diaphragm unit.
- 5 Remove the two securing screws, and withdraw the diaphragm unit from its bracket, then remove the securing clip and unhook the operating rod from the throttle lever (photo).
- 6 Refitting is a reversal of removal.

#### Adjustment

- 7 Check that the clearance between the fast idle device operating lever and the throttle lever ("9" in Fig. 3.3) is approximately 0.5 mm (0.02 in). If adjustment is necessary, loosen the locknut at the diaphragm unit end of the fast idle device operating rod, then adjust the length of the rod to give the specified clearance, and tighten the locknut.



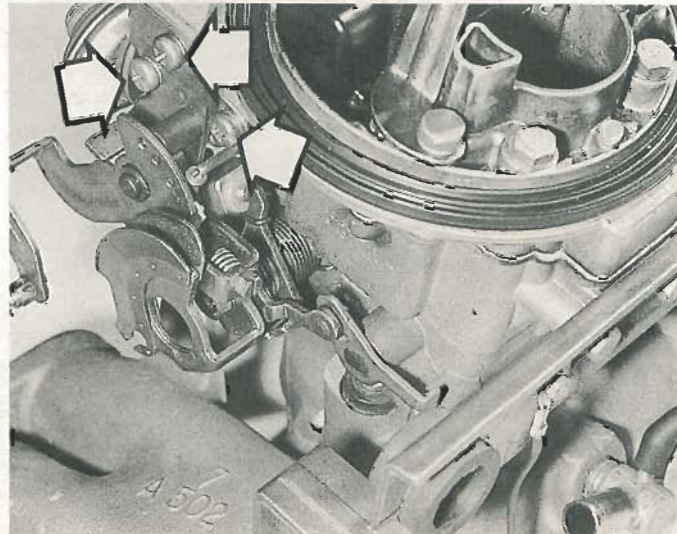
23.5 Carburettor fast idle device vacuum diaphragm unit securing screws (arrowed)

- 8 Start the engine, and run it until it reaches normal operating temperature (the cooling fan should have cut in and out twice).
- 9 Check and if necessary adjust the idle speed and mixture as described in Section 17.
- 10 Stop the engine and disconnect the exhaust gas analyser, but leave the tachometer connected.
- 11 Disconnect the vacuum pipe which runs from the inlet manifold vacuum union to the thermostatic vacuum valve at the inlet manifold.
- 12 Disconnect the vacuum pipe which runs from the vacuum T-piece to the thermostatic vacuum valve at the vacuum valve.
- 13 Connect the previously disconnected T-piece vacuum pipe directly to the inlet manifold vacuum union.
- 14 Start the engine, and check that the fast idle speed is as specified. If adjustment is necessary, turn the adjuster screw in the end of the fast idle diaphragm unit until the correct fast idle speed is obtained.
- 15 On completion, stop the engine, disconnect the tachometer, and reconnect the vacuum pipes to their correct locations.

### 24 Carburettor choke vacuum pull-down diaphragm - renewal

**Note:** The diaphragm unit must be renewed in its entirety complete with the choke linkage, as no spares are available

- 1 The diaphragm unit can be removed without removing the car-



24.5 Carburettor choke vacuum pull-down unit/choke linkage securing screws (arrowed)



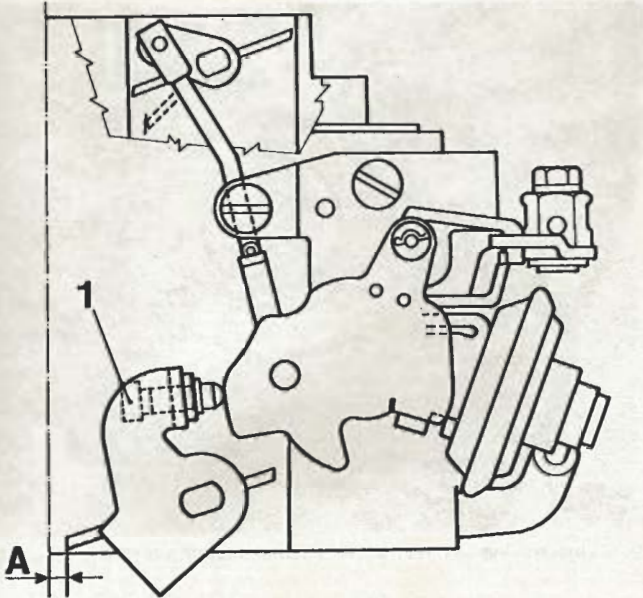


Fig. 3.6 Fast idle adjustment (Sec 25)

- 1 Fast idle adjustment screw    A "Fast idle gap" - see Specifications

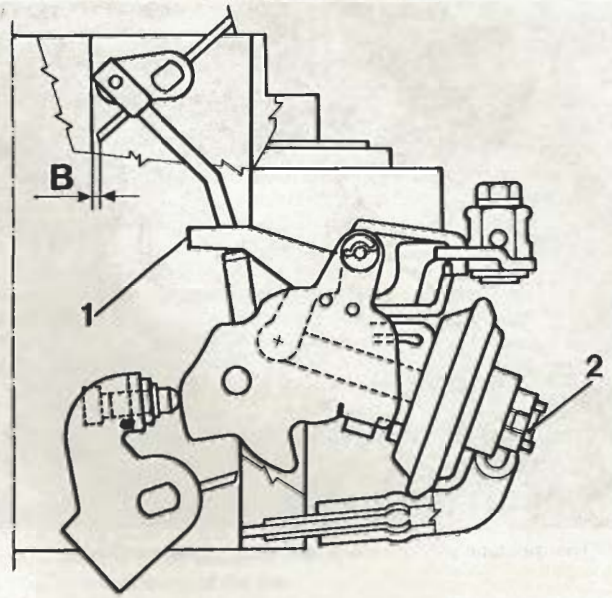


Fig. 3.7 Choke vacuum pull-down adjustment (Sec 25)

- 1 Choke pull-down lever    B Vacuum pull-down gap - see Specifications  
2 Vacuum pull-down adjustment screw

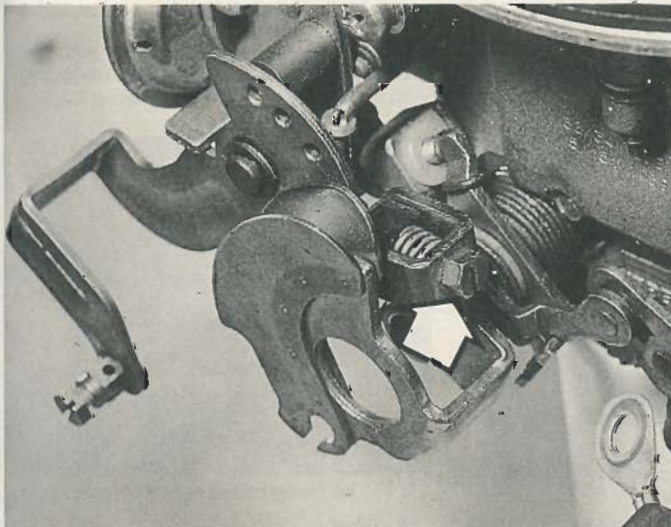
burettor as follows. If the carburettor has been removed, proceed to paragraph 5.

- 2 Disconnect the battery negative lead.
- 3 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 4 Disconnect the vacuum hose from the diaphragm unit.
- 5 Remove the three securing screws, and withdraw the diaphragm unit/choke linkage assembly from the carburettor (photo).
- 6 Refitting is a reversal of removal.

## 25 Carburettor choke - adjustments

### Fast idle adjustment

- 1 With the carburettor removed as described in Section 16, proceed as follows.
- 2 Move the choke operating cam to the end of its travel, to fully close the choke plate, and hold it in this position.
- 3 Using a twist drill of appropriate diameter, or a similar item, measure the distance between the lower side of the primary throttle valve and



25.4 Fast idle adjustment screw (arrowed)

the wall of the primary barrel. Check that the clearance is as given for the "fast idle gap" in the Specifications.

- 4 If the adjustment is necessary, turn the adjuster screw to give the specified clearance (photo).
- 5 On completion, refit the carburettor as described in Section 16.

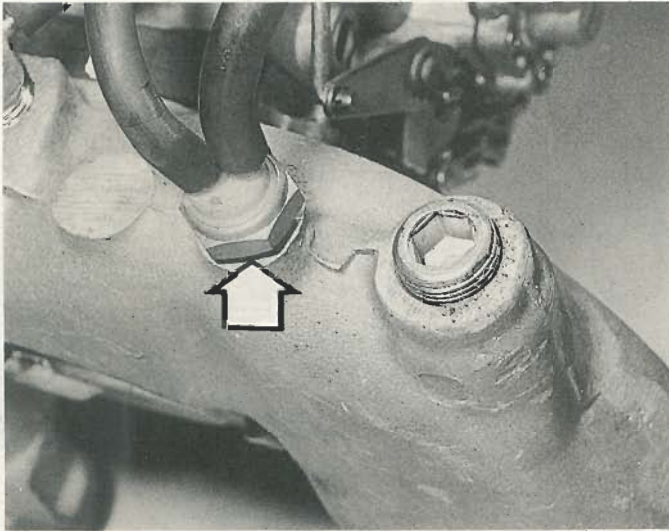
### Vacuum pull-down adjustment

- 6 If the carburettor is fitted to the vehicle, remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 7 Move the choke operating cam to the end of its travel, to fully close the choke plate, and hold it in this position.
- 8 Using a screwdriver or similar suitable tool, fully depress the choke pull-down lever (see Fig. 3.7), and hold it in this position.
- 9 Using a twist drill of appropriate diameter, or a similar item, measure the distance between the lower side of the choke valve and the wall of the primary barrel. Check that the clearance is as given for the "choke vacuum pull-down gap" in the Specifications.
- 10 If adjustment is necessary, turn the adjuster screw in the end of the vacuum pull-down diaphragm unit to give the specified clearance.
- 11 Where applicable, on completion refit the air cleaner or the carburettor air box (as applicable).

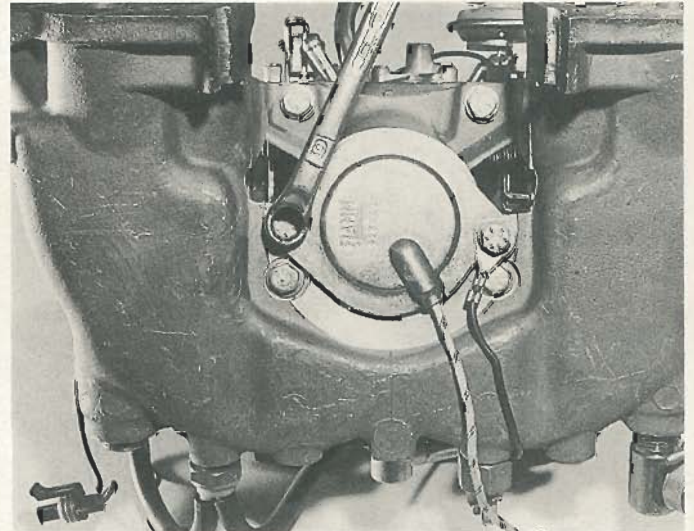
## 26 Thermostatic vacuum valve - removal and refitting

- 1 The thermostatic vacuum valve controls the carburettor thermostatically-controlled accelerator pump and the vacuum-operated fast idle device (see Section 15), and is mounted in the rear of the inlet manifold (photo).
- 2 To remove the valve, proceed as follows.
- 3 Disconnect the battery negative lead.
- 4 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 5 Partially drain the cooling system as described in Chapter 2. Note that there is no need to drain the cylinder block.
- 6 Disconnect the vacuum hoses from the valve.
- 7 Unscrew the valve and withdraw it from the inlet manifold.
- 8 Refitting is a reversal of removal, bearing in mind the following points.





26.1 Thermostatic vacuum valve (arrowed) - inlet manifold removed



27.6 Unscrewing an inlet manifold heater securing screw

- 9 Coat the threads of the valve with suitable sealant before refitting.
- 10 On completion, top up the cooling system as described in Chapter 2.

### 27 Inlet manifold heater components - description, removal and refitting

#### Description

1 The inlet manifold heater is controlled by a thermostatic switch mounted in the manifold, and the purpose of the heater is to assist evaporation of the air/fuel mixture when the engine is below its normal operating temperature.

2 The heater consists of three Positive Temperature Coefficient (PTC)

pads, which increase their electrical resistance with an increase in temperature. The heater surface is in direct contact with the air/fuel mixture in the manifold.

3 The thermostatic switch allows current to pass to the heater at coolant temperatures up to 65°C, at which point the switch opens to cut the electrical supply.

4 When the heater is first switched on, the current supplied is very high (30 to 40 amps). This decreases rapidly to around 5 amps as the resistance of the PTC pads increases, thus slowing down the rate of heating. When the coolant temperature reaches 65°C, the heater is switched off, and the air/fuel mixture is heated solely by the warm coolant flowing through the manifold.

#### Removal and refitting

##### Heater unit

**Note:** A new heater O-ring must be used on refitting

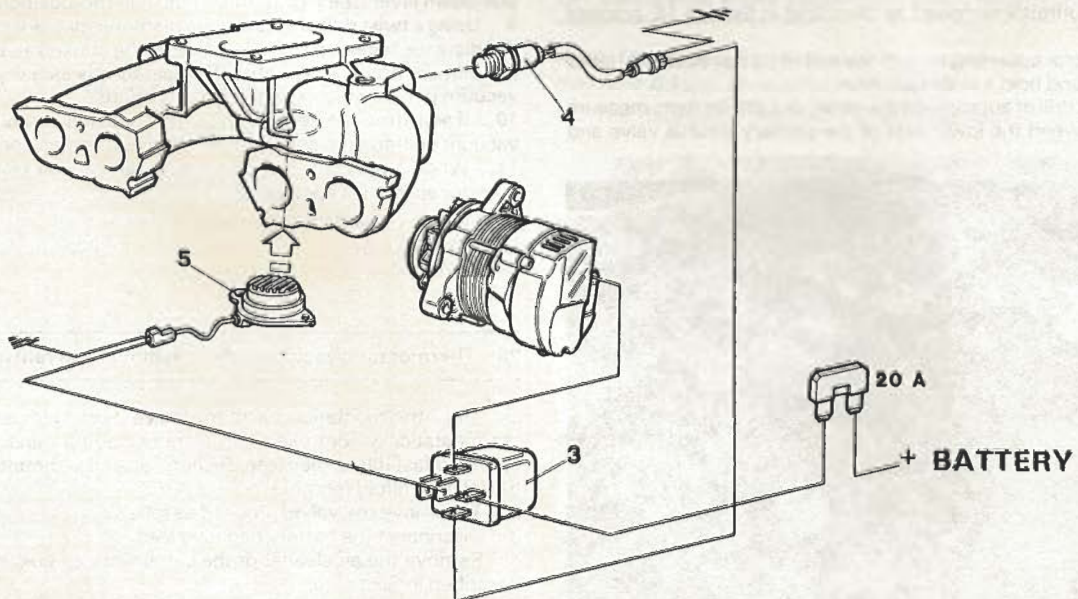


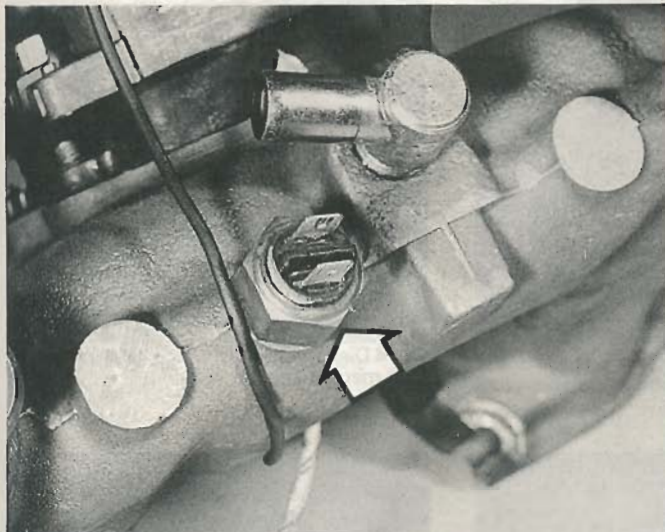
Fig. 3.8 Inlet manifold heater system components (Sec 27)

3 Control relay

4 Heater switch

5 Heater





27.9 Inlet manifold heater switch (arrowed) – inlet manifold removed

- 5 Remove the inlet manifold as described in Section 28.
- 6 Working underneath the inlet manifold, remove the two securing screws (photo) and withdraw the heater from the manifold, noting that one of the screws also secures an earth lead. Recover the O-ring.
- 7 Refitting is a reversal of removal, but use a new O-ring, and ensure that the earth lead is in position under the heater securing screw.
- 8 On completion, refit the inlet manifold as described in Section 28.

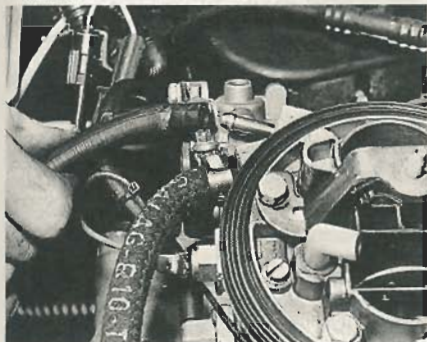
#### Heater switch

**Note:** A new switch sealing ring must be used on refitting

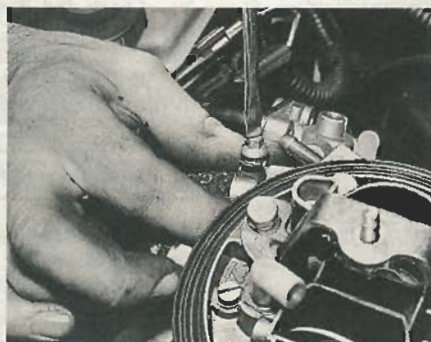
- 9 The heater switch is located in the rear of the inlet manifold (photo).
- 10 If the inlet manifold is fitted to the engine in the vehicle, proceed as follows, otherwise proceed to paragraph 15.
- 11 Disconnect the battery negative lead.
- 12 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.
- 13 Partially drain the cooling system as described in Chapter 2. Note that there is no need to drain the cylinder block.
- 14 Disconnect the wiring from the switch.
- 15 Unscrew the switch and withdraw it from the manifold. Recover the sealing ring.
- 16 Refitting is a reversal of removal, but use a new sealing ring.
- 17 On completion, where applicable, top up the cooling system as described in Chapter 2.

#### 28 Manifolds – removal and refitting

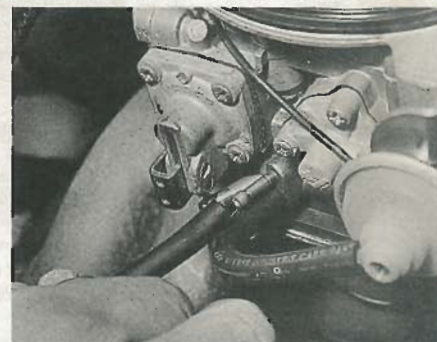
**Note:** New manifold gaskets and new exhaust downpipe-to-manifold nut locktabs must be used on refitting, and suitable exhaust assembly paste will be required when reconnecting the downpipes to the exhaust manifold



28.9A Disconnect the carburettor fuel return ...



28.9B ... and supply hoses



28.10 Disconnecting the distributor vacuum unit hose from the carburettor – 1.4 litre model

1 The inlet and exhaust manifolds are secured to the cylinder head using common studs and nuts, so both manifolds must be removed together.

2 If only the exhaust manifold is to be removed, the inlet manifold can be left in position, but must be moved away from the cylinder head sufficiently to enable the manifold gaskets to be renewed before the exhaust manifold is refitted. In this case, it will only be necessary to disconnect the fuel supply hose from the carburettor to enable the manifold to be moved, and there is no need to disconnect the remaining hoses, pipes and wiring from the inlet manifold, provided that they are not strained as the manifold is moved.

3 To remove the manifolds, proceed as follows.

4 Disconnect the battery negative lead.

5 Partially drain the cooling system as described in Chapter 2.

6 Remove the air cleaner or the carburettor air box, as applicable, as described in Section 5.

7 Turn the throttle lever on the carburettor to the fully open position, then unhook the end of the throttle cable from the lever. Pull the threaded sleeve on the end of the cable sheath from the rubber grommet in the carburettor cable support bracket. Move the cable to one side out of the way.

8 Loosen the clamp screw and disconnect the end of the choke cable from the choke lever on the carburettor, then loosen the clamp screw which retains the cable sheath in the carburettor cable bracket. Move the cable to one side out of the way.

9 Disconnect the fuel return and supply hoses from the carburettor (photos). Be prepared for fuel spillage and take adequate fire precautions. Plug the open ends of the hoses to prevent dirt ingress and to minimise fuel loss.

10 On 1.4 litre models, disconnect the distributor vacuum unit hose from the front of the carburettor (photo).

11 Disconnect the wiring connectors for the carburettor "throttle closed" switch and the fuel cut-off valve (photo).

12 Disconnect the coolant hose from the rear of the inlet manifold.

13 Disconnect the brake servo vacuum hose from the rear of the manifold (photo).

14 Disconnect the wiring plugs from the inlet manifold heater switch in the rear of the manifold (photo).

15 Disconnect the inlet manifold heater wiring connector (photo).

16 Make a final check to ensure that all relevant hoses, pipes and wires have been disconnected.

17 Prise back the ends of the locktabs from the exhaust downpipe-to-manifold nuts, then unscrew the four nuts, and disconnect the downpipes. Recover the locktabs.

18 Disconnect the hot air hose from the exhaust manifold hot air shroud. Where applicable, also disconnect the hot air hose from the pipe on the camshaft cover and remove the hose to improve access.

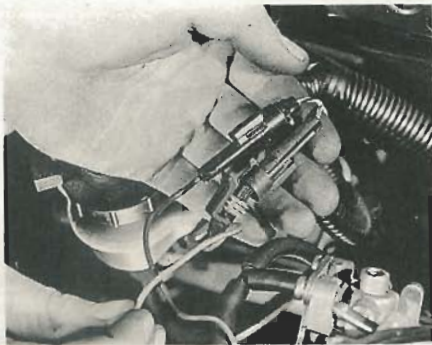
19 Unscrew the three securing nuts and remove the exhaust manifold hot air shroud (photo).

20 Unscrew the manifold securing nuts, and withdraw the manifolds from the cylinder head. Note that the exhaust manifold must be removed before the inlet manifold can be withdrawn, and recover the spacer sleeves from under the two outermost exhaust manifold securing nuts (photos).

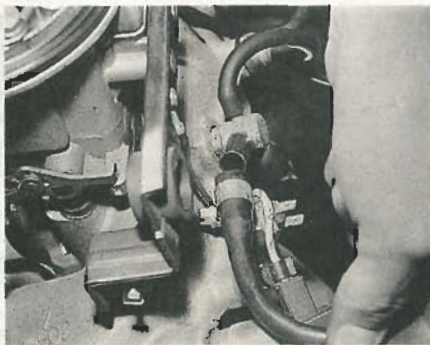
21 Recover the manifold gaskets and discard them.

22 It is possible that some of the manifold studs may be unscrewed from the cylinder head when the manifold securing nuts are unscrewed. In this event, the studs should be screwed back into the cylinder head

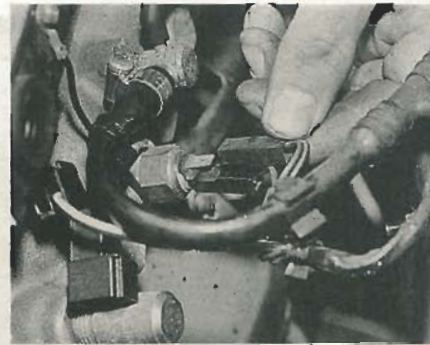




28.11 Carburettor "throttle closed" switch and fuel cut-off valve wiring connectors



28.13 Disconnecting the brake servo vacuum hose from the inlet manifold



28.14 Disconnecting a wiring plug from the inlet manifold heater switch



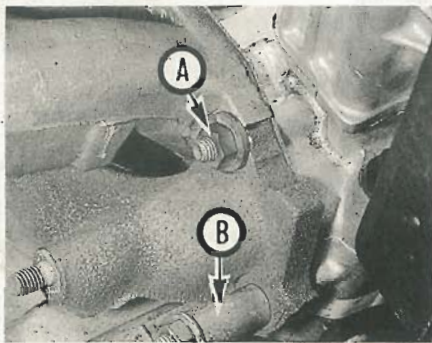
28.15 Disconnecting the inlet manifold heater wiring connector



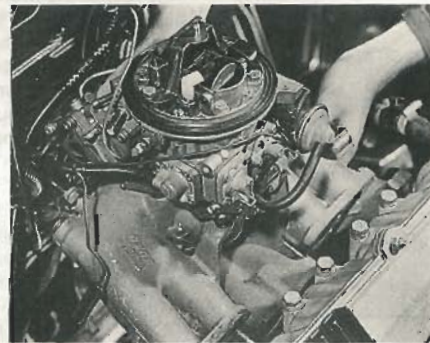
28.19 Removing the exhaust manifold hot air shroud



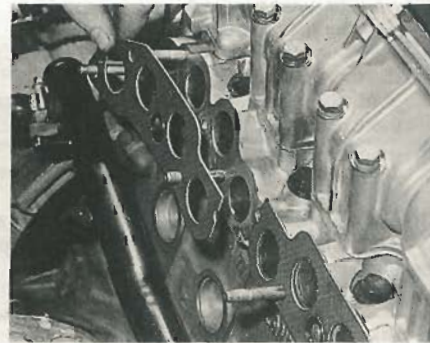
28.20A Unscrewing an exhaust manifold securing nut



28.20B Shared inlet/exhaust manifold nut (A), and exhaust manifold nut spacer sleeve (B)



28.20C Withdrawing the manifolds



28.25 Fitting a new manifold gasket

once the manifolds have been removed, using two manifold studs locked together.

23 If desired, the various ancillary components can be removed from the inlet manifold with reference to the relevant Sections of this Chapter.

24 Refitting is a reversal of removal, bearing in mind the following points.

25 Refit the manifolds using new gaskets, and tighten the securing nuts to the specified torque (photo). Note that the inlet manifold must be fitted *before* the exhaust manifold.

26 Clean the mating faces of the exhaust manifold and the downpipes, then coat the mating faces with exhaust assembly paste. Fit new locktabs, and tighten the downpipe-to-manifold nuts, then bend over the ends of the locktabs to secure the nuts.

27 Ensure that all relevant hoses, pipes and wires are correctly reconnected.

28 On completion, check and if necessary top up the coolant level as described in Chapter 2.

29 Check and if necessary adjust the throttle cable free play as described in Section 13.

30 Check the choke cable adjustment as described in Section 14.

31 If the carburettor has been disturbed, check the idle speed and mixture as described in Section 17.

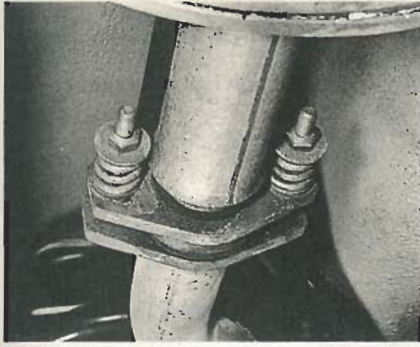
### 29 Exhaust system – checking, removal and refitting

**Note:** The procedures given here apply to the FIAT original equipment exhaust system

1 Periodically, the exhaust system should be checked for signs of leaks or damage. Also inspect the exhaust system rubber mountings, and renew if necessary.

2 To check for leaks, apply the handbrake, then start the engine and allow it to idle. Lie down on each side of the vehicle in turn and check the full length of the exhaust system for leaks, while an assistant tempor-

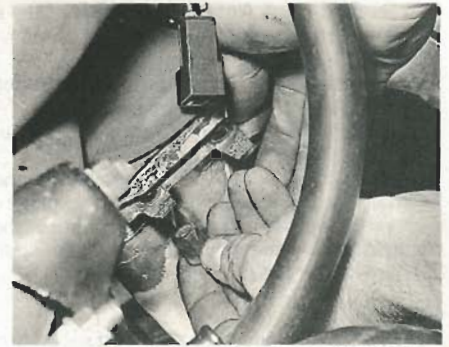




29.9 Exhaust system front flexible joint



29.16A Coating the exhaust downpipe mating face with assembly paste



29.16B Fitting a downpipe-to-manifold nut



29.16C Using a drift to bend over a downpipe-to-manifold nut locktab



29.20 Exhaust centre-to-rear section clamp



29.21 Exhaust centre section rubber mounting

arity places a wad of cloth over the tailpipe.

3 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.

4 The original factory-fitted exhaust system consists of three separate sections, all of which can be renewed individually.

5 Before renewing an individual section of the exhaust system, it is wise to inspect the remaining sections. If corrosion or damage is evident on more than one section of the system, it may prove more economical to renew the entire system.

6 Individual sections of the system can be removed as follows.

#### Front section (downpipes)

**Note:** New downpipe-manifold nut locktabs and suitable exhaust assembly paste will be required on refitting

7 Working in the engine compartment, prise back the ends of the locktabs from the exhaust downpipe-to-manifold nuts, then unscrew the four nuts, and disconnect the downpipes. Recover the locktabs.

8 Apply the handbrake, then jack up the front of the vehicle and support securely on axle stands.

9 Working under the vehicle, measure the length of exposed thread on the exhaust front flexible joint bolts (photo).

10 Unscrew the flexible joint nuts, whilst counterholding the bolts using a second spanner. Recover the washers and springs.

11 Withdraw the flexible joint bolts, and recover the spacer sleeves, then separate the joint and withdraw the front section of the exhaust system.

12 Commence refitting as follows.

13 Clean the exhaust front and centre section mating faces, then coat the mating faces with exhaust assembly paste.

14 Ensure that the flexible joint bolts, spacer sleeves, springs and washers are correctly assembled, then fit the nuts and tighten them to expose the length of bolt thread noted before removal. Counterhold the bolts using a second spanner as the nuts are tightened.

15 Lower the vehicle to the ground.

16 Clean the mating faces of the exhaust manifold and the downpipes, then coat the mating faces with exhaust assembly paste. Fit new

locktabs, and tighten the downpipe-to-manifold nuts, then bend over the ends of the locktabs to secure the nuts (photos).

#### Centre section

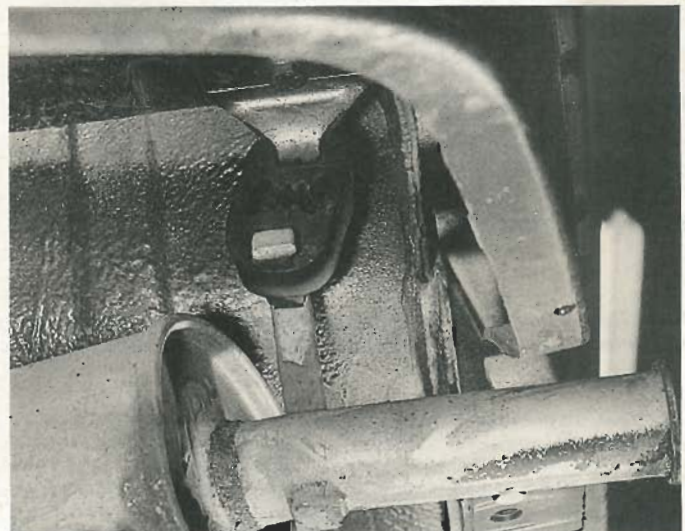
**Note:** Suitable exhaust assembly paste will be required on refitting

17 Jack up the vehicle and support securely on axle stands.

18 Proceed as described in paragraphs 9 and 10.

19 Withdraw the flexible joint bolts, and recover the spacer sleeves, then separate the joint.

20 Working at the rear of the exhaust centre box, unscrew the clamp nut whilst counterholding the bolt with a second spanner, and disconnect the exhaust centre section from the rear section. If necessary, tap around the joint with a hammer to break the seal, and gently prise the



29.28 Exhaust rear section rubber mounting



two sections apart. Note that the ends of the exhaust sections fit one inside the other to form a sleeve joint. Recover the clamp assembly (photo).

21 Manipulate the exhaust centre section from its rubber mountings, and withdraw it from the vehicle (photo).

22 Commence refitting by fitting the exhaust centre section to its rubber mountings.

23 Proceed as described in paragraphs 13 and 14.

24 Lubricate the mating faces of the exhaust centre and rear sections with exhaust assembly paste, then connect the two sections, refit the clamp assembly and tighten the nut whilst counterholding the bolt.

25 Lower the vehicle to the ground.

#### Rear section

26 Jack up the vehicle and support securely on axle stands.

27 Proceed as described in paragraph 20.

28 Manipulate the exhaust rear section from its rubber mountings, and withdraw it from the vehicle (photo).

29 Commence refitting by fitting the exhaust rear section to its rubber mountings.

30 Proceed as described in paragraphs 24 and 25.

#### Complete system

31 Proceed as described in paragraph 7.

32 Jack up the vehicle and support securely on axle stands.

33 Release the system from the rubber mountings on the vehicle underbody, and withdraw it from the vehicle.

34 Refitting is a reversal of removal, but reconnect the downpipe to the manifold as described in paragraph 16.

### 30 Fault diagnosis – fuel and exhaust systems

**Note:** High fuel consumption and poor performance are not necessarily due to carburettor faults. Make sure that the ignition system is properly adjusted, and that the engine itself is in good mechanical condition. Items such as binding brakes or under-inflated tyres should not be overlooked

Symptom	Reason(s)
Engine will not start	Fuel tank empty Fault in fuel line Blocked fuel filter Faulty fuel pump Air leak at inlet manifold Ignition system fault – see Chapter 4 Faulty choke mechanism
Fuel consumption excessive	Leak in fuel system Air cleaner element choked, giving rich mixture Carburettor worn Carburettor float chamber flooding due to incorrect level or worn needle valve Carburettor idle adjustments incorrect Unsympathetic driving style Faulty choke mechanism
Lack of power	Fault in fuel line Faulty fuel pump Air leak at inlet manifold Ignition system fault – see Chapter 4 Faulty choke mechanism
Poor or erratic idling	Carburettor idle adjustments incorrect Air leak at inlet manifold Leak in ignition advance vacuum hose Leak in brake servo vacuum hose Ignition system fault – see Chapter 4 Leak in crankcase ventilation hose – see Chapter 1
Backfiring in exhaust	Air leak in exhaust system Ignition timing incorrect Mixture grossly incorrect Exhaust valve(s) burnt or sticking, or valve clearance(s) too small
Spitting back in inlet manifold or carburettor	Mixture very weak Ignition timing incorrect Inlet valve(s) burnt or sticking, or valve clearance(s) too small

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice



# Chapter 4 Ignition system

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## Specifications

### System type

1.4 litre models.....	Magnetti Marelli inductive discharge system
1.6 litre models.....	Magnetti Marelli Digiplex 2 system

### Coil

Primary winding resistance:	
1.4 litre models .....	0.666 to 0.814 ohms
1.6 litre models .....	0.405 to 0.495 ohms
Secondary winding resistance:	
1.4 litre models .....	2970 to 3630 ohms
1.6 litre models .....	4320 to 5280 ohms

### Distributor

Direction of rotor arm rotation .....	Anti-clockwise
Firing order.....	1-3-4-2 (No 1 cylinder nearest timing cover)
Dwell angle.....	Automatically controlled by electronic module (not adjustable)

### Ignition timing (at idle with vacuum pipe disconnected)

1.4 litre models.....	10° ± 2° BTDC
1.6 litre models.....	12° ± 2° BTDC

### Spark plugs

Type:	
1.4 litre models .....	Champion RN9YCC or RN9YC
1.6 litre models .....	Champion RN7YCC or RN7YC
Electrode gap:	
RN7YC and RN9YC plugs.....	0.7 mm (0.028 in)
RN7YCC and RN9YCC plugs.....	0.8 mm (0.032 in)

### Torque wrench setting

Spark plugs .....	Nm	lbf ft
	37	27

## 1 General description

The ignition system is responsible for igniting the air/fuel mixture in each cylinder at the correct moment in relation to engine speed and load. It 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 many times a second under high compression pressures, providing that the system is in good condition. The low tension (LT, or primary) circuit consists of the battery, the lead to the ignition switch, the lead from the ignition switch to the LT coil windings and also to the supply terminal on the electronic module, and the lead from the LT coil windings to the control terminal on the electronic module. The high tension (HT, or



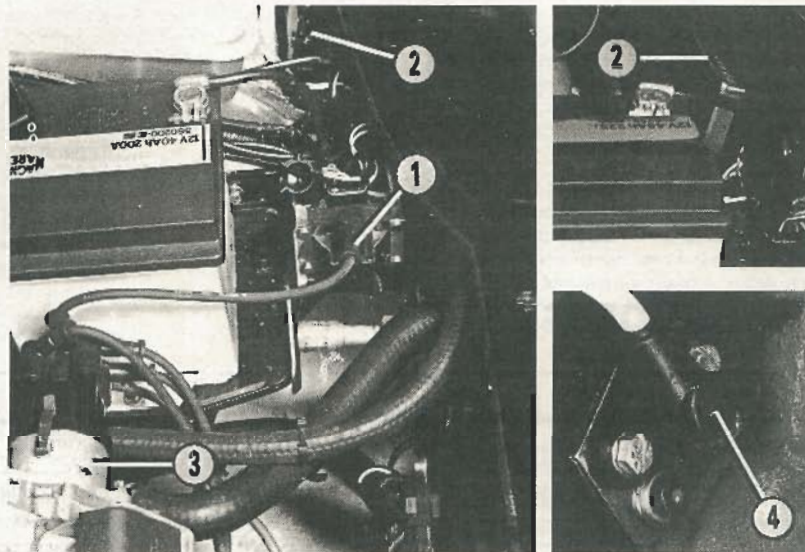


Fig. 4.1 Digiplex 2 ignition system components – 1.6 litre models (Sec 1)

1 Ignition coil

2 Digiplex 2 module

3 Distributor

4 Crankshaft speed/position sensor

secondary) circuit consists of the HT coil windings, the HT lead from the coil to the distributor cap, the rotor arm, the HT leads to the spark plugs, and the spark plugs.

The system functions in the following manner. Current flowing through the LT coil windings produces a magnetic field around the HT windings. As the engine rotates, a sensor produces an electrical impulse which is amplified in the electronic module and used to switch off the LT circuit.

The subsequent collapse of the magnetic field over the HT windings produces HT voltage which is then fed to the relevant spark plug via the distributor cap and rotor arm. The LT circuit is automatically switched on again by the electronic module, to allow the magnetic field to build up again before the firing of the next spark plug. The ignition is advanced and retarded automatically to ensure that the spark occurs at the correct instant in relation to engine speed and load.

Two different types of ignition system are fitted to models within the Tipo range, and these are described in more detail as follows.

#### *Inductive discharge system (1.4 litre models)*

This system comprises a breakerless distributor and an electronic switching/amplifier module in addition to the coil and spark plugs.

The electrical impulse which is required to switch off the LT circuit is generated by a magnetic trigger coil in the distributor. A trigger wheel rotates next to a magnetic stator, the magnetic field being provided by a permanent magnet. The magnetic field across the two poles (stator and trigger wheel) is dependent on the air gap between the two poles. When the air gap is at its minimum, a trigger wheel arm is directly opposite the stator, and this is the trigger point. As the magnetic flux between the stator and the trigger wheel varies, a voltage is induced in the trigger coil which is wound round the stator, and this voltage is sensed and then amplified by the electronic module and used to switch off the LT circuit. There is one trigger wheel arm for each cylinder (4).

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

The vacuum control consists of a diaphragm unit, one side of which is connected via a small bore hose to the carburettor and the other side to the distributor. Depression in the carburettor, which varies with engine speed and throttle position, causes the diaphragm to move, so moving the distributor baseplate and advancing or retarding the spark.

A fine degree of control is achieved by the use of a calibrated spring in the diaphragm assembly.

A fuel cut-off control module is fitted, which receives engine speed information from the ignition coil. A "throttle closed" switch mounted on the carburettor supplies a signal to the fuel cut-off module to indicate when the engine is operating under overrun conditions (ie when the throttle valves are closed during deceleration). When the engine is operating under overrun conditions, the module cuts the electrical supply to the carburettor fuel cut-off valve to temporarily shut off the fuel supply. When a certain minimum engine rpm threshold is reached (between 1600 and 1700 rpm), the electrical supply to the valve is restored to enable the engine to continue idling without stalling. This saves fuel, and reduces harmful exhaust gas emissions.

#### *Digiplex 2 system (1.6 litre models)*

This system comprises various sensors and a Digiplex 2 electronic module in addition to the coil and spark plugs. The distributor serves purely to distribute the HT voltage to the spark plugs and consists simply of a rotor arm driven from the end of the camshaft, and a distributor cap.

The electrical impulse which is required to switch off the low tension circuit is generated by a crankshaft speed/position sensor which is activated by a sensor wheel on the crankshaft. The sensor wheel has 5 pins around its periphery. The crankshaft speed/position sensor transmits a pulse to the control unit whenever one of the pins passes. Four of the pins are equally spaced at 90° intervals, and indicate the instantaneous engine speed (rpm) from the frequency of the pulses generated by the sensor. A signal from the 5th pin, which is very close to one of the other 4 pins, enables the control unit to identify the TDC positions of Nos 1 and 4 pistons.

Engine load information is supplied to the electronic module by a vacuum transducer within the module which is connected to the inlet manifold by a vacuum pipe.

A "throttle closed" switch mounted on the carburettor supplies a signal to the electronic module to indicate when the engine is operating under overrun conditions (ie when the throttle valves are closed during deceleration).

The electronic module selects the optimum ignition advance setting from a large range of values stored within its memory, according to the information supplied by the sensors. The advance setting selected is based on a compromise between the requirements for low fuel consumption, low exhaust gas emissions, and reasonable performance.

When the engine is operating under overrun conditions, the module selects a suitable advance setting to minimise exhaust gas emissions. At the same time, the module cuts the electrical supply to the carburettor.



tor fuel cut-off valve to temporarily shut off the fuel supply. When a certain minimum engine rpm threshold is reached (between 1600 and 1700 rpm), the electrical supply to the valve is restored to enable the engine to continue idling without stalling. This saves fuel, and reduces harmful exhaust gas emissions.

Note that there is no provision for adjustment of ignition timing with the Digiplex 2 system.

## 2 Ignition system – precautions

**Warning:** *The HT voltage generated by an electronic ignition system is extremely high, and in certain circumstances could prove fatal. Take care to avoid receiving electric shocks from the HT side of the ignition system. Do not handle HT leads, or touch the distributor or coil when the engine is running. If tracing faults in the HT circuit, use well insulated tools to manipulate live leads. Persons with surgically-implanted cardiac pacemaker devices should keep well clear of the ignition circuits, components and test equipment*

Ignition electronic modules are very sensitive components, and precautions must be taken to avoid damage to the module when working on the vehicle, as follows.

Never start the engine with loose or suspect battery connections.

Never disconnect the battery with the engine running.

When carrying out welding operations on the vehicle using electric welding equipment, the battery and the alternator should be disconnected.

Although underbonnet-mounted modules will tolerate normal underbonnet conditions, they can be adversely affected by excess heat or moisture. If using welding equipment or pressure-washing equipment in the vicinity of the module, take care not to direct heat, or jets of water or steam at the module. If this cannot be avoided, remove the module from the vehicle, and protect its wiring plug with a plastic bag. On models with the Digiplex 2 ignition system, remove the module if the vehicle is to be placed in a paint-baking oven at temperatures in excess of 80°C.

Before disconnecting any wiring, or removing components, always ensure that the ignition is switched off.

Do not attempt to improvise fault diagnosis procedures using a test lamp or multimeter, as irreparable damage could be caused to the module.

After working on ignition system components, ensure that all wiring is correctly reconnected before reconnecting the battery or switching on the ignition.

## 3 Routine maintenance

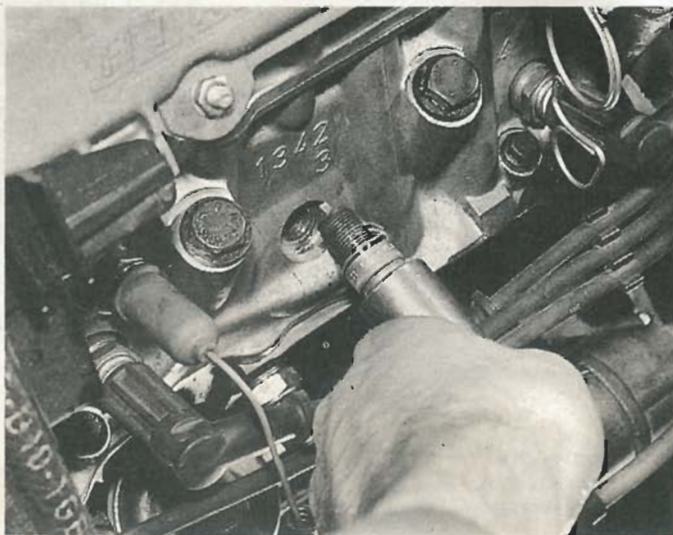
**Note:** *Refer to Section 2 before proceeding*

- 1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the following tasks should be carried out.
- 2 Check the condition of the spark plugs as described in Section 4.
- 3 Renew the spark plugs as described in Section 4.
- 4 Inspect the distributor cap, rotor arm and HT leads as described in Section 7.
- 5 Inspect the ignition system electrical and vacuum connections, and make sure that they are clean and secure.
- 6 On 1.4 litre models, check and if necessary adjust the ignition timing, as described in Section 10.

## 4 Spark plugs – inspection and renewal

**Note:** *Refer to Section 2 before proceeding*

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, and the suitable type is specified at the beginning of this Chapter. If this type is used and the engine is in good condition, the spark plugs should not need attention between scheduled replacement intervals. Spark plug cleaning is rarely necessary and



### 4.4 Removing a spark plug

should not be attempted unless specialised equipment is available as damage can easily be caused to the firing ends. Inspect the plugs as follows.

- 2 For improved access, remove the air cleaner as described in Chapter 3.
- 3 If necessary identify each HT lead for position, so that the leads can be refitted to their correct cylinders, then disconnect the leads from the plugs by pulling on the connectors, not the leads.
- 4 Clean the area around each spark plug using a small brush, then using a plug spanner (preferably with a rubber insert), unscrew and remove the plugs (photo). Cover the spark plug holes with a clean rag to prevent the ingress of any foreign matter.
- 5 The condition of the spark plugs will tell much about the overall condition of the engine.
- 6 If the insulator nose of the spark plug is clean and white, with no deposits, this is indicative of a weak air/fuel mixture, or too hot a plug. (A hot plug transfers heat away from the electrode slowly – a cold plug transfers it away quickly).
- 7 If the tip and insulator is covered with hard black-looking deposits, then this is indicative that the mixture is too rich. Should the plug be black and oily, then it is likely that the engine is fairly worn, in addition to the mixture being too rich.
- 8 If the insulator nose is covered with light tan to greyish brown deposits, then the mixture is correct and it is likely that the engine is in good condition.
- 9 The spark plug gap is of considerable importance, as if it is too large or too small, the size of the spark and its efficiency will be seriously impaired. The spark plug gap should be set to the figure given in the Specifications. To set the gap, measure the existing gap with feeler gauges, and then bend open, or close the *outer* plug electrode until the correct gap is achieved. The centre electrode should *never* be bent as this may crack the insulation and cause plug failure.
- 10 Before fitting the spark plugs, check that the threaded connector sleeves are tight and that the plug exterior surfaces are clean. Also make sure that the threads and seats are clean.
- 11 Screw in the spark plugs by hand, then tighten them to the specified torque. *Do not exceed the torque figure given.*
- 12 Push the HT leads firmly onto the spark plugs, and refit the air cleaner.
- 13 The HT leads and distributor cap should be cleaned and checked at the intervals specified in the *Routine maintenance* Section at the beginning of this manual (see Section 7).

## 5 Coil – testing

**Note:** *Refer to Section 2 before proceeding*

- 1 The coil is located on the left-hand side of the engine compartment, and is bolted to the front edge of the battery tray.
- 2 To test the coil, first disconnect the battery negative lead, then



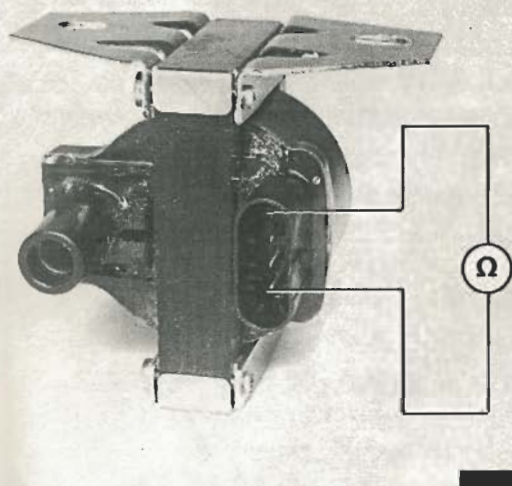


Fig. 4.2 Checking the coil primary winding resistance (Sec 5)

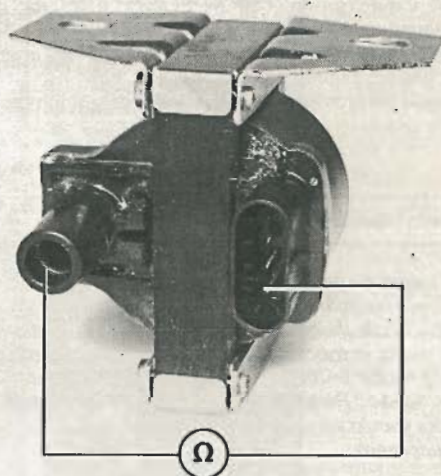


Fig. 4.3 Checking the coil secondary winding resistance (Sec 5)

disconnect the wiring plug and the HT lead from the coil.

3 Connect an ohmmeter between both LT terminals (the two outermost terminals in the coil wiring socket), and check that the primary winding resistance is as given in the Specifications.

4 Connect the ohmmeter between the HT terminal and either LT terminal and check that the secondary winding resistance is as given in the Specifications.

5 If either winding resistance is not as specified, the coil should be renewed.

6 Reconnect the coil wiring plug and HT lead, and the battery negative lead on completion.

## 6 Coil - removal and refitting

**Note:** Refer to Section 2 before proceeding

1 The coil is located on the left-hand side of the engine compartment, and is bolted to the front edge of the battery tray.

2 Disconnect the battery negative lead.

3 Disconnect the HT lead and the wiring plug from the coil (photos).

4 Remove the two coil securing nuts, noting that one of the nuts also secures an earth lead, and withdraw the coil from the battery tray.

5 Refitting is a reversal of removal, but ensure that the earth lead is in position under the relevant coil securing screw.

## 7 Distributor cap, rotor arm and HT leads - removal, inspection and refitting

**Note:** Refer to Section 2 before proceeding

1 Disconnect the battery negative lead.

2 If necessary, identify each HT lead for position, so that the leads can be refitted to their correct cylinders, then disconnect the leads from their spark plugs by pulling on the connectors, not the leads. Similarly disconnect the HT lead from the coil. Pull the leads from the bracket on the cylinder head.

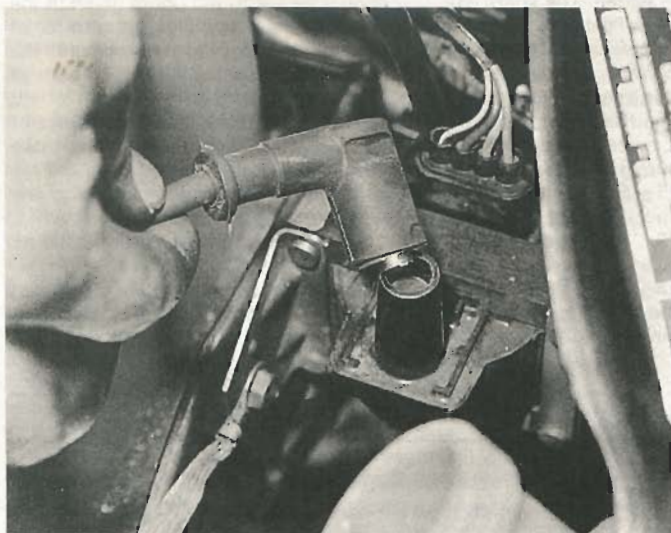
3 Prise away the two spring clips with a screwdriver, and lift off the distributor cap (photos).

4 The rotor arm is a push-fit on the end of the distributor shaft (photo).

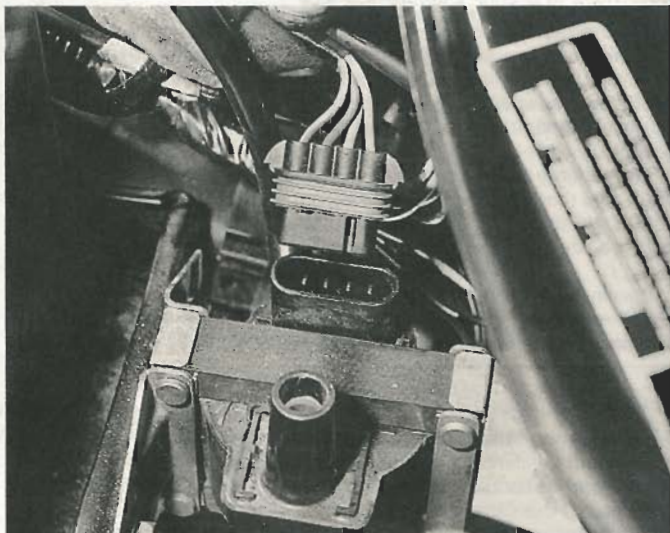
5 On 1.4 litre models, if desired, the plastic shield can be pulled from the end of the distributor, to allow examination of the distributor components (photo).

6 Check the distributor cap for corrosion or the contacts, and for signs of tracking, indicated by a thin black line between the contacts. Make sure that the carbon brush in the centre of the cap moves freely, and stands proud of the surface of the cap and that the HT segments are not worn excessively. Clean or renew the cap if necessary.

7 If the metal contact on the rotor arm is badly burnt or loose, renew the rotor arm. If slightly burnt or corroded, the contact can be carefully cleaned with a fine file.

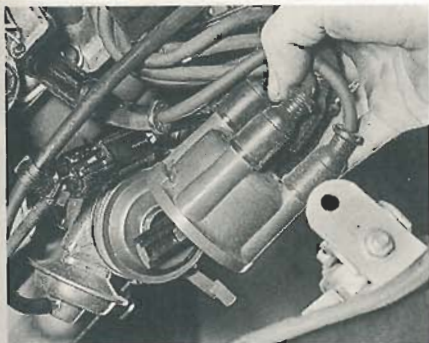


6.3A Disconnect the HT lead ...

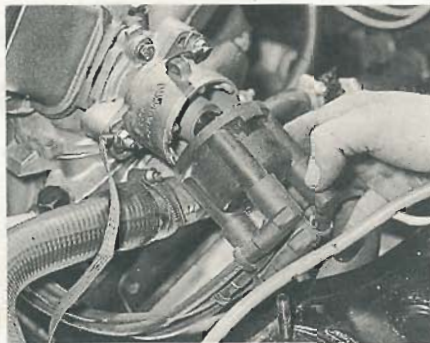


6.3B ... and the wiring plug from the coil

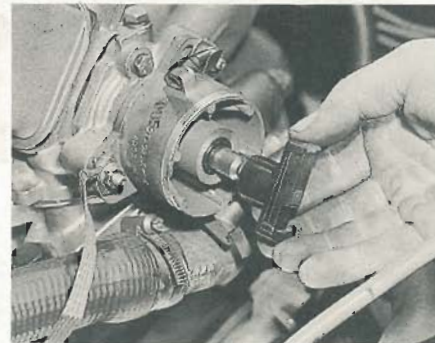




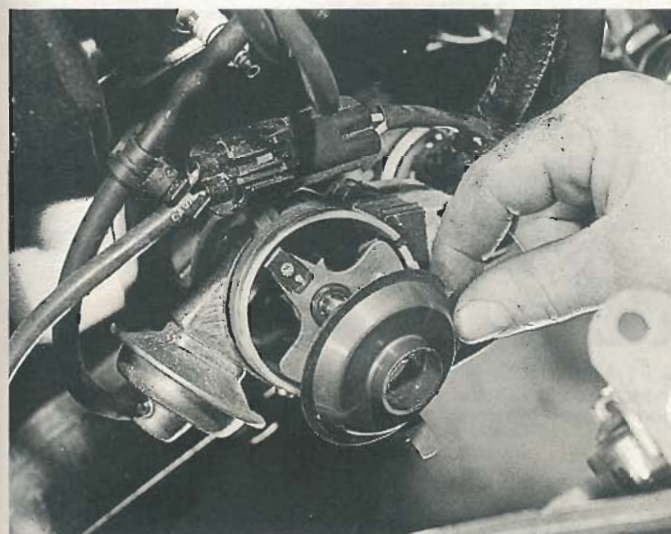
7.3A Removing the distributor cap on a 1.4 litre model ...



7.3B ... and on a 1.6 litre model



7.4 The rotor arm is a push-fit on the distributor shaft - 1.6 litre model shown



7.5 Removing the distributor plastic shield - 1.4 litre model

- 8 Wipe the HT leads clean and check for hairline cracks and signs of arcing. Renew if necessary.
- 9 Refitting is a reversal of removal, noting that the rotor arm can only be fitted in one position. Ensure that the HT leads are correctly reconnected to the cap, plugs and coil.

- (b) The tip of the rotor arm is pointing to the position occupied by the No 1 cylinder HT lead terminal in the distributor cap
- (c) The tip of the rotor arm is pointing to the reference mark on the distributor plastic shield - see Fig. 4.4

- 7 Unscrew the clamp bolt and remove the clamp plate, then withdraw the distributor from the cylinder block.
- 8 If desired, the distributor can be dismantled, as described in Section 9.
- 9 Check the condition of the sealing ring on the base of the distributor body, and renew if necessary.
- 10 Commence refitting by checking that No 1 cylinder is still at the firing point. The relevant timing marks should be aligned. If the engine has been turned whilst the distributor has been removed, check that No 1 cylinder is on its firing stroke by removing No 1 cylinder spark plug and placing a finger over the plug hole. Turn the crankshaft until compression can be felt, which indicates that No 1 piston is rising on its compression stroke. Continue turning the crankshaft until the relevant timing marks are in alignment.
- 11 Turn the rotor arm to the position noted in paragraph 6(c), and hold the rotor arm in this position as the distributor is fitted. Align the marks made on the distributor body and the cylinder block before removal (if a new distributor is being fitted, transfer the alignment mark made on the old distributor before removal to the new distributor).
- 12 Refit the clamp plate and bolt, but do not fully tighten the bolt at this stage.
- 13 Reconnect the vacuum hose to the diaphragm unit.
- 14 Reconnect the distributor wiring plug.
- 15 Refit the distributor cap, with reference to Section 7 if necessary.
- 16 Reconnect the battery negative lead.

## 8 Distributor - removal and refitting

Note: Refer to Section 2 before proceeding

### 1.4 litre models

- 1 Disconnect the battery negative lead.
- 2 Remove the distributor cap as described in Section 7.
- 3 Disconnect the ignition module wiring connector (photo).
- 4 Disconnect the vacuum hose from the diaphragm unit on the side of the distributor.
- 5 Make alignment marks between the distributor body and the cylinder block, so that the distributor can be refitted in its original position.
- 6 Using a suitable socket or spanner on the crankshaft pulley nut, or by engaging top gear and pushing the vehicle backwards or forwards as necessary (with the handbrake released!), turn the engine to bring No 1 cylinder to the firing point. No 1 cylinder is at the firing point when:

- (a) The relevant timing marks are aligned. The mark on the crankshaft pulley should be aligned with the 10° BTDC mark on the outer timing belt cover, and similarly the mark on the flywheel (visible with the rubber cover removed from the clutch bellhousing) should be aligned with the 10° BTDC mark on the bellhousing

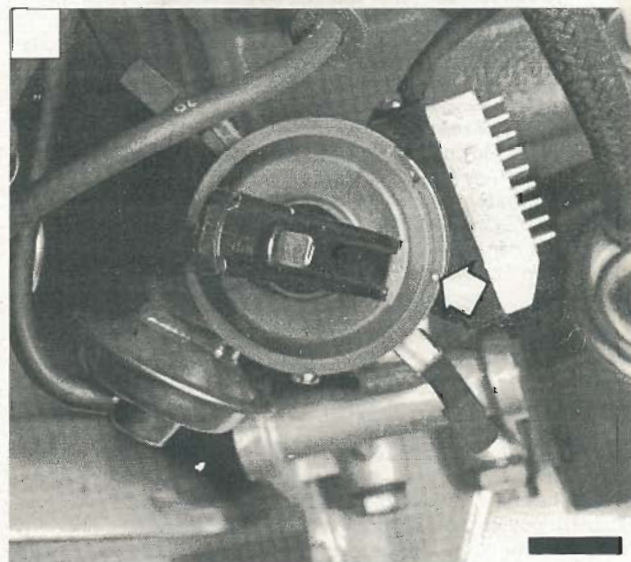
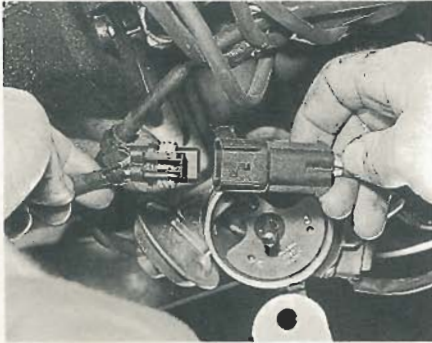
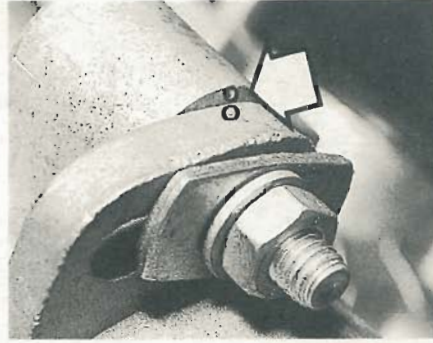


Fig. 4.4 Rotor arm tip aligned with reference mark (arrowed) on distributor plastic shield - 1.4 litre model (Sec 8)

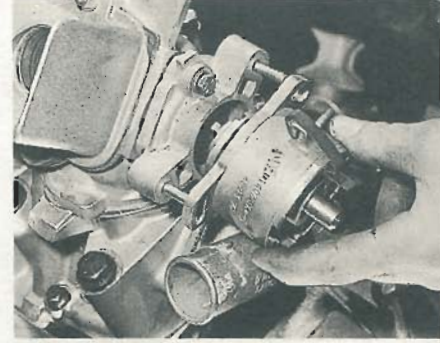




8.3 Disconnecting the ignition module wiring connector – 1.4 litre model



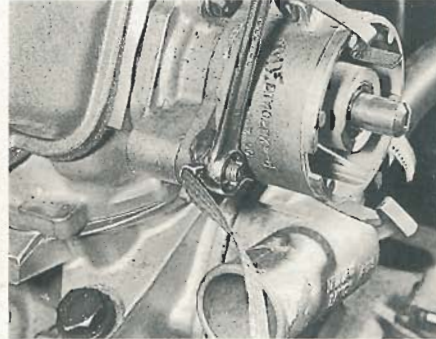
8.20 Make alignment marks on the distributor body and housing – 1.6 litre model



8.22 Removing the distributor – 1.6 litre model



8.23 Examine the O-ring at the base of the distributor – 1.6 litre model



8.26 Ensure that the earth strap is in place under the distributor securing bolt – 1.6 litre model

17 Check and if necessary adjust the ignition timing, as described in Section 10.

### 1.6 litre models

18 Disconnect the battery negative lead.

19 Remove the distributor cap as described in Section 7.

20 Make alignment marks on the distributor body and the distributor housing, so that the distributor can be refitted in its original position, and mark the position of the rotor arm tip on the edge of the distributor body (photo).

21 Using a suitable socket or spanner on the crankshaft pulley nut, or by engaging top gear and pushing the vehicle backwards or forwards as necessary (with the handbrake released!), turn the engine to bring No 1 cylinder to the firing point. No 1 cylinder is at the firing point when:

- (a) *The timing mark on the crankshaft pulley is pointing slightly to the right of the 10° BTDC mark on the outer-timing belt cover (No 1 piston positioned 12° BTDC), and similarly the mark on the flywheel (visible with the rubber cover removed from the clutch bellhousing) should be pointing slightly to the right of the 10° BTDC mark on the bellhousing*
- (b) *The tip of the rotor arm is pointing to the position occupied by the No 1 cylinder HT lead terminal in the distributor cap*

22 Unscrew the three distributor securing bolts, noting that one of the bolts also secures an earth strap, recover the washers, and withdraw the distributor (photo).

23 Examine the O-ring at the base of the distributor body and renew if necessary (photo).

24 Commence refitting by checking that No 1 cylinder is still at the firing point. The relevant timing marks should be positioned as described in paragraph 21(a). If the engine has been turned whilst the distributor has been removed, check that No 1 cylinder is on its firing stroke by removing No 1 cylinder spark plug and placing a finger over the plug hole. Turn the crankshaft until compression can be felt, which indicates that No 1 piston is rising on its compression stroke. Continue turning the crankshaft until the relevant timing marks are positioned as described in paragraph 21(a).

25 Refit the distributor, and align the marks made on the distributor body and housing before removal (if a new distributor is being fitted, transfer the alignment mark made on the old distributor before removal to the new distributor). Check that the rotor arm is aligned with the mark made on the edge of the distributor body before removal.

26 Refit the securing bolts and washers, ensuring that the earth strap is in place under the relevant bolt, and tighten the bolts (photo).

27 Refit the distributor cap with reference to Section 7 if necessary.

28 Reconnect the battery negative lead.

## 9 Distributor – dismantling, inspection and reassembly

**Note:** Before contemplating dismantling of a distributor, check the cost and availability of replacement parts. It may prove more economical to renew the complete distributor assembly

### 1.4 litre models

1 With the distributor removed as described in Section 8, proceed as follows.

2 Pull off the rotor arm and remove the plastic shield.

3 To remove the electronic module, disconnect the distributor wiring plug from the module, remove the two securing screws, then withdraw the module with the spacer.

4 If desired, the vacuum diaphragm unit can be removed by extracting the two securing screws and unhooking the operating arm from the distributor baseplate.

5 The vacuum unit can be tested by applying suction to the vacuum port, and checking that the operating rod moves into the unit as suction is applied. Remove the suction, and check that the operating rod returns to its original position. If the operating rod does not move as described, renew the vacuum unit.

6 The baseplate/trigger coil assembly can be removed after removing the C-clip and washers from the top of the distributor shaft. Note the number of washers and their positions to aid refitting.



# 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 valve, ignition timing, fuel octane rating (too low) and fuel mixture (too weak).

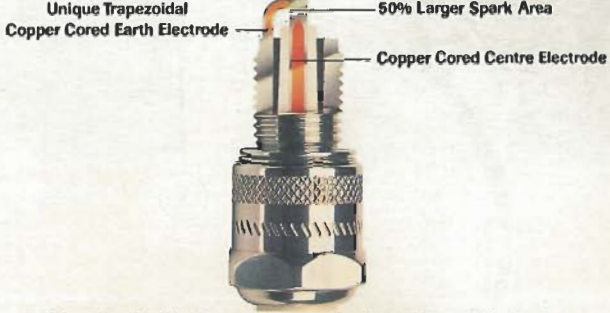


**Electrode damage.**  
Electrodes burned away; core nose has burned, glazed appearance. Fault: pre-ignition. Check: for correct heat range and as for 'overheating'.

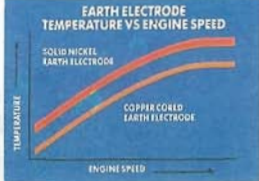


**Split core nose.**  
(May appear initially as a crack). Fault: detonation or wrong gap-setting technique. Check: ignition timing, cooling system, fuel mixture (too weak).

# 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.



DOUBLE COPPER



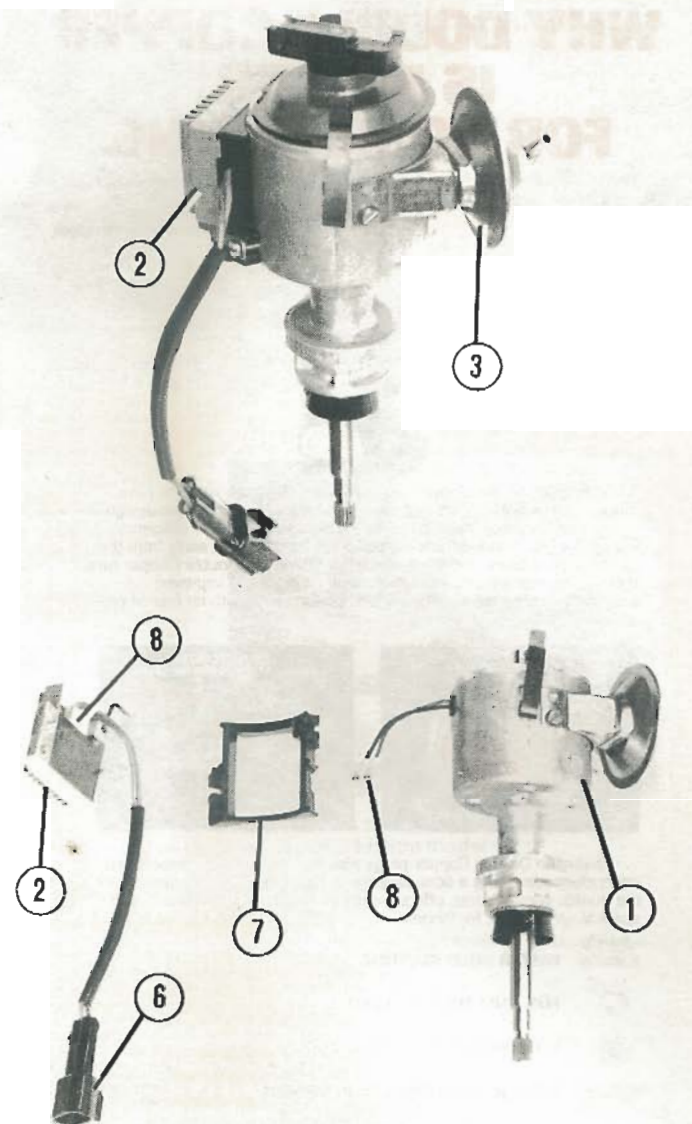


Fig. 4.5 Distributor components – 1.4 litre models (Sec 9)

- |                         |                                    |
|-------------------------|------------------------------------|
| 1 Distributor body      | 6 Ignition module wiring connector |
| 2 Ignition module       | 7 Spacer                           |
| 3 Vacuum diaphragm unit | 8 Distributor wiring connector     |

7 Although it is possible to dismantle the distributor further, this is of academic interest, as no spare parts are available, and no adjustments are necessary.

8 Reassembly is a reversal of dismantling, ensuring that the vacuum unit operating arm is correctly engaged with the peg on the baseplate.

9 Refit the distributor as described in Section 8, and then check and if necessary adjust the ignition timing as described in Section 10.

#### 1.6 litre models

10 On 1.6 litre models, the distributor consists simply of a shaft, housing and rotor arm. Dismantling is unnecessary, as no spare parts are available, and no adjustments are required.

### 10 Ignition timing – checking and adjustment

**Note:** Refer to Section 2 before proceeding. A stroboscopic timing light will be required for this procedure

#### 1.4 litre models

1 Before checking the ignition timing, the following conditions must be met:

- The engine must be at normal operating temperature
- The vacuum pipe to the distributor vacuum unit must be disconnected at the distributor and plugged
- The idle speed and mixture adjustments must be correct – see Chapter 3

2 Connect a stroboscopic timing light to the engine in accordance with the manufacturer's instructions. Note that the timing light should be connected to No 1 cylinder HT circuit (No 1 cylinder is nearest the timing belt end of the engine).

3 Remove the rubber cover from the timing aperture in the clutch bellhousing (photo).

4 Start the engine and allow it to run at idling speed.

5 Point the timing light at the timing aperture in the clutch bellhousing, and check that the timing mark on the flywheel is aligned with the 10° BTDC mark on the bellhousing (photo).

6 If the marks are not aligned as previously described, loosen the distributor clamp bolt, and turn the distributor body slightly in the required direction to align the marks (photo).

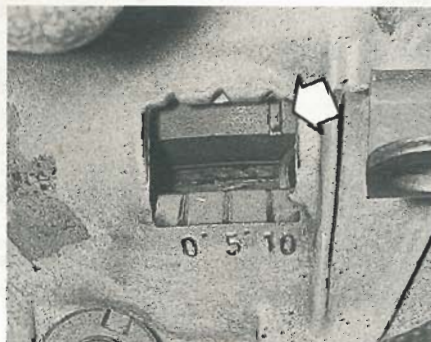
7 Tighten the distributor clamp bolt, and check that the timing marks are still aligned.

8 The mechanical and vacuum advance mechanisms can be checked as follows.

9 With the engine idling, timing light connected and vacuum pipe disconnected as described previously, increase the engine speed to approximately 2000 rpm (if desired, connect a tachometer to the engine in accordance with the manufacturer's instructions). Note the approximate distance which the flywheel mark moves out of alignment with the 10° BTDC mark on the bellhousing.



10.3 Removing the rubber cover from the timing aperture in the clutch bellhousing

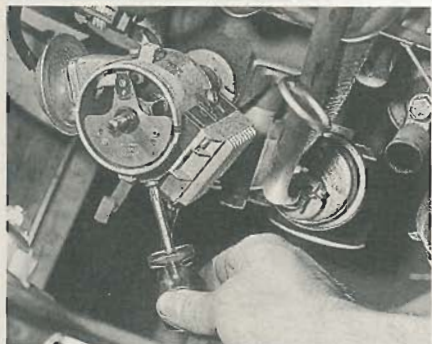


10.5 Timing mark on flywheel (arrowed) aligned with 10° BTDC mark on bellhousing – 1.4 litre model

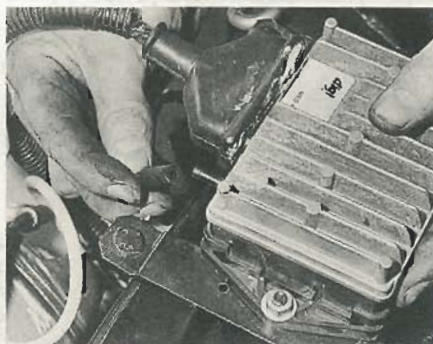


10.6 Loosening the distributor clamp bolt – 1.4 litre model

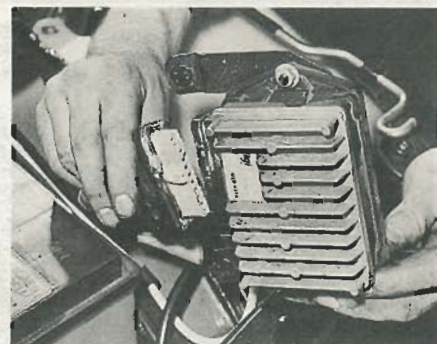




12.4 Unscrewing an ignition module securing screw – 1.4 litre model



12.10A Disconnect the vacuum hose ...



12.10B ... and the wiring plug from the Digiplex 2 module – 1.6 litre model

10 Reconnect the vacuum pipe to the distributor, and repeat the procedure given in the previous paragraph, when for the same increase in engine speed, the alignment differential between the timing marks should be greater than previously observed.

11 If the flywheel mark does not appear to move during the first part of the check, a fault in the distributor mechanical advance mechanism is indicated. No increased movement of the mark during the second part of the check indicates a punctured diaphragm in the distributor vacuum unit, or a leak in the vacuum pipe.

12 On completion of the adjustments and checks, stop the engine and disconnect the timing light (and tachometer where applicable).

13 Where applicable, reconnect the vacuum pipe if not already done, and refit the rubber cover to the timing aperture in the bellhousing. Make a final check to ensure that the distributor clamp bolt is tight.

14 Finally, the idle speed and mixture should be checked and adjusted as necessary as described in Chapter 3.

### 1.6 litre models

15 No adjustment of the ignition timing is possible with the Digiplex 2 system, but a rough check of the ignition advance at various engine speeds can be made as follows.

16 Before checking the ignition timing, the following conditions must be met:

- The engine must be at normal operating temperature
- The vacuum pipe to the Digiplex 2 module must be connected, and must be secure and free from blockage
- The idle speed and mixture adjustments must be correct – see Chapter 3

17 Proceed as described in paragraphs 2 to 4 inclusive.

18 Point the timing light at the timing aperture in the clutch bellhousing, and check that the timing mark on the flywheel is pointing slightly to the right of the 10° BTDC mark on the bellhousing (the value for ignition timing should be approximately 12° BTDC at idle).

19 The ignition advance, which is controlled by the Digiplex 2 module, can be checked as follows.

20 With the engine idling, timing light connected, and vacuum pipe still connected as described previously, gradually increase the engine speed. The flywheel mark should appear to move progressively in an anti-clockwise direction in relation to the marks on the bellhousing.

21 If the flywheel mark does not appear to move, it is likely that the Digiplex 2 module is faulty. A FIAT dealer will be able to test the module using specialist dedicated test equipment, but it is likely that renewal of the module will prove to be the only viable cure.

22 On completion of the checks, stop the engine, disconnect the timing light, and refit the rubber cover to the timing aperture in the bellhousing.

### 11 Ignition timing – adjustment for use with unleaded petrol

1 All models have the ignition timing adjusted for use with 95 RON unleaded petrol before they leave the factory, and no further adjustments are required.

2 Leaded petrol (98 RON) can be used if necessary with no adverse effects.

## 12 Electronic modules – removal and refitting

**Note:** Refer to Section 2 before proceeding

### Ignition module (1.4 litre models)

- The ignition module is mounted on the side of the distributor.
- Disconnect the battery negative lead.
- Disconnect the distributor wiring plug from the module, and disconnect the module wiring plug from the ignition coil.
- Remove the two securing screws, and withdraw the module and the spacer from the side of the distributor (photo).
- Refitting is a reversal of removal.

### Fuel cut-off module (1.4 litre models)

- Refer to Section 14.

### Digiplex 2 module (1.6 litre models)

- The Digiplex 2 module is located on the left-hand side of the engine compartment, behind the headlamp.
- Disconnect the battery negative lead.
- Unscrew the three securing nuts, two on the left-hand side of the module, and one on the right-hand side, then carefully withdraw the module from its location.
- Disconnect the vacuum hose and the wiring plug (prise back the plug locking clip using a screwdriver) from the module, noting that the wiring plug is filled with waterproof grease, and withdraw the module from the vehicle (photos).
- Refitting is a reversal of removal, but ensure that the wiring plug is filled with a suitable waterproof grease before reconnection.

## 13 Crankshaft speed/position sensor (Digiplex 2 system) – removal and refitting

**Note:** Do not unbolt the sensor bracket from the oil seal housing unless absolutely necessary (ie for renewal of the bracket or oil seal housing). If the bracket is removed, FIAT special tool No 1895898000, or an improvised alternative will be required to ensure correct alignment of the bracket on refitting

- The sensor is located in a bracket bolted to the crankshaft rear oil seal housing, on the manifold side of the engine.
- Disconnect the battery negative lead.
- Disconnect the sensor wiring connector (photo).
- Unscrew the two securing bolts, and withdraw the sensor from its bracket.
- Refitting is a reversal of removal.
- The position of the sensor bracket on the oil seal housing is set during production, and to prevent tampering, one of the two bolts securing the bracket to the oil seal housing is a shear-head bolt.
- If it proves necessary to remove the bracket (the head will have to be drilled off the shear-head bolt to enable removal), proceed as follows when refitting.
- Using a suitable socket or spanner on the crankshaft pulley nut, or



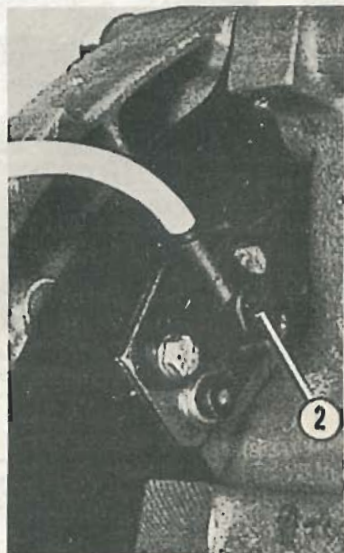


Fig. 4.6 Crankshaft speed/position sensor (2) (Sec 13)

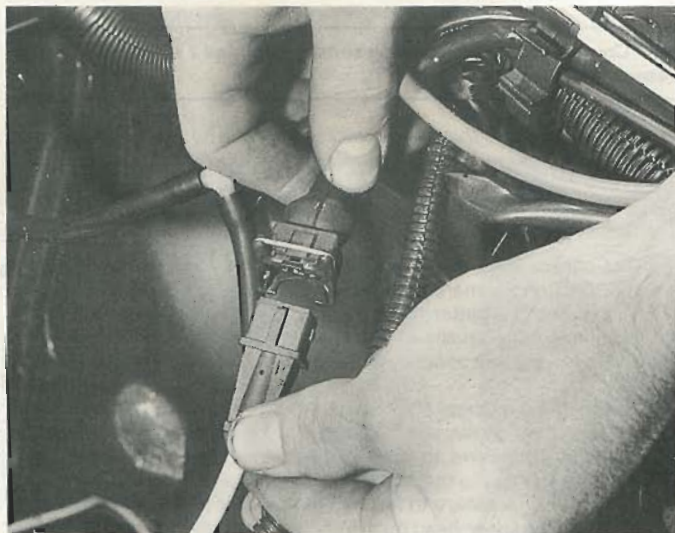
by engaging top gear and pushing the vehicle backwards or forwards as necessary (with the handbrake released!), turn the engine to align the timing mark on the crankshaft pulley with the 0° mark on the outer timing belt cover. Similarly, the timing mark on the flywheel (visible with the rubber cover removed from the clutch bellhousing) should be aligned with the 0° mark on the bellhousing. Ensure that the relevant marks are aligned exactly.

9 Position the bracket on the oil seal housing, and fit the securing bolts (a new shear-head bolt will be required). **Do not** fully tighten the bolts at this stage.

10 FIAT special tool No 1895898000 must now be obtained, or a suitable alternative must be improvised. The tool fits into the sensor bracket in place of the sensor, and a slot in the tool fits exactly over the TDC pin on the flywheel - see Fig. 4.7. If an improvised tool is used, accuracy of manufacture is vital.

11 Fit the tool to the sensor bracket using the sensor securing bolts. The tool must slip freely into the bracket, and the sensor securing bolts must tighten easily. Reposition the bracket to achieve this if necessary.

12 With the bracket correctly positioned, tighten the securing bolts (tighten the shear-head bolt until the head breaks off), and remove the tool.



13.3 Disconnecting the crankshaft speed/position sensor wiring connector - 1.6 litre model

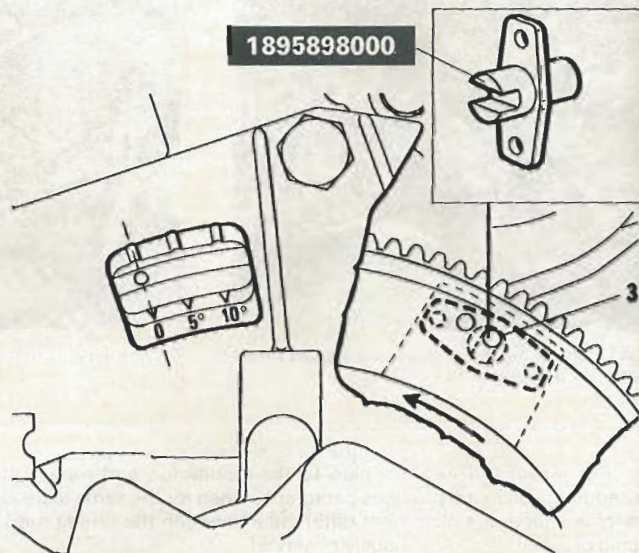


Fig. 4.7 FIAT special tool used to position crankshaft speed/position sensor (Sec 13)

3 Flywheel TDC pin

#### 14 Fuel cut-off system components - testing, removal and refitting

**Note:** Refer to Section 2 before proceeding

##### Fuel cut-off module

- 1 The fuel cut-off module is located on the left-hand side of the engine compartment, behind the headlamp.
- 2 If it is suspected that the module is faulty, refer to a FIAT dealer for advice. It is likely that renewal will be the only course of action available.
- 3 Disconnect the battery negative lead.
- 4 Unscrew the two securing nuts, then carefully withdraw the module from its location (photo).
- 5 Disconnect the wiring plug (prise back the locking clip using a screwdriver), and withdraw the module from the vehicle (photo).
- 6 Refitting is a reversal of removal.

##### Fuel cut-off valve

- 7 If the operation of the valve is suspect, first check that battery voltage is present at the valve terminal when the ignition is switched on, using a suitable multimeter or test lamp.
- 8 If no voltage is present, then the fault lies in the wiring to the valve. If voltage is present, the valve can be tested as follows.
- 9 With the valve unscrewed from the carburettor, as described later in this sub-Section, connect the body of the valve to the negative terminal of a 12-volt battery. When the battery positive terminal is connected to the valve terminal, there should be an audible click, and the valve plunger should retract.
- 10 Renew the valve if faulty.

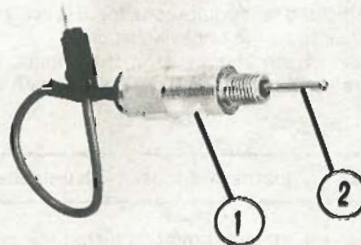
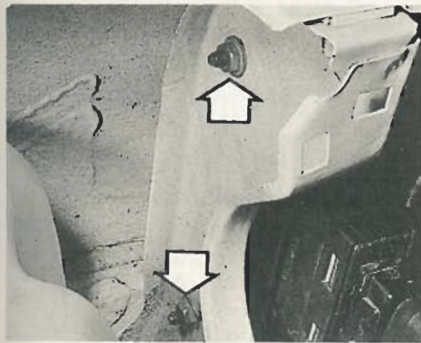


Fig. 4.8 Fuel cut-off valve (Sec 14)

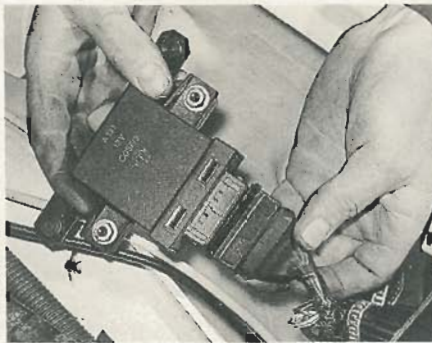
1 Valve body

2 Plunger

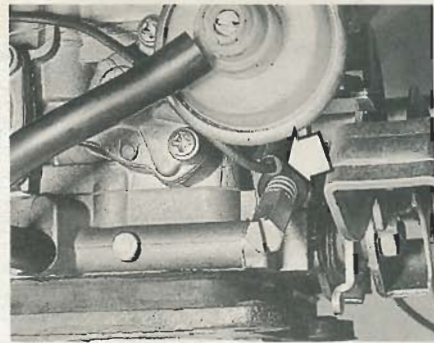




14.4 Fuel cut-off module securing nuts (arrowed) – 1.4 litre model



14.5 Disconnecting the fuel cut-off module wiring plug – 1.4 litre model



14.17 Carburettor "throttle closed" switch (arrowed)

- 11 To remove the valve, proceed as follows.
- 12 Disconnect the battery negative lead.
- 13 Disconnect the valve wiring connector.
- 14 Unscrew the valve from the carburettor. Be prepared for fuel spillage and take adequate fire precautions.
- 15 Check the condition of the valve sealing ring and renew if necessary.
- 16 Refitting is a reversal of removal.

#### "Throttle closed" switch

- 17 The switch consists of a sleeve around the throttle stop screw with a contact which provides an electrical feed to the screw (photo).
- 18 When the throttle is closed, the throttle lever makes contact with the throttle stop screw, and the feed is earthed through the carburettor body.
- 19 If a faulty switch is suspected, first try cleaning the end of the throttle stop screw and the throttle lever.
- 20 The only other likely sources of trouble with the switch are a faulty contact in the sleeve, or a break in the wiring.
- 21 To test the switch, check for continuity between the switch wiring connector and the throttle lever with the throttle closed, using a suitable multimeter or test lamp (disconnect the battery negative lead and the switch wiring connector before carrying out the test).
- 22 To remove the switch, remove the throttle stop screw, noting the number of turns required to unscrew it.
- 23 The switch can now be pulled from the throttle stop screw housing.
- 24 Refitting is a reversal of removal, but screw the throttle stop screw into the housing the number of turns noted during removal, and on completion, check the idle speed and mixture as described in Chapter 3.

as described in paragraph 11 of this Section, and renew the relevant component(s) as necessary.

- 5 If no sparks occur, check the continuity of the coil HT lead using a suitable multimeter or test lamp, and renew as necessary. Should the lead be serviceable, check that all wiring and wiring plugs are secure on the distributor (where applicable) and the electronic module.
- 6 Check the coil as described in Section 5.
- 7 If the above checks reveal no faults, but there is still no spark, the distributor or the electronic module must be suspect. Consult a FIAT dealer for further testing, or test by substitution of a known good unit.

#### Engine misfires

- 8 If the engine misfires regularly, run it at a fast idle speed, then *with a well-insulated pair of pliers*, pull off each of the spark plug HT leads in turn, and listen to the note of the engine.
- 9 No difference in engine running will be noticed when the lead from the defective circuit is removed. Removing the lead from one of the good cylinders will accentuate the misfire.
- 10 Remove the plug lead from the end of the plug in the defective circuit, and hold it about 5.0 mm (0.2 in) away from the cylinder head, again using *well-insulated pliers*. While an assistant spins the engine on the starter motor, check that a regular blue spark occurs. If so, the fault must lie in the spark plug.
- 11 If the spark is irregular, it is likely that there is a break in the HT lead. Check the continuity of the lead using a suitable multimeter or test lamp, while manipulating the lead to see if the continuity is broken. If necessary, renew the lead.
- 12 If the above checks reveal no faults, the distributor or the electronic module must be suspect. Consult a FIAT dealer for further testing, or test by substitution of a known good unit.

## 15 Fault diagnosis – ignition system

**Note:** Refer to Section 2 before proceeding

- 1 There are two main symptoms indicating ignition faults, either the engine will not start or fire, or the engine is difficult to start and misfires. If a regulator misfire is present, the fault is almost sure to be in the HT circuit.

#### Engine fails to start

- 2 If the starter motor fails to turn the engine, check the battery and starter motor with reference to Chapter 11.
- 3 Disconnect the HT lead from any spark plug and hold the end of the cable approximately 5.0 mm (0.2 in) away from the cylinder head using *well insulated pliers*. Have an assistant spin the engine on the starter motor, and check that a regular blue spark occurs. If so, remove and check the spark plugs as described in Section 4.
- 4 If no spark occurs, disconnect the coil HT lead from the distributor cap, and check for a spark as in paragraph 3. If sparks now occur, check the rotor arm, distributor cap as described in Section 7, and the HT leads

## 16 Fault diagnosis – Digiplex 2 system

**Note:** Refer to Section 2 before proceeding

- 1 If no fault has been found in the ignition system (see Section 15), then a fault in the Digiplex 2 system must be suspected.
- 2 Do not immediately assume that a fault is caused by a faulty electronic module. First check that all wiring is in good condition, and that all wiring plugs are securely connected. Similarly, check the vacuum pipe.
- 3 Unless components are freely available for testing by substitution, further investigation should be left to a FIAT dealer or other competent specialist. Note that the electronic module has a self-analysis system, which operates in conjunction with specialist dedicated test equipment, available to a FIAT dealer.
- 4 Note that relays, modules and other components cannot necessarily be substituted from another vehicle. The electronic module in particular may be dedicated to particular engine, gearbox and territory combinations.
- 5 The fuel cut-off system components can be tested with reference to Section 14.



# Chapter 5 Clutch

## Contents

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Clutch - refitting .....	8	Clutch release bearing and arm - removal, inspection and refitting	9
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Clutch cable - adjustment.....	3	General description.....	1
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## Specifications

**Clutch type** ..... Single dry plate cable-operated

### Friction disc diameter

1.4 litre models..... 180.0 mm  
1.6 litre models..... 190.0 mm

**Clutch pedal travel** ..... 145.0 ± 5.0 mm (5.7 ± 0.2 in)

### Torque wrench settings

	Nm	lbf ft
Clutch cover-to-flywheel bolts:		
M6 bolts .....	17	12
M8 bolts .....	30	22

## 1 General description

The clutch is of single dry plate type, and consists of five main components - friction disc, pressure plate, diaphragm spring, cover and release bearing.

The friction disc is free to slide along the splines of the gearbox input shaft, and is held in position between the flywheel and the pressure plate due to the pressure exerted on the pressure plate by the diaphragm spring. Friction lining material is riveted to both sides of the friction disc, and spring cushioning between the friction linings and the hub absorbs transmission shocks and helps to ensure a smooth take-up of power as the clutch is engaged.

The diaphragm spring is mounted on pins and is held in place in the cover by annular fulcrum rings.

The release bearing is located on a guide sleeve at the front of the gearbox, and the bearing is free to slide on the sleeve under the action of

the release arm which pivots inside the clutch bellhousing.

The release arm is operated by the clutch pedal via a cable. The cable can be adjusted by means of a threaded rod and adjuster nut at the release arm.

Depressing the clutch pedal actuates the release arm by means of the cable. The release arm pushes the release bearing forwards to bear against the centre of the diaphragm spring, thus pushing the centre of the diaphragm spring inwards. The diaphragm spring is sandwiched between fulcrum rings in the cover, and so as the centre of the spring is pushed in, the outside of the spring is pushed out, so allowing the pressure plate to move backwards away from the friction disc.

When the clutch pedal is released, the diaphragm spring forces the pressure plate into contact with the friction linings on the friction disc, and simultaneously pushes the friction disc forwards on its splines, forcing it against the flywheel. The friction disc is now firmly sandwiched between the pressure plate and the flywheel, and drive is taken up.



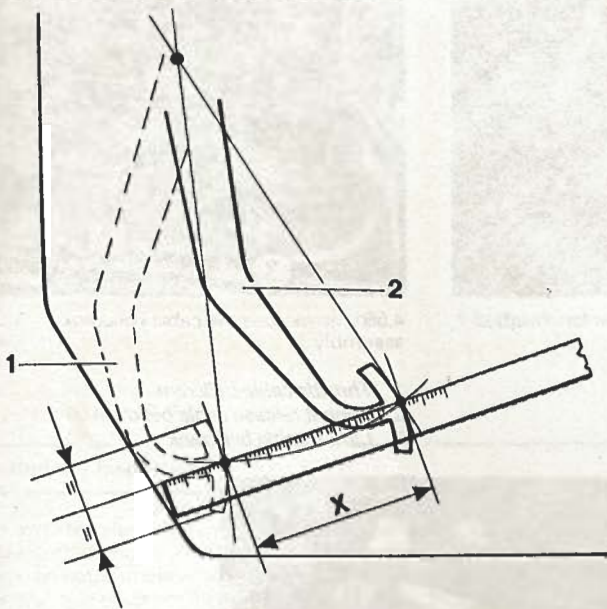


Fig. 5.1 Clutch cable adjustment (Sec 3)

- 1 Pedal end-of-travel position  
 2 Pedal rest position  
 X Pedal travel - see Specifications

## 2 Routine maintenance

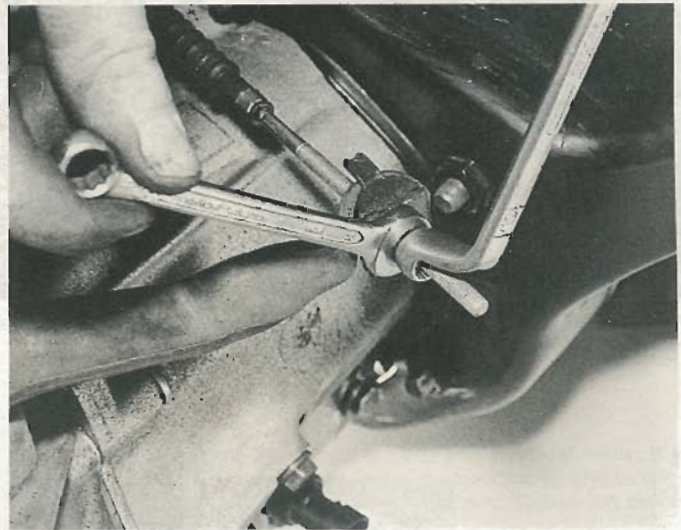
- At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, carry out the following tasks.
- Check the clutch cable adjustment as described in Section 3.
- Periodically, examine the clutch cable for signs of wear and damage. Inspect the cable strands for signs of fraying, and ensure that the cable is not chafing against surrounding components. Renew the cable if necessary, with reference to Section 4.

## 3 Clutch cable - adjustment

- At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, or if the operation of the clutch mechanism is suspect, the clutch cable adjustment should be checked as follows.
- Fully depress and then release the clutch pedal two or three times.
- Using a suitable rule, measure the pedal travel at the centre-line of the pedal pad, between the end-of-travel position (pedal touching the footwell panel) and the rest position - see Fig. 5.1. Alternatively, the end of travel and rest positions can be marked on a suitable straight-edged piece of wood or metal, and the distance between the marks can then be measured using a rule to ascertain the pedal travel.
- If adjustment is required, this should be carried out at the release arm end of the cable in the engine compartment as follows.
- Loosen the locknut on the threaded rod at the release arm, then turn the adjuster nut as necessary to adjust the cable (photo). Turn the nut clockwise to increase the pedal travel, or anti-clockwise to decrease the pedal travel. Tighten the locknut on completion of adjustment.
- Re-check the pedal travel as described in paragraph 3, and if necessary carry out further adjustments until the pedal travel is within the specified limits.

## 4 Clutch cable - removal and refitting

- The clutch cable is in two sections. One section runs from the clutch



3.5 Counterholding the clutch cable adjuster nut while loosening the locknut

pedal to the bellcrank assembly on the engine compartment bulkhead, and the remaining section runs from the bellcrank assembly to the clutch release arm on the gearbox bellhousing.

### Clutch pedal-to-bellcrank cable

- Working in the engine compartment, loosen the locknut on the threaded rod at the clutch release arm, then loosen the adjuster nut to slacken the cable.
- Working in the driver's footwell, for improved access remove the lower facia trim panel, with reference to Chapter 10 if necessary.
- Unhook the end of the cable from the top of the clutch pedal (photo).
- Working in the engine compartment, for improved access remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead (photos).
- Turn the clutch cable bellcrank as necessary to allow the cable end to be slid free.
- Withdraw the cable through the bulkhead grommet into the engine compartment.
- Refitting is a reversal of removal, but ensure that the bulkhead grommet is correctly located.
- On completion, check the clutch mechanism for satisfactory operation, and if necessary adjust the cable as described in Section 3.

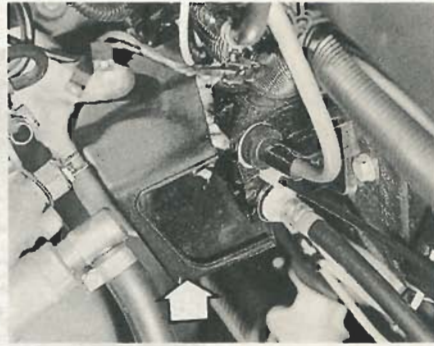
### Bellcrank-to-clutch release arm cable

- Working in the engine compartment, note the length of exposed thread on the threaded rod at the release arm end of the clutch cable, then unscrew the adjuster nut and locknut from the threaded rod, and withdraw the plastic block which locates in the release arm (photo). Slide the end of the clutch cable from the release arm.
- Pull the cable sheath rubber grommet from the lugs on the gearbox casing (photo).
- For improved access, remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead.
- Slide the cable end from the clutch cable bellcrank, then slide the cable sheath from the bellcrank bracket. Withdraw the cable, taking careful note of its routing.
- Refitting is a reversal of removal, bearing in mind the following points.
- Ensure that the cable is routed as noted during removal.
- Screw the adjuster nut and locknut onto the threaded rod at the release arm end of the cable to leave the approximate amount of

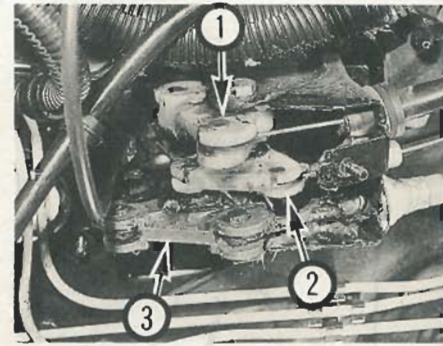




4.4 Unhook the end of the clutch cable (arrowed) from the pedal



4.6A Remove the plastic cover (arrowed) ...



4.6B ... to expose the cable bellcrank assembly

- 1 Throttle cable bellcrank
- 2 Bonnet release cable bellcrank
- 3 Clutch cable bellcrank



4.11 Withdraw the plastic block from the release arm



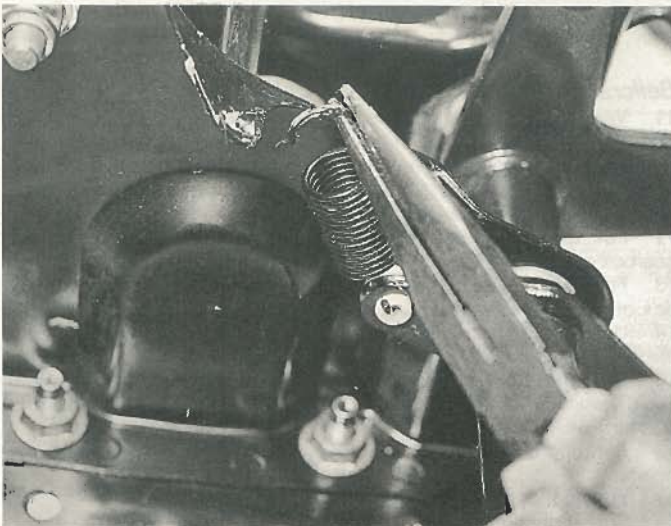
4.12 Cable sheath rubber grommet (arrowed) on gearbox casing

exposed thread noted before removal, then adjust the cable as described in Section 3.

19 On completion, check the clutch mechanism for satisfactory operation.

## 5 Clutch pedal - removal and refitting

1 Remove the pedal box assembly as described for brake servo removal in Chapter 8, Section 15.



5.2 Unhooking the clutch pedal return spring

2 Unhook the clutch pedal return spring from the bracket on the pedal box (photo).

3 Unscrew the nut from the end of the pedal pivot shaft.

4 Remove the washers and the pedal box support bracket from the end of the shaft.

5 The pedal can now be withdrawn from the shaft (photo).

6 Examine the pedal pivot bush for wear, and renew if necessary.

7 Refitting is a reversal of removal, bearing in mind the following points.

8 Ensure that the washers and pedal box support bracket are correctly assembled (photos).

9 Do not fully tighten the pedal pivot shaft nut until the pedal box assembly has been refitted to the vehicle, with the support bracket correctly positioned.

10 Refit the pedal box as described in Chapter 8, Section 15.

## 6 Clutch - removal

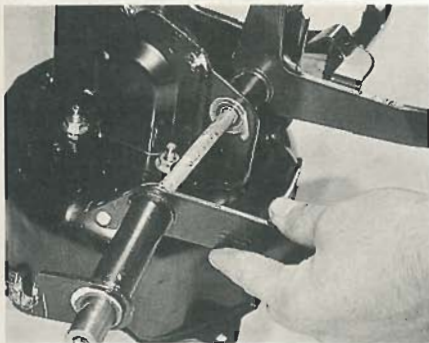
1 In order to remove the clutch, it is necessary to remove the engine (Chapter 1) or the gearbox (Chapter 6). With the engine or gearbox removed, proceed as follows.

2 If the original clutch is to be refitted, mark the clutch cover and the flywheel for alignment which will ensure identical positioning on refitting.

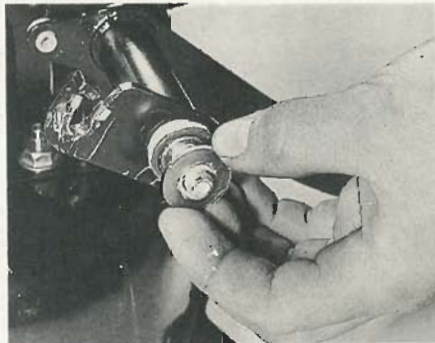
3 Progressively unscrew, in a diagonal sequence, the six bolts and washers which secure the clutch cover to the flywheel.

4 With all the bolts removed, lift the clutch assembly from the flywheel. Be prepared to catch the friction disc as the cover assembly is removed, and note which way round the friction disc is fitted. The projecting side of the friction disc hub faces away from the flywheel.

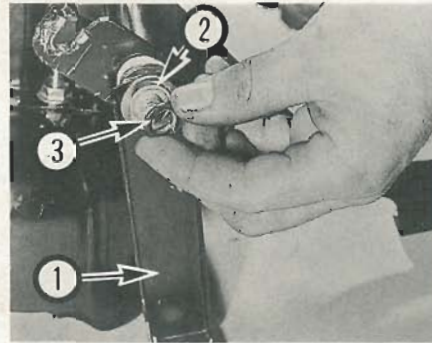




5.5 Withdrawing the clutch pedal from the pivot shaft



5.8A Fit the plain washer ...



5.8B ... pedal box support bracket (1), plain washer (2) and shake-proof washer (3) to the pivot shaft

## 7 Clutch - inspection

1 With the clutch assembly removed, clean off all traces of dust using a dry cloth. Although most friction discs now have asbestos-free linings, some do not, and it is wise to take suitable precautions - *asbestos dust is harmful, and must not be inhaled.*

2 Examine the linings of the friction disc for wear and loose rivets, distortion, cracks, broken torsion springs and worn splines. The surface of the friction lining may be highly glazed, but, as long as the friction material pattern can be clearly seen, this is satisfactory. If there is any sign of oil contamination, indicated by a continuous, or patchy, shiny black discolouration, the plate must be renewed and the source of the contamination traced and rectified. Contamination is likely to be due to either a leaking crankshaft rear oil seal or gearbox input shaft oil seal, or both. Renewal procedures are given in Chapters 1 and 6 respectively. The friction disc must also be renewed if the lining thickness has worn down to, or just above, the level of the rivet heads.

3 Check the machined faces of the flywheel and pressure plate. If either is grooved, or heavily scored, renewal is necessary. The pressure plate must also be renewed if any cracks are apparent, or if the diaphragm spring is damaged or its pressure suspect.

4 With the engine and gearbox separated, it is advisable to check the condition of the release bearing, as described in Section 9.

## 8 Clutch - refitting

1 It is important to ensure that no oil or grease contaminates the

friction disc linings, or the pressure plate and flywheel faces. It is advisable to refit the clutch assembly with clean hands, and to wipe down the pressure plate and flywheel faces with a clean rag before assembly begins.

2 Place the friction disc against the flywheel, ensuring that it is fitted the correct way round. The projecting side of the friction disc hub must face away from the flywheel (photo).

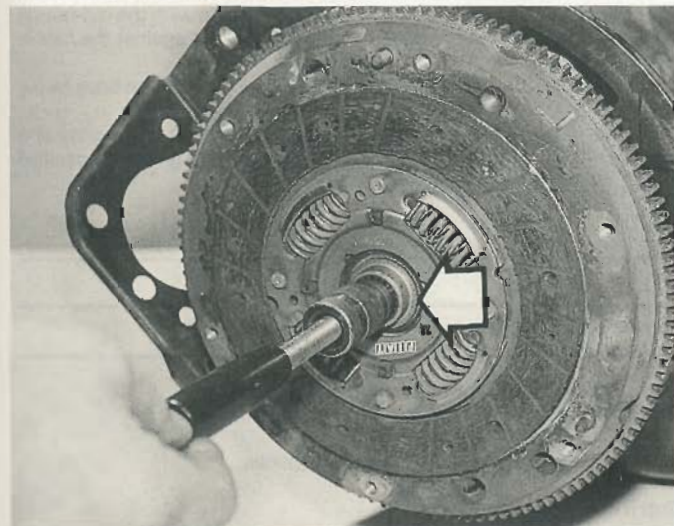
3 Fit the clutch cover assembly, aligning the previously made marks on the clutch cover and flywheel if the original clutch is being refitted. Insert the six bolts and washers (where applicable), and tighten them finger-tight so that the friction disc is gripped, but can still be moved.

4 The friction disc must now be centralised so that when the engine and gearbox are mated, the gearbox input shaft splines will pass through the splines in the centre of the friction disc.

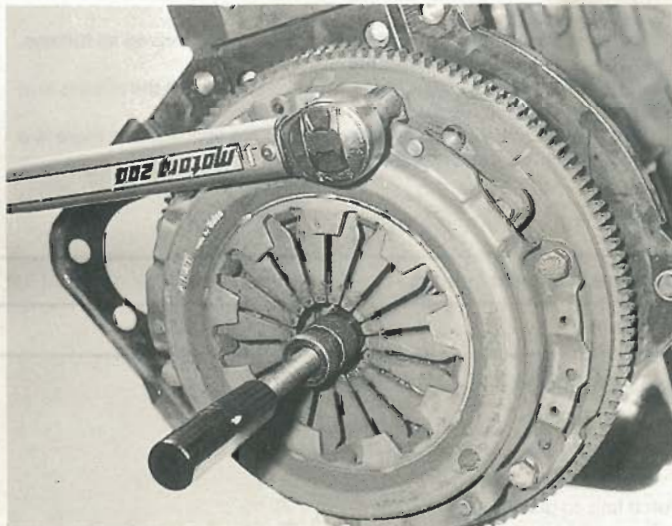
5 Centralisation can be carried out by inserting a round bar or a long screwdriver through the hole in the centre of the friction disc, so that the end of the bar rests in the recess in the centre of the crankshaft. Where possible use a blunt instrument, and if a screwdriver is used, wrap tape around the blade to prevent damage to the crankshaft recess. Moving the bar sideways or up and down will move the friction disc in whichever direction is necessary to achieve centralisation. With the bar removed, view the friction disc hub in relation to the recess in the end of the crankshaft and the circle created by the ends of the diaphragm spring fingers. When the hub appears exactly in the centre, all is correct. Alternatively, if a clutch alignment tool is available, this will eliminate all the guesswork, obviating the need for visual alignment.

6 Tighten the cover retaining bolts progressively in a diagonal sequence, to the specified torque (photo).

7 Refit the gearbox (Chapter 6), or the engine (Chapter 1) as applicable.

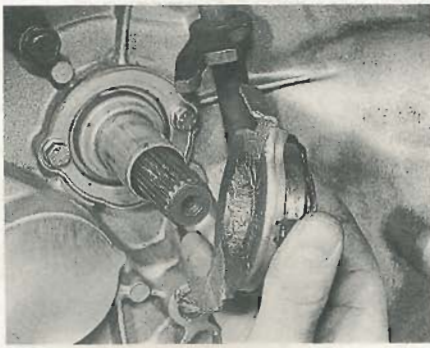


8.2 Friction disc fitted to flywheel with clutch alignment tool. Projecting side of hub (arrowed) faces away from flywheel

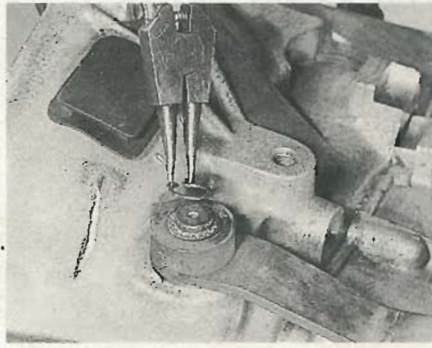


8.6 Tightening a clutch cover retaining bolt





9.2 Removing the clutch release bearing



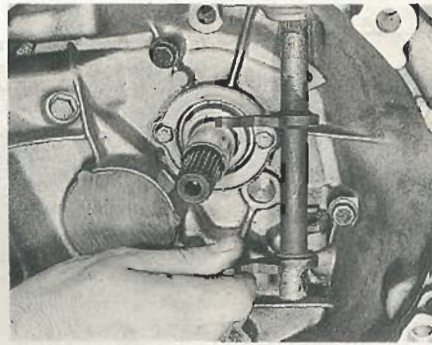
9.7A Extract the circlip ...



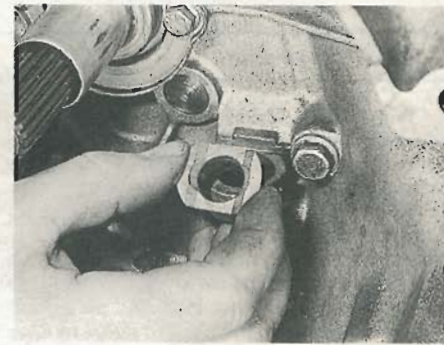
9.7B ... and remove the clutch release arm



9.8A Remove the release fork rod upper bush ...



9.8B ... and manipulate the release fork rod from the bellhousing



9.9 Remove the release fork rod lower bush

## 9 Clutch release bearing and arm – removal, inspection and refitting

- 1 With the engine and gearbox separated to provide access to the clutch, attention can be given to the release bearing located in the clutch bellhousing, over the gearbox input shaft.
- 2 The release bearing can simply be slid from the guide sleeve over the end of the gearbox input shaft (photo).
- 3 Spin the release bearing and check it for roughness. Hold the outer race and attempt to move it laterally against the inner race. If any excessive movement or roughness is evident, renew the bearing. If a new clutch has been fitted, it is wise to renew the release bearing as a matter of course.
- 4 If desired, the release arm and fork rod can be removed as follows, otherwise proceed to paragraph 11.
- 5 If not already done, disconnect the clutch cable from the release arm with reference to Section 4.
- 6 The release arm and the release fork rod are splined, and there is a master spline to ensure correct alignment.

7 Extract the circlip which secures the release arm to the end of the fork rod, then pull the arm from the rod (photo). If the arm is tight on the splines, carefully lever against the gearbox casing using a screwdriver or similar suitable tool.

8 Carefully prise the release fork rod upper bush from its recess in the bellhousing, using a screwdriver or similar suitable tool, then manipulate the release fork rod from the bellhousing (photos).

9 Prise the release fork rod lower bush from its recess inside the bellhousing (photo).

10 Examine the bushes for wear, and renew if necessary.

11 Refitting is a reversal of removal, bearing in mind the following points.

12 If the release fork rod has been removed, ensure that when refitting the bushes, the lugs in the top bush engage with the cut-outs in the bellhousing, and the flats on the lower bush rest against the flats in the bellhousing.

13 Ensure that the release arm is fitted correctly with the boss facing upwards.

14 Where applicable, reconnect the clutch cable to the release arm with reference to Section 4, and adjust the cable to give the specified pedal travel as described in Section 3.

## 10 Fault diagnosis – clutch

### Symptom

### Reason(s)

Judder when taking up drive

Loose or worn engine/gearbox mountings  
Friction disc linings worn or contaminated with oil  
Clutch cable sticking or defective  
Friction disc hub sticking on input shaft splines

Clutch fails to disengage

Clutch cable sticking or defective  
Incorrect cable adjustment  
Friction disc linings contaminated with oil  
Friction disc hub sticking on input shaft splines



Symptom	Reason(s)
Clutch slips	Clutch cable sticking or defective Incorrect cable adjustment Faulty pressure plate or weak or broken diaphragm spring Friction disc linings contaminated with oil
Noise when depressing clutch pedal	Worn release bearing Defective release mechanism Faulty pressure plate or diaphragm spring
Noise when releasing clutch pedal	Faulty pressure plate or diaphragm spring Broken friction disc torsion spring(s) Gearbox internal wear

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice.



# Chapter 6 Manual gearbox

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## Specifications

**Type** ..... Five forward speeds and reverse. Synchromesh on all forward speeds

### Ratios

Final drive:	
1.4 litre models.....	3.765:1 or 3.938:1*
1.6 litre models.....	3.563:1
1st.....	3.909:1
2nd.....	2.267:1
3rd.....	1.440:1
4th.....	1.029:1
5th.....	0.827:1 or 0.849:1*
Reverse.....	3.909:1

**\*Note:** Gearboxes with these ratios can be identified by a label with a white background and a diagonal purple band, or from the code number C513.5.13.32

### Lubrication

Lubricant type/specification ..... Gear oil, viscosity SAE 80 to API GL4 (Duckhams Hypoid 80)  
Capacity..... 1.4 litres (2.5 pints)

### Torque wrench settings

	Nm	lbf ft
Gearbox casing-to-bellhousing bolts .....	25	18
Gearbox endplate-to-gearbox casing bolts .....	25	18
Reverse idler shaft-to-gearbox casing bolt.....	34	25
Input shaft nut.....	118	87
Mainshaft nut .....	118	87
Gear selector fork-to-selector shaft bolts.....	25	18
Reverse selector fork securing bolts .....	25	18
Speedometer drive clamp screw .....	12	9
Gearbox oil filler/level plug.....	46	34
Gearbox oil drain plug .....	46	34
Gear selector lever-to-gearbox casing bolts.....	15	11
Gearchange lever-to-floor bolts.....	7	5
Selector rod-to-gearchange lever bolts .....	28	20
Left-hand gearbox mounting-to-gearbox bolts.....	49	36
Left-hand gearbox mounting-to-body bolts.....	40	30
Left-hand gearbox mounting rubber through-bolt nyloc nut.....	49	36
Centre engine/gearbox mounting-to-gearbox nuts (M12).....	88	65
Centre engine/gearbox mounting-to-gearbox nut (M8) .....	24	18
Centre engine/gearbox mounting-to-subframe bolts .....	28	21
Centre engine/gearbox mounting rubber-to-bracket bolt.....	88	65



## 1 General description

The gearbox is mounted on the left-hand side of the engine and may be removed separately, leaving the engine in the vehicle.

Drive from the clutch is picked up by the input shaft, which runs in parallel with the mainshaft and the reverse idler shaft. The gear clusters are in constant mesh.

Gear engagement is by sliding synchromesh hubs, which lock the appropriate gear to the relevant shaft.

As is common practice in five-speed gearboxes, the 5th gear components are located on an intermediate plate mounted at the end of the gearbox. The intermediate plate carries the bearings which support the rear ends of the input and mainshafts, while the front ends of the shafts are supported by bearings located in the bellhousing.

Reverse gear is obtained by sliding an idler gear into mesh with two straight-cut gears on the input shaft and mainshaft.

All the forward gear teeth are helically cut, to reduce noise and improve wear characteristics.

The differential is mounted in the main gearbox casing, and drive is transmitted to the differential by a pinion gear on the end of the mainshaft. The inboard ends of the driveshafts locate directly into the differential.

Gear selection is by a floor-mounted gearchange lever, via a remote control linkage.

## 2 Routine maintenance

1 Maintenance is limited to checking the gearbox oil level periodically, as described later in this Section, and checking for leaks if the level is low. At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the oil should be renewed as described in paragraph 8 onwards.

### Oil level – checking

2 For improved access, jack up the vehicle and support securely on axle stands. Note that the vehicle must be level in order to carry out an accurate check.

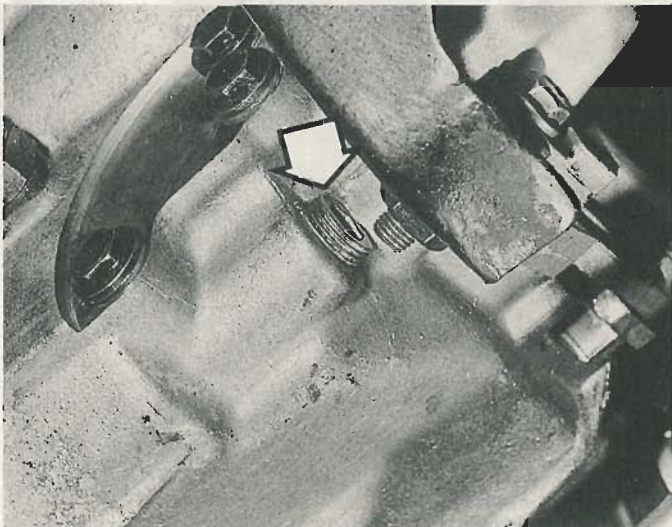
3 If the gearbox is hot due to the vehicle having been driven recently, allow it to cool for a few minutes. This is necessary because the oil can foam when hot, leading to a false level reading.

4 Wipe clean around the filler/level plug, which is located in the front of the gearbox casing. Unscrew the plug and remove it.

5 The oil level should reach the lower edge of the filler/level hole.

6 If necessary, top up the level with oil of the specified grade.

7 On completion, refit and tighten the filler/level plug, and where applicable lower the vehicle to the ground.



2.12 Gearbox oil drain plug (arrowed)

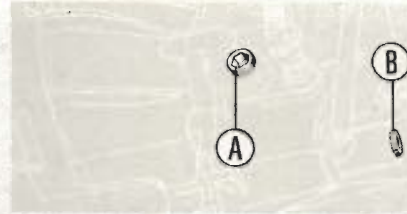


Fig. 6.1 Gearbox oil filler/level plug (A), and drain plug (B) (Sec 2)

### Oil – renewal

8 The oil should be drained when the gearbox is hot, immediately after a run.

9 For improved access, jack up the vehicle and support securely on axle stands. Note that the vehicle must be level in order to achieve the correct oil level when topping-up.

10 Wipe clean around the filler/level plug, which is located in the front of the gearbox casing. Unscrew the plug and remove it.

11 Position a suitable container under the drain plug at the left-hand end of the gearbox.

12 Wipe clean around the drain plug, then slowly unscrew the plug using a suitable hexagon key (photo). Oil will be released before the drain plug is withdrawn, so take precautions against scalding, as the oil will be hot. Allow the oil to drain for at least 10 minutes.

13 When the oil has finished draining, clean the drain plug threads and the mating face of the gearbox casing, then refit and tighten the drain plug.

14 Fill the gearbox with the correct grade and quantity of oil through the filler/level hole. The oil level should reach the lower edge of the hole.

15 When refitting is complete, refit and tighten the filler/level plug, and where applicable lower the vehicle to the ground.

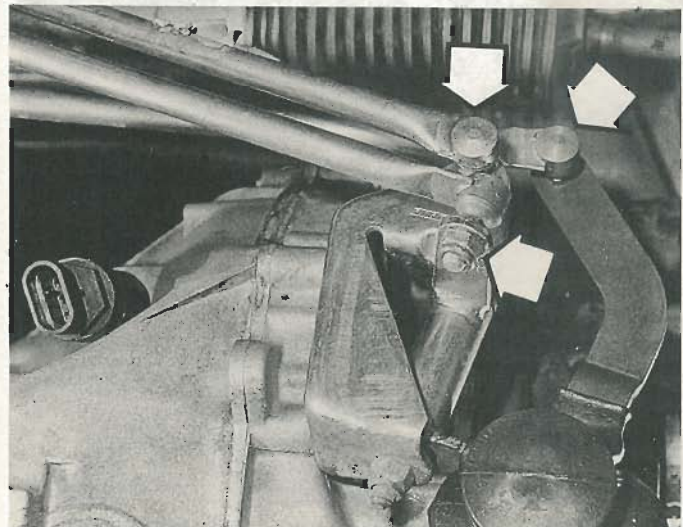
16 Dispose of the old gearbox oil safely. Do not pour it down a drain.

## 3 Gear selector linkage – removal, overhaul and refitting

1 Working in the engine compartment, disconnect the three gear selector rods from the gearbox, identifying the rods for location. Counterhold the selector rod balljoints using a second spanner on the flats provided in order to unscrew the rod securing nuts (photo).

2 Apply the handbrake, then jack up the front of the vehicle and support securely on axle stands.

3 Working underneath the vehicle, remove the through-bolt and nut, and disconnect the gear selector rod from the base of the gearchange lever.



3.1 Gear selector rod connections (arrowed) at gearbox



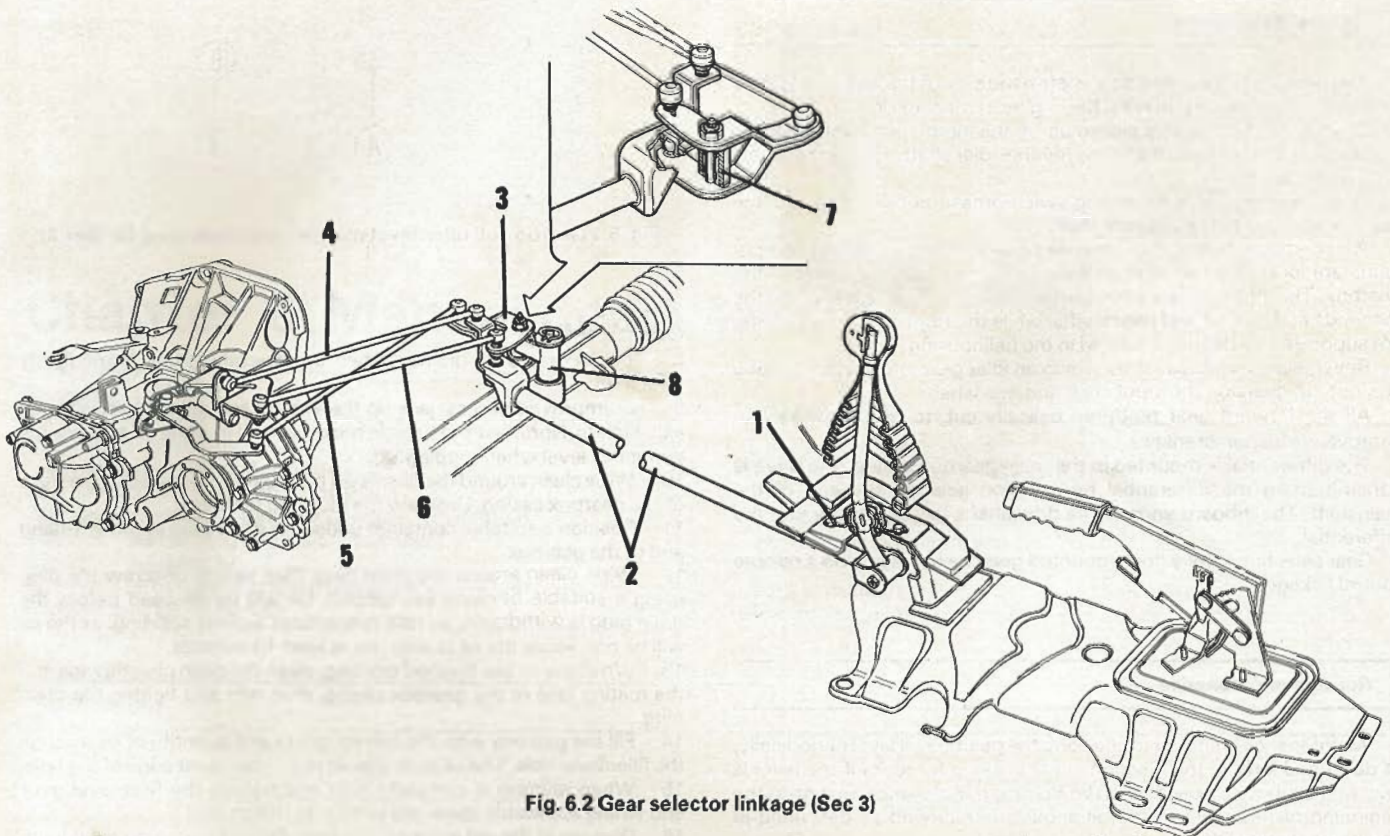


Fig. 6.2 Gear selector linkage (Sec 3)

1 Gearchange lever mounting  
2 Gear selector rod

3 Bellcrank  
4 Gear selector control rod

5 Gear engagement control rod  
6 Reaction rod

7 Bearing  
8 Linkage pivot

4 Remove the securing spring clip and washer, and slide the gear selector linkage pivot assembly from the bracket on the steering gear (photo).

5 The complete gear selector linkage assembly can now be withdrawn from the vehicle.

6 Dismantling of the gear selector linkage is self-explanatory.

7 Inspect all components for wear and damage, and renew as necessary.

8 Refitting is a reversal of removal.

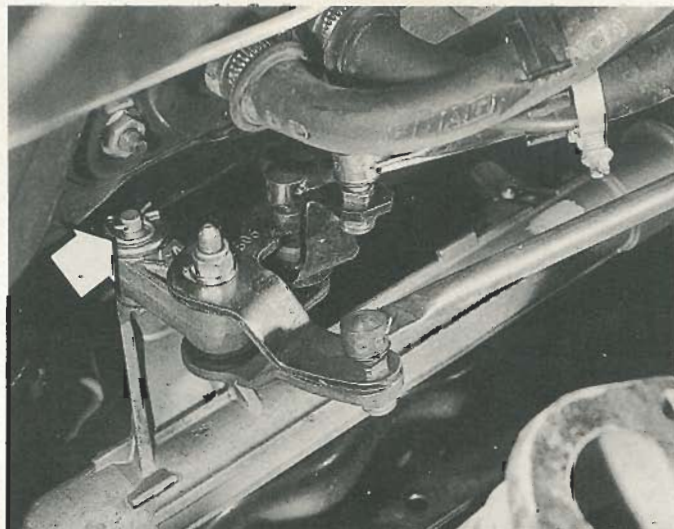
9 Note that no adjustment of the gear selector linkage is possible.

#### 4 Gearchange lever – removal and refitting

1 Working inside the vehicle, pull the lower end of the gearchange lever gaiter from the centre console or trim plate (as applicable), then pull the knob/gaiter moulding from the lever (photo).

2 Apply the handbrake, then jack up the front of the vehicle and support securely on axle stands.

3 Working underneath the vehicle, remove the through-bolt and nut, and disconnect the gear selector rod from the base of the gearchange lever.



3.4 Gear selector linkage pivot assembly – spring clip and washer arrowed



4.1 Removing the gearchange lever knob/gaiter moulding – model without centre console





Fig. 6.3 FIAT special tools used to support engine during gearbox removal (Sec 5)

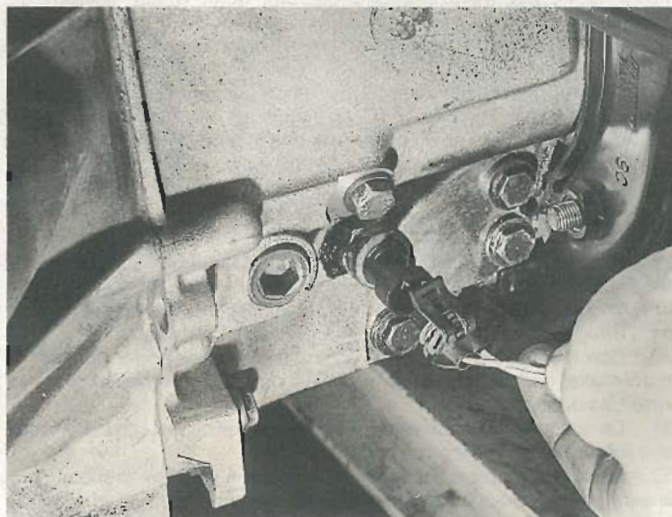
- 4 Unscrew the two securing nuts, and withdraw the gearchange lever assembly down through the floor underneath the vehicle.
- 5 Refitting is a reversal of removal.

## 5 Gearbox – removal and refitting (leaving engine in vehicle)

**Note:** Suitable equipment will be required to support the engine during this procedure

### Removal

- 1 Disconnect the battery negative lead.
- 2 Working in the engine compartment, disconnect the three gear selector rods from the gearbox, identifying the rods for location. Counterhold the selector rod balljoints using a second spanner on the flats provided in order to unscrew the rod securing nuts.
- 3 Note the length of exposed thread on the threaded rod at the release arm end of the clutch cable, then unscrew the adjuster nut and locknut from the threaded rod, and withdraw the plastic block which locates in the release arm. Slide the end of the clutch cable from the release arm, and pull the cable sheath rubber grommet from the lugs on the gearbox casing. Move the cable to one side out of the way, taking note of its routing.
- 4 Disconnect the wiring from the reversing lamp switch, which is located at the front of the gearbox casing (photo).
- 5 On models with an analogue instrument panel, unscrew the securing sleeve and disconnect the speedometer cable from the gearbox. Move the cable to one side out of the way, taking note of its routing.
- 6 On models with digital instruments, disconnect the wiring from the speedometer sender unit.
- 7 Unbolt the earth lead from the gearbox casing. Refit the securing bolt when the lead has been disconnected.
- 8 The engine must now be supported from its left-hand end. No lifting brackets are provided, so care must be taken when deciding on an engine support point. In the workshop, a right-angled bracket was made up by bending a suitable piece of steel plate. The bracket was then bolted to the engine using the rear left-hand camshaft housing securing bolts with suitable packing washers. Ideally, the engine should be supported using a strong wooden or metal beam, resting on blocks positioned securely on the suspension turrets and the front body panels. The FIAT special tool designed specifically for this purpose is shown in Fig. 6.3. Alternatively, the engine can be supported using a suitable hoist and lifting tackle, but in this case, the hoist must be of such a design to enable the engine to be supported with the vehicle raised off the ground, leaving sufficient clearance to withdraw the gearbox from under the front of the vehicle.
- 9 Apply the handbrake, then remove the wheel trims and loosen the front roadwheel bolts. Jack up the front of the vehicle and support securely on axle stands. Note that the vehicle must be raised sufficiently



5.4 Disconnecting the wiring from the reversing lamp switch

high to enable the gearbox to be withdrawn from under the front of the vehicle. Remove the roadwheels.

10 Working under the left-hand side of the vehicle, disconnect the brake pad wear sensor wire, then release the clips securing the gearbox splash shield to the wheel arch liner and the body. To release the clips, carefully tap out the pins from the centre of the clips using a suitable pin punch, the clips can then be pulled from their locations. Manipulate the splash shield out from under the engine compartment.

11 Unbolt and remove the starter motor, noting that the top securing bolt also secures a wiring harness bracket.

12 Make a final check to ensure that all relevant cables, wires etc have disconnected to facilitate removal of the gearbox.

13 Drain the gearbox oil with reference to Section 2.

14 Working on one side of the vehicle, unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush, noting that the convex side of the washer lies against the bush.

15 Unscrew the nut and the pinch-bolt securing the lower arm balljoint to the hub carrier.

16 Working at the inboard end of the driveshaft, remove the clip securing the driveshaft joint rubber gaiter to the differential casing.

17 Using a suitable bar to lever against the subframe, lever the lower arm down to separate the balljoint from the hub carrier.

18 Place a suitable container under the inboard end of the driveshaft to catch any remaining gearbox oil which may be released as the driveshaft is withdrawn from the differential.

19 Pull the inboard end of the driveshaft from the differential (be prepared for possible oil spillage). The inboard end of the driveshaft must be supported, for example by suspending with wire or string from the vehicle underbody. **Do not allow a driveshaft to hang down under its own weight.**

20 Repeat the procedure given in paragraphs 14 to 19 inclusive on the remaining side of the vehicle.

21 Ensure that the engine is adequately supported as described in paragraph 8.

22 Support the gearbox using a trolley jack, with an interposed block of wood to spread the load.

23 Unscrew and remove the three bolts securing the left-hand gearbox mounting bracket to the body, and the four bolts securing the mounting to the gearbox. Withdraw the complete gearbox mounting assembly.

24 Unscrew the single nut (which also secures the engine/gearbox mounting to the gearbox) and two bolts securing the clutch bellhousing cover plate to the bellhousing, and withdraw the plate.

25 Unscrew the two remaining nuts securing the engine/gearbox centre mounting to the gearbox, and the two bolts securing the mounting to the subframe. Withdraw the complete mounting assembly. Note that on some later models, the mounting bracket incorporates an additional bracing strut which is bolted to the top of the gearbox.

26 Ensure that the gearbox is adequately supported, then unscrew



and remove the three engine-to-gearbox bolts which fit from the gearbox side, and the single nut which fits from the engine side. Take note of the positions of any brackets which may be secured by the engine-to-gearbox bolts.

27 Carefully pull the gearbox away from the engine, taking care not to strain the gearbox input shaft.

28 The gearbox can now be lowered, and manipulated from under the front of the vehicle. The help of an assistant will greatly ease this operation.

### Refitting

29 If the clutch has been removed from the flywheel, make sure that the friction disc has been centralised as described in Chapter 5, Section 8. This is necessary to ensure that the gearbox input shaft splines will pass through the splines in the centre of the friction disc.

30 Commence refitting by positioning the gearbox under the front of the vehicle, and support with a trolley jack and interposed block of wood, as during removal.

31 Check that the clutch release arm and bearing are correctly fitted, and lightly grease the input shaft splines.

32 Raise the gearbox, then carefully offer the gearbox to the engine, ensuring that the engine adapter plate is correctly positioned, until the bellhousing is located on the dowels in the cylinder block. Refit the engine-to-gearbox bolts and nut, but do not fully tighten them at this stage. Make sure that any brackets noted during removal are in place under the engine-to-gearbox bolts. Ensure that the weight of the gearbox is not allowed to hang on the input shaft as it is engaged with the clutch friction disc.

33 Refit the centre engine/gearbox mounting (do not fit the smaller mounting-to-gearbox nuts at this stage, as it also secures the bellhousing cover plate), and tighten all bolts and nuts to the specified torque.

34 Refit the left-hand gearbox mounting, and tighten all bolts to the specified torque.

35 Tighten the engine-to-gearbox bolts and nut to the specified torque, then withdraw the jack from under the gearbox.

36 Refit the clutch bellhousing cover plate, and tighten the securing nuts to the specified torque.

37 Working on one side of the vehicle, remove the wire or string supporting the driveshaft, then manipulate the driveshaft as necessary to engage the inboard end with the differential.

38 Lever the lower arm down, as during removal, to engage the balljoint with the hub carrier.

39 Refit the nut and pinch-bolt securing the lower arm balljoint to the hub carrier, and tighten to the specified torque.

40 Refit the rubber bush and the washer to the end of the anti-roll bar vertical link (the convex side of the washer should lie against the bush), then fit the securing nut and tighten it to the specified torque.

41 Repeat the procedure given in paragraphs 37 to 40 inclusive on the remaining side of the vehicle.

42 Refit the starter motor, ensuring that the wiring harness bracket is in position under the top securing bolt.

43 Refit the gearbox splash shield, and reconnect the brake pad wear sensor wire.

44 If a hoist and lifting tackle has been used to support the engine, either disconnect the lifting tackle, or lower the hoist sufficiently to enable the vehicle to be lowered to the ground.

45 Refit the roadwheels and lower the vehicle to the ground. Fully tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trims.

46 Disconnect and remove the equipment used to support the engine, if not already done.

47 Reconnect the earth strap to the gearbox casing and tighten the securing bolt.

48 On models with digital instruments, reconnect the wiring to the speedometer sender unit.

49 On models with analogue instruments reconnect the speedometer cable to the gearbox, and tighten the securing sleeve. Ensure that the cable is routed as noted previously.

50 Reconnect the wiring to the reversing lamp switch.

51 Reconnect the clutch cable to the release arm, ensuring that it is routed as noted previously. Refit the plastic block, adjuster nut and locknut to the threaded rod at the end of the cable, and locate the cable sheath rubber grommet in the lugs on the gearbox casing. Screw the adjuster nut and locknut onto the threaded rod to leave the approximate amount of exposed thread noted before removal, then adjust the cable as described in Chapter 5.

52 Reconnect the three gear selector rods to the gearbox, in their previously noted positions, and tighten the securing nuts.

53 Reconnect the battery negative lead.

54 Refill the gearbox with oil as described in Section 2.

## 6 Gearbox overhaul - general

If gearbox overhaul is considered necessary, careful consideration should be given to the likely cost. It is often more economical to obtain a factory exchange or good second-hand unit, rather than to fit new components to the existing gearbox.

Overhaul of the gearbox requires the use of certain special tools, and a number of components must be renewed regardless of their condition. It is suggested that the relevant procedures are studied closely before starting work, in order to ensure that the necessary tools and new components are available.

Before starting work, prepare a clean working surface, with containers and trays handy to store the various components. Label all components as they are removed, and make a note of the orientation of fitted components if any confusion is likely to arise during reassembly.

All circlips should be renewed as a matter of course, as should bearings, unless they are known to be in perfect condition.

Before commencing reassembly, all components must be absolutely clean. Lubricate all components with clean engine oil during reassembly.

## 7 Gearbox - dismantling into major assemblies

- 1 Clean the exterior of the gearbox with paraffin and wipe dry.
- 2 Remove the clutch release bearing, arm and fork rod as described in Chapter 5, Section 9.
- 3 Unscrew and remove the reversing lamp switch.
- 4 Extract the speedometer drive clamp screw using a suitable Allen key or hexagon bit, then withdraw the speedometer drive assembly.
- 5 Unscrew the six securing bolts and withdraw the gearbox endplate.
- 6 Using a suitable punch or similar tool, relieve the staking on the mainshaft and input shaft nuts.
- 7 Extract the screw securing the 5th gear selector fork to the selector shaft.
- 8 Move the 5th gear selector fork downwards to engage 5th gear (photo), then engage any other gear by moving the selector lever. This will lock the mainshaft and input shaft together to enable the nuts to be unscrewed.

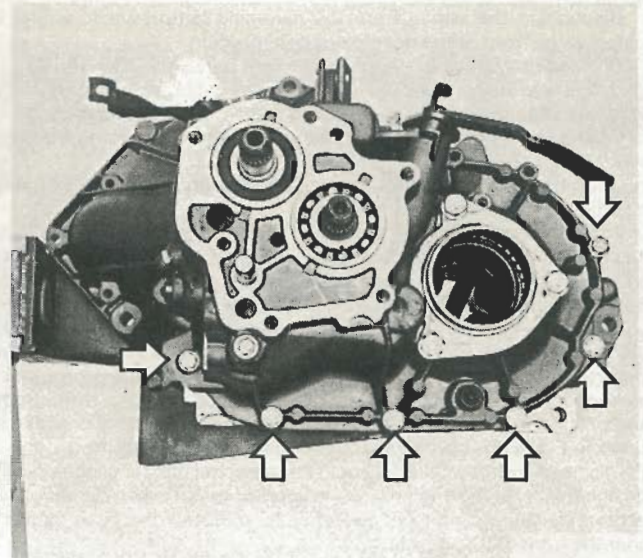
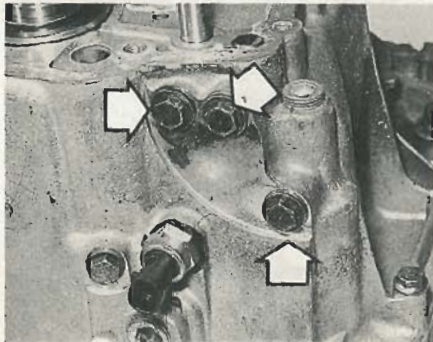


Fig. 6.4 Six of the gearbox casing-to-bellhousing bolts (arrowed) - external selector lever assembly removed (Sec 7)

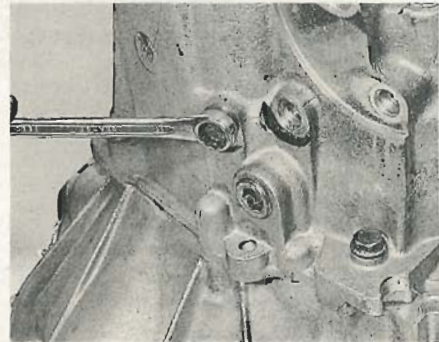




7.8 Extract the securing screw and move the 5th gear selector fork downwards to engage 5th gear



7.16 Gearbox detent plugs (arrowed)



7.19 Tightening the reverse idler shaft securing bolt

9 Using a suitable socket, loosen the mainshaft and input shaft nuts, but do not remove them at this stage.

10 Slide the 5th speed synchro sleeve into the neutral position, then remove the input shaft nut, and carefully withdraw the 5th gear synchro assembly along with the selector fork and 5th driving gear. Note that the synchro sleeve fits with the stepped end uppermost.

11 Separate the synchro assembly from the 5th driving gear, and recover the synchro ring. Take care not to allow the synchro components to fly apart, as it is very easy to lose the rollers and springs. Recover the washer from the top of the synchro hub.

12 Lift the needle-roller bearing from the sleeve on the input shaft, then withdraw the sleeve and collar from the shaft.

13 Remove the mainshaft nut, and withdraw the 5th driven gear.

14 Unscrew the single securing bolt and withdraw the intermediate plate from the gearbox casing.

15 Extract the shaft bearing circlips from the grooves in the bearings using a suitable pair of circlip pliers.

16 Unscrew the three detent plugs from the edge of the gearbox casing, and recover the detent springs and balls (photo).

17 Working inside the clutch bellhousing, unscrew the eight bolts, accessible from the top of the gearbox casing, which secure the gearbox casing to the clutch bellhousing – see Fig. 6.4. Note that two of the bolts also secure the external selector lever assembly to the gearbox casing.

18 Working inside the clutch bellhousing, unscrew the three bolts securing the gearbox casing to the bellhousing.

19 Unscrew the bolt securing the reverse idler shaft to the side of the gearbox casing (photo).

20 Select neutral, then push the gear selector lever upwards towards the top of the gearbox casing, and carefully lever the gearbox casing away from the bellhousing using two screwdrivers inserted between the mating faces. Take care not to damage the mating faces.

21 Unscrew the two securing bolts and remove the reverse selector fork assembly.

22 Extract the screws securing the 1st/2nd and 3rd/4th selector forks to their respective selector shafts.

23 Lift the 5th/reverse shaft slightly, then withdraw the 3rd/4th selector shaft, leaving the 3rd/4th selector fork in position. Recover the interlock pin from the end of the 3rd/4th selector shaft.

24 Withdraw the 1st/2nd selector shaft, then slide the 1st/2nd selector fork from the synchro sleeve.

25 Withdraw the 5th/reverse selector shaft complete with the 3rd/4th selector fork. If desired, the 5th/reverse selector dog sleeve can be removed from the selector shaft by driving out the securing roll-pin.

26 Recover the remaining two interlock pins from their locations in the bellhousing.

27 Lift the mainshaft and input shaft slightly to enable the reverse idler gear assembly to be withdrawn. Note the positions of the two sleeves on the reverse idler shaft. The cut-out in the lower sleeve locates over a lug on the bellhousing. If desired, the sleeves and the reverse idler gear can be withdrawn from the shaft.

28 Carefully lift the mainshaft and input shaft geartrains from the bellhousing as an assembly.

29 Recover the swarf-collecting magnet from its location in the gearbox casing.

30 The differential assembly can now be lifted from the bellhousing if desired.

31 If desired, the gear selector lever assembly can be removed from the gearbox casing with reference to Section 13. For details of differential overhaul, refer to Section 11.

## 8 Input shaft – overhaul

**Note:** A suitable gear puller will be required during this operation

1 Clamp the rear (5th gear) end of the shaft in a soft-jawed vice.

2 Using a suitable bearing splitter tool, pull the bearing from the splined end of the shaft (photo). The bearing is extremely close to a gear, and very little clearance is available to use a puller. It is quite likely that the bearing will be damaged during removal.

3 Turn the shaft over, and clamp the opposite end in the vice.

4 Using a suitable puller, with the claws positioned under the 3rd driving gear, pull the complete gears/synchro/bearing assembly from the shaft (photo).

5 Separate the components, taking care not to allow the synchro components to fly apart, as it is very easy to lose the rollers and springs.

6 Examine all components for wear and damage. If any of the gears are worn or damaged, the complete gear cluster must be renewed, as must the corresponding gears on the mainshaft.

7 The synchro unit can be overhauled as described in Section 10.

8 Renew the bearings unless their condition is known to be perfect.

9 With all components clean and well oiled, commence reassembly as follows.

10 With the splined (clutch) end of the shaft clamped in a soft-jawed vice, slide the 3rd gear needle-roller bearing over the shaft (photo).

11 Slide the 3rd driving gear over the needle-roller bearing (photo).

12 Ensure that the synchro unit is correctly assembled, as described in Section 10, then fit the assembly, and leave the clips holding the assembly together in position until reassembly of the shaft is complete. Note that the 3rd gear synchro ring has a rough internal face with widely-spaced oil grooves, while the 4th gear synchro ring has a machined internal face with closely-spaced oil grooves (photos).

13 Fit the 4th gear bearing sleeve (photo).

14 Fit the 4th gear needle-roller bearing (photo).

15 Slide the 4th driving gear over the needle-roller bearing (photo).

16 Fit the thrustwasher (photo).

17 Fit the bearing, with the circlip groove furthest away from the 4th driving gear. Press or drive the bearing down the shaft, using a length of suitable diameter tubing applied to the bearing inner race (photo).

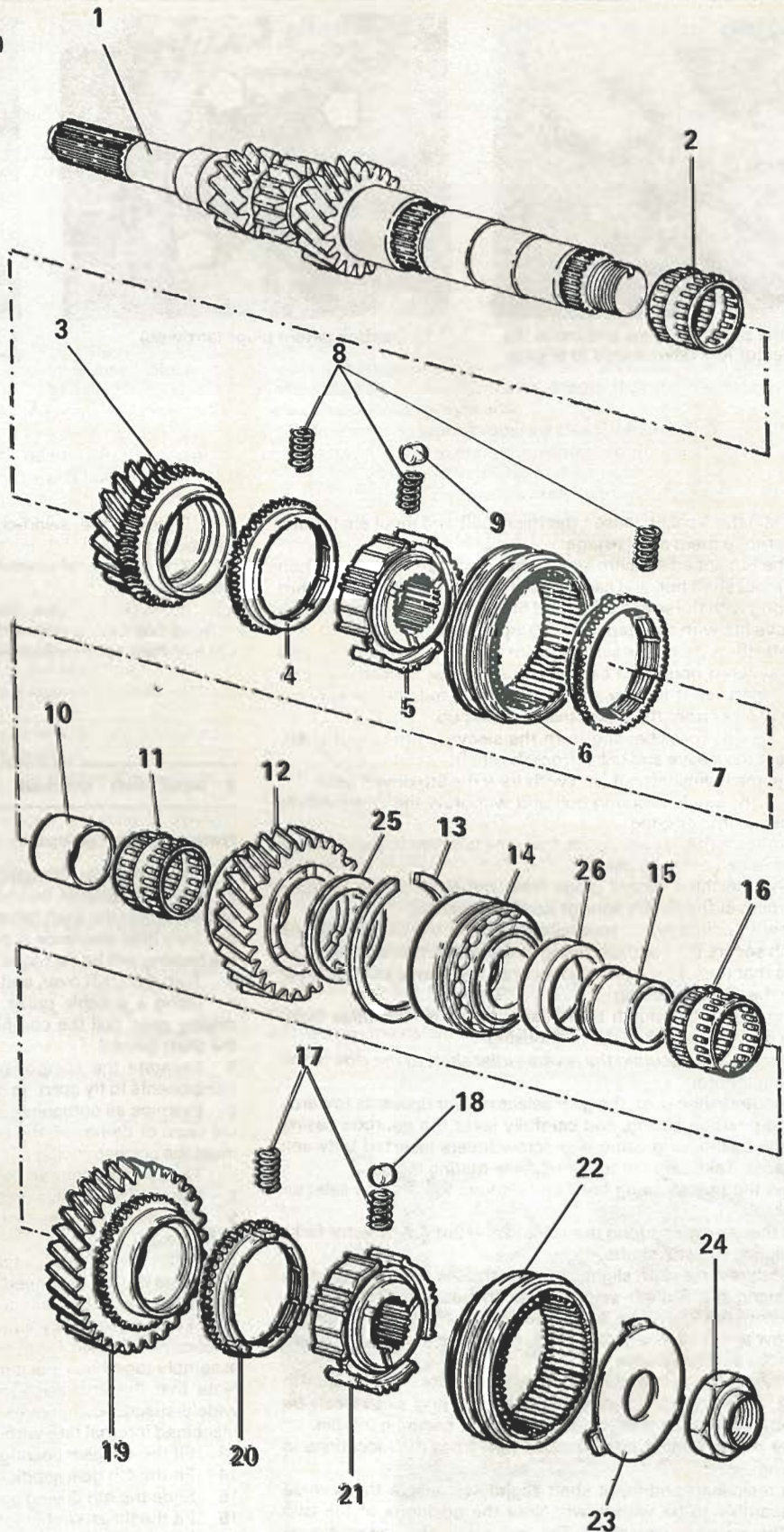
18 The clips can now be removed from the synchro assembly.

19 Turn the shaft over and clamp the opposite end in the vice.

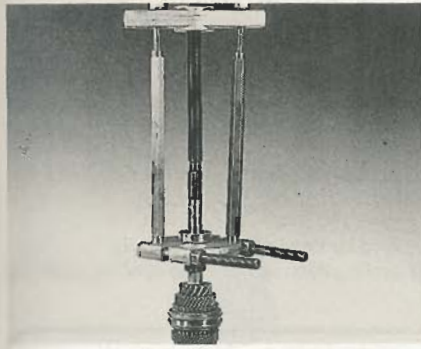


Fig. 6.5 Input shaft components (Sec 8)

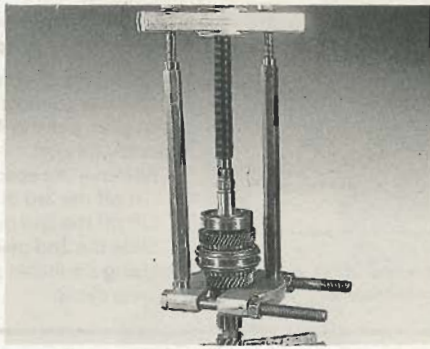
- 1 Shaft
- 2 3rd gear needle-roller bearing
- 3 3rd driving gear
- 4 3rd gear synchro ring
- 5 3rd/4th gear synchro hub
- 6 3rd/4th gear synchro sleeve
- 7 4th gear synchro ring
- 8 Synchro springs
- 9 Synchro roller
- 10 4th gear bearing sleeve
- 11 4th gear needle-roller bearing
- 12 4th driving gear
- 13 Circlip
- 14 Bearing
- 15 5th gear bearing sleeve
- 16 5th gear needle-roller bearing
- 17 Synchro springs
- 18 Synchro roller
- 19 5th driving gear
- 20 5th gear synchro ring
- 21 5th gear synchro hub
- 22 5th gear synchro sleeve
- 23 Washer
- 24 Input shaft nut
- 25 Thrustwasher
- 26 Collar



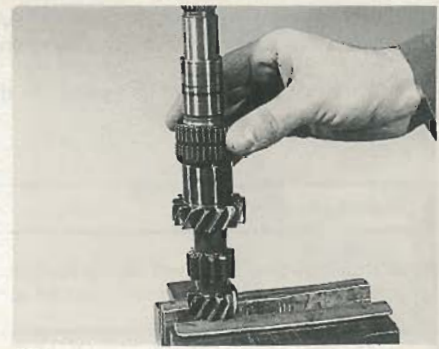




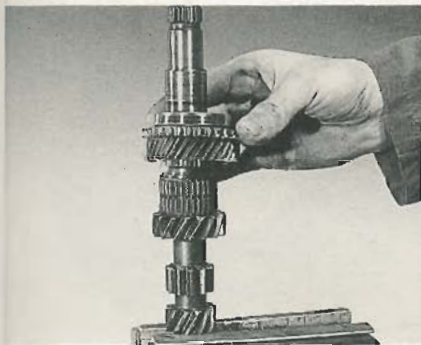
8.2 Using a bearing splitter tool to remove the input shaft bearing



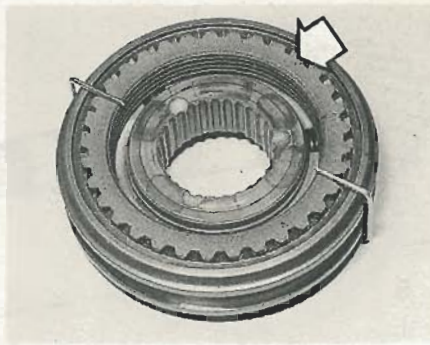
8.4 Using a puller to remove the gears/synchro/bearing assembly from the input shaft



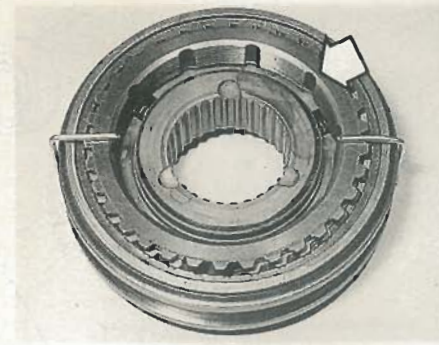
8.10 Slide the 3rd gear needle-roller bearing over the input shaft ...



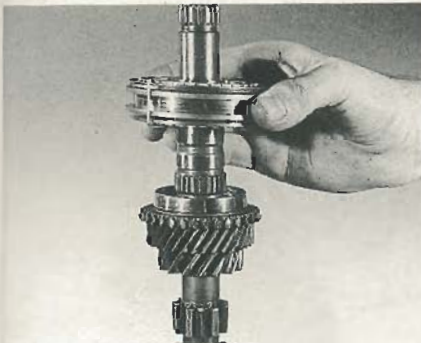
8.11 ... then slide the 3rd driving gear over the bearing



8.12A The 3rd gear synchro ring (arrowed) has a rough internal face with widely-spaced oil grooves



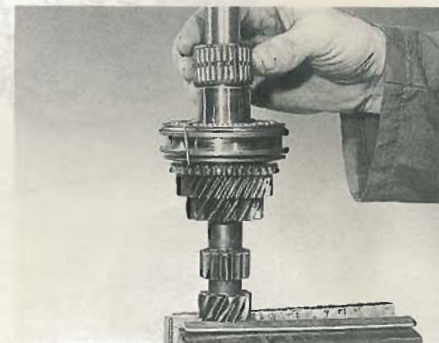
8.12B The 4th gear synchro ring (arrowed) has a machined internal face with closely-spaced oil grooves



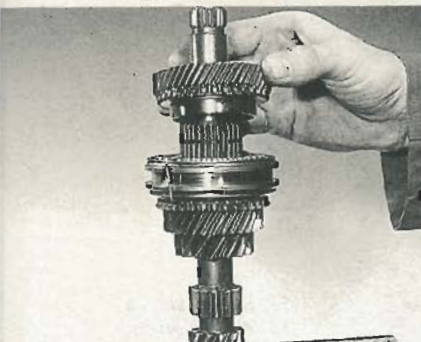
8.12C Fit the synchro unit ...



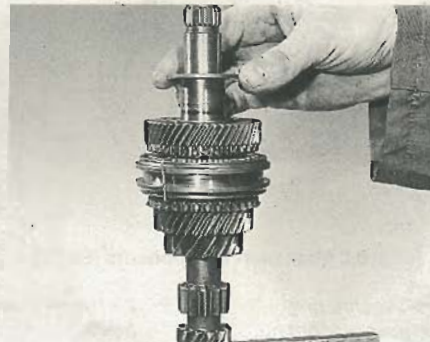
8.13 ... followed by the 4th gear bearing sleeve



8.14 ... the 4th gear needle-roller bearing ...



8.15 ... the 4th driving gear ...



8.16 ... and the thrustwasher



8.17 Drive the bearing down the shaft using a piece of tubing



20 Fit the bearing to the shaft. Press or drive the bearing down the shaft, using a length of suitable diameter tubing applied to the bearing inner race.

21 Check that all gears turn freely and that the synchro sleeve slides freely.

### 9 Mainshaft - overhaul

**Note:** A suitable gear puller will be required during this operation. A new synchro assembly retaining circlip must be used on reassembly. If the

mainshaft is renewed, it is advisable to renew the differential crownwheel to ensure correct meshing of the crownwheel and pinion

- 1 Clamp the pinion end of the shaft in a soft-jawed vice.
- 2 Using a suitable puller, with the claws positioned under the 4th driven gear, pull the 4th driven gear and the bearing from the shaft as an assembly (photo).
- 3 Remove the spacer sleeve from the shaft.
- 4 Lift off the 3rd driven gear.
- 5 Lift off the 2nd driven gear.
- 6 Slide the 2nd gear needle-roller bearing from the shaft.
- 7 Using a suitable pair of circlip pliers, remove the synchro assembly retaining circlip.

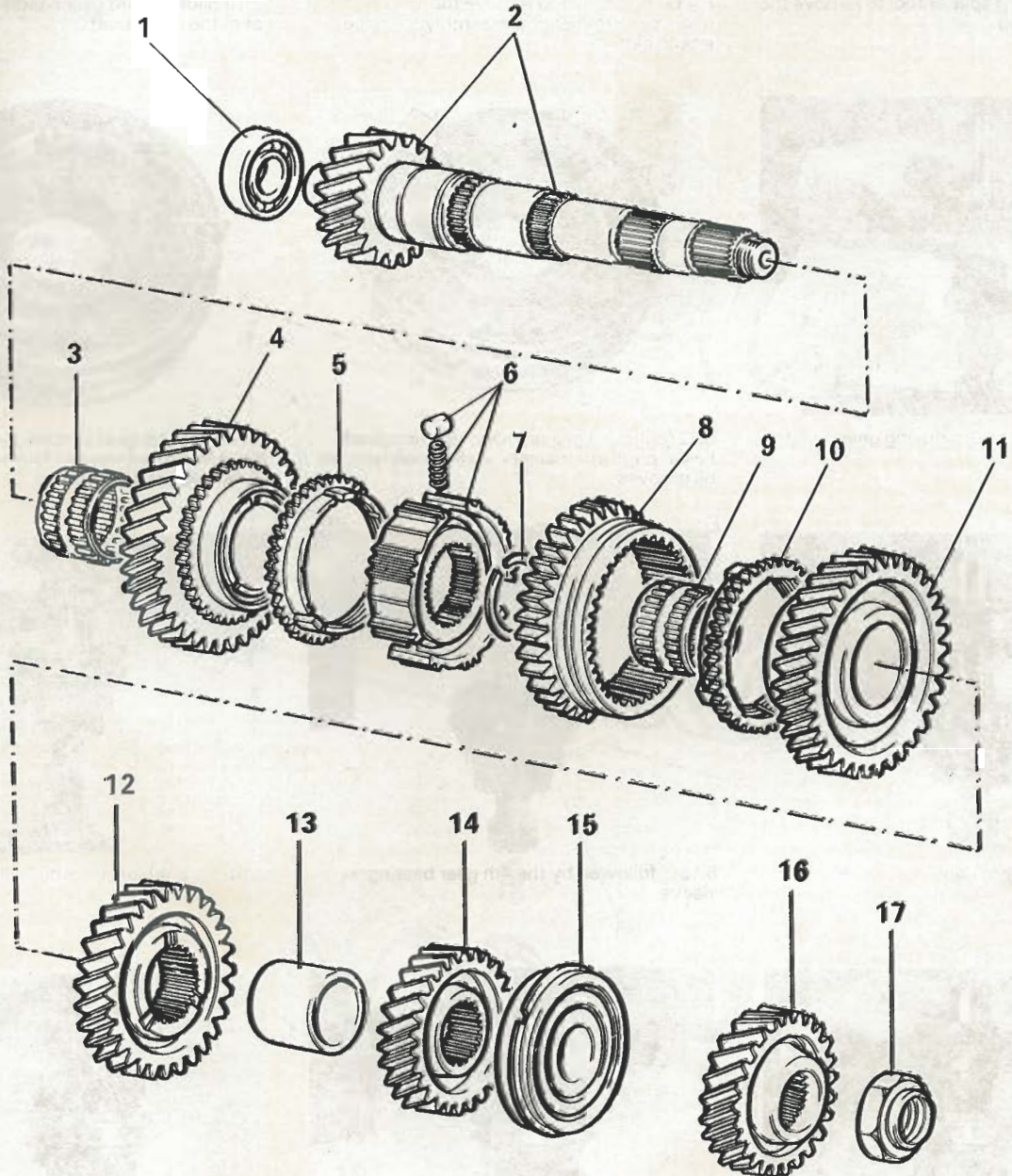


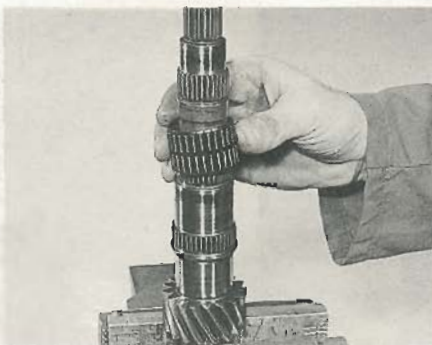
Fig. 6.6 Mainshaft components (Sec 9)

- |                                  |   |                                  |                    |
|----------------------------------|---|----------------------------------|--------------------|
| 1 Bearing                        | 5 1st gear synchro ring                       | 9 2nd gear needle-roller bearing | 13 Spacer sleeve   |
| 2 Mainshaft                      | 6 1st/2nd gear synchro hub, spring and roller | 10 2nd gear synchro ring         | 14 4th driven gear |
| 3 1st gear needle-roller bearing | 7 Circlip                                     | 11 2nd driven gear               | 15 Bearing         |
| 4 1st driven gear                | 8 1st/2nd gear synchro sleeve                 | 12 3rd driven gear               | 16 5th driven gear |
|                                  |   |                                  | 17 Mainshaft nut   |

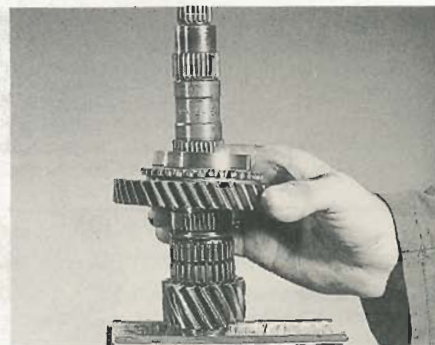




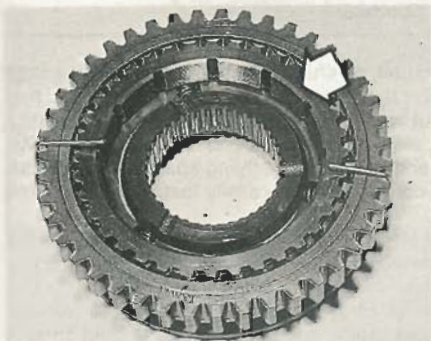
9.2 Using a puller to remove the bearing and 4th driven gear from the mainshaft



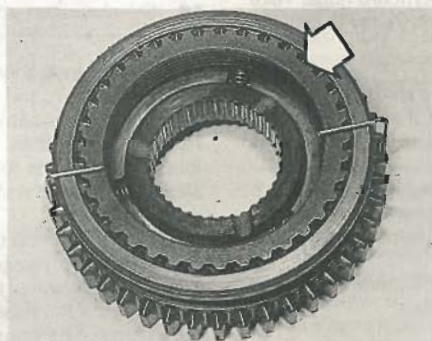
9.15 Slide the 1st gear needle-roller bearing over the mainshaft ...



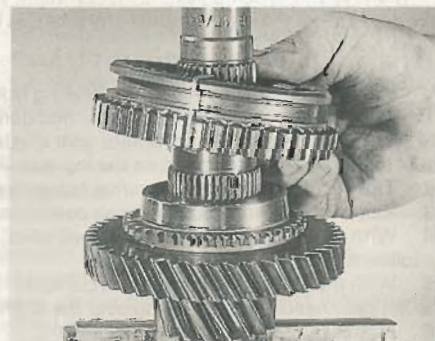
9.16 ... followed by the 1st driven gear



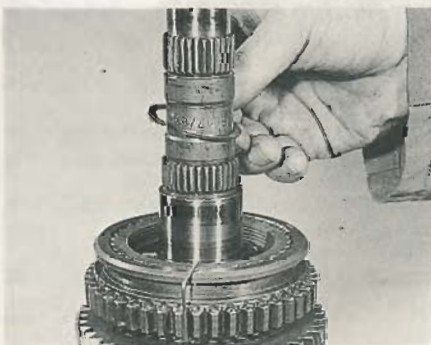
9.17A The 1st gear synchro ring (arrowed) has a machined internal face with closely-spaced oil grooves



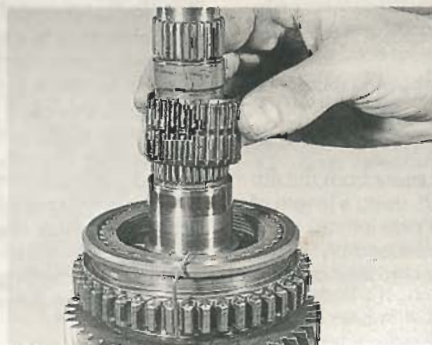
9.17B The 2nd gear synchro ring (arrowed) has a rough internal face with widely-spaced oil grooves



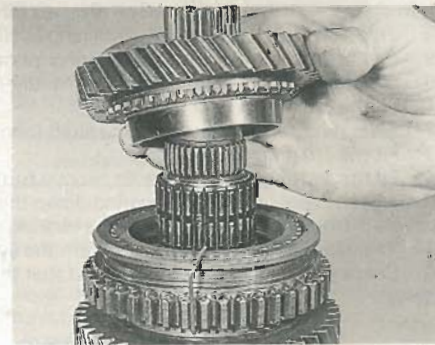
9.17C Fit the synchro unit ...



9.18 ... followed by a new circlip



9.19 Fit the 2nd gear needle-roller bearing ...



9.20 ... then slide the 2nd driven gear over the bearing

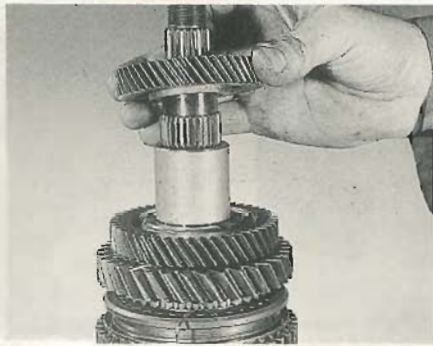


9.21 Fit the 3rd driven gear ...



9.22 ... followed by the spacer sleeve, ...





9.23 ... and the 4th driven gear



9.24 Drive the bearing down the shaft using a piece of tubing

8 Remove the synchro assembly, complete with synchro rings. Take care not to allow the synchro unit to fly apart, as it is very easy to lose the rollers and springs.

9 Lift off the 1st driven gear.

10 Slide the 1st gear needle-roller bearing from the shaft.

11 Examine all components for wear and damage. If any of the gears are worn or damaged, the complete gear cluster must be renewed, as must the corresponding gears on the input shaft.

12 The synchro unit can be overhauled as described in Section 10.

13 Renew the bearings unless their condition is known to be perfect.

14 With all components clean and well oiled, commence reassembly as follows.

15 With the pinion end of the shaft clamped in a soft-jawed vice, slide the 1st gear needle-roller bearing over the shaft (photo).

16 Fit the 1st driven gear (photo).

17 Ensure that the synchro unit is correctly assembled, as described in Section 10, then fit the assembly, and leave the clips holding the assembly together in position until reassembly of the shaft is complete. Note that the 1st gear synchro ring has a machined internal face with closely-spaced oil grooves, while the 2nd gear synchro ring has a rough internal face with widely-spaced oil grooves (photos).

18 Fit a new synchro assembly retaining circlip (photo).

19 Fit the 2nd gear needle-roller bearing (photo).

20 Slide the 2nd driven gear over the needle-roller bearing (photo).

21 Fit the 3rd driven gear (photo).

22 Slide the spacer sleeve over the shaft (photo).

23 Fit the 4th driven gear (photo).

24 Fit the bearing, with the circlip groove furthest away from the 4th driven gear. Press or drive the bearing down the shaft, using a length of suitable diameter tubing applied to the bearing inner race (photo).

25 The clips can now be removed from the synchro assembly.

26 Check that all gears turn freely and that the synchro sleeve slides freely.

## 10 Synchroniser units - overhaul

1 To dismantle a synchro unit, carefully slide the synchro sleeve from the synchro hub, and recover the rollers and springs. It is suggested that this procedure is carried out with the synchro assembly placed inside a high-walled container, such as a cardboard box, as it is virtually impossible to prevent the rollers and springs from flying apart as the synchro sleeve is moved, and the components are easily lost. You have been warned! (photo).

2 If either the hub or the sleeve shows signs of wear in its teeth, the individual part may be renewed, but general wear is best rectified by complete renewal of the unit.

3 To check the synchro rings for wear, twist them onto their relevant gear cones. The rings should "stick" to the cone, and should show a definite clearance between the ring teeth and the synchro teeth on the gear shoulder. If these conditions are not met, renew the synchro ring(s).

4 Renew the synchro springs if they are broken, or have become weak, and renew the rollers if they show any signs of pitting or wear.

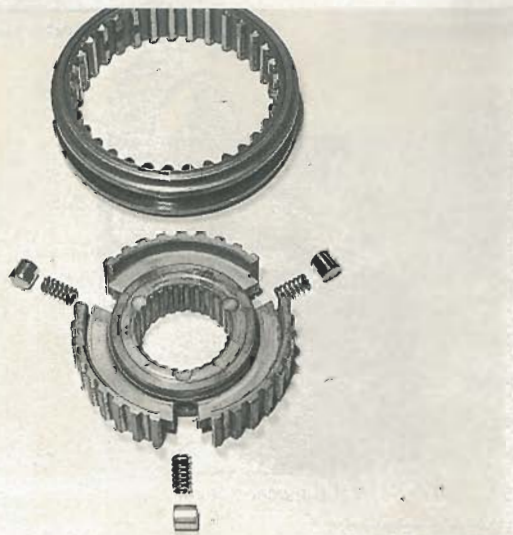
### 1st/2nd and 3rd/4th gear synchro assemblies

5 Commence reassembly by fitting the synchro springs to the synchro hub, then slide the synchro sleeve over the hub, ensuring that the notches for the rollers in the sleeve are aligned with the springs and cut-outs in the hub.

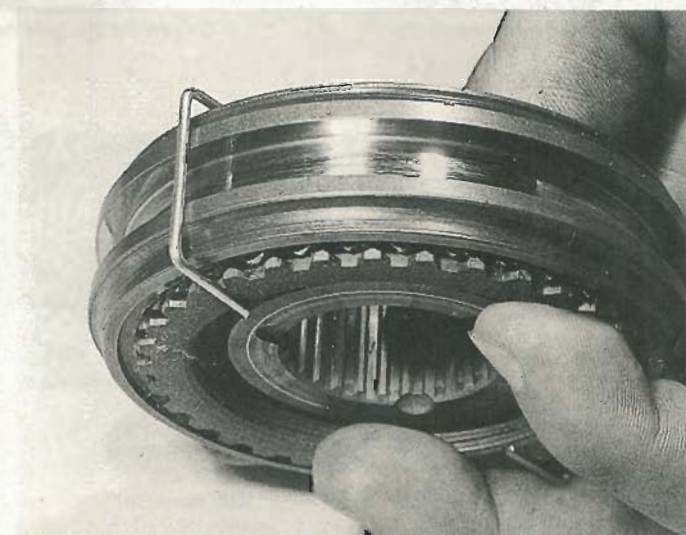
6 Fit one of the synchro rings, noting that the lugs on the ring must engage with the cut-outs in the synchro hub, and turn the assembly over so that it is resting on the synchro ring.

7 Using a screwdriver, carefully manipulate the three rollers into position between the springs and the synchro sleeve. This is a tricky operation, and patience will be required.

8 Fit the remaining synchro ring (again noting that the lugs must engage with the cut-outs in the hub), which will help to retain the rollers



10.1 Synchroniser unit components

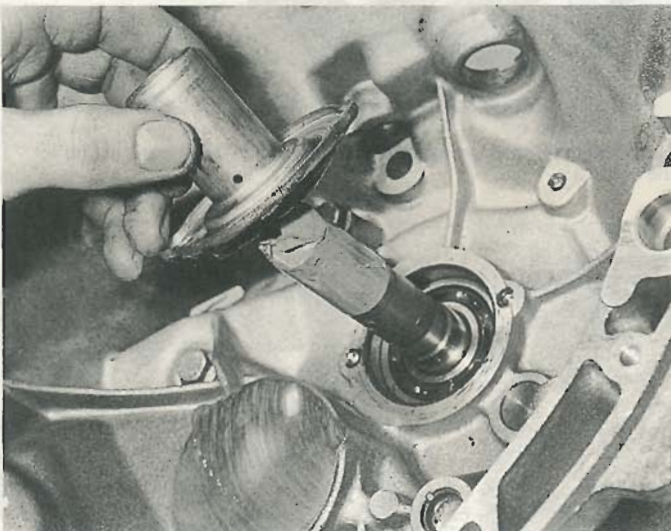


10.8 Hold the synchro assembly together using suitable clips





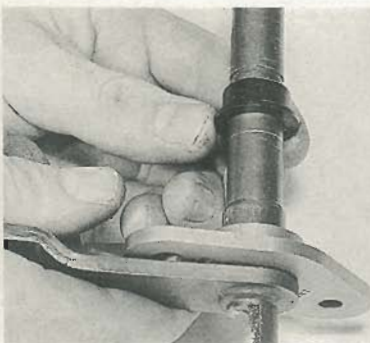
12.5 A suitable socket can be used to drive the input shaft oil seal into the guide sleeve



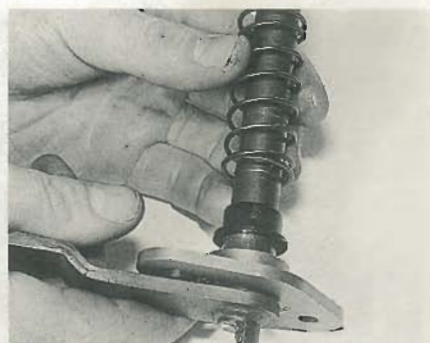
12.7 Sliding the guide sleeve over the input shaft (note adhesive tape over end of shaft)



13.14 Sliding the mounting plate over the gear selector shaft



13.15A Fit the thrust collar ...



13.15B ... followed by the spring, ...

and springs in position, then hold the complete assembly together using suitable clips manufactured from welding rod or stiff wire (photo).

9 The assembly is now ready for refitting.

#### 5th gear synchro assembly

10 The 5th gear synchro assembly should be reassembled *in situ* on the input shaft as described in Section 15.

### 11 Differential - overhaul

**Note:** If the differential is renewed, or if new bearings are fitted, it will be necessary to have the bearing preload adjusted by a FIAT dealer once the gearbox has been reassembled. If the crownwheel is renewed, it is advisable to renew the gearbox mainshaft to ensure correct meshing of the crownwheel and pinion

1 Before considering overhaul of the differential assembly, compare the price of the new components required with the cost of a new or reconditioned unit, as it may prove more economical to fit a complete new assembly. In any case, it is unlikely that individual components will be worn or damaged, without affecting the surrounding components.

2 Dismantling and reassembly of the differential is best entrusted to a dealer who will have the necessary tools and facilities to ensure correct reassembly.

### 12 Input shaft oil seal - renewal

1 With the engine or gearbox removed, proceed as follows.

2 Slide the clutch release bearing from the guide sleeve.

3 Unscrew the two guide sleeve securing bolts, and withdraw the guide sleeve from the bellhousing.

4 Using a screwdriver, prise the oil seal assembly from the rear of the guide sleeve.

5 Drive the new oil seal assembly into the guide sleeve using a metal tube or socket of suitable diameter (photo).

6 Wrap a length of adhesive tape around the splined end of the gearbox input shaft to prevent damage to the oil seal as it is refitted.

7 Slide the guide sleeve over the input shaft, then refit and tighten the securing bolts (photo).

8 Remove the adhesive tape from the end of the input shaft.

9 Refit the clutch release bearing.

### 13 Gear selector lever assembly - overhaul

1 The gear selector lever assembly is mounted in the gearbox casing.

2 With the gearbox casing removed as described in Section 7, proceed as follows.

3 Unbolt the external lever assembly from the gearbox casing, and pull the assembly from the rubber selector cover.

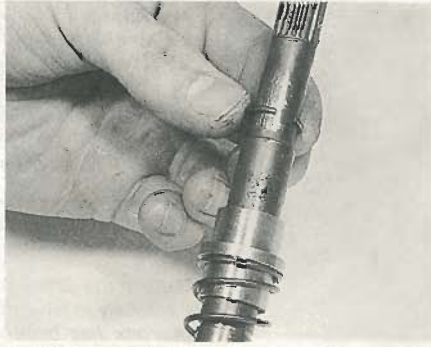
4 Pull the rubber selector cover from the selector lever.

5 Unscrew the two bolts securing the selector shaft mounting plate to the gearbox casing.

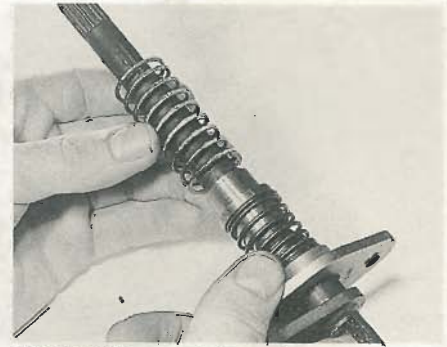




13.16A ... centre sleeve ...



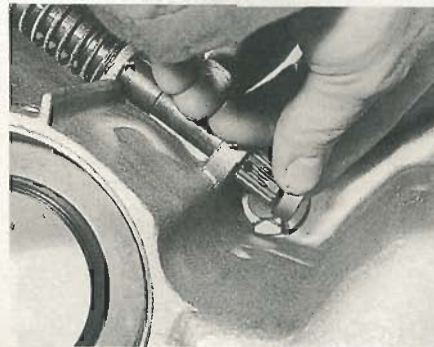
13.16B ... and circlip



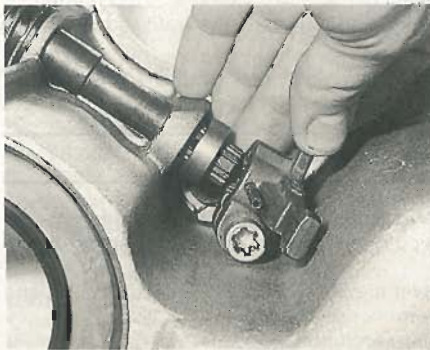
13.17A Fit the remaining spring ...



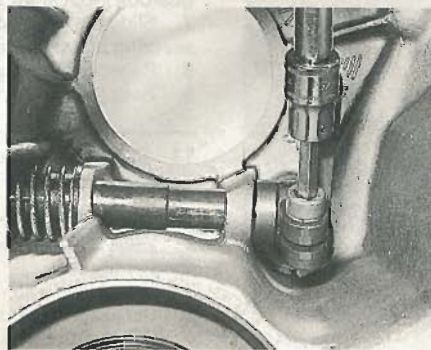
13.17B ... and the thrust collar



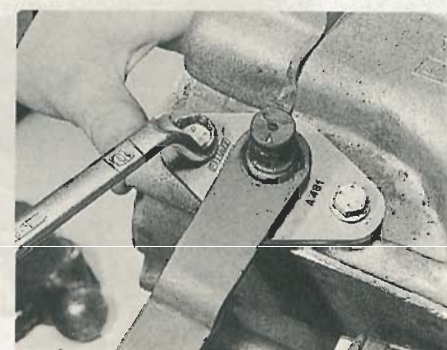
13.19 Refit the spacer sleeve to the end of the shaft ...



13.20 ... followed by the selector fork



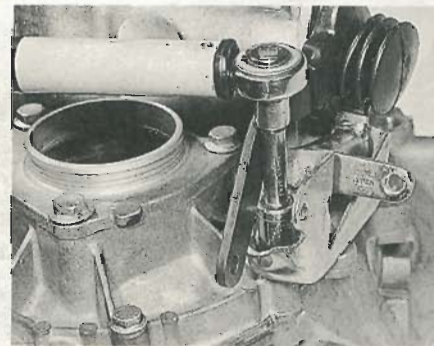
13.22 Tightening the selector fork bolt



13.23 Tightening a selector shaft mounting plate securing bolt



13.25A Refit the external lever assembly ...



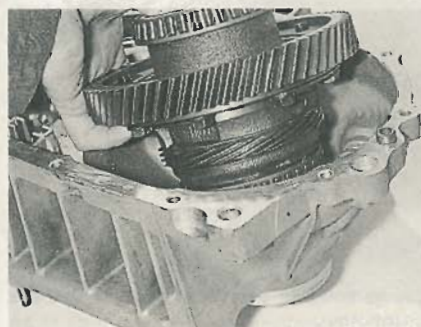
13.25B ... and tighten the securing bolts



- 6 Working inside the casing, using a suitable pin punch, drive out the roll-pin securing the selector fork to the end of the shaft.
- 7 Using a suitable Allen key or hexagon bit, loosen the bolt securing the selector fork to the end of the shaft, then manipulate the shaft as necessary to enable removal of the selector fork. Note that the fork locates on a master spline on the end of the shaft.
- 8 Recover the spacer sleeve from the end of the shaft.
- 9 Withdraw the selector shaft from the gearbox casing.
- 10 Slide the thrust collar and the spring from the end of the selector shaft.
- 11 Using a suitable pair of circlip pliers, remove the circlip from the shaft, then withdraw the centre sleeve, and the remaining spring and thrust collar. If desired, the mounting plate can now be slid from the selector shaft.
- 12 Examine all components for wear and damage, and renew as necessary. Pay particular attention to the springs, and renew them if they are weak or broken.
- 13 Commence reassembly as follows.
- 14 Slide the mounting plate over the shaft. Note that the plate fits with the boss furthest away from the selector lever (photo).
- 15 Fit the thrust collar, with its larger diameter nearest the mounting plate, then refit the spring (photos).
- 16 Fit the centre sleeve, and secure with the circlip (photos).
- 17 Fit the remaining spring and thrust collar, noting that the thrust collar should fit with its smaller diameter inside the spring (photos).
- 18 Slide the selector shaft into the gearbox casing.
- 19 Fit the spacer sleeve to the end of the shaft (photo).
- 20 Fit the selector fork to the end of the shaft, ensuring that the fork engages with the master spline on the shaft (photo).
- 21 Push the selector fork onto the shaft until the roll-pin holes in the fork line up with the hole in the shaft, then secure the fork to the shaft using a new roll-pin.
- 22 Tighten the bolt securing the selector fork to the end of the shaft (photo).
- 23 Fit and tighten the two bolts securing the selector shaft mounting plate to the gearbox casing (photo).
- 24 Fit the rubber cover to the selector lever.
- 25 Fit the external lever assembly, engaging it with the rubber cover, then refit and tighten the securing bolts (photos). Note that two of the securing bolts also secure the gearbox casing to the bellhousing.
- 26 Where applicable, refit the gearbox casing as described in Section 7.

#### 14 Gearbox casing - overhaul

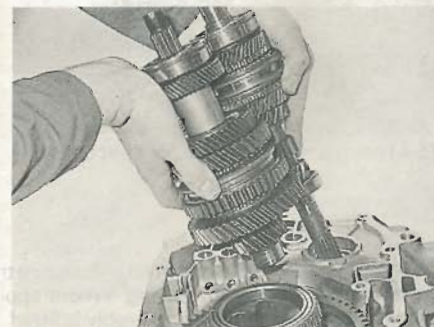
- 1 The clutch release assembly can be removed from the bellhousing as described in Chapter 5, Section 9, and the input shaft oil seal can be renewed as described in Section 12 of this Chapter.
- 2 Inspect the mainshaft bearing in the bellhousing, and renew if necessary by driving out the old bearing using a tube of suitable diameter on the bearing outer race. Fit a new bearing in the same way.
- 3 The differential bearings should not be disturbed unless they are to be renewed, in which case the differential bearing preload must be adjusted by a FIAT dealer once the gearbox has been reassembled. Do not unbolt the differential bearing cover from the gearbox casing unless the bearing is to be renewed.



15.1 Fitting the differential assembly



15.2 Fitting the swarf-collecting magnet



15.3 Fitting the input shaft and mainshaft gear clusters

#### 15 Gearbox - reassembly

- 1 Where applicable, refit the selector lever assembly with reference to Section 13, and refit the differential assembly (photo).
- 2 Refit the swarf-collecting magnet to its location in the gearbox casing (photo).
- 3 Mesh the input shaft and mainshaft gear clusters together, and offer them into position in the bellhousing (photo).
- 4 Examine the condition of the O-ring on the end of the reverse idler shaft, and renew if necessary (photo).
- 5 Where applicable, refit the reverse idler gear and the sleeves to the reverse idler shaft, noting that the gear must fit with the boss nearest the lower (O-ring) end of the shaft, and the lower sleeve fits with the cut-out nearest the lower end of the shaft (photos).
- 6 Lift the mainshaft and input shaft slightly to enable the reverse idler gear assembly to be fitted. Note that the cut-out in the lower sleeve locates over a lug on the bellhousing (photos).
- 7 Using a suitable pair of long-nose pliers, fit the two smaller interlock pins to their location in the bellhousing (photos).
- 8 Where applicable, refit the 5th/reverse selector dog sleeve to the 5th/reverse selector shaft, with the selector dog uppermost, and secure with a new roll-pin.
- 9 Slide the 3rd/4th selector fork over the 5th/reverse selector shaft, with the selector fork securing screw hole uppermost, then slide the selector shaft into position in the bellhousing, engaging the selector fork with the 3rd/4th synchro sleeve (photos). Note that the notch in the bottom of the selector shaft must align with the interlock pin in the bellhousing.
- 10 Fit the remaining interlock pin to its location in the bottom of the 3rd/4th selector shaft, using a little grease to retain it if necessary, then slide the selector shaft through the 3rd/4th selector fork into the bellhousing (photo). Note that the interlock pin in the end of the shaft must align with the interlock pins in the bellhousing.
- 11 Fit and tighten the screw securing the 3rd/4th selector fork to the 3rd/4th selector shaft (photo).
- 12 Engage the 1st/2nd selector fork with the 1st/2nd synchro sleeve, then slide the 1st/2nd selector shaft through the selector fork into the bellhousing (photo). Note that the notch in the bottom of the selector shaft must align with the interlock pin in the bellhousing.
- 13 Fit and tighten the screw securing the 1st/2nd selector fork to the 1st/2nd selector shaft (photo).
- 14 Fit the reverse selector fork assembly, and tighten the securing bolts (photos).
- 15 Ensure that the mating faces of the bellhousing and gearbox casing are absolutely clean, then coat the mating faces with sealant (Loctite 573, or a suitable equivalent) (photo).
- 16 Position the selector forks in neutral, then engage 2nd gear. It is suggested that the gearbox is laid on its side during this operation, otherwise 2nd gear is likely to slip out of engagement, as the detent assemblies have not yet been fitted.
- 17 Push the gear selector lever upwards towards the top of the gearbox casing, then holding the selector lever in this position, carefully lower the gearbox casing onto the bellhousing (photo). As the gearbox casing is lowered, check through the mainshaft bearing aperture that the gear selector lever engages with the 1st/2nd selector dog.
- 18 Fit and tighten the eight bolts accessible from the top of the gearbox casing which secure the gearbox casing to the bellhousing



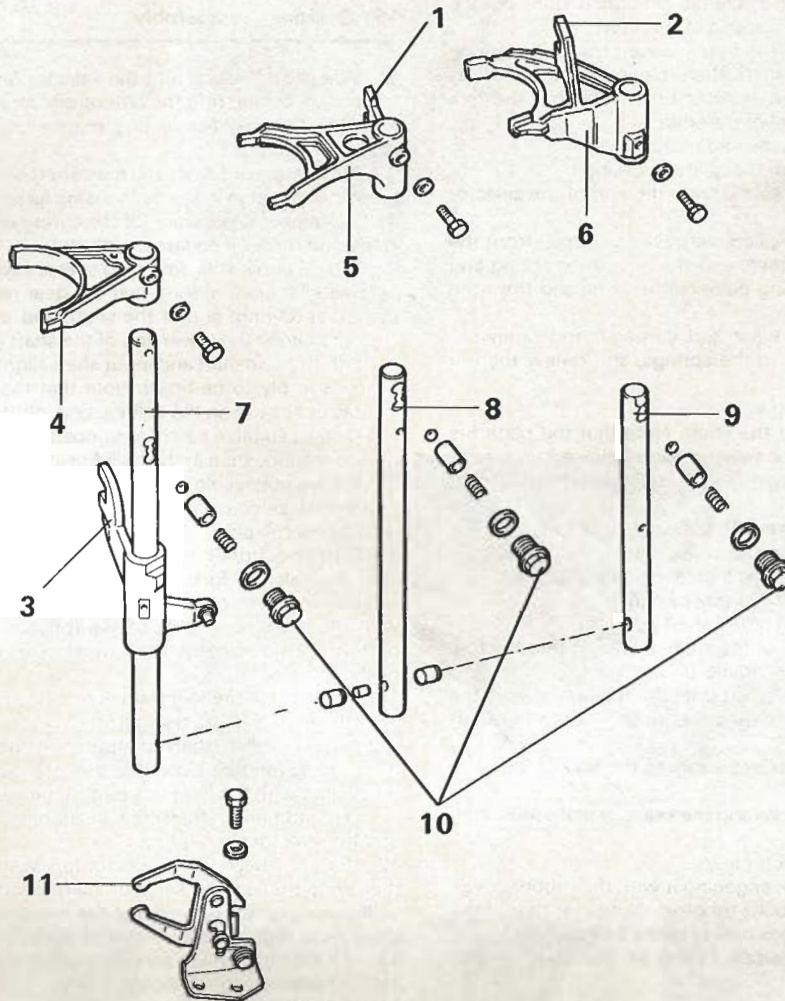
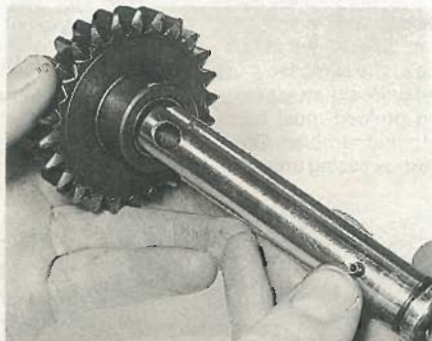


Fig. 6.7 Gear selector components (Sec 15)

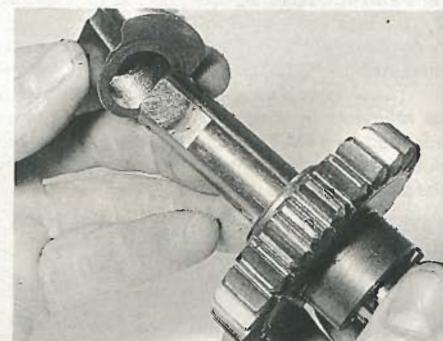
- |   |                               |   |                            |    |                                 |    |                             |
|---|-------------------------------|---|----------------------------|----|---------------------------------|----|-----------------------------|
| 1 | 3rd/4th gear selector dog     | 4 | 5th gear selector fork     | 7  | 5th/reverse gear selector shaft | 9  | 1st/2nd gear selector shaft |
| 2 | 1st/2nd gear selector dog     | 5 | 3rd/4th gear selector fork | 8  | 3rd/4th gear selector shaft     | 10 | Detent assemblies           |
| 3 | 5th/reverse gear selector dog | 6 | 1st/2nd gear selector fork | 11 | Reverse gear selector fork      |    |                             |



15.4 Fitting a new reverse idler shaft O-ring



15.5A Fit the reverse idler gear, ...



15.5B ... the upper sleeve ...

(photo). Note that two of the bolts also secure the external selector lever assembly to the gearbox casing. Where applicable, leave these two bolts until the selector lever assembly is fitted.

19 Working inside the clutch bellhousing, refit and tighten the three bolts securing the gearbox casing to the bellhousing (photo).

20 Fit and tighten the bolt securing the reverse idler shaft to the side

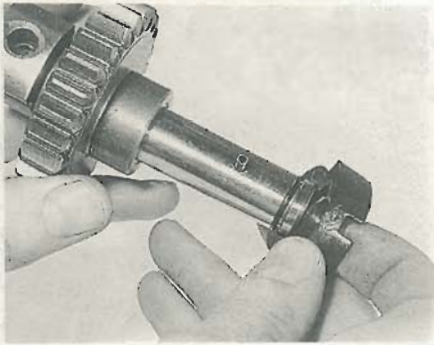
of the gearbox casing.

21 Fit the detent balls, springs and plugs to the side of the gearbox casing, and tighten the plugs (photos).

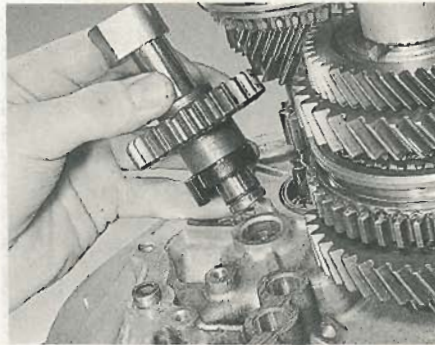
22 Fit new bearing circlips to the grooves in the bearings, aligning the circlip gaps as shown (photos).

23 Ensure that the mating faces of the gearbox casing and the

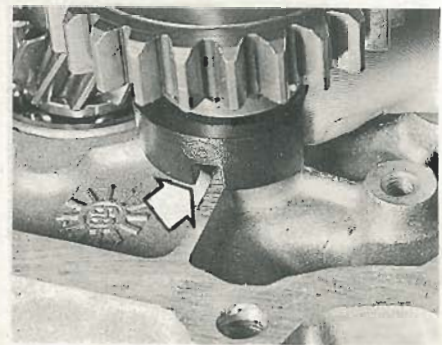




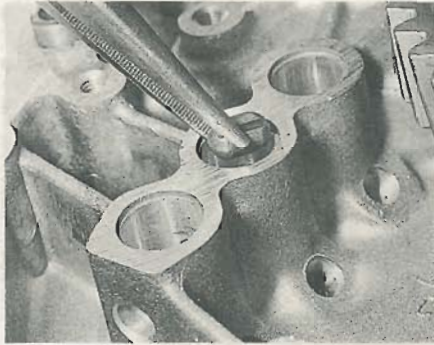
15.5C ... and the lower sleeve to the reverse idler shaft



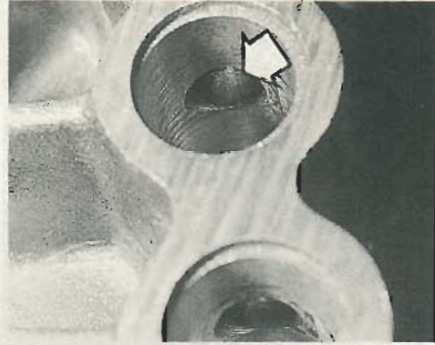
15.6A Refitting the reverse idler gear assembly



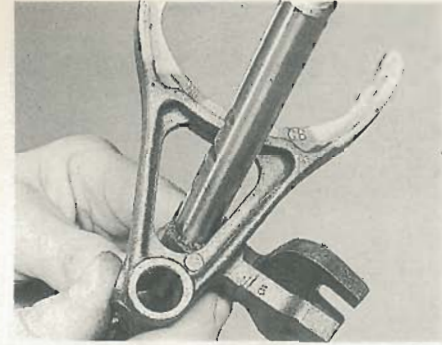
15.6B The cut-out in the lower sleeve (arrowed) locates over the lug in the bellhousing



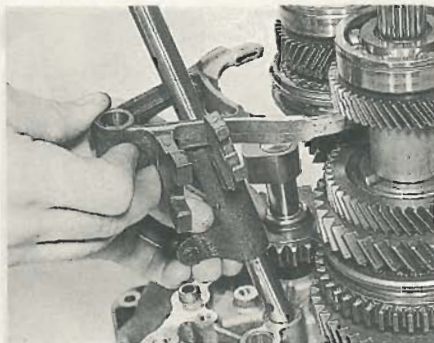
15.7A Fitting an interlock pin ...



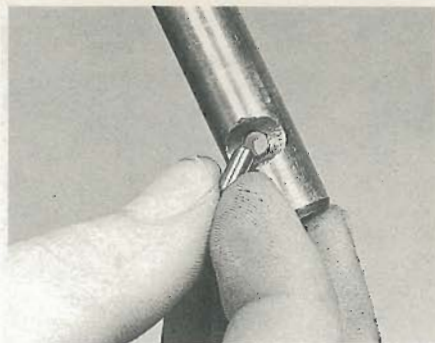
15.7B ... to its location in the bellhousing (arrowed)



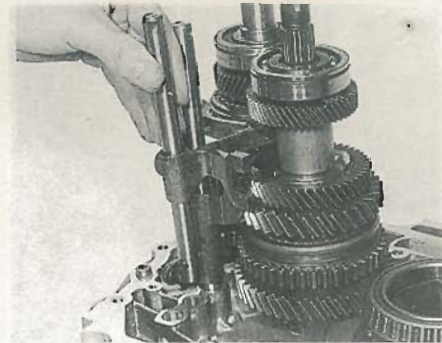
15.9A Slide the 3rd/4th selector fork over the 5th/reverse selector shaft ...



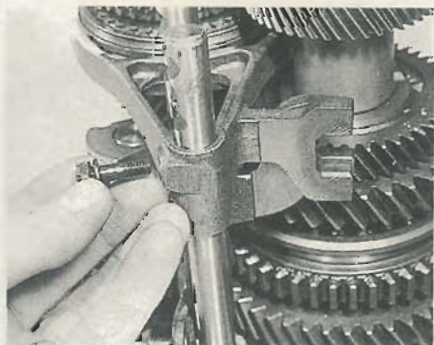
15.9B ... then fit the assembly to the bellhousing



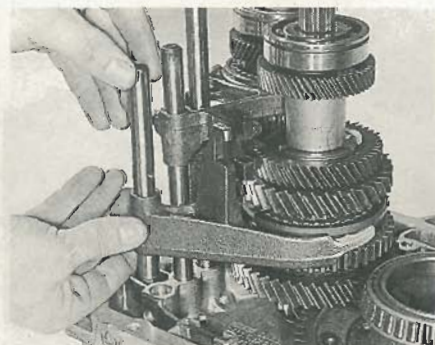
15.10A Fit the interlock pin to the 3rd/4th selector shaft ...



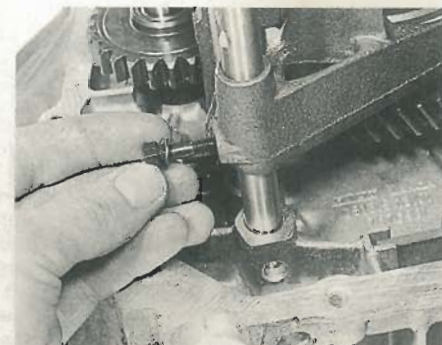
15.10B ... then fit the selector shaft



15.11 Fit the 3rd/4th selector fork securing screw

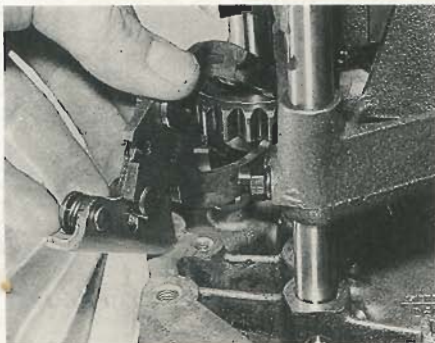


15.12 Fit the 1st/2nd selector fork and shaft ...

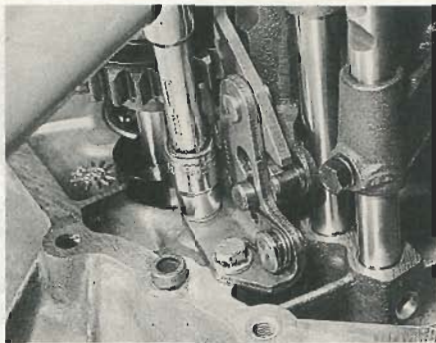


15.13 ... then fit the selector fork securing screw

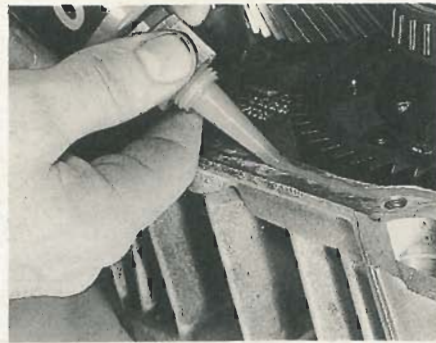




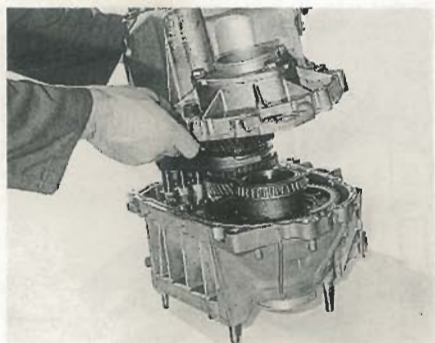
15.14A Fit the reverse selector fork assembly ...



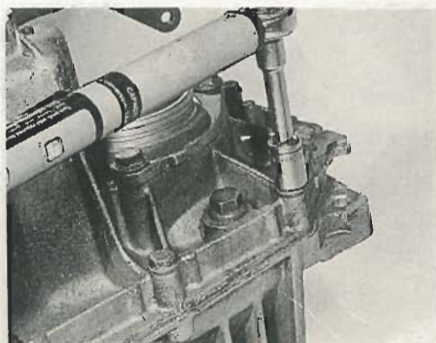
15.14B ... and tighten the securing bolts



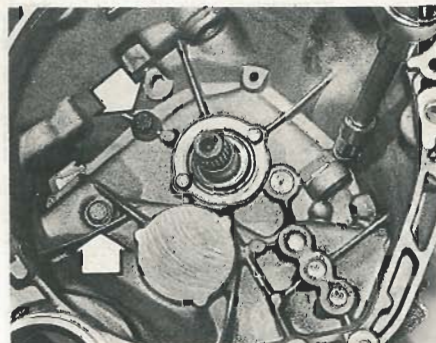
15.15 Coating the bellhousing mating face with sealant



15.17 Lowering the gearbox casing onto the bellhousing



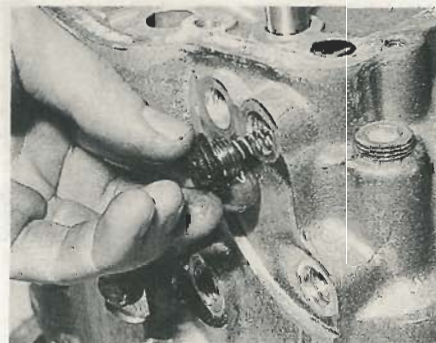
15.18 Tightening a gearbox casing-to-bellhousing bolt



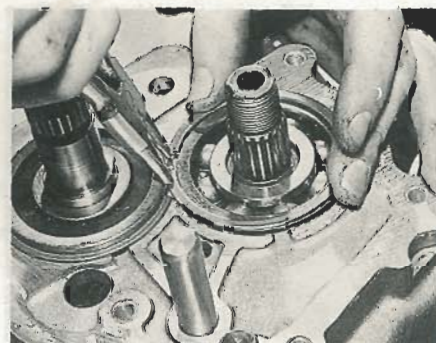
15.19 Tightening one of the gearbox casing-to-bellhousing bolts accessible from the clutch bellhousing. Remaining two bolts arrowed



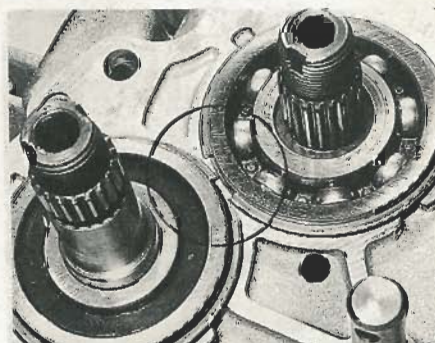
15.21A Refitting a detent ball, ...



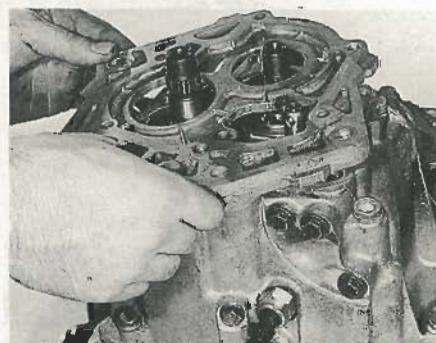
15.21B ... followed by the spring and plug



15.22A Fit new bearing circlips...



15.22B ... aligning the gaps as shown

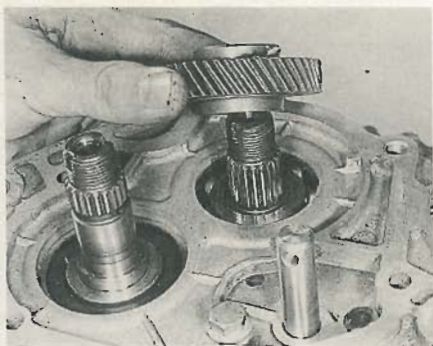


15.24A Refit the intermediate plate ...



15.24B ... and tighten the securing bolt





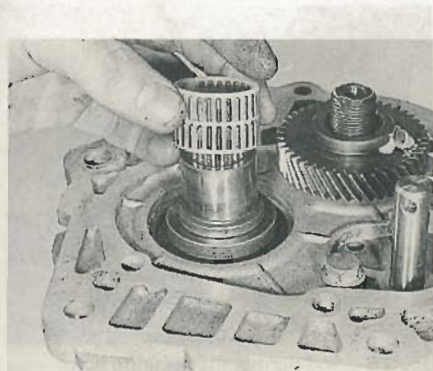
15.25 Refit the 5th driven gear to the mainshaft



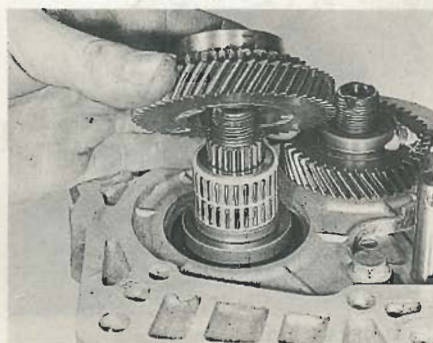
15.26A Fit the collar ...



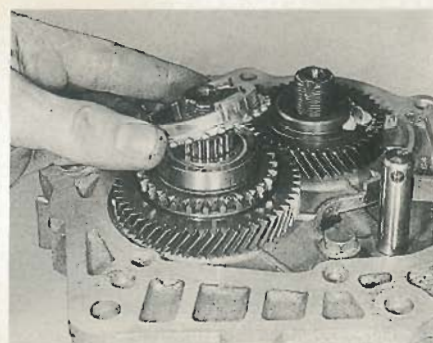
15.26B ... and the sleeve to the input shaft



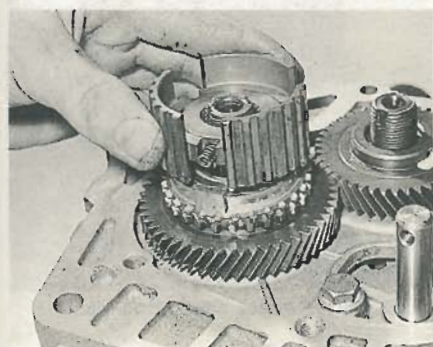
15.27 Fit the needle-roller bearing ...



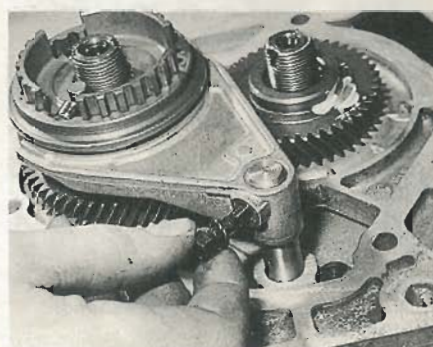
15.28 ... followed by the 5th driving gear ...



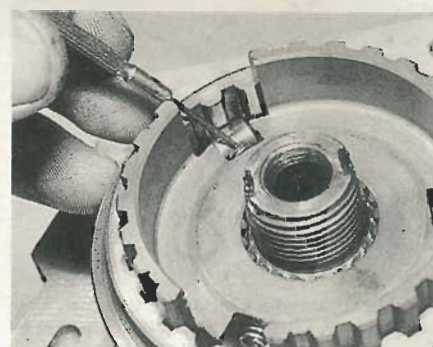
15.29 ... and the synchro ring



15.30 Fitting the synchro hub and springs



15.32 Fitting the 5th gear selector fork securing bolt



15.33 Manipulating a synchro roller into position

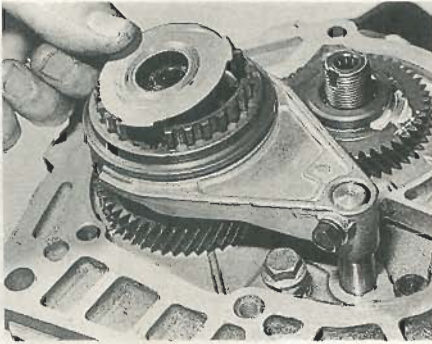
intermediate plate are absolutely clean, then coat the mating faces with sealant (Loctite 573, or a suitable equivalent).

- 24 Fit the intermediate plate, and tighten the securing bolt (photos).
- 25 Fit the 5th driven gear to the end of the mainshaft (photo).
- 26 Fit the collar and the sleeve to the end of the input shaft. Note that the flange on the sleeve rests against the collar (photos).
- 27 Slide the needle-roller bearing over the sleeve (photo).
- 28 Fit the 5th driving gear over the needle-roller bearing (photo).
- 29 Fit the 5th gear synchro ring (photo).
- 30 Locate the synchro springs in the synchro hub, then fit the synchro hub (photo). Note that the lugs on the synchro ring must engage with the cut-outs in the synchro hub.
- 31 Engage the 5th gear selector fork with the synchro sleeve, then fit the synchro sleeve over the synchro hub, at the same time sliding the selector fork over the 5th/reverse selector shaft. Note that the synchro

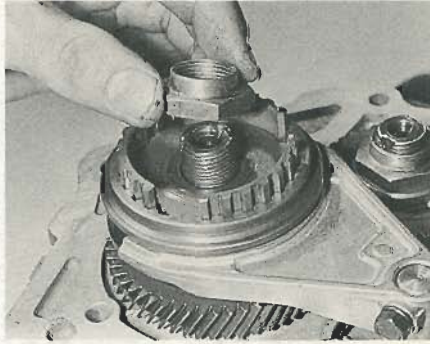
sleeve fits with the stepped end uppermost, and ensure that the notches for the rollers in the sleeve are aligned with the springs and cut-outs in the hub.

- 32 Fit and partially tighten the screw securing the 5th gear selector fork to the selector shaft (photo).
- 33 Ensure that the synchro sleeve is in the neutral position, then using a screwdriver, carefully manipulate the three rollers into position between the springs and the synchro sleeve (photo). This is a tricky operation, and patience will be required.
- 34 Fit the washer to the top of the synchro hub (photo).
- 35 Fit new mainshaft and input shaft nuts (photo).
- 36 In order to tighten the mainshaft and input shaft nuts, the mainshaft and input shaft must be locked together by engaging two gears simultaneously as follows.
- 37 Select any gear other than 5th using the gear selector lever on the

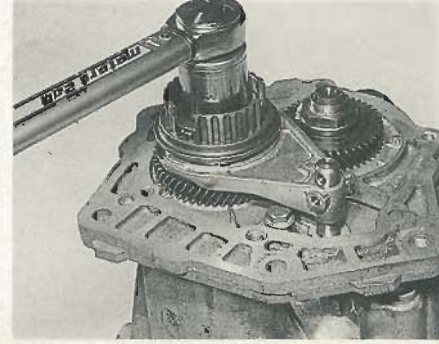




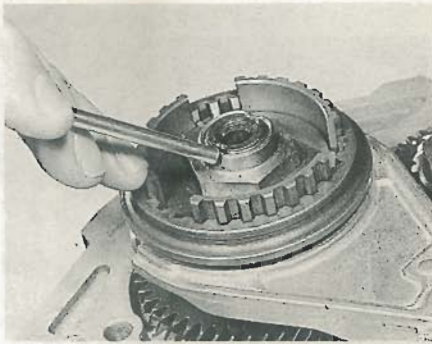
15.34 Fit the synchro hub washer ...



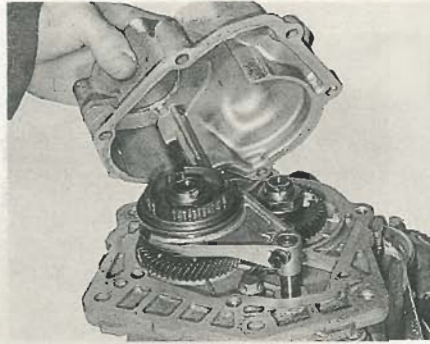
15.35 ... followed by a new input shaft nut



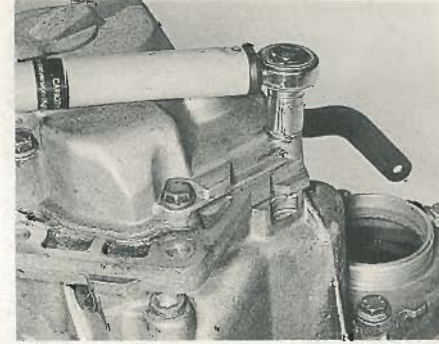
15.38A Tighten the input shaft nut ...



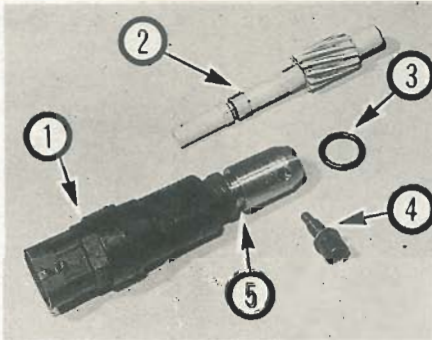
15.38B ... and stake it to the shaft



15.42A Fit the gearbox endplate ...

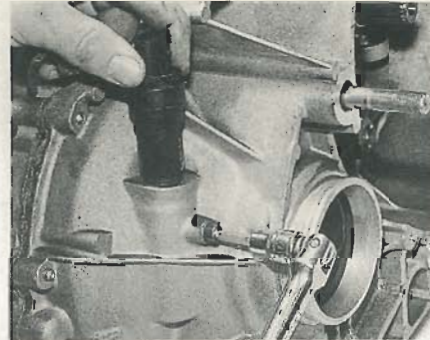


15.42B ... and tighten the securing bolts

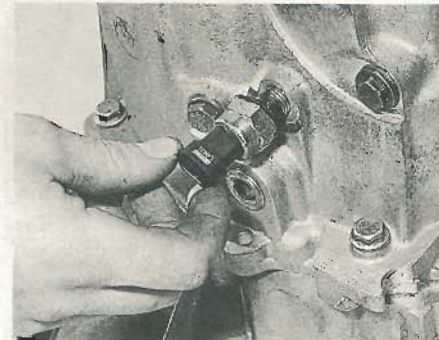


15.44 Speedometer sender and drive components - model with digital instruments

- |              |                 |
|--------------|-----------------|
| 1 Sender     | 4 Clamp screw   |
| 2 Drive gear | 5 O-ring groove |
| 3 O-ring     |                 |



15.45 Tightening the speedometer sender clamp screw - model with digital instruments



15.46 Fitting the reversing lamp switch

side of the gearbox casing, then loosen the screw securing the 5th gear selector fork to the selector shaft, and push the fork down to engage 5th gear.

38 Tighten the mainshaft and input shaft nuts to the specified torque, and secure them by staking them to the relevant shaft (photos).

39 Slide the 5th gear selector fork back up the selector shaft into the neutral position, and tighten the securing screw.

40 Move the gear selector lever to check that all gears can be engaged satisfactorily.

41 Ensure that the mating faces of the intermediate plate and the gearbox end cover are absolutely clean, then coat the mating faces with sealant (Loctite 573, or a suitable equivalent).

42 Fit the gearbox endplate and tighten the securing bolts (photos).

43 If a new differential has been fitted, or if the differential bearings have been renewed, have the differential bearing preload adjusted by a FIAT dealer.

44 Examine the condition of the O-ring on the speedometer drive assembly, and renew if necessary (photo).

45 Fit the speedometer drive assembly, and tighten the clamp screw (photo).

46 Fit and tighten the reversing lamp switch (photo).

47 Refit the clutch release fork rod, arm and bearing as described in Chapter 5, Section 9.



## 16 Fault diagnosis – manual gearbox

Symptom	Reason(s)
Gearbox noisy in neutral	Worn input shaft bearing(s) Oil level low or incorrect grade
Gearbox noisy when moving (in all gears)	Mainshaft bearing(s) worn Differential bearing(s) worn Wear of differential crownwheel and mainshaft pinion teeth Oil level low or incorrect grade.
Gearbox noisy in only one gear	Worn, damaged or chipped gear teeth
Gearbox jumps out of gear	Worn synchroniser components Worn selector components Worn gear(s)
Ineffective synchromesh	Worn synchroniser components
Difficulty in engaging gears	Worn selector components Seized input shaft bearing(s) Clutch fault – see Chapter 5

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice.



# Chapter 7 Driveshafts

## Contents

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## Specifications

**Type** .....

Solid with ball and cage type constant velocity joint at outer end, and tripod joint at inner end (tripode joint is a sliding fit in differential planet gear)

### Lubrication

Inner joint .....

From gearbox/differential oil

Outer joint .....

Lithium based molybdenum disulphide grease (Duckhams LBM 10)

### Torque wrench settings

Roadwheel bolts .....

Nm	lbf ft
86	63

Front hub nut:

Early type plain nut .....

250 184

Later type nut with integral washer .....

235 173

Anti-roll bar-to lower arm nut .....

31 23

Lower arm balljoint pinch-bolt .....

35 26

## 1 General description

Drive to the front wheels is transmitted from the differential unit to the front hubs by two driveshafts. The inner ends of the driveshafts have tripod type joints which are a sliding fit in the differential planet gears, while ball and cage type constant velocity joints are fitted to the outboard ends of the shafts. The joints allow for relative movement between the gearbox and the hubs due to suspension and steering motion.

The outer ends of the driveshafts are splined to the front hubs.

The inner joint gaiters are secured to the differential casing at their inner ends, and to bearings at their outer ends. The bearings are a press-fit on the driveshafts, and allow the driveshafts to rotate while the gaiters remain stationary.

The longer right-hand driveshaft has a damper weight fitted to reduce vibration.

## 2 Routine maintenance

**1** At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, carry out a thorough inspection of each driveshaft as follows.

**2** Apply the handbrake, jack up the front of the vehicle, and support securely on axle stands.

**3** Slowly rotate the roadwheel and inspect the outer joint gaiter. Check for any signs of cracking, splits or deterioration of the rubber which may allow the lubricant to escape and lead to water and dirt entry into the joint. Also check the security and condition of the gaiter retaining clips. Repeat these checks on the inner joint, also checking the bearing at the outer end of the gaiter for any signs of roughness or excessive wear as the roadwheel is rotated. If any damage or deterioration is found, renew the applicable component(s) as described in the relevant Section(s) of this Chapter.



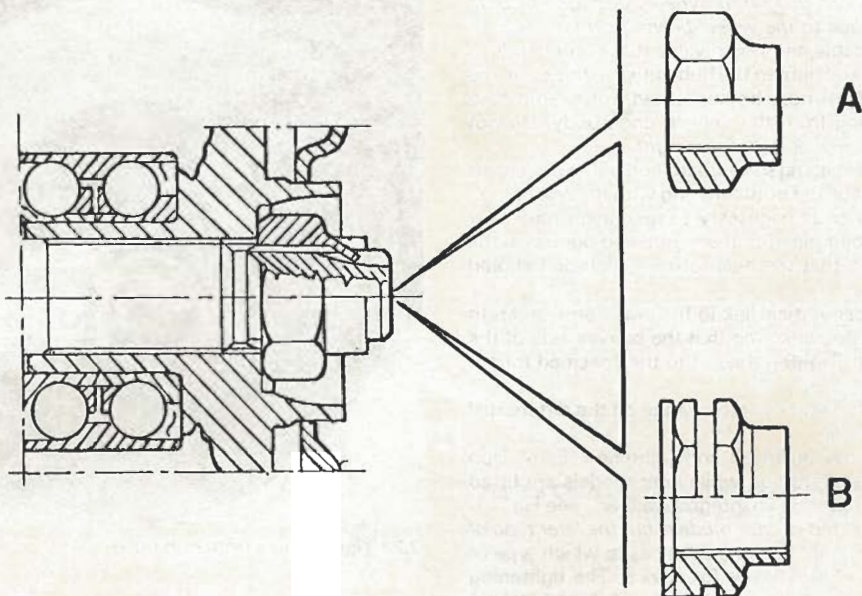


Fig. 7.1 Front hub nut types (Sec 3)

A Early type plain nut

B Modified nut with integral washer

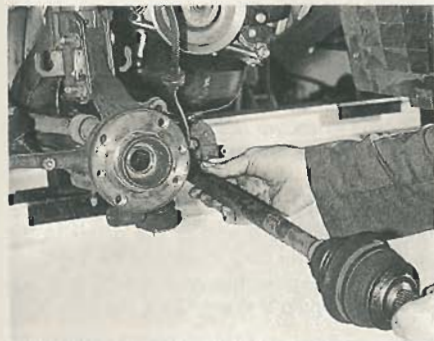
- 4 Continue rotating the roadwheel and check for any signs of distortion or damage to the driveshaft. Check for any free play in the joints by first holding the driveshaft and attempting to rotate the wheel. Repeat this check by holding the outer joint and attempting to rotate the driveshaft. Any appreciable movement indicates wear in the joints, wear in the splines at the outer end of the driveshaft, or a loose hub nut.
- 5 Road-test the vehicle and listen for a metallic clicking from the front as the vehicle is driven slowly in a circle with the steering on full lock. If a clicking noise is heard, this indicates wear in the outer joint. Remove and inspect the joint as described in Section 7.
- 6 If vibration, consistent with roadspeed, is felt through the vehicle when accelerating, there is a possibility of wear in the inner driveshaft joint. Remove the driveshaft and inspect the joint as described in Section 6.

### 3 Driveshaft – removal and refitting

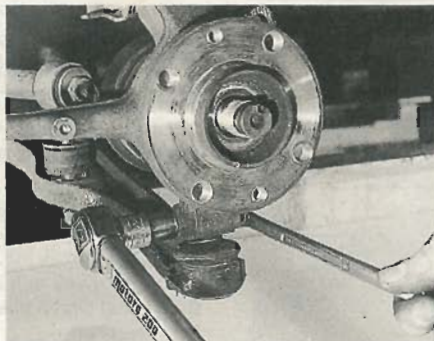
**Note:** A new front hub nut of the appropriate type must be used on refitting – see text. Suitable thread-locking compound will be required when fitting an early type hub nut. A new inboard gaiter securing clip must be used on refitting.

- 1 Apply the handbrake, remove the relevant wheel trim and loosen the roadwheel bolts, then jack up the front of the vehicle and support securely on axle stands. Remove the roadwheel.

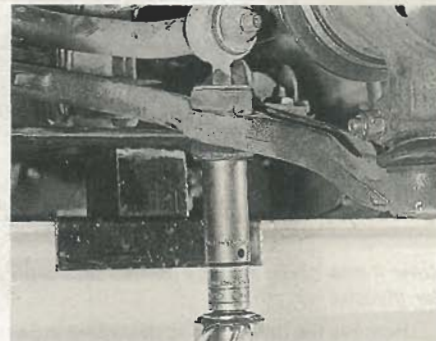
- 2 Relieve the staking on the front hub nut.
- 3 Prevent the hub from turning by inserting two roadwheel bolts and using a metal bar inserted between them to counterhold the hub, then loosen the hub nut using a suitable socket and extension bar, but do not remove it yet. Note that the nut is very tight.
- 4 Drain the gearbox oil as described in Chapter 6.
- 5 Unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush, noting that the convex side of the washer lies against the bush.
- 6 Unscrew the nut and the pinch-bolt securing the lower arm balljoint to the hub carrier.
- 7 Working at the inboard end of the driveshaft, remove the clip securing the driveshaft joint rubber gaiter to the differential casing.
- 8 Using a suitable bar to lever against the subframe, lever the lower arm down to separate the balljoint from the hub carrier.
- 9 Remove the hub nut and washer (where applicable) from the end of the driveshaft.
- 10 Place a suitable container under the inboard end of the driveshaft to catch any remaining gearbox oil which may be released as the driveshaft is withdrawn from the differential.
- 11 Manipulate the splined outboard end of the driveshaft from the hub carrier, lightly tapping the end of the driveshaft with a soft-faced mallet if necessary to free it. **Do not use heavy blows, as damage to the driveshaft joints may result.**
- 12 Pull the inboard end of the driveshaft from the differential (be prepared for possible oil spillage), then withdraw the driveshaft from the vehicle (photo).



3.12 Withdrawing the right-hand driveshaft



3.15 Tightening the lower arm balljoint pinch-bolt and nut



3.16 Tightening the anti-roll bar vertical link-to-lower arm nut



**13** Do not allow the vehicle to rest on its wheels with one or both driveshafts removed, as damage to the wheel bearing(s) may result. If moving the vehicle is unavoidable, temporarily insert the outer ends of the driveshaft(s) in the hub(s) and tighten the hub nut(s); in this case, the inner end(s) of the driveshaft(s) must be supported, for example by suspending with wire or string from the vehicle underbody. Do not allow a driveshaft to hang down under its own weight.

**14** Commence refitting by engaging the inboard end of the driveshaft with the differential, then engage the outboard end with the hub carrier.

**15** Manipulate the hub carrier as necessary to reconnect the lower arm balljoint, then fit the balljoint pinch-bolt and nut, and tighten to the specified torque (photo). Note that the head of the pinch-bolt should face the front of the vehicle.

**16** Reconnect the anti-roll bar vertical link to the lower arm, and refit the rubber bush, washer and nut, ensuring that the convex side of the washer rests against the bush. Tighten the nut to the specified torque (photo).

**17** Fit the inboard driveshaft gaiter over the flange on the differential casing, and secure with a new clip.

**18** A new hub nut must now be fitted and tightened. Early Tipo models were fitted with a plain hub nut, while later models are fitted with a modified hub nut incorporating an integral washer - see Fig. 7.1. The earlier type of nut can be fitted to later models, but the later type of nut cannot be fitted to early models. If in any doubt as to which type of nut should be used, consult a FIAT dealer for advice. The tightening procedure for the early type of nut involves the use of thread-locking compound. Proceed as follows.

**19** Clean the threaded end of the driveshaft with a wire brush, then clean the threads on the new nut and driveshaft with a cloth soaked in methylated spirit.

**20** When fitting an early type plain nut, coat the threaded end of the driveshaft with Loctite 270 thread-locking compound or an equivalent product. Note that the nut must be tightened to the specified torque within 5 minutes of applying the thread-locking compound, and the manufacturers specify that the vehicle must not be driven for at least 2½ hours after tightening the nut.

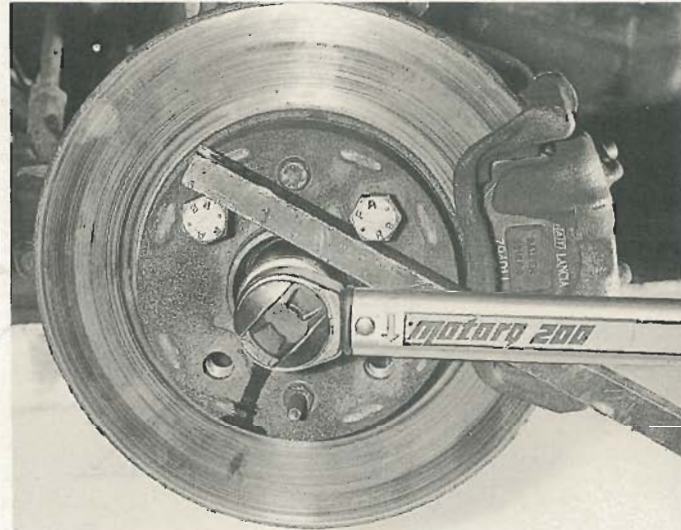
**21** To prevent the driveshaft from turning as the nut is tightened, insert two roadwheel bolts, then insert a metal bar between them to counterhold the hub.

**22** Tighten the nut to the specified torque, noting that different torques are specified for the two types of nut, then stake the nut to the end of the driveshaft (photo).

**23** Refit the roadwheel and lower the vehicle to the ground.

**24** Finally tighten the roadwheel bolts to the specified torque with the vehicle resting on its wheels, and refit the wheel trim.

**25** Ensure that the gearbox drain plug has been refitted and tightened, then refill the gearbox with oil as described in Chapter 6.



3.22 Tightening a front hub nut

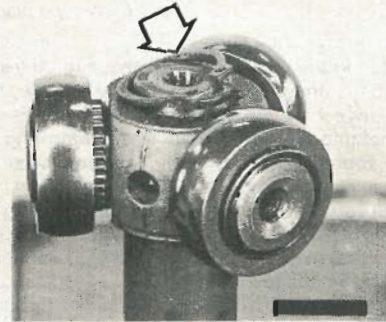


Fig. 7.2 Tripode joint spider securing circlip (arrowed) (Sec 6)

#### 4 Inboard joint gaiter - renewal

Renewal of the inboard gaiter is described in Section 8 as part of the gaiter bearing removal and refitting procedure.

#### 5 Outboard joint gaiter - renewal

Renewal of the outboard gaiter is described in Section 7 as part of the constant velocity joint removal and refitting procedure.

#### 6 Tripode joint - inspection, removal and refitting

**Note:** A new circlip must be used to secure the joint spider to the end of the driveshaft on refitting.

- 1 Remove the driveshaft as described in Section 3.
- 2 Push the gaiter away from the joint to allow access to the joint spider.
- 3 Examine the rollers for any signs of scoring, pitting, or wear ridges. Also check that the rollers rotate freely, without excessive play. If any

sign of wear is evident, renew the joint spider as follows.

- 4 Extract the circlip which secures the joint spider to the end of the driveshaft.
- 5 Pull the spider from the splines on the end of the driveshaft. If the spider is tight, use a suitable three-legged puller to remove it, positioning the legs of the puller on the body of the spider, not on the rollers. Do not lever or tap on the rollers.
- 6 Refitting is a reversal of removal, bearing in mind the following points.
- 7 If necessary, tap the spider on to the driveshaft splines using a metal tube of suitable diameter on the body of the spider.
- 8 Secure the spider with a new circlip.
- 9 Refit the driveshaft as described in Section 3.

#### 7 Constant velocity joint - removal, inspection and refitting

**Note:** A new circlip must be used to secure the joint to the end of the driveshaft on refitting. The outboard gaiter clip(s) must be renewed on refitting.

- 1 Remove the driveshaft as described in Section 3.
- 2 Remove the clip securing the outboard end of the gaiter to the constant velocity joint, then pull the gaiter back to expose the joint.
- 3 Wipe away sufficient grease to expose the joint retaining circlip, then using circlip pliers extract the circlip and withdraw the joint from the driveshaft.
- 4 If desired, the gaiter can now be slid from the end of the driveshaft after removing the inboard securing clip.
- 5 With the joint removed, wipe away as much grease as possible, using cloth only. Do not use any solvents.



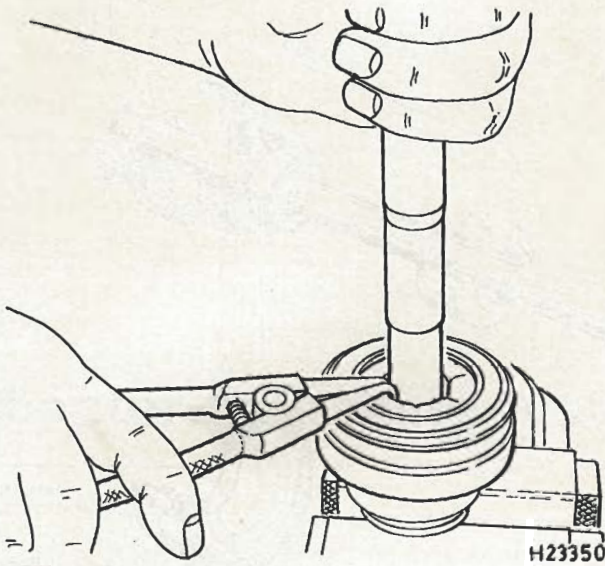


Fig. 7.3 Extracting the constant velocity joint retaining circlip (Sec 7)

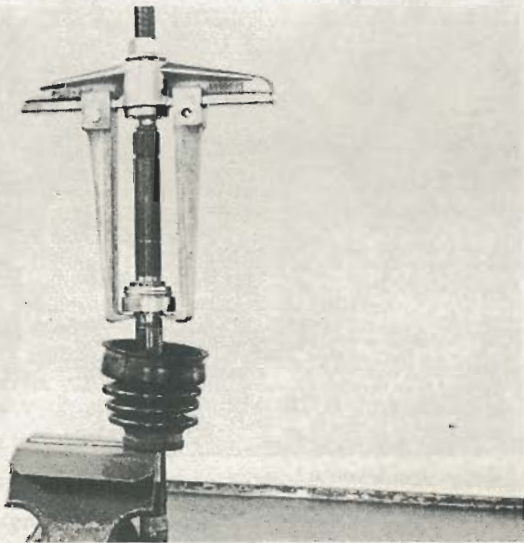


Fig. 7.5 Removing the inboard gaiter bearing using a two-legged puller (Sec 8)

- 6 Move the internal parts of the joint around, and check for signs of scoring, pitting and wear ridges on the balls, ball tracks and ball cage. If wear is evident, or if the components move with very little resistance and appear loose, then a new joint should be obtained.
- 7 Refitting is a reversal of removal, bearing in mind the following points.
- 8 Pack both the joint and the gaiter with the recommended type of grease.
- 9 Use a new circlip to secure the joint to the driveshaft.
- 10 On later models, modified gaiters are fitted, which are a tighter fit on the driveshaft to improve sealing. The driveshaft is also modified, with a newly positioned shoulder ("A" in Fig. 7.4) against which the gaiter rests. *The modified gaiters can be fitted to early models, but the early gaiters cannot be fitted to later models.*
- 11 When fitting a later type modified gaiter, to ease assembly, lubricate the contact area on the driveshaft with the same type of grease used to lubricate the driveshaft joint.
- 12 When fitting a later type modified gaiter to an early model, position

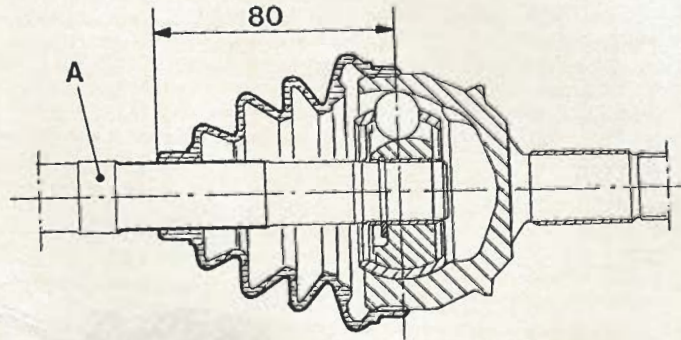


Fig. 7.4 Correct position of later type modified outboard joint gaiter fitted to early type driveshaft (Sec 7)

A Shoulder

Dimension in mm

the end of the gaiter as shown in Fig. 7.4.

- 13 Ensure that the gaiter is not twisted, and secure it with new clips.
- 14 Refit the driveshaft as described in Section 3.

### 8 Inboard gaiter bearing - inspection, removal and refitting

**Note:** A suitable puller will be required to remove the bearing. New inboard gaiter securing clips must be used on refitting

- 1 With the driveshaft removed as described in Section 3, remove the tripod joint spider as described in Section 6.
- 2 Remove the securing clip, and release the outboard end of the gaiter from the bearing. Slide the gaiter down the driveshaft away from the bearing.
- 3 Spin the bearing and check it for roughness. Attempt to move the outer race laterally against the inner race. If any excessive movement or roughness is evident, renew the bearing as follows.
- 4 Measure and note the exact distance of the bearing from the inboard end of the driveshaft (photo).
- 5 Using a suitable two-legged puller with the claws positioned on the



8.4 Measure the exact distance of the bearing from the inboard end of the driveshaft



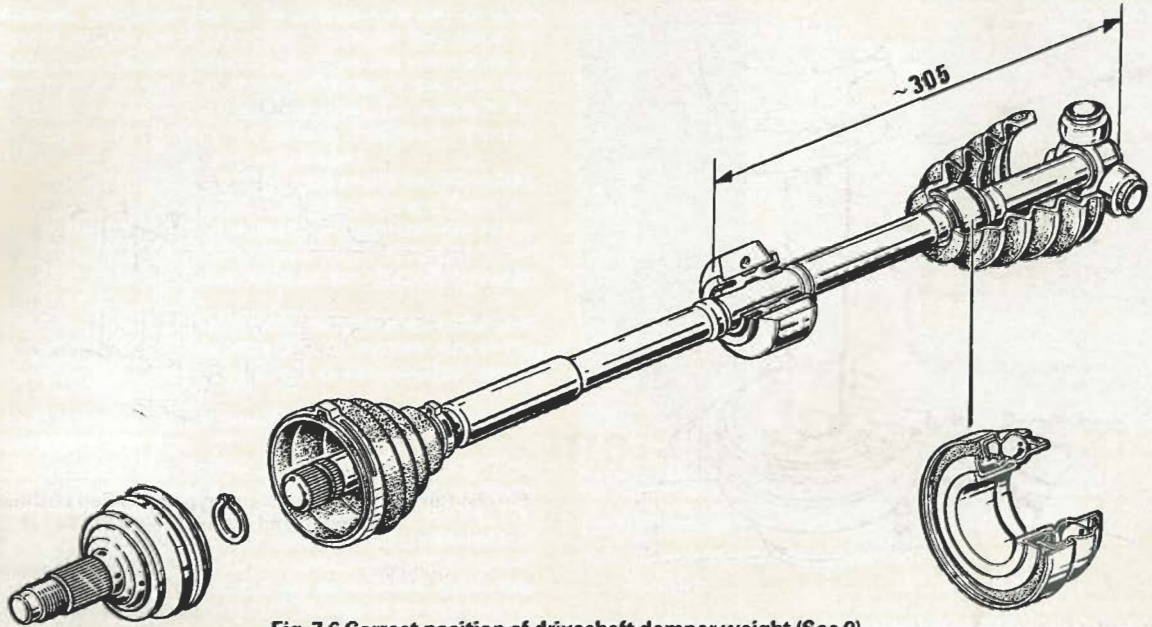


Fig. 7.6 Correct position of driveshaft damper weight (Sec 9)

Dimension in mm

inner race of the bearing, pull the bearing from the driveshaft.

6 If desired, the gaiter can now be slid from the inboard end of the driveshaft for renewal.

7 Ensure that the gaiter is in position on the driveshaft.

8 Using a suitable metal tube on the bearing inner race, carefully drive the bearing down the driveshaft to the exact position noted in paragraph 4.

9 Refit the tripod joint spider as described in Section 6.

10 Slide the gaiter over the bearing, and fit a new outboard securing clip.

11 Refit the driveshaft as described in Section 3.

### 9 Driveshaft damper weight – removal and refitting

1 A damper weight is fitted to the longer, right-hand driveshaft to reduce vibration (photo).

2 It should not be necessary to remove the damper weight unless the driveshaft is to be renewed, or the weight has been damaged.

3 The weight is in two halves, and can be removed by simply unscrewing the two clamp bolts securing the two halves to the driveshaft. Note that the weight locates on a rubber mounting which is split along its length, and can simply be pulled from the driveshaft for renewal if necessary.



9.1 Right-hand driveshaft damper weight

4 Refitting is a reversal of removal, but ensure that the damper weight is positioned exactly as shown in Fig. 7.6.

### 10 Fault diagnosis – driveshafts

#### Symptom

#### Reason(s)

Vibration and/or noise on turns

Lack of lubricant in outer constant velocity joint  
Worn outer constant velocity joint  
Suspension or steering fault – see Chapter 9

Vibration when accelerating, or on overrun

Worn inner joint  
Distorted or damaged driveshaft  
Suspension or steering fault – see Chapter 9

Noise on taking up drive

Worn driveshaft or constant velocity joint splines  
Loose hub nut  
Worn joint(s)  
Suspension or steering fault – see Chapter 9

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice



# Chapter 8 Braking system

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Brake pedal – removal and refitting.....	20	Rear brake backplate – removal and refitting.....	10
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## Specifications

<b>System type</b> .....	Front discs and rear drums with vacuum servo assistance. Dual hydraulic circuits split diagonally. Cable-operated handbrake on rear wheels	
<b>Front brakes</b>	Solid discs with single piston sliding calipers	
Type.....	240.0 mm	
Disc diameter.....	10,80 to 11,10 mm	
Disc thickness:	10,10 mm	
New .....	9,20 mm	
Minimum disc thickness after machining .....	0,15 mm	
Wear limit.....	1,5 mm (0,06 in)	
Maximum disc run-out (measured a distance of 2.0 mm from the outer circumference of the disc) .....		
Minimum disc pad thickness.....		
<b>Rear brakes</b>	Drums with leading and trailing shoes and self-adjuster mechanism	
Type.....	180,00 to 180,25 mm	
Drum internal diameter:	180,95 mm	
New .....	181,35 mm	
Maximum drum diameter after machining .....	1,5 mm (0,06 mm)	
Wear limit.....		
Minimum brake shoe lining thickness.....		
<b>Brake fluid type/specification</b> .....	Hydraulic fluid to SAE J1703 (Duckhams Universal Brake and Clutch Fluid)	
<b>Torque wrench settings</b>	<b>Nm</b>	<b>lbf ft</b>
Rear brake backplate securing bolts .....	24	18
Brake caliper carrier bracket-to-hub carrier bolts .....	24	18
Caliper guide pin bolts.....	53	39
Brake disc securing bolts .....	12	9
Brake drum securing bolts .....	12	9
Rear wheel cylinder securing bolts .....	10	7
Handbrake lever securing bolts .....	28	20



## 1 General description

The braking system is of the diagonally-split dual circuit hydraulic type. The two hydraulic circuits are operated independently from a tandem master cylinder, so that in the event of a hydraulic failure in one circuit, full braking force will still be available to two wheels through the remaining circuit.

All models are fitted with solid front disc brakes. The calipers are of single piston sliding type, which ensures that equal pressure is applied to each disc pad.

Rear drum brakes are fitted, incorporating leading and trailing shoes operated by double-acting wheel cylinders. A self-adjuster mechanism is fitted, which effectively lengthens the upper shoe strut to compensate for wear in the shoe linings, thus eliminating the need for manual adjustment.

The handbrake is mechanically-operated via a cable, and operates on the rear wheels.

## 2 Routine maintenance

1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the following tasks should be carried out.

2 Check the brake fluid level in the reservoir. Note that the level will drop slightly as the friction material wears, but any sudden drop in level, or the need for frequent topping-up should be investigated immediately. Always top up with the specified type of hydraulic fluid which has been stored in an airtight container (photo). Brake hydraulic fluid is hygroscopic (it absorbs moisture from the atmosphere) and must not be stored in an open container. For the same reason, do not shake the container before topping-up.

3 Inspect the thickness of the friction material on the disc pads and the brake shoes, as described in the relevant Sections of this Chapter. Renew as necessary. At the same time inspect the condition of the discs and drums.

4 Examine the rigid and flexible hydraulic pipes and hoses for leaks and damage. Pay particular attention to the anti-corrosive coating on the rigid pipes. Bend the flexible hoses sharply with the fingers and examine the surface of the hoses for signs of cracking or perishing of the rubber. Renew if evident.

5 Check the operation of the hydraulic fluid level warning system. Turn the ignition key to the "MAR" position, then press the centre of the fluid reservoir filler cap which should cause the warning lamp to illuminate.

6 Inspect the handbrake cable and linkage and lubricate the exposed parts. Adjustment should only be necessary to compensate for cable stretch or after fitting a new cable - see Section 17.

7 Renew the hydraulic fluid at the specified intervals, as described in Section 3. At the same time, consider renewing the flexible hoses and rubber seals as a precautionary measure.

## 3 Brake hydraulic system - bleeding

**Note:** If brake fluid is spilt on the paintwork, the affected area must be washed down with cold water immediately - brake fluid is an effective paint stripper!

1 If any of the hydraulic components in the braking system have been removed or disconnected, or if the fluid level in the reservoir has been allowed to fall appreciably, it is inevitable that air will have been introduced into the system. The removal of all this air from the hydraulic system is essential if the brakes are to function correctly, and the process of removing it is known as bleeding.

2 Where an operation has only affected one circuit (the system is split diagonally) of the hydraulic system, then it will only be necessary to bleed the relevant circuit. If the master cylinder has been disconnected and reconnected, or the fluid level has been allowed to fall appreciably, then the complete system must be bled.

3 One of three methods can be used to bleed the system as follows.



2.2 Topping-up the brake fluid level

### Bleeding - two-man method

4 Gather together a clean jar and a length of rubber or plastic bleed tubing which will fit the bleed screws tightly. The help of an assistant will be required.

5 Remove the dust cap where fitted, and clean around the bleed screw on the relevant caliper or wheel cylinder, then attach the bleed tube to the screw (photo).

6 Check that the fluid reservoir is topped up, and then destroy the vacuum on the brake servo by giving several applications of the brake pedal.

7 Immerse the open end of the bleed tube in the jar which should contain two or three inches of hydraulic fluid. The jar should be positioned about 300mm (12.0 in) above the level of the bleed screw to prevent any possibility of air entering the system down the threads of the bleed screw when it is slackened.

8 Open the bleed screw half a turn and have your assistant depress the brake pedal slowly to the floor and then, after the bleed screw is retightened, quickly remove his/her foot to allow the pedal to return unimpeded. Repeat the procedure.

9 Observe the submerged end of the tube in the jar. When air bubbles cease to appear, tighten the bleed screw when the pedal is being held fully down by your assistant.

10 Top up the fluid level in the reservoir. It must be kept topped-up throughout the bleeding operations. If the connecting holes to the



Fig. 8.1 Bleeding a front brake (Sec 3)





3.5 Pulling the dust cap from a front disc caliper bleed screw

master cylinder are exposed at any time due to low fluid level, then air will have been drawn into the system and work will have to start all over again.

11 The procedure described in the preceding paragraphs should be repeated for the remaining relevant bleed screw(s), bearing in mind the point made in paragraph 2.

12 On completion, remove the bleed tube, and discard the fluid which has been bled from the system unless it is required for bleed jar purposes. **Do not re-use old fluid.**

13 On completion of bleeding, top up the fluid level in the reservoir. Check the action of the brake pedal, which should be firm and free from any sponginess which would indicate that air is still present in the system.

#### Bleeding - with one-way valve

14 There are a number of one-man brake bleeding kits currently available from motor accessory shops. It is recommended that one of these kits should be used wherever possible, as they greatly simplify the bleeding operation and also reduce the risk of expelled air or fluid being drawn back into the system.

15 Proceed as described in paragraphs 5 and 6.

16 Open the bleed screw half a turn, then depress the brake pedal to the floor and slowly release it. The one-way valve in the bleeder will prevent expelled air from returning to the system at the completion of each stroke. Repeat the operation until clear hydraulic fluid, free from air bubbles, can be seen coming through the tube. Tighten the bleed screw.

17 Proceed as described in paragraphs 11 to 13.

#### Bleeding - with pressure bleeding kit

18 These too are available from motor accessory shops and are usually operated by air pressure from the spare tyre.

19 By connecting a pressurised container to the 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 bubbles are visible in the fluid being expelled.

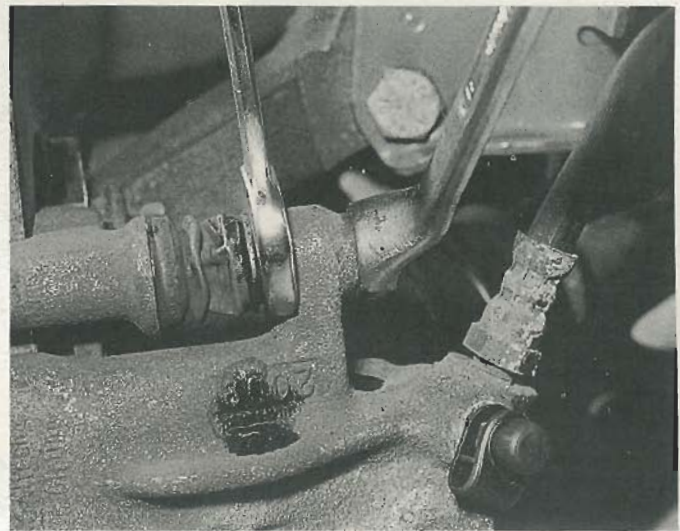
20 Using this system, the large reserve of fluid provides a safeguard against air bubbles being drawn into the master cylinder during the bleeding operations.

21 This method is particularly effective when bleeding the entire system at the time of routine fluid renewal.

22 Begin bleeding with reference to paragraphs 5 and 6, and proceed as described in paragraphs 11 to 13.

## 4 Front disc pads - inspection and renewal

**Warning:** Disc brake pads must be renewed on both sides of the vehicle at the same time - never renew the pads on only one side, as uneven braking may result. The dust created by wear of the pads may contain



4.7 Unscrewing an upper caliper guide pin bolt

*asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts - use brake cleaner or methylated spirit only. The brake caliper guide pin bolts are of the self-locking type, and must be renewed each time they are loosened or removed*

1 Remove the front wheel trims and loosen the roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands.

2 Remove the roadwheels. Turn the steering to full right-hand lock, and check the wear of the friction material on the right-hand disc pads. Check that the friction material thickness is not less than the minimum given in the Specifications.

3 Turn the steering to full left-hand lock, and check the left-hand disc pads in the same way.

4 If any one of the pads has worn below the specified limit, all the front pads must be renewed as a set (4 pads).

5 To renew the pads, proceed as follows.

6 Disconnect the battery negative lead, then disconnect the pad wear sensor wiring connector. Note that only the left-hand pads are fitted with a wear sensor.

7 Unscrew and remove the bolt from the upper caliper guide pin, while holding the pin stationary with a spanner (photo).

8 Swing the caliper downwards and lift out the disc pads.

9 Brush all dust and dirt from the caliper, pads and disc, but do not inhale it as it may be injurious to health. Scrape any corrosion from the disc.

10 As the new pads will be thicker than the old ones, the caliper piston

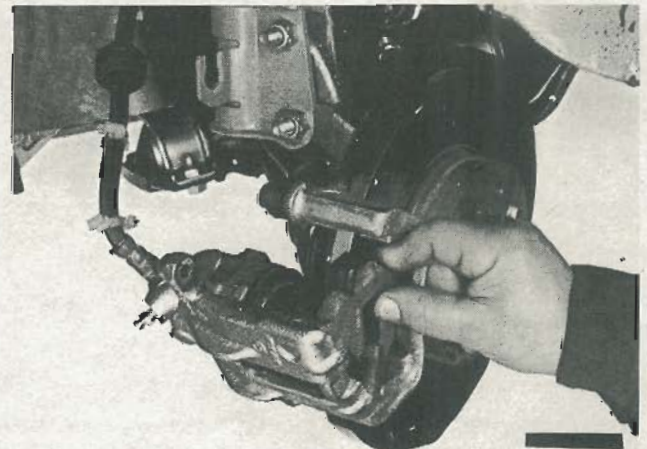
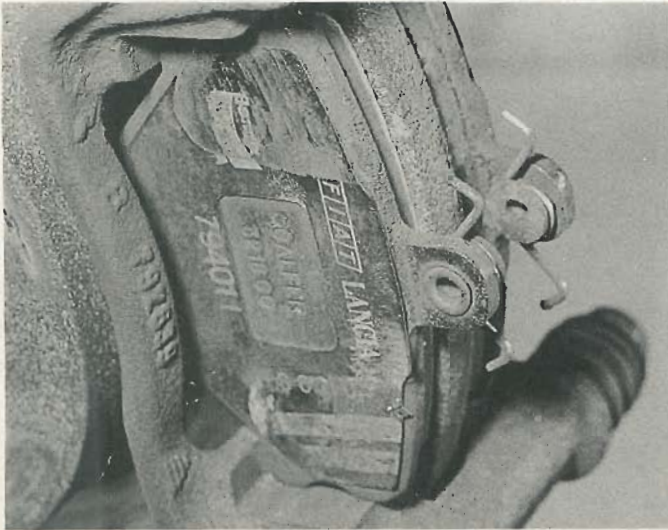
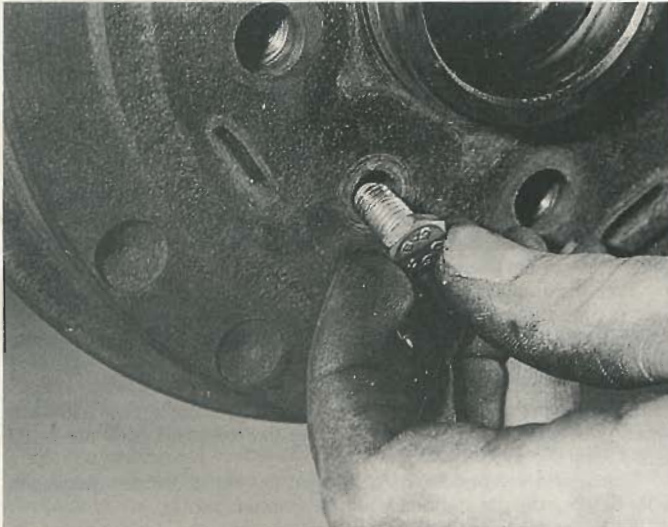


Fig. 8.2 Removing a front disc pad (Sec 4)

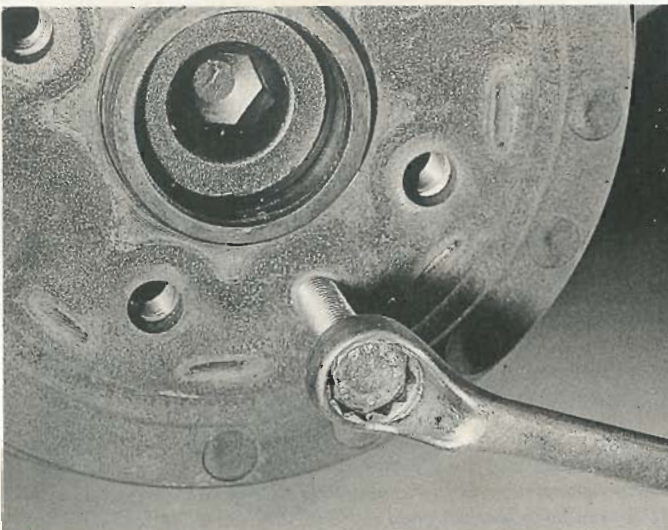




4.13 Disc pad anti-rattle clips should be positioned as shown (caliper removed for clarity)



5.4A Extracting a drum securing bolt



5.4B Using an M10 bolt to draw the drum over the brake shoes

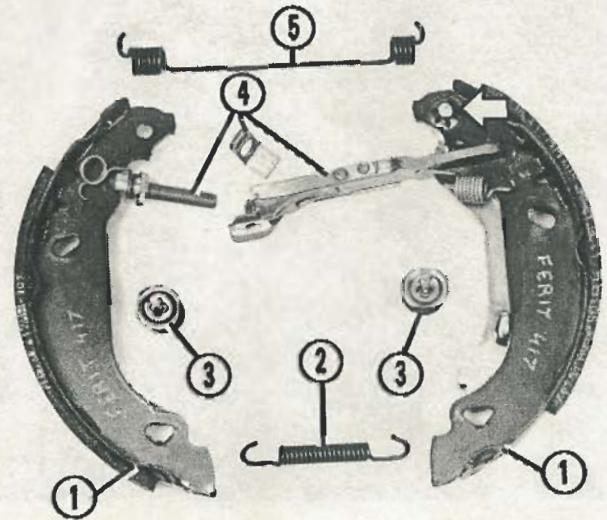


Fig. 8.3 Left-hand rear brake components (Sec 5)

- |                             |  |
|-----------------------------|--|
| 1 Brake shoes               | 4 Self-adjuster components                   |
| 2 Lower shoe return spring  | 5 Upper shoe return spring                   |
| 3 Shoe hold-down components | Handbrake lever securing spring clip arrowed |

must be pushed squarely into its bore to accommodate the new thicker pads. Depressing the piston will cause the fluid level in the reservoir to rise, so to avoid spillage, syphon out some fluid using an old hydrometer or a test pipette. Refer to the note at the beginning of Section 3. Do not lever between the piston and the disc to depress the piston - use a suitable block of wood to push the piston squarely into its bore.

11 Further refitting is a reversal of removal, bearing in mind the following points.

12 The pad with the wear sensor wire should be fitted on the inboard left-hand side.

13 Ensure that the anti-rattle clips are positioned correctly before refitting the caliper (photo).

14 Renew the upper caliper guide pin bolt.

15 Repeat the procedure on the opposite front brake.

16 On completion, apply the footbrake hard several times to settle the pads, then check and if necessary top up the fluid level in the reservoir.

17 Avoid heavy braking, if possible, for the first hundred miles or so after fitting new pads. This will allow the pads to bed in and reach full efficiency.

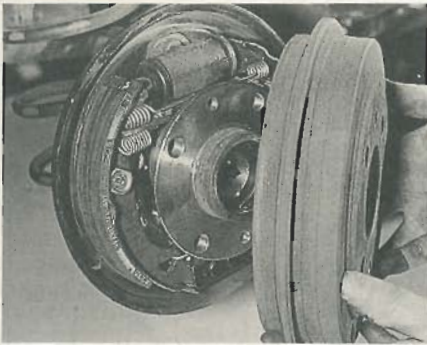
## 5 Rear brake shoes - inspection and renewal

**Warning:** Drum brake shoes must be renewed on both sides of the vehicle at the same time - never renew the shoes on only one side as uneven braking may result. The dust created by wear of the shoes may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts - use brake cleaner or methylated spirit only

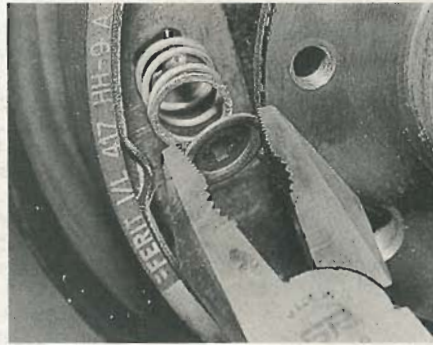
1 Remove the rear wheel trims and loosen the roadwheel bolts, then chock the front wheels, jack up the rear of the vehicle and support securely on axle stands.

2 Remove the roadwheels and fully release the handbrake.

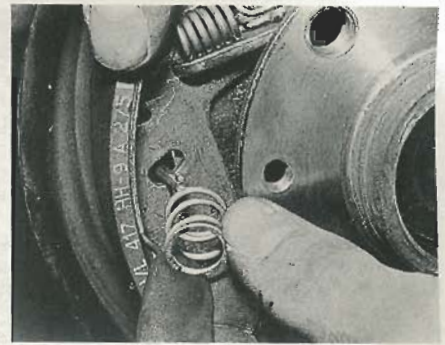




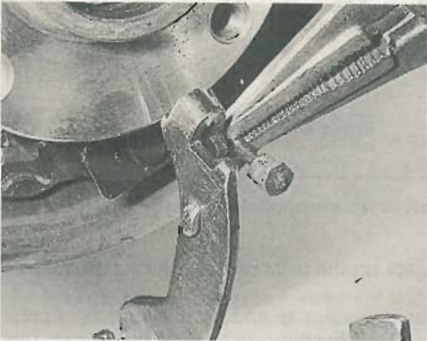
5.4C Removing a brake drum



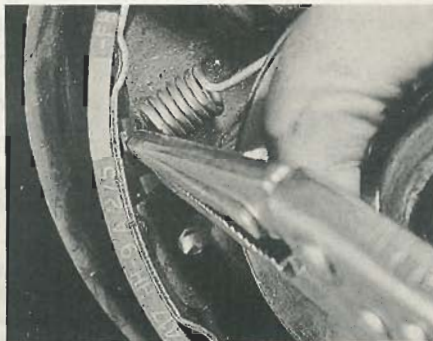
5.10A Removing a brake shoe hold-down cup ...



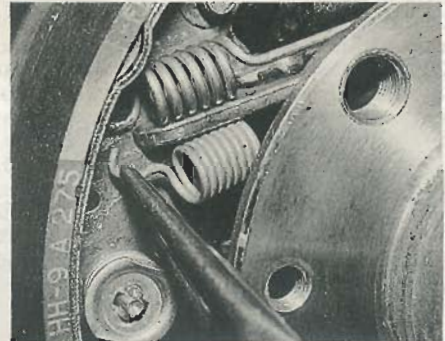
5.10B ... and spring



5.21 Hooking the end of the handbrake cable onto the end of the handbrake operating lever



5.24A Fit the upper shoe return spring, ...



5.24B ... the self-adjuster return spring ...

3 Remove the plastic cover from the rear of the brake backplate, and push the handbrake operating lever towards the brake shoe to move the shoes away from the drum. If necessary, slacken the handbrake cable adjuster (see Section 17).

4 Extract the drum securing bolts, and remove the drum. If the drum is tight, screw two M10 bolts into the drum securing bolt holes (the holes in the drum are of a larger diameter than those in the hub), and tighten the bolts to draw the drum over the brake shoes (photos).

5 Note the location and orientation of all components before dismantling, as an aid to reassembly.

6 Clean the dust and dirt from the drum and the shoes, taking care not to inhale it.

7 Unhook the end of the handbrake cable from the operating lever.

8 Using a suitable pair of pliers, unhook the lower shoe return spring from the shoes.

9 Similarly, unhook the self-adjuster return spring, and the upper shoe return spring.

10 Remove the shoe hold-down cups and springs by depressing the

cups and turning them through 90° using a pair of pliers (photos). Note that the hold-down pins are removed through the rear of the brake backplate.

11 Withdraw the shoes and the self-adjuster assembly.

12 If the shoes are to be removed for some time, fit a stout rubber band or a spring clip to the wheel cylinder, to prevent the pistons from being pushed out of their bores. In any event, **do not** press the brake pedal while the drum is removed.

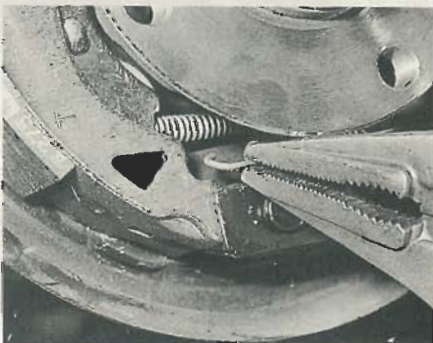
13 Clean the dust and dirt from the brake backplate, but take care not to inhale it.

14 Apply a small amount of brake grease to the shoe rubbing areas on the backplate.

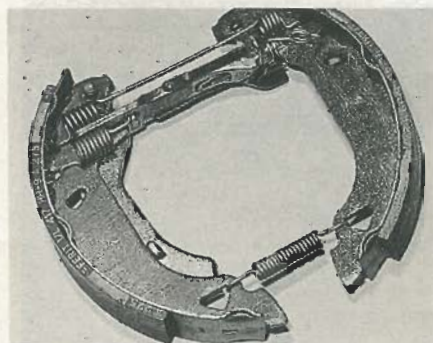
15 Investigate and rectify any source of contamination of the linings (wheel cylinder leaking etc).

16 Dismantle and clean the self-adjuster components, noting the position and orientation of the components.

17 If both brake assemblies are dismantled at the same time, take care not to mix up the components.



5.24C ... and the lower shoe return spring



5.25 Rear brake components on bench to illustrate correct assembly

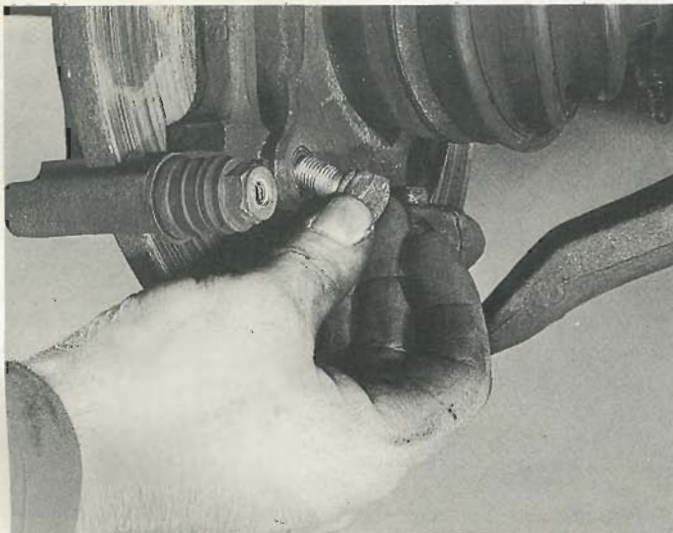


- 18 Examine the return springs. If they are distorted, or if they have seen extensive service, renewal is advisable. Weak springs may cause the brakes to bind.
- 19 If a new handbrake operating lever was not supplied with the new shoes, transfer the lever from the old shoes, but use a new spring clip to secure the lever to the shoe.
- 20 Commence reassembly as follows.
- 21 Hook the end of the handbrake cable onto the handbrake operating lever (photo).
- 22 Assemble the self-adjuster components, then offer the shoes, complete with the self-adjuster assembly, to the brake backplate. Remember to remove the rubber band or spring clip from the wheel cylinder, where applicable.
- 23 When the shoes are in position, insert the hold-down pins and secure them with the springs and cups.
- 24 Fit the upper shoe return spring and the self-adjuster return spring, then fit the lower shoe return spring (photos).
- 25 Make a final check to ensure that all components are correctly assembled (photo).
- 26 If necessary, back off the self-adjuster to reduce the length of the strut, until the brake drum will pass over the shoes.
- 27 Refit the brake drum, then fit and tighten the securing bolts.
- 28 If not already done, refit the handbrake operating lever cover to the rear of the brake backplate.
- 29 Repeat the operations on the remaining side of the vehicle.
- 30 Adjust the brakes by operating the footbrake a number of times. A clicking noise will be heard at the drums, as the self-adjusters operate. When the clicking stops, adjustment is complete.
- 31 Check the handbrake cable adjustment as described in Section 17.
- 32 Refit the roadwheels and lower the vehicle to the ground. Fully tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trims.
- 33 Avoid heavy braking, if possible, for the first hundred miles or so after fitting new shoes. This will allow the linings to bed in and reach full efficiency.

## 6 Front disc caliper – removal, overhaul and refitting

**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts – use brake cleaner or methylated spirit only. The brake caliper guide pin bolts are of the self-locking type, and must be renewed each time they are loosened or removed

- 1 Apply the handbrake, remove the relevant wheel trim and loosen



6.6 Removing a caliper carrier bracket securing bolt

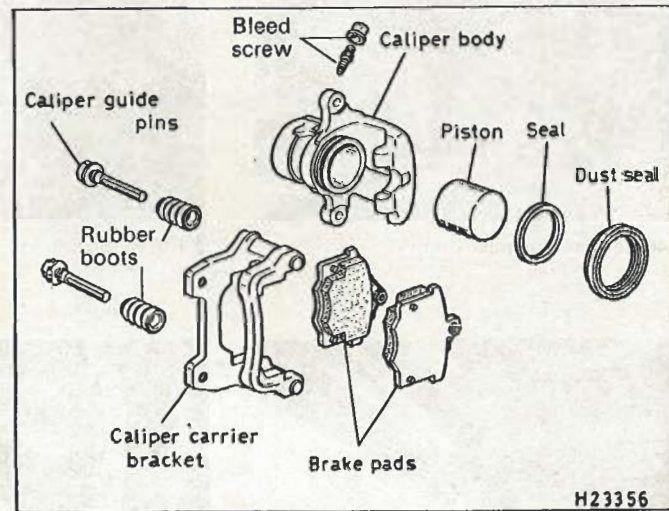
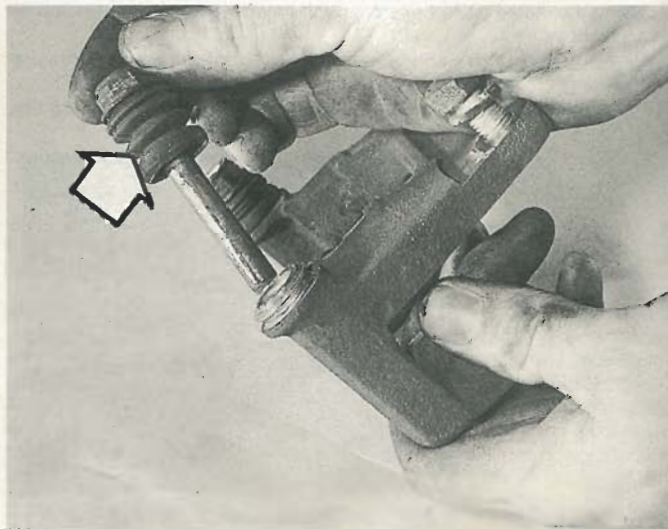


Fig. 8.4 Front brake components (Sec 6)

the roadwheel bolts, then jack up the front of the vehicle and support securely on axle stands.

- 2 Remove the brake fluid reservoir cap and secure a piece of polythene over the filler neck with a rubber band, or by refitting the cap. This will reduce the loss of fluid during the following operation.
- 3 Disconnect the flexible fluid hose from the rigid brake pipe under the wing of the vehicle, or alternatively unscrew the flexible hose from the union on the caliper. Be prepared for fluid spillage. Take care not to twist the hose, and plug the open ends to prevent fluid loss and dirt ingress.
- 4 Remove the disc pads as described in Section 4.
- 5 Unscrew and remove the bolt from the lower caliper guide pin, while holding the pin stationary with a spanner, then remove the caliper.
- 6 If required, the caliper carrier bracket can be unbolted and removed from the hub carrier, noting that the securing bolts also secure the brake disc shield (photo).
- 7 Brush away all external dust and dirt, but take care not to inhale it.
- 8 The caliper can be overhauled as follows, otherwise proceed to paragraph 17.
- 9 Pull the dust-excluding rubber seal from the end of the piston.



6.16 Removing a caliper guide pin from the caliper carrier bracket – rubber seal arrowed



10 Apply air pressure to the caliper fluid inlet union, and eject the piston. Only low air pressure is required for this, such as is produced by a foot-operated type pump. Position a thin piece of wood between the piston and caliper body to prevent damage to the end face of the piston in the event of it being ejected suddenly.

11 Using a suitable pointed instrument, prise the piston seal from the groove in the cylinder bore. Take care not to scratch the surface of the bore.

12 Clean the piston and caliper body with methylated spirit and allow to dry. Examine the surfaces of the piston and cylinder bore for wear, damage and corrosion. If the piston surface alone is unserviceable, a new piston must be obtained along with seals. If the cylinder bore is unserviceable, the complete caliper must be renewed. The seals must be renewed regardless of the condition of the other components.

13 Coat the piston and seals with clean brake fluid, then manipulate the piston seal into the groove in the cylinder bore.

14 Push the piston squarely into its bore.

15 Fit the dust-excluding rubber seal between the piston and caliper, then depress the piston fully.

16 Examine the condition of the guide pin rubber seals, and renew if necessary (photo).

17 Refitting is a reversal of removal, bearing in mind the following points.

18 Renew the caliper guide pin bolts.

19 Refit the disc pads with reference to Section 4.

20 Tighten all bolts to the specified torque.

21 On completion, bleed the relevant brake hydraulic circuit as described in Section 3.

## 7 Brake disc – examination, removal and refitting

**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts – use brake cleaner or methylated spirit only

1 Remove the disc caliper and the carrier bracket with reference to Section 6, but do not disconnect the flexible hose. Support the caliper on an axle stand, or suspend it with wire or string to avoid straining the flexible hose.

2 Rotate the disc and examine it for deep scoring or grooving. Light scoring is normal, but if excessive, the disc should be removed and either renewed or reground by a suitable specialist. Scrape any corrosion from the disc.

3 Using a dial gauge or a flat metal block and feeler gauges, check that the disc run-out does not exceed the limit given in the Specifications. To do this, fix the measuring equipment to measure at a distance of 2.0 mm from the outside circumference of the disc, then rotate the disc, noting the variation in measurement as the disc is rotated. The difference between the minimum and maximum measurements recorded is known as disc run-out.

4 If the original disc is to be refitted, mark the position of the disc in relation to the hub.

5 Unscrew the two disc securing bolts, and withdraw the disc from the hub (photo).

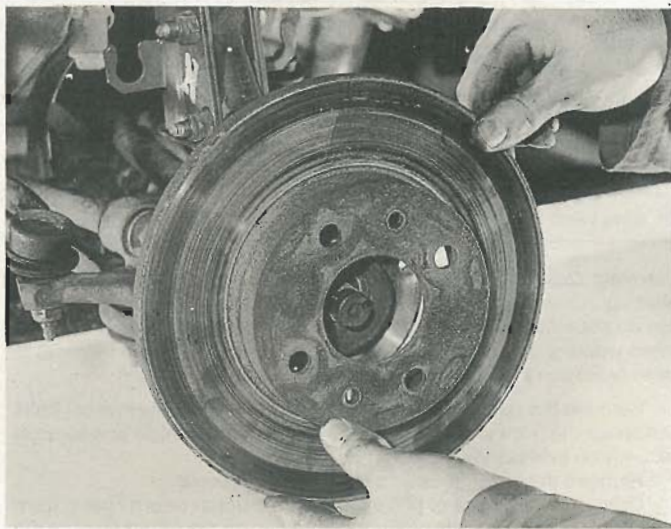
6 Refitting is a reversal of removal, but make sure that the mating faces of the disc and hub are perfectly clean, and where applicable, align the marks made on the disc and hub before removal.

7 Refit the caliper carrier bracket and the caliper as described in Section 6.

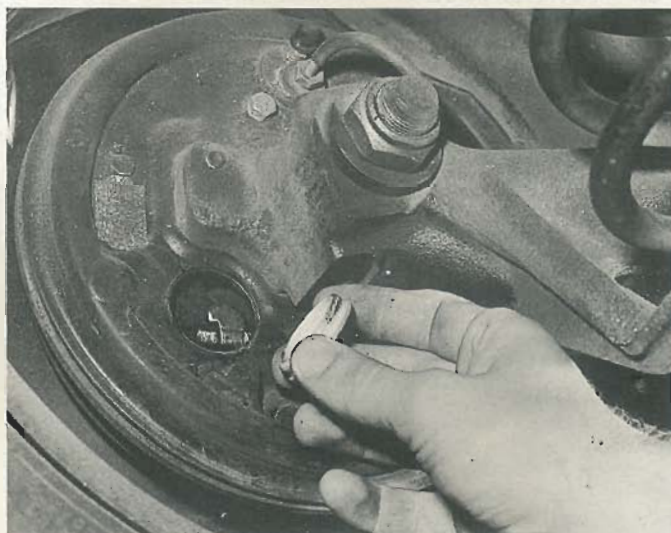
## 8 Brake drum – removal, inspection and refitting

**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts – use brake cleaner or methylated spirit only

1 Remove the rear wheel trims and loosen the roadwheel bolts, then chock the front wheels, jack up the rear of the vehicle and support securely on axle stands.



7.5 Removing a brake disc



8.3 Removing the plastic cover from the brake backplate to expose the end of the handbrake operating lever

2 Remove the roadwheels and fully release the handbrake.

3 Remove the plastic cover from the rear of the brake backplate, and push the handbrake operating lever towards the brake shoe to move the shoes away from the drum (photo). If necessary, slacken the handbrake cable adjuster.

4 Extract the drum securing bolts, and remove the drum. If the drum is tight, screw two M10 bolts into the drum securing bolt holes (the holes in the drum are of a larger diameter than those in the hub), and tighten the bolts to draw the drum over the brake shoes.

5 Brush the dirt and dust from the drum, taking care not to inhale it.

6 Examine the internal friction surface of the drum. If it is deeply scored, or so worn that the drum has become significantly ridged to the width of the shoes, then both drums should be renewed.

7 Measure the internal diameter of the drum across the friction surface. If the diameter is greater than the maximum wear limit given in the Specifications, both drums must be renewed. It may be possible to have the friction surface reground by a competent specialist, provided that the internal diameter of the drum after regrounding does not exceed the figure given in the Specifications, although renewal is always preferable.

8 If necessary, back off the brake shoe self-adjuster to reduce the length of the strut, until the brake drum will pass over the shoes (see Section 5).

9 Refit the brake drum, then fit and tighten the securing bolts.

10 If not already done, refit the handbrake operating lever cover to the rear of the brake backplate.

11 Adjust the brakes by operating the footbrake a number of times. A



clicking noise will be heard at the drums, as the self-adjusters operate. When the clicking stops, adjustment is complete.

12 Check the handbrake cable adjustment as described in Section 17.

13 Refit the roadwheels and lower the vehicle to the ground. Fully tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trims.

### 9 Rear wheel cylinder - removal, overhaul and refitting

**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. **DO NOT** use petroleum based solvents to clean brake parts - use brake cleaner or methylated spirit only

1 Remove the relevant wheel trim, then loosen the roadwheel bolts and chock the front wheels. Jack up the rear of the vehicle and support securely on axle stands. Remove the roadwheel.

2 Remove the brake drum as described in Section 8.

3 Using a suitable pair of pliers, unhook the upper return spring from the brake shoes, noting its orientation, then push the upper ends of the shoes apart until they are clear of the wheel cylinder.

4 Working under the bonnet, remove the filler cap from the brake fluid reservoir and secure a piece of polythene over the filler neck with a rubber band, or by refitting the cap. This will reduce the loss of fluid during the following procedure.

5 Unscrew the brake fluid pipe union nut from the rear of the wheel cylinder, and disconnect the pipe. Take care not to strain the pipe. Be prepared for fluid spillage, and plug the open ends of the pipe and wheel cylinder to prevent dirt ingress and further fluid loss.

6 Unscrew the two securing bolts from the rear of the brake backplate, and withdraw the wheel cylinder (photo).

7 If desired, the wheel cylinder can be overhauled as follows. Otherwise proceed to paragraph 16 for details of refitting.

8 Brush the dust and dirt from the wheel cylinder, but take care not to inhale it.

9 Pull the rubber dust seals from the ends of the cylinder body.

10 The pistons will normally be ejected by the pressure of the coil spring, but if they are not, tap the end of the cylinder body on a piece of wood, or apply low air pressure (eg from a foot pump) to the hydraulic fluid union hole in the rear of the cylinder body, to eject the pistons from their bores.

11 Inspect the surfaces of the pistons and their bores in the cylinder body for scoring or evidence of metal-to-metal contact. If evident, renew the complete wheel cylinder assembly.

12 If the pistons and bores are in good condition, discard the seals and obtain a repair kit, which will contain all the necessary renewable items.

13 Lubricate the piston seals with clean brake fluid, and insert them into the cylinder bores with the spring between them, using finger pressure only.

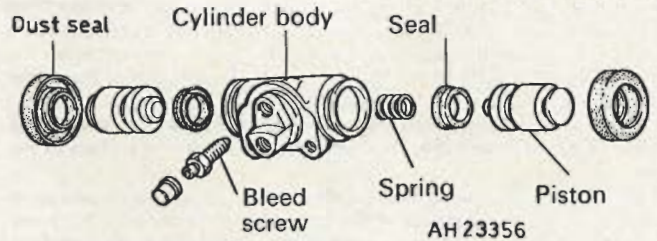


Fig. 8.5 Rear wheel cylinder components (Sec 9)

14 Dip the pistons in clean brake fluid, and insert them into the cylinder bores.

15 Fit the dust seals and check that the pistons can move freely in their bores.

16 Refit the wheel cylinder to the backplate and tighten the securing bolts.

17 Reconnect the brake fluid pipe to the cylinder, and tighten the union nut.

18 Push the brake shoes against the pistons, then refit the upper return spring as noted before removal.

19 If necessary, back off the brake shoe self-adjuster to reduce the length of the strut, until the brake drum will pass over the shoes (see Section 5).

20 Refit the brake drum, then fit and tighten the securing bolts.

21 If not already done, refit the handbrake operating lever cover to the rear of the brake backplate.

22 Remove the polythene from the brake fluid reservoir filler neck, and bleed the relevant brake hydraulic circuit, as described in Section 3.

23 Adjust the brakes by operating the footbrake a number of times. A clicking noise will be heard at the drum as the self-adjuster operates. When the clicking stops, adjustment is complete.

24 Refit the roadwheel and lower the vehicle to the ground. Finally tighten the roadwheel bolts with the vehicle resting on its wheels, then refit the wheel trim.

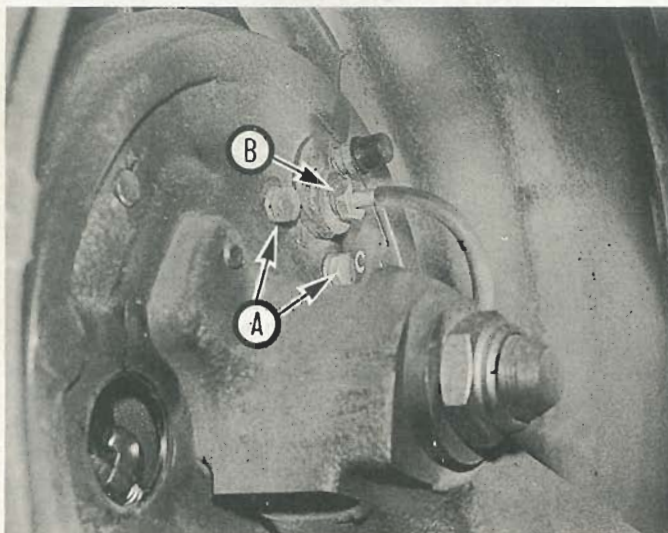
### 10 Rear brake backplate - removal and refitting

**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. **DO NOT** use petroleum based solvents to clean brake parts - use brake cleaner or methylated spirit only

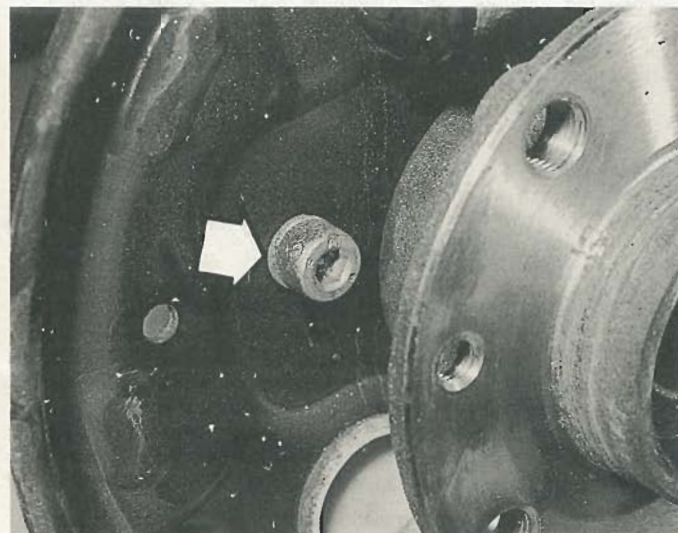
1 Remove the brake shoes as described in Section 5.

2 Remove the wheel cylinder with reference to Section 9.

3 Pull the handbrake cable end fitting from the brake backplate.

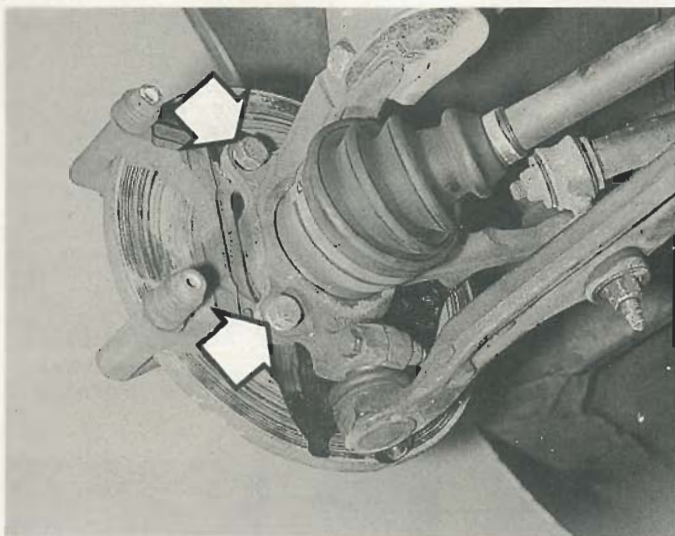


9.6 Rear wheel cylinder securing bolts (A), and fluid pipe union (B)



10.5 Rear brake backplate securing bolt (arrowed)





11.4A Caliper carrier bracket/disc shield securing bolts (arrowed) - brake caliper removed

- 4 Remove the rear hub as described in Chapter 9.
- 5 Using a suitable Allen key or hexagon bit, extract the two screws securing the brake backplate to the trailing arm, and withdraw the brake backplate (photo).
- 6 Refitting is a reversal of removal, bearing in mind the following points.
- 7 Refit the rear hub as described in Chapter 9.
- 8 Refit the wheel cylinder as described in Section 9.
- 9 Refit the brake shoes as described in Section 5.

## 11 Front brake disc shield - removal and refitting

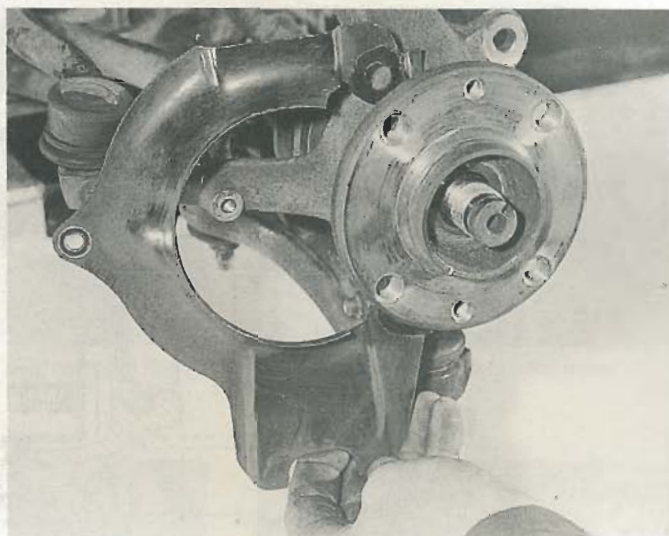
**Warning:** Dust created by the braking system may contain asbestos, which is a health hazard. Never blow the dust out with compressed air and do not inhale any of it. An approved filtering mask should be worn when working on the brakes. DO NOT use petroleum based solvents to clean brake parts - use brake cleaner or methylated spirit only

- 1 Apply the handbrake, remove the relevant wheel trim and loosen the roadwheel bolts, then jack up the front of the vehicle and support securely on axle stands.
- 2 Remove the disc pads as described in Section 4.
- 3 Unscrew the single bolt securing the rear of the disc shield to the hub carrier.
- 4 Unscrew the two bolts securing the caliper carrier bracket and the disc shield to the hub carrier, and withdraw the disc shield towards the rear of the vehicle (photos). Support the caliper assembly on an axle stand, or suspend it with wire or string to avoid straining the flexible hose.
- 5 Refitting is a reversal of removal, bearing in mind the following points.
- 6 Tighten the caliper carrier bracket securing bolts to the specified torque.
- 7 Refit the disc pads as described in Section 4.
- 8 Do not fully tighten the roadwheel bolts until the vehicle is resting on its wheels.

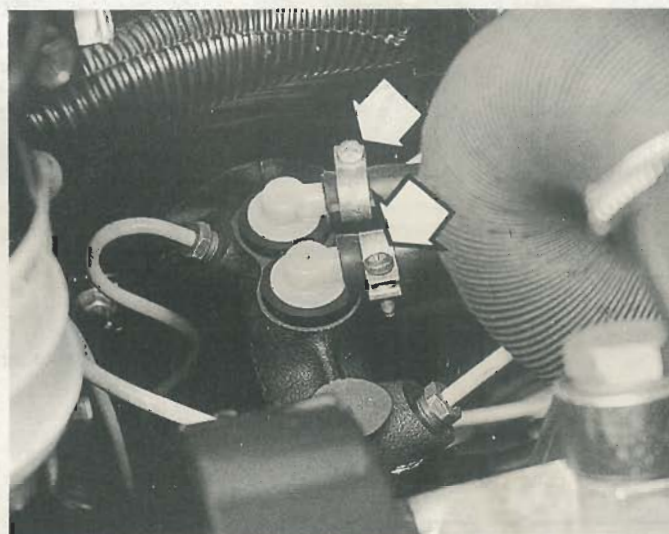
## 12 Master cylinder - removal and refitting

**Note:** If brake fluid is spilt on the paintwork, the affected area must be washed down with cold water immediately - brake fluid is an effective paint stripper!

- 1 Disconnect the battery negative lead.



11.4B Removing a brake disc shield (brake disc removed)



12.5 Brake fluid hose connections (arrowed) at master cylinder - model with power steering

- 2 Depress the footbrake several times to dissipate the vacuum in the servo.
- 3 Disconnect the wiring from the brake fluid level sensor in the reservoir filler cap.
- 4 If possible, use a teat pipette or an old hydrometer to remove the brake fluid from the reservoir. This will reduce the loss of fluid later in the procedure.
- 5 On models with power steering, disconnect the fluid reservoir hoses from the master cylinder (photo). Be prepared for fluid spillage.
- 6 Locate a suitable container beneath the master cylinder, to catch the brake fluid which will be released as the fluid pipes are disconnected.
- 7 Identify the brake fluid pipes for position, then unscrew the union nuts and disconnect the pipes from the master cylinder.
- 8 Unscrew the two securing nuts, and withdraw the master cylinder from the studs on the vacuum servo unit.
- 9 Clean the external surfaces of the master cylinder.
- 10 On models with manual steering, the fluid reservoir and its seals can be prised from the top of the master cylinder using a screwdriver. Similarly, on models with power steering, the plastic fluid hose connectors can be prised from the top of the master cylinder.
- 11 No overhaul of the master cylinder is possible, and if faulty, the complete unit must be renewed.
- 12 Refitting is a reversal of removal, but on models with manual steering, use new seals when fitting the brake fluid reservoir, and on



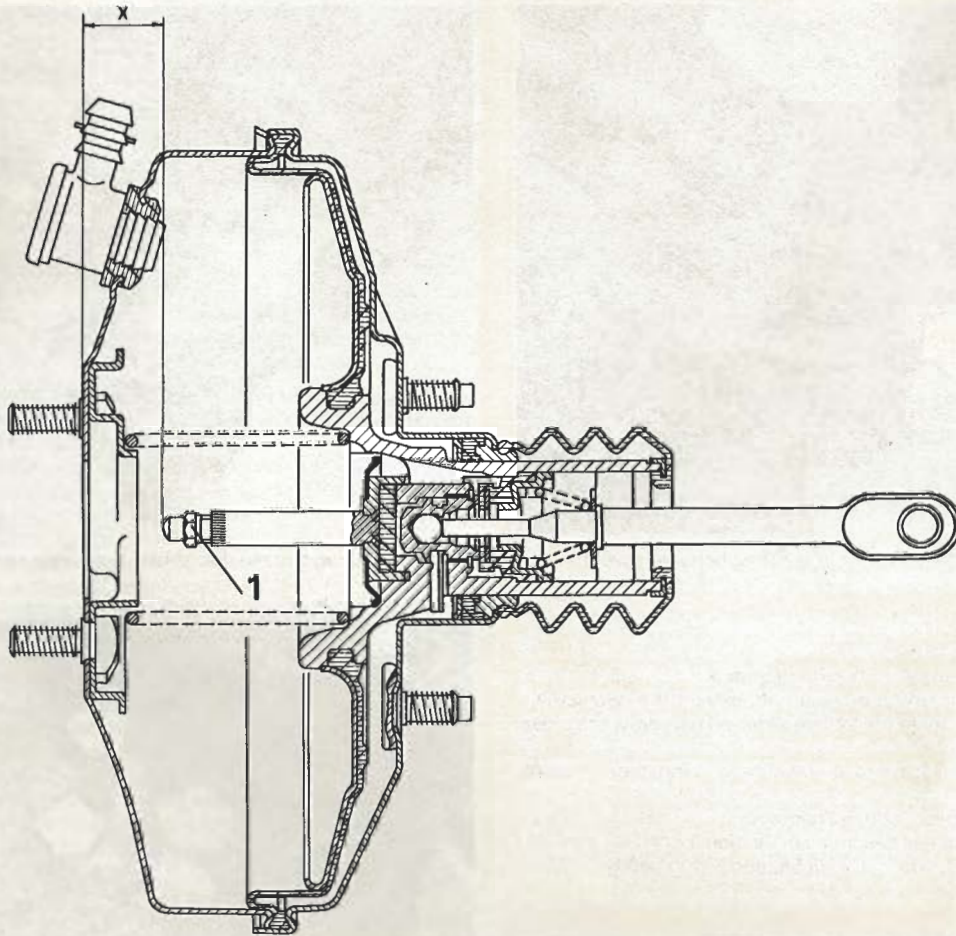


Fig. 8.6 Vacuum servo push rod adjustment (Sec 15)

1 Adjuster nut

$X = 22.45$  to  $22.65$  mm

completion, bleed the complete brake hydraulic system as described in Section 3.

### 13 Master cylinder – overhaul

No overhaul of the master cylinder is possible, and if faulty, the complete unit must be renewed.

### 14 Vacuum servo – description and testing

1 The vacuum servo is fitted between the brake pedal and the master cylinder and provides assistance to the driver when the pedal is depressed, reducing the effort required to operate the brakes. The unit is operated by vacuum from the inlet manifold. With the brake pedal released, vacuum is channelled to both sides of the internal diaphragm, however when the pedal is depressed, one side of the diaphragm is opened to the atmosphere, resulting in assistance to the pedal effort. Should the vacuum servo develop a fault, the hydraulic system is not affected, though greater effort will be required at the pedal.

2 The operation of the servo can be checked as follows.

3 With the engine stopped, destroy the vacuum in the servo by depressing the brake pedal several times.

4 Hold the brake pedal depressed and start the engine. The pedal should sink slightly as the engine is started.

5 If the pedal does not sink, check the servo vacuum hose for leaks.

6 If no defects are found in the vacuum hose, the fault must lie in the servo itself.

7 No overhaul of the servo is possible, and if faulty, the complete unit must be renewed.

### 15 Vacuum servo – removal and refitting

**Note:** A new split-pin should be used to secure the servo pushrod to the intermediate bellcrank on refitting

1 The vacuum servo is housed within the pedal box assembly in the driver's footwell.

2 To remove the servo, the pedal box assembly must be removed as follows.

3 Disconnect the battery negative lead.

4 Working in the engine compartment, unscrew the two securing nuts, and carefully withdraw the brake master cylinder from the studs on the servo. Move the master cylinder forwards slightly, taking care not to strain the brake pipes (photo).

5 Pull the end of the servo vacuum hose from the rear of the servo (photo).

6 Working in the driver's footwell, remove the lower facia trim panel as described in Chapter 10.

7 Remove the steering column as described in Chapter 9.

8 Remove the throttle pedal, with reference to Chapter 3 if necessary.

9 Push the release lever at the rear of the fuse box, and pull the fuse box down from the facia.

10 Extract the two bolts securing the front of the fuse box frame to the facia.

11 Working at the right-hand rear of the fuse box, unscrew the nut from the pivot through-bolt, then withdraw the through-bolt, which secures the fuse box to the pedal box assembly.

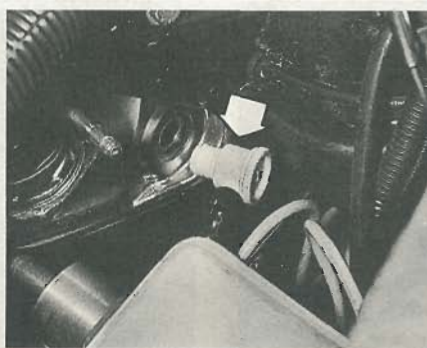
12 Pull the fuse box clear of the pedal box assembly, and lay it on the floor of the driver's footwell, taking care not to strain the wiring.

13 Pull the rubber plug from the slot in the bonnet release lever, and slide the end of the release cable from the lever.

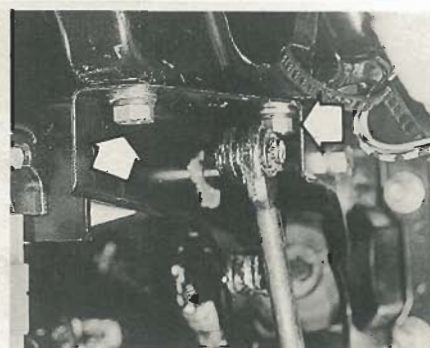




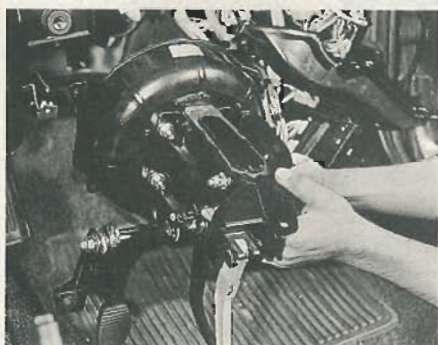
15.4 Withdraw the brake master cylinder from the studs on the servo



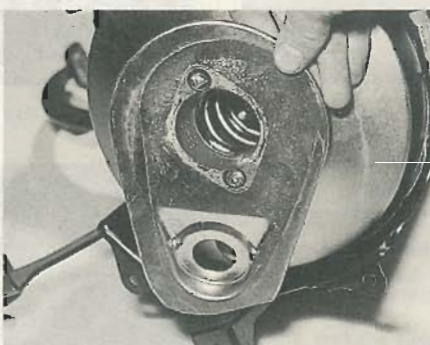
15.5 Vacuum hose (arrowed) removed from rear of brake servo



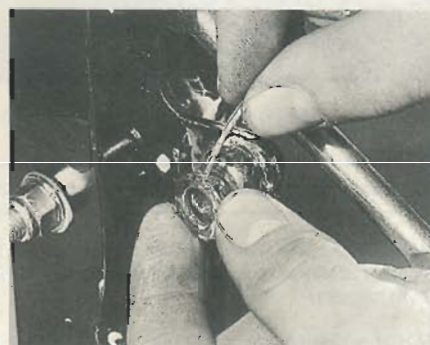
15.16 Pedal box-to-facia bracket bolts (arrowed)



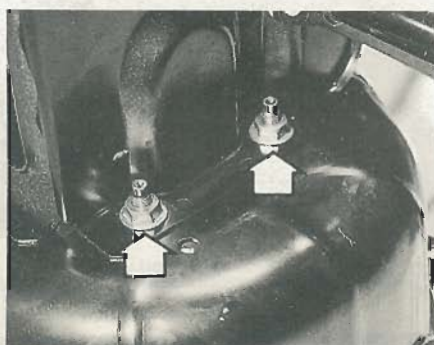
15.18 Withdrawing the pedal box assembly



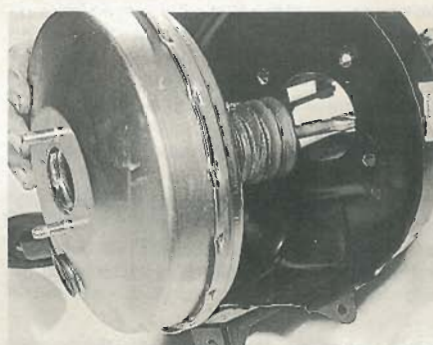
15.19 Removing the metal plate from the master cylinder securing studs



15.20 Removing the split-pin and washer securing the servo pushrod to the intermediate bellcrank



15.21 Two of the brake servo securing nuts (arrowed)



15.22 Withdrawing the servo from the pedal box

14 Disconnect the wiring plug from the brake lamp switch.

15 Unhook the end of the clutch cable from the top of the clutch pedal. If necessary, slacken the cable adjuster with reference to Chapter 5.

16 Remove the two bolts securing the pedal box assembly to the facia bracket (photo).

17 Unscrew the three nuts securing the pedal box to the studs on the bulkhead, and the single nut securing the bracket at the left-hand end of the pedal pivot shaft to the stud on the bulkhead.

18 The pedal box assembly can now be manipulated from the footwell and withdrawn from the vehicle (photo).

19 Recover the metal plate from the master cylinder securing studs on the servo (photo).

20 Remove the split-pin and the washer securing the servo pushrod to the intermediate bellcrank (photo).

21 Unscrew the four nuts and washers securing the servo to the pedal box (photo).

22 Withdraw the servo from the pedal box, at the same time manipulating the servo pushrod from the brake pedal (photo).

23 The servo cannot be overhauled, and if faulty, the complete unit must be renewed.

24 Before refitting the servo, check that the operating fork dimension is correct as follows.

25 Working on the bulkhead side of the servo, measure the distance from the end of the pushrod to the outer face of the servo casing - see Fig. 8.6.

26 If adjustment is necessary, turn the nut on the end of the pushrod to give the correct dimension.

27 Refitting is a reversal of removal, bearing in mind the following points.

28 Use a new split-pin to secure the servo pushrod to the intermediate bellcrank.

29 After reconnecting the end of the clutch cable to the clutch pedal, check the cable adjustment as described in Chapter 5.

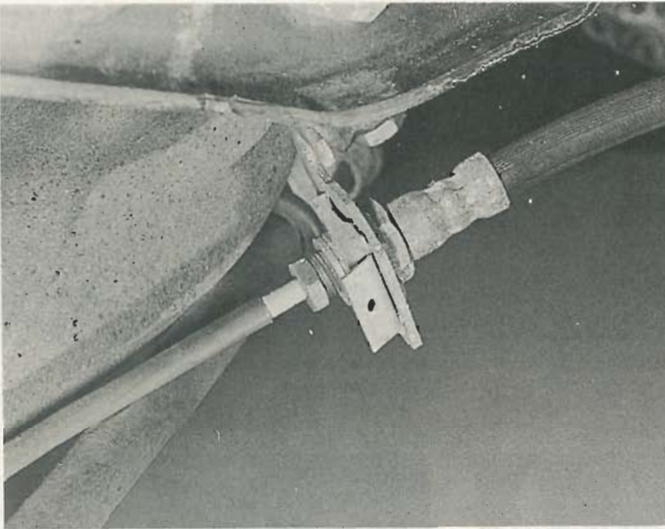
30 After refitting the throttle pedal and reconnecting the throttle cable, check the cable adjustment as described in Chapter 3.

31 If either of the pedals has been removed, finally tighten the nut on the end of the pedal pivot shaft after refitting the pedal box assembly.

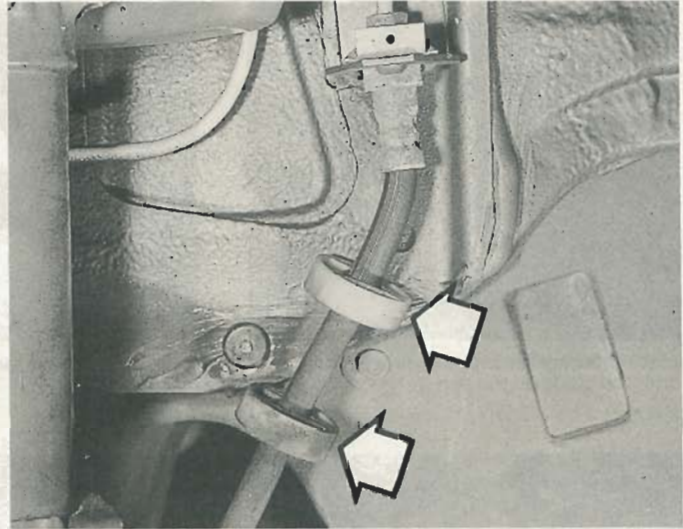
32 Refit the steering column as described in Chapter 9.

33 On completion, check the operation of the servo as described in Section 14.





16.3 Rigid brake pipe-to-flexible hose union on trailing arm



16.8 Front brake flexible hose. Plastic spacers arrowed

## 16 Brake fluid pipes and hoses – removal and refitting

**Note:** If the brake fluid is spilt on the paintwork, the affected area must be washed down with cold water immediately – brake fluid is an effective paint stripper!

### Rigid pipes

1 Most of the commonly-used brake pipes can be obtained from FIAT dealers, ready-formed and complete with unions. Alternatively, kits for making the brake pipes can be obtained from certain motor accessory shops.

2 Before removing a brake pipe, remove the brake fluid reservoir cap, and secure a piece of polythene over the filler neck with a rubber band, or by refitting the cap. This will reduce the loss of fluid as the pipe is disconnected.

3 To remove a brake pipe, unscrew the unions at each end, and release the pipe from the retaining clips (photo).

4 Plug the open ends of all disconnected pipes to prevent dirt ingress, and to minimise fluid loss.

5 Refitting is a reversal of removal, but take care not to distort the pipe, and do not overtighten the unions.

6 On completion, remove the polythene from the brake fluid reservoir filler neck, and bleed the relevant hydraulic circuit(s) as described in Section 3.

### Flexible hoses

7 Proceed as described previously for the rigid pipes, but note that a flexible hose must never be installed twisted, although a slight "set" is permissible to give the hose clearance from adjoining components.

8 Ensure that the front brake flexible hoses are positioned to prevent contact with the wheel arches and suspension components. If necessary, reposition the plastic spacers on the hose to achieve this (photo).

## 17 Handbrake – adjustment

1 The handbrake will normally be kept in correct adjustment by the self-adjusting action of the rear brake shoes. However, due to cable stretch over a period of time, the travel of the handbrake lever may become excessive, in which case the following operations should be carried out.

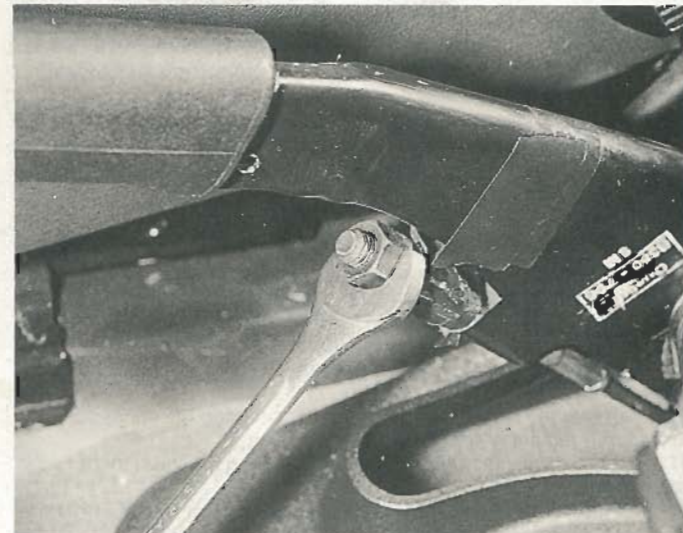
2 Chock the front wheels, jack up the rear of the vehicle and support securely on axle stands.

3 Working inside the vehicle, extract the single securing screw, and remove the cover from the handbrake lever (photo).

4 Fully release the handbrake, then pull the lever up one notch.

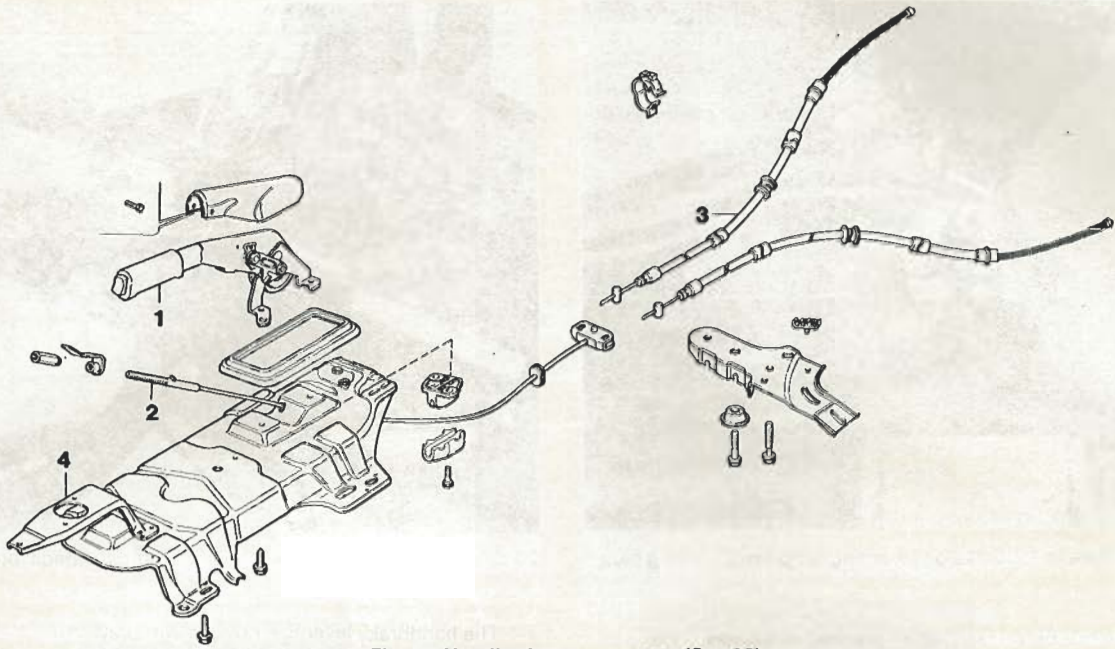


17.3 Removing the handbrake lever cover securing screw



17.5 Turning the handbrake cable adjuster nut





**Fig. 8.7 Handbrake components (Sec 18)**

- |                               |                  |
|-------------------------------|------------------|
| 1 Handbrake lever             | 3 Rear cable     |
| 2 Threaded end of front cable | 4 Mounting plate |

- 5 Turn the cable adjuster nut on the underside of the handbrake lever until the brake shoes can just be heard to rub on the drums when the wheels are turned by hand in the normal direction of rotation (photo).
- 6 Loosen the adjuster nut until the wheels are just free to turn.
- 7 The handbrake should be fully applied after pulling the lever up a maximum of three notches.
- 8 On completion of adjustment, check the handbrake cables for free movement.
- 9 Lower the vehicle to the ground.

vehicle, and the two rear sections (left and right) run from the cable equaliser to the rear brake shoes.

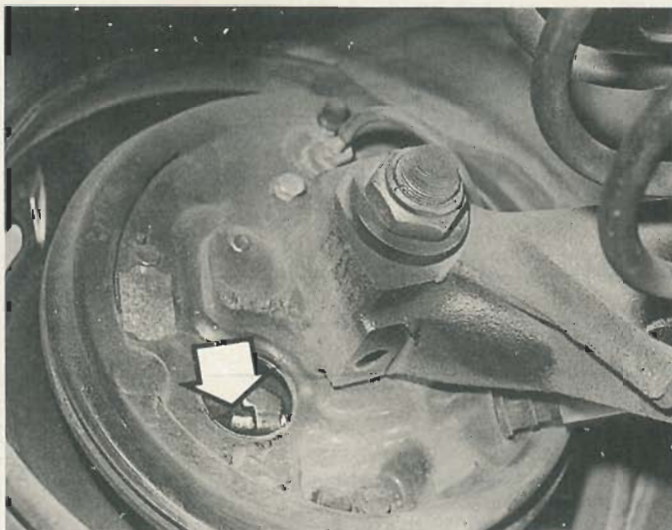
- 2 To remove a cable, proceed as follows.

#### *Front cable*

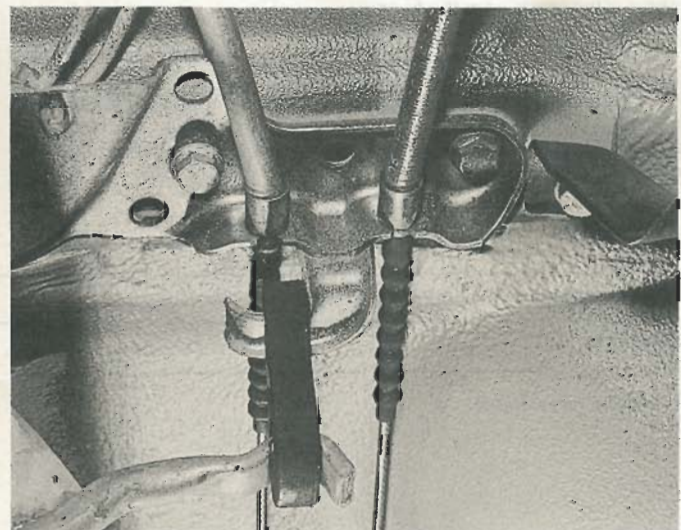
- 3 Chock the front wheels, jack up the rear of the vehicle and support securely on axle stands.
- 4 Working inside the vehicle, extract the single securing screw, and remove the cover from the handbrake lever.
- 5 Fully release the handbrake.
- 6 Unscrew the cable adjuster nut on the underside of the handbrake lever from the threaded end of the cable.
- 7 Working underneath the vehicle, unhook the two rear sections of the cable from the cable equaliser.
- 8 Pull the cable through the aperture in the floor, and withdraw it from under the vehicle.
- 9 Refitting is a reversal of removal, but on completion, check the handbrake adjustment as described in Section 17.

### **18 Handbrake cable - removal and refitting**

- 1 The handbrake cable is in three sections. The forward section runs from the handbrake lever to the cable equaliser under the floor of the

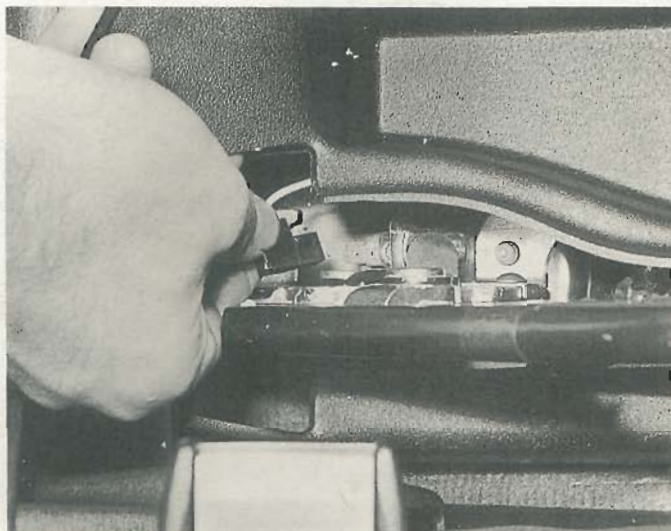


**18.15** Plastic cover removed from rear brake backplate to expose handbrake cable end fitting (arrowed)



**18.16** Rear handbrake cable/exhaust mounting bracket on vehicle underbody





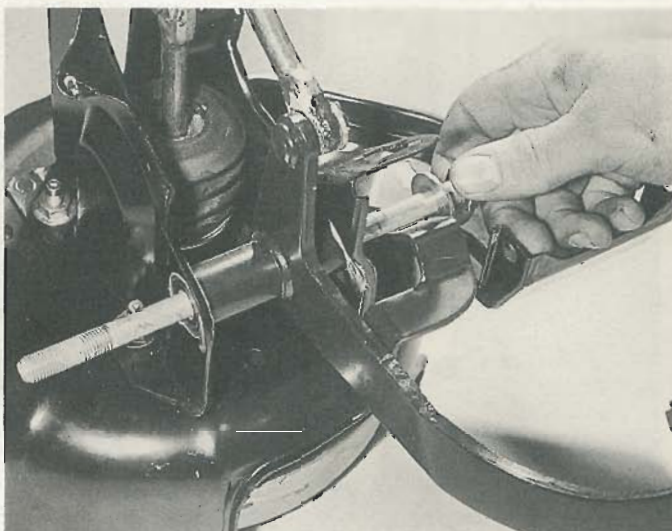
19.5 Disconnect the "handbrake on" warning lamp switch wiring plug

### Rear cables

- 10 To remove one of the rear cables, proceed as follows.
- 11 Chock the front wheels, then jack up the rear of the vehicle and support securely on axle stands.
- 12 Proceed as described in paragraphs 4 and 5.
- 13 Turn the cable adjuster nut on the underside of the handbrake lever to slacken the cable.
- 14 Working underneath the vehicle, unhook the relevant rear cable from the cable equaliser.
- 15 Remove the plastic cover from the rear brake backplate, and unhook the end of the handbrake cable from the handbrake operating lever (photo).
- 16 Pull the cable end fitting from the brake backplate, unhook the cable from the brackets on the vehicle underbody, and withdraw the cable from under the vehicle (photo).
- 17 Refitting is a reversal of removal, but on completion, check the handbrake adjustment as described in Section 17.

### 19 Handbrake lever- removal and refitting

- 1 Chock the rear wheels, then jack up the front of the vehicle and support securely on axle stands.
- 2 Working inside the vehicle, extract the single securing screw, and remove the cover from the handbrake lever.
- 3 Fully release the handbrake.
- 4 Unscrew the cable adjuster nut on the underside of the handbrake lever from the threaded end of the cable.
- 5 Disconnect the "handbrake on" warning lamp switch wiring plug (photo).
- 6 Working underneath the vehicle, unscrew the two handbrake lever securing bolts.



20.5 Withdrawing the pedal pivot shaft from the pedal box

- 7 The handbrake lever can now be withdrawn from the inside of the vehicle. Slide the end of the handbrake cable from the lever as it is withdrawn.
- 8 Refitting is a reversal of removal, but on completion, adjust the handbrake as described in Section 17.

### 20 Brake pedal - removal and refitting

**Note:** A new split-pin should be used to secure the intermediate pushrod-to-brake pedal pivot pin on refitting

- 1 Remove the pedal box assembly as described in Section 15 for the vacuum servo removal procedure.
- 2 Unhook the clutch pedal return spring from the bracket on the pedal box.
- 3 Unscrew the nut from the end of the pedal pivot shaft.
- 4 Remove the washers, the pedal box support bracket, and the clutch pedal from the end of the shaft.
- 5 Slide the pedal pivot shaft from the pedal box assembly, noting the position of any washers and/or spacers on the pivot shaft (photo).
- 6 Extract the split-pin and washer, then pull out the pivot pin securing the intermediate pushrod to the brake pedal, and withdraw the brake pedal.
- 7 Refitting is a reversal of removal, bearing in mind the following points.
- 8 Ensure that any washers and/or spacers on the pedal pivot shaft are refitted in their original positions.
- 9 Use a new split-pin to secure the intermediate pushrod-to-brake pedal pivot pin.
- 10 Refit the pedal box assembly as described in Section 15.

### 21 Fault diagnosis - braking system

#### Symptom

#### Reason(s)

Excessive pedal travel

Low fluid level  
Air in hydraulic system  
Fluid leak  
Faulty rear brake self-adjuster mechanism  
Faulty master cylinder  
Faulty vacuum servo  
Excessive disc run-out



Symptom	Reason(s)
Brake pedal feels spongy	Air in hydraulic system Fluid leak Faulty master cylinder Faulty vacuum servo
Excessive pedal pressure required to stop vehicle	Air in hydraulic system Fluid leak Faulty vacuum servo Caliper or wheel cylinder piston seized Pad or shoe friction material worn or contaminated Incorrect grade of pads fitted New pads or shoes fitted – not yet bedded in
Brakes pull to one side	Pad or shoe friction material worn or contaminated Caliper or wheel cylinder piston seized Faulty rear brake self-adjuster mechanism Pads or shoes renewed on one side only Disc or drum badly worn or distorted Tyre, steering or suspension defect – see Chapter 9
Brakes binding	Air in hydraulic system Caliper or wheel cylinder piston seized Faulty master cylinder Faulty rear brake self-adjuster mechanism Incorrectly adjusted handbrake cable
Judder felt through brake pedal or steering wheel when braking	Excessive disc run-out or thickness variation Pads or shoe friction material badly worn or contaminated Caliper mountings loose or worn Wear in suspension or steering components – see Chapter 9

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice



# Chapter 9 Suspension and steering

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## Specifications

### Front suspension

Type .....

Independent, with MacPherson struts with offset coil springs and integral telescopic shock absorbers. Anti-roll bar fitted to all models

### Rear suspension

Type .....

Independent by trailing arms, coil springs and telescopic shock absorbers. Anti-roll bar fitted to all models

### Steering

Type .....

Rack and pinion steering gear linked to collapsible steering column by shaft with universal joints. Power steering optional on certain models  
3.75

Turns lock to lock .....

Steering gear lubricant:

    Type/specification .....

Lithium-based molybdenum disulphide grease to NLGI 000 (refer to FIAT dealer)

    Quantity .....

80 g

Power steering pump drivebelt tension .....

Approximately 5.0 mm (0.2 in) deflection midway between coolant pump and power steering pump pulleys under firm thumb pressure  
Dexron II type ATF (Duckhams D-Matic)

Power steering fluid .....

### Front wheel alignment

Toe setting .....

1.0 mm (0.04 in) toe-out to 1.0 mm (0.04 in) toe-in

### Roadwheels

Type .....

Pressed steel

Size .....

5.00B x 13H

### Tyres

Size .....

165/70R13 78S

Pressures (cold) in lbf/in<sup>2</sup> (tbat):

    Normal load .....

**Front**

**Rear**

    Full load .....

29 (2.0)

28 (1.9)

29 (2.0)

32 (2.2)



**Torque wrench settings**

	Nm	lbf ft
<i>Front suspension</i>		
Front subframe-to-body bolts.....	108	80
Rear subframe-to-body bolts:		
Bolts with 15 mm AF heads .....	90	66
Bolts with 17 mm AF heads .....	80	59
Lower arm-to-subframe bolts .....	69	51
Suspension strut-to-suspension turret bolts.....	40	30
Hub carrier-to-suspension strut nuts.....	70	52
Lower arm-to-hub carrier balljoint nut .....	35	26
Anti-roll bar-to-subframe clamp bolts.....	28	21
Anti-roll bar vertical link-to-anti-roll bar nut.....	70	52
Anti-roll bar vertical link-to-lower arm nut.....	31	23
Front hub nut:		
Early type plain nut.....	250	184
Later type with integral washer .....	235	173
<i>Rear suspension</i>		
Subframe-to-body bolts .....	108	80
Trailing arm-to-subframe pivot bolt .....	150	111
Shock absorber lower mounting nut .....	88	65
Shock absorber upper mounting bolt .....	56	41
Rear hub nut .....	280	236
Anti-roll bar-to-trailing arm clamp bolts .....	28	21
Anti-roll bar end-to-trailing arm bolt.....	56	41
<i>Steering</i>		
Track-rod end-to-hub carrier balljoint nut .....	34	25
Steering gear-to-subframe bolts .....	70	52
Steering column lower universal joint-to-steering gear pinion nut .....	20	15
Steering wheel retaining nut .....	50	37
Upper steering column mounting bracket-to-facia bracket bolts.....	7	5
Steering column tilt adjuster nut (tighten with adjuster lever in locked position) .....	24	18
<i>Roadwheels</i>		
Roadwheel bolts.....	86	63

**1 General description**

Both front and rear suspension assemblies are mounted on subframes which are bolted to the body. The front subframe is bolted rigidly to the body, and also carries the engine/transmission assembly. The rear subframe is attached to the body via flexible rubber mountings.

The front suspension is of independent MacPherson strut type incorporating offset coil springs and integral telescopic shock absorbers. The lower end of each strut is attached to a hub carrier, which carries the wheel hub and bearings, and the brake assembly. The lower end of each hub carrier is attached to a suspension lower arm by a sealed balljoint. The inboard ends of the lower arms are attached to the front subframe, and the lower arms thus provide lateral location for the strut assemblies. The upper end of each strut is bolted to a suspension turret on the vehicle body. An anti-roll bar is mounted to the rear of the lower arms, and resists the roll tendency of the front suspension.

The rear suspension is of independent type, incorporating trailing arms mounted on the subframe, coil springs, telescopic shock absorbers, and an anti-roll bar. The trailing arms are attached to the subframe at their forward ends and carry the hub assemblies at their rear ends. The coil springs and shock absorbers are located between the trailing arms and the subframe. The anti-roll bar is mounted between the forward ends of the trailing arms.

The steering gear is of the conventional rack-and-pinion type, located behind the front wheels. Movement of the steering wheel is transmitted to the steering gear by means of a shaft containing two universal joints. The front hub carriers are connected to the steering gear by track-rods which have balljoints at their inner and outer ends to allow for the relative movement of the steering and suspension components.

Power steering is available on certain models. The power steering is hydraulically-operated, and pressure is supplied by a fluid pump driven via a drivebelt from the coolant pump, which is itself driven by a drivebelt from the engine crankshaft.

**2 Routine maintenance**

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

2 Check the tyre pressures, and inspect the surfaces of the tyres for damage and wear as described in Section 34.

3 Check the torque of the roadwheel bolts.

4 Where applicable, check the power steering fluid level in the reservoir and top up if necessary. To check the fluid level, the engine must be running. The level should be above the "LIVELLO" mark on the side of the reservoir. If necessary, top up the fluid level. A regular need for topping-up indicates a leak, which should be located and rectified without delay.

5 Where applicable, check the tension of the power steering fluid pump drivebelt, and adjust if necessary, as described in Section 28.

6 Periodically inspect all suspension and steering components for wear and damage, using the following as a guide, and take corrective action as necessary.

**Wheels and tyres**

7 Carefully inspect each tyre, including the spare, for signs of uneven wear, lumps, bulges or damage to the sidewalls or tread face. Refer to Section 34 for further details.

8 Check the wheel rims for distortion, damage and excessive run-out. Also make sure that the balance weights are secure with no obvious signs that any are missing.

**Front suspension and steering**

9 Apply the handbrake, jack up the front of the vehicle and support securely on axle stands.

10 Visually inspect the lower arm-to-hub carrier balljoints, and the track rod end-to-hub carrier balljoints for any signs of damage or wear. If the lower arm balljoint requires renewal, the complete lower arm must be renewed. If the track rod end balljoint requires renewal, the track rod



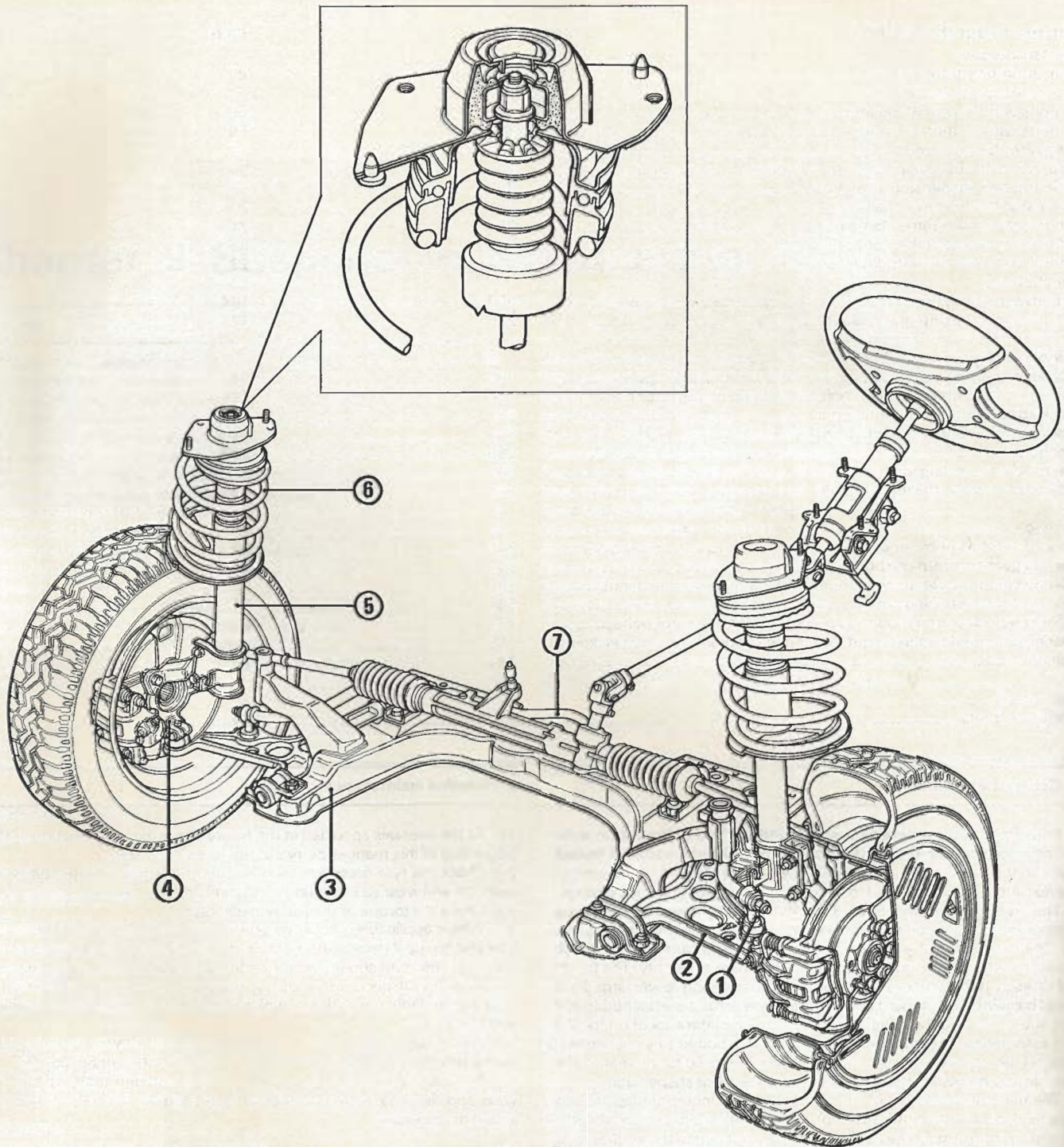


Fig. 9.1 Front suspension and steering assembly - left-hand drive model shown (Sec 1)

- |                               |                  |                    |                 |
|-------------------------------|------------------|--------------------|-----------------|
| 1 Anti-roll bar vertical link | 3 Front subframe | 5 Suspension strut | 7 Anti-roll bar |
| 2 Lower arm                   | 4 Hub carrier    | 6 Coil spring      |                 |

end must be renewed. Also check the steering gear gaiters for any signs of splits or damage, and renew if necessary as described in Section 22.

11 Grasp the roadwheel at the 12 o'clock and 6 o'clock positions and try to rock it. Very slight free play may be felt, but if the movement is appreciable, further investigation is necessary to determine the source. Continue rocking the wheel while an assistant depresses the footbrake. If the movement is now eliminated or significantly reduced, it is likely that the wheel bearings are at fault. If the free play is still evident with the footbrake depressed, then there is wear in the suspension joints or

mountings. Pay close attention to the lower arm-to-hub carrier balljoint and the lower arm mounting bushes. Renew any worn components as described in the relevant Sections of this Chapter.

12 Now grasp the wheel at the 9 o'clock and 3 o'clock positions and try to rock it as before. Any movement felt now may again be caused by wear in the hub bearings, or the steering track rod inner or outer balljoints. If the outer balljoint is worn, then visible movement will be obvious. If the inner balljoint is suspect, place a hand over the steering gear gaiter and grip the track rod. If the wheel is now rocked, movement



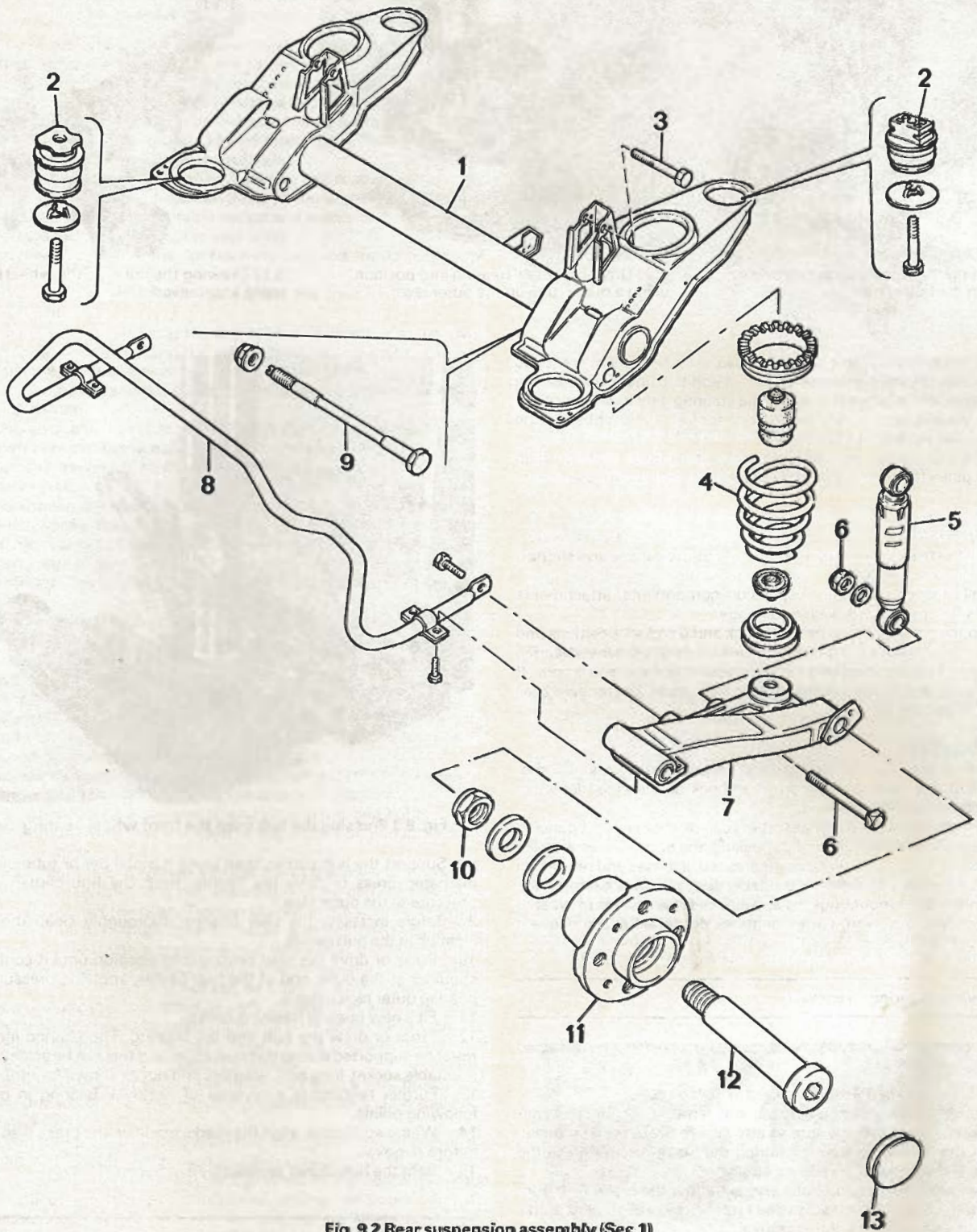


Fig. 9.2 Rear suspension assembly (Sec 1)

- |                                    |  |                           |              |
|------------------------------------|--|---------------------------|--------------|
| 1 Subframe                         | 4 Coil spring                                | 7 Trailing arm            | 11 Hub       |
| 2 Rubber mounting                  | 5 Shock absorber                             | 8 Anti-roll bar           | 12 Stub axle |
| 3 Shock absorber top mounting bolt | 6 Shock absorber lower mounting nut and bolt | 9 Trailing arm pivot bolt | 13 Dust cap  |
|                                    |  | 10 Hub nut                |              |

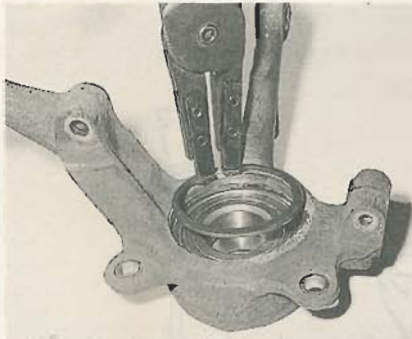
will be felt at the inner joint if wear has taken place. Again, renew any worn components as described in the relevant Sections of this Chapter.

13 Using a large screwdriver or flat bar, check for wear in the anti-roll bar mountings and the lower arm mountings by carefully levering against these components. Some movement is to be expected as the

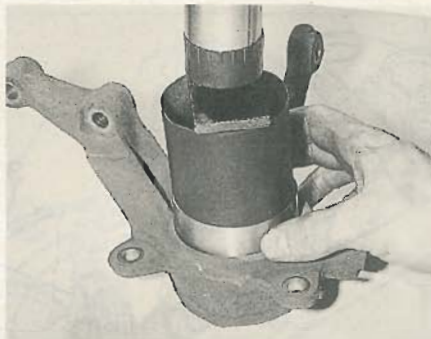
mountings are made of rubber, but excessive wear should be obvious. Renew any worn or damaged bushes.

14 With the vehicle standing on its wheels, have an assistant turn the steering wheel back and forth approximately one-eighth of a turn in each direction. There should be no lost movement between the steering

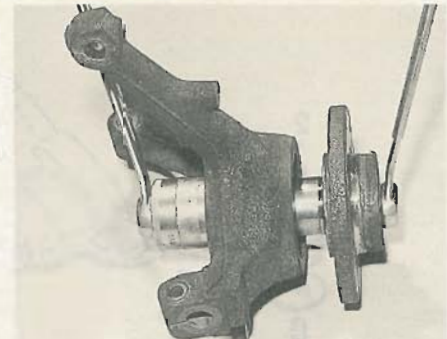




3.7 Extracting the wheel bearing retaining circlip from the hub carrier



3.10 Driving a wheel bearing into position using a metal tube on the outer race



3.12 Drawing the hub into the wheel bearing using improvised tools

wheel and roadwheels. If this is not the case, closely observe the joints and mountings previously described, but in addition check the steering shaft universal joints for wear and also the steering gear itself. Any wear should be visually apparent and must be rectified as described in the appropriate Sections(s) of this Chapter.

15 Where applicable, periodically inspect the power steering fluid hoses and pipes for signs of damage or leakage, and rectify as necessary.

### Rear suspension

16 Chock the front wheels, jack up the rear of the vehicle and support it securely on axle stands.

17 Visually inspect the rear suspension components, attachments and bushes for any signs of wear or damage.

18 Grasp the roadwheel at the 12 o'clock and 6 o'clock positions and try to rock it. Any excess movement indicates wear in the wheel bearing which may be accompanied by a rumbling sound as the wheel is spun. If the bearing is worn, the complete rear hub must be renewed, as described in Section 13.

### Shock absorbers

19 Check for any signs of fluid leakage around each shock absorber body. Should any fluid be noticed, the shock absorber is defective internally and should be renewed.

20 The efficiency of the shock absorbers can be checked by bouncing the vehicle at each corner. Generally speaking, the body will return to its normal position and stop after being depressed. If it rises and returns on a rebound, the shock absorber is probably suspect. Also examine the shock absorber/strut mountings (as applicable) for any signs of wear. If necessary, renew any worn components as described in the relevant Section(s) of this Chapter.

## 3 Front wheel bearing - renewal

**Note:** The bearing will probably be destroyed during the removal operation

- 1 Remove the hub carrier as described in Section 5.
- 2 Unscrew the two securing screws, and remove the brake caliper carrier bracket, noting that the screws also secure the brake disc shield.
- 3 Extract the remaining screw securing the brake disc shield to the hub carrier, and withdraw the disc shield.
- 4 Remove the two securing bolts and withdraw the brake disc from the hub. If the original brake disc is to be refitted, make alignment marks between the disc and hub before removal.
- 5 Support the hub carrier on two metal bars positioned as shown in Fig. 9.3, then using a metal bar or tube of suitable diameter, press or drive the hub from the wheel bearing. Alternatively, screw two roadwheel bolts into the hub and, using progressively thicker packing pieces, tighten the bolts to force the hub from the bearing. Note that it is likely that one half of the inner bearing race will remain on the hub.
- 6 Where applicable, using a suitable puller, pull the half inner bearing race from the hub. Alternatively, support the bearing race on suitably thin metal bars, and press or drive the hub from the bearing race.
- 7 Extract the bearing retaining circlip from the inner end of the hub carrier (photo).

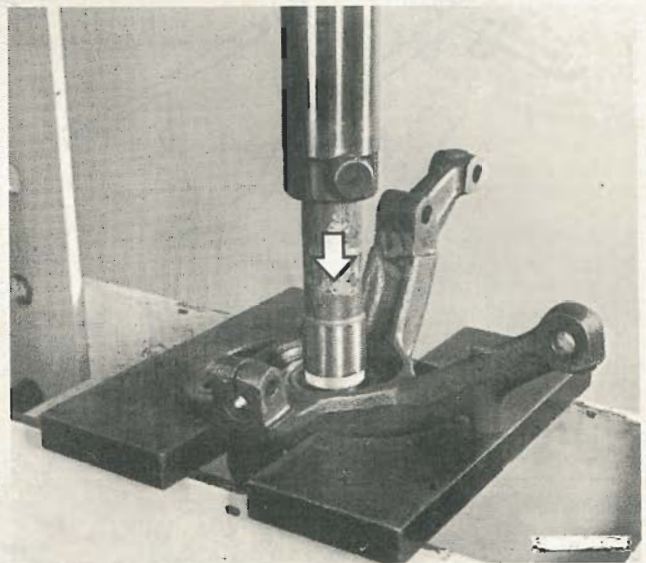


Fig. 9.3 Pressing the hub from the front wheel bearing (Sec 3)

8 Support the hub carrier, then using a metal bar or tube of suitable diameter, press or drive the bearing from the hub carrier, applying pressure to the outer race.

9 Before installing the new bearing, thoroughly clean the bearing location in the hub carrier.

10 Press or drive the new bearing into position until it contacts the shoulder at the outer end of the hub carrier, applying pressure to the bearing outer race (photo).

11 Fit a new bearing retaining circlip.

12 Press or draw the hub into the bearing. The bearing inner track **must** be supported during this operation, and this can be achieved using a suitable socket, long bolt, washers and nut as shown (photo).

13 Further refitting is a reversal of removal, bearing in mind the following points.

14 Where applicable, align the marks made on the brake disc and hub before removal.

15 Refit the hub carrier as described in Section 5.

## 4 Front hub - removal and refitting

Front hub removal and refitting is described in Section 3 as part of the wheel bearing renewal procedure.

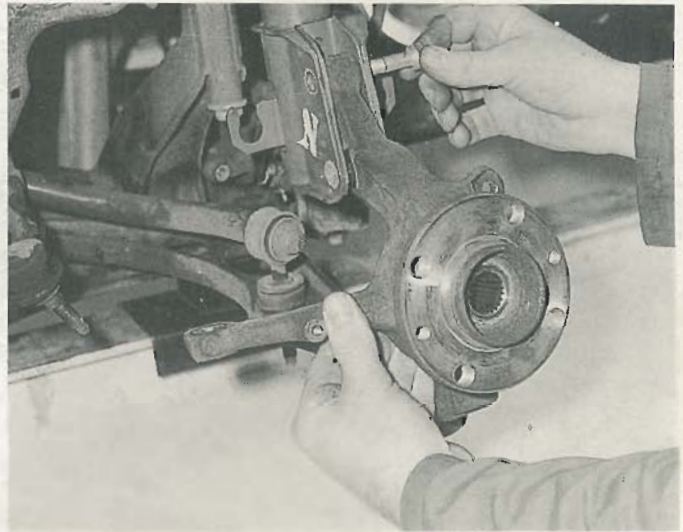
## 5 Front hub carrier - removal and refitting

**Note:** A balljoint separator tool will be required for this operation. The brake caliper securing bolts are of the self-locking type, and must be



renewed on refitting. A new front hub nut must be used on refitting, and the new nut must be coated with suitable thread-locking compound

- 1 Remove the wheel trim and loosen the relevant front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands. Remove the roadwheel.
- 2 Remove the brake caliper with reference to Chapter 8, Section 6, but do not disconnect the flexible hose. Support the caliper on an axle stand, or suspend it with wire or string to avoid straining the flexible hose.
- 3 Relieve the staking on the front hub nut.
- 4 Prevent the hub from turning by inserting two roadwheel bolts and using a metal bar inserted between them to counterhold the hub, then loosen the hub nut using a suitable socket and extension bar but do not remove it yet. Note that the nut is very tight.
- 5 Unscrew and remove the nut from the track rod end-to-hub carrier balljoint.
- 6 Using a balljoint separator, disconnect the track rod end-to-hub carrier balljoint.
- 7 Unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush, noting that the convex side of the washer lies against the bush.
- 8 Unscrew the nut and the pinch-bolt securing the lower arm balljoint to the hub carrier.
- 9 Using a suitable bar to lever against the subframe, lever the lower arm down to separate the balljoint from the hub carrier.
- 10 Remove the hub nut and washer (where applicable) from the end of the driveshaft.
- 11 Manipulate the splined outboard end of the driveshaft from the hub carrier, lightly tapping the end of the driveshaft with a soft-faced mallet if necessary to free it. **Do not use heavy blows, as damage to the driveshaft joints may result.** Support the driveshaft by suspending with wire or string - **do not** allow the driveshaft to hang down under its own weight.
- 12 Unscrew the two nuts and bolts securing the hub carrier to the suspension strut, and withdraw the hub carrier (photo).
- 13 If desired, the wheel bearing can be renewed as described in Section 3.
- 14 Commence refitting as follows.
- 15 Offer the hub carrier to the suspension strut, then refit the securing bolts and nuts, noting that the bolt heads should face the front of the vehicle, and tighten them to the specified torque.
- 16 Engage the outboard end of the driveshaft with the hub carrier.
- 17 Manipulate the hub carrier as necessary to reconnect the lower arm balljoint, then fit the balljoint pinch-bolt and nut, and tighten to the specified torque. Note that the head of the pinch-bolt should face the front of the vehicle.
- 18 Reconnect the anti-roll bar vertical link to the lower arm, and refit the rubber bush, washer and nut, ensuring that the convex side of the washer rests against the bush. Tighten the nut to the specified torque.
- 19 A new hub nut must now be fitted and tightened. Early Tipo models were fitted with a plain hub nut, while later models are fitted with a modified hub nut incorporating an integral washer - see Fig. 7.1 in Chapter 7. *The earlier type of nut can be fitted to later models, but the later type of nut cannot be fitted to early models.* If in any doubt as to which type of nut should be used, consult a FIAT dealer for advice. The tightening procedure for the early type of nut involves the use of thread-locking compound. Proceed as follows.
- 20 Clean the threaded end of the driveshaft with a wire brush, then clean the threads on the new nut and driveshaft with a cloth soaked in methylated spirit.
- 21 When fitting an *early type plain nut*, coat the threaded end of the driveshaft with Loctite 270 thread-locking compound or an equivalent product. Note that the nut must be tightened to the specified torque within 5 minutes of applying the thread-locking compound, and the manufacturers specify that the vehicle must not be driven for at least 2½ hours after tightening the nut.
- 22 To prevent the driveshaft from turning as the nut is tightened, insert two roadwheel bolts, then insert a metal bar between them to counterhold the hub.
- 23 Tighten the nut to the specified torque, noting that different torques are specified for the two types of nut, then stake the nut to the end of the driveshaft.
- 24 Reconnect the track rod end balljoint to the hub carrier, and tighten the securing nut to the specified torque.
- 25 Refit the brake caliper with reference to Chapter 8, Section 6.
- 26 Refit the roadwheel and lower the vehicle to the ground.



5.12 Withdrawing the hub carrier

27 Finally tighten the roadwheel bolts with the vehicle resting on its wheels, and refit the wheel trim.

28 On completion, check and if necessary adjust the front wheel alignment as described in Section 33.

## 6 Front suspension strut - removal and refitting

**Note:** A balljoint separator tool will be required for this operation. The brake caliper securing bolts are of the self-locking type, and must be renewed on refitting. A new front hub nut must be used on refitting, and the new nut must be coated with suitable thread-locking compound. Front struts should be renewed in pairs

- 1 Proceed as described in Section 5, paragraphs 1 to 11 inclusive, but additionally, unclip the brake fluid hose (photo), and where applicable the brake pad wear sensor wiring from the bracket(s) on the suspension strut.
- 2 Working in the engine compartment, unscrew the three bolts securing the suspension strut to the suspension turret. Support the suspension strut as the bolts are unscrewed, as once the bolts have been removed, the strut is free to drop from the vehicle.
- 3 Withdraw the suspension strut/hub carrier assembly from the vehicle.

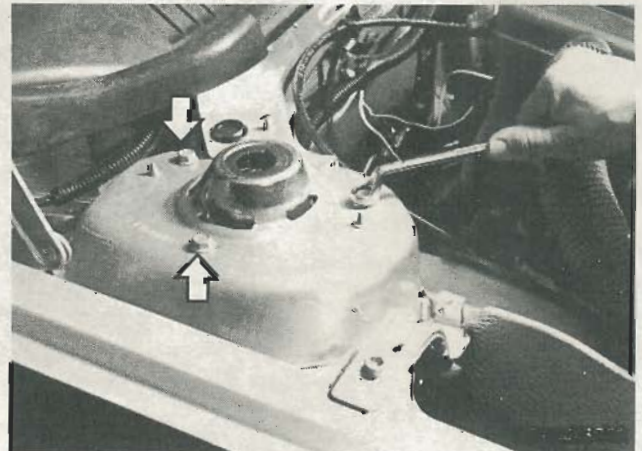
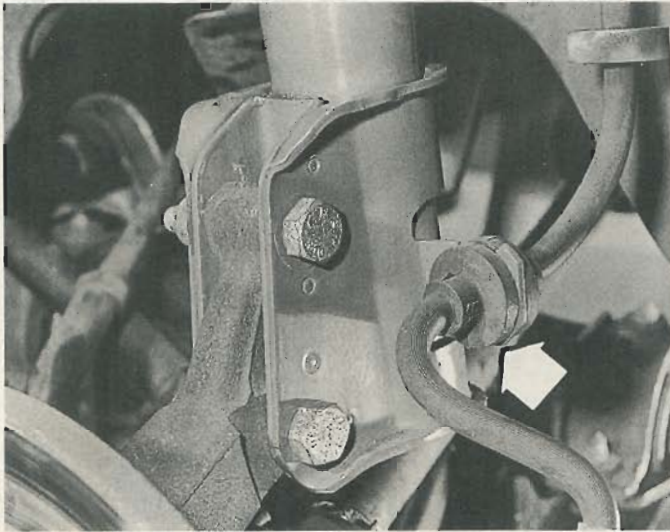


Fig. 9.4 Unscrewing the suspension strut-to-suspension turret bolts (See 6)



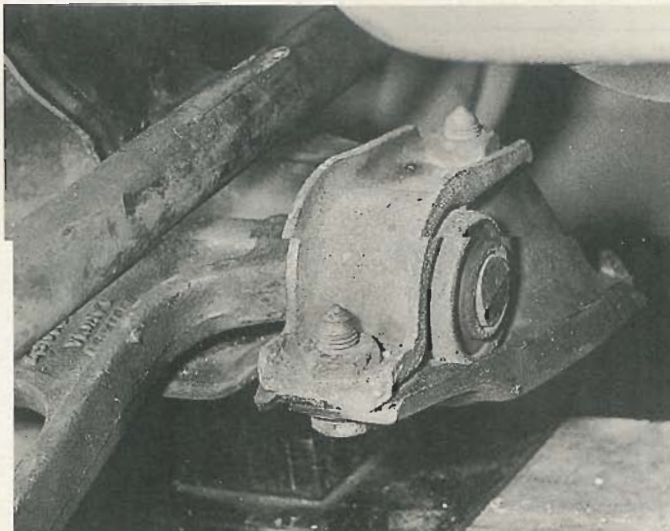


6.1 Brake fluid hose (arrowed) clipped to bracket on suspension strut

- 4 The hub carrier can be removed from the strut after unscrewing the two securing nuts and bolts, but any further dismantling of the strut should be entrusted to a FIAT dealer who will have the suitable special tools required to compress the coil spring.
- 5 Commence refitting as follows.
- 6 Where applicable, refit the hub carrier to the suspension strut, and tighten the securing bolts and nuts to the specified torque, noting that the bolt heads should face the front of the vehicle when the strut is fitted.
- 7 Locate the top end of the strut in the suspension turret, then fit the securing bolts, and tighten them to the specified torque.
- 8 Proceed as described in Section 5, paragraph 16 onwards, but additionally, clip the brake fluid hose, and where applicable the brake pad wear sensor wiring to the bracket(s) on the suspension strut.

## 7 Front suspension strut – overhaul

The strut coil spring is of the offset type, and when fitted, the spring is in a state of very high compression. For safety reasons, it is therefore recommended that overhaul of the strut is entrusted to a FIAT dealer who will have the suitable special tools required to compress the coil spring safely. Note that the shock absorber is integral with the main



8.8A Front lower arm-to-subframe clamp

strut body, and if the shock absorber is faulty, the complete strut body must be renewed.

## 8 Front suspension lower arm – removal and refitting

- 1 Remove the wheel trim and loosen the relevant front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands.
- 2 For improved access, remove the roadwheel.
- 3 Unscrew the nut and pinch-bolt securing the lower arm balljoint to the hub carrier.
- 4 Unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush, noting that the convex side of the washer lies against the bush.
- 5 Using a suitable bar to lever against the subframe, lever the lower arm down to separate the balljoint from the hub carrier.
- 6 Unscrew the nut securing the anti-roll bar vertical link to the end of the anti-roll bar. Recover the washer.
- 7 Manipulate the lower arm and the anti-roll bar as necessary in order to facilitate removal of the anti-roll bar vertical link. Recover the remaining washer and rubber bush located between the vertical link and the lower arm.
- 8 Unscrew the four bolts securing the inboard end of the lower arm to the subframe, then carefully manipulate the lower arm from the vehicle (photos).
- 9 If desired, the mounting bushes can be renewed by sliding the old mounting assemblies from the ends of the lower arm, tapping them free if necessary.
- 10 Fit the new mounting assemblies, tapping them into position on the lower arm using a suitable tube if necessary. Note that the mounting assemblies fit with the longer arms of the brackets uppermost, and the larger diameter mounting fits on the side of the lower arm nearest the rear of the vehicle.
- 11 Refitting is a reversal of removal, bearing in mind the following points.
- 12 When refitting the anti-roll bar vertical link, note that the washers should be fitted with their convex sides against their relevant rubber bushes.
- 13 Tighten all nuts and bolts to the specified torque.
- 14 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.
- 15 On completion, check and if necessary adjust the front wheel alignment as described in Section 33.

## 9 Front suspension lower arm bushes – renewal

Proceed as described in Section 8.



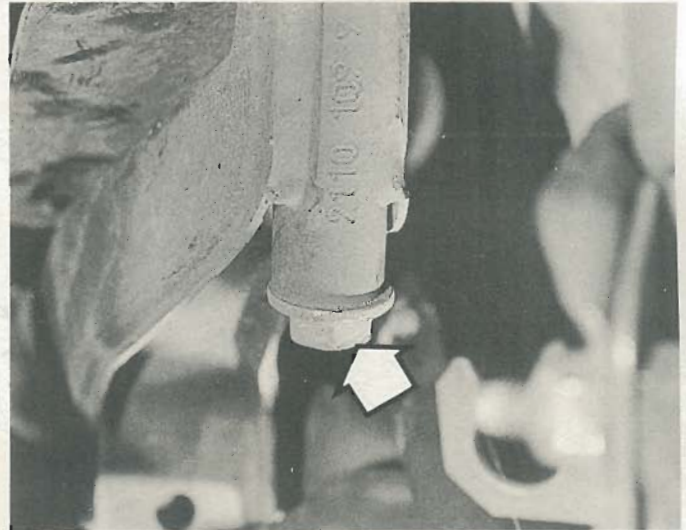
8.8B Rear lower arm-to-subframe clamp (arrowed)



## 10 Front subframe - removal and refitting

**Note:** Suitable equipment will be required to support the gearbox during this procedure. Two 12.0 mm dowels will be required to ensure correct alignment of the subframe on refitting

- 1 The subframe is removed complete with the anti-roll bar.
- 2 Before removing the subframe, the gearbox must be supported from its lifting bracket. Ideally the gearbox should be supported using a strong wooden or metal beam resting on blocks positioned securely on the suspension turrets and the front body panel. The FIAT special tool designed specifically for this purpose is shown being used to support the engine in Fig. 6.3 in Chapter 6. Alternatively, the gearbox can be supported using a suitable hoist and lifting tackle, but in this case, the hoist must be of such a design as to enable the gearbox to be supported with the vehicle raised off the ground, leaving sufficient clearance to withdraw the subframe from under the front of the vehicle.
- 3 Remove the wheel trims and loosen the front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands. Remove the roadwheels.
- 4 Remove the front section of the exhaust system as described in Chapter 3.
- 5 Ensure that the gearbox is adequately supported, then remove the centre engine/gearbox mounting as described in Chapter 1, Section 13.
- 6 Remove the lower arms as described in Section 8.
- 7 Support the subframe on a trolley jack, with an interposed wooden beam to prevent the subframe from tipping as it is withdrawn.
- 8 Unscrew and remove the two bolts securing the steering gear to the subframe.
- 9 Ensure that the subframe is adequately supported, then progressively unscrew and remove the eight bolts securing the subframe to the vehicle underbody (photo). The bolts are very tight, and a suitable extension bar will probably be required to loosen them.
- 10 Lower the jack supporting the subframe, and withdraw the assembly from under the front of the vehicle.
- 11 If desired, the anti-roll bar can be removed from the subframe with reference to Section 11.
- 12 Refitting is a reversal of removal, bearing in mind the following points.
- 13 If the anti-roll bar has been removed from the subframe, refit it with reference to Section 11.
- 14 Support the subframe on a jack, with interposed block of wood, as during removal, and offer it to the underside of the vehicle.
- 15 Fit the securing bolts, but do not fully tighten them at this stage.
- 16 Insert two 12.0 mm dowels through the alignment holes in the rear of the subframe, so that they rest in the corresponding holes in the vehicle underbody - see Fig. 9.5. This will ensure correct alignment of the subframe.
- 17 Finally tighten the subframe securing bolts to the specified torque.



10.9 One of the front subframe securing bolts (arrowed) accessible from the wheel arch

- 18 Further refitting is a reversal of removal, bearing in mind the following points.
- 19 Refit the lower arms as described in Section 8.
- 20 Refit the centre engine/gearbox mounting as described in Chapter 1, Section 13.
- 21 Refit the front section of the exhaust system as described in Chapter 3.
- 22 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.
- 23 On completion, check and if necessary adjust the front wheel alignment as described in Section 33.

## 11 Front anti-roll bar - removal and refitting

- 1 Remove the front subframe as described in Section 10.
- 2 Unscrew the four clamp bolts, and remove the anti-roll bar from the subframe.

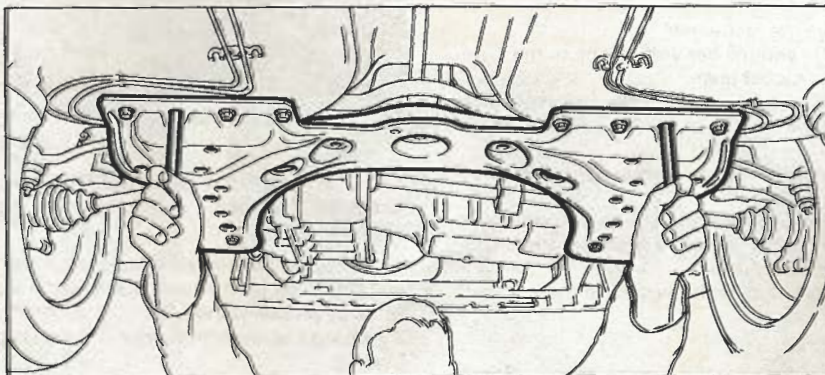


Fig. 9.5 Aligning the front subframe using dowels (Sec 10)



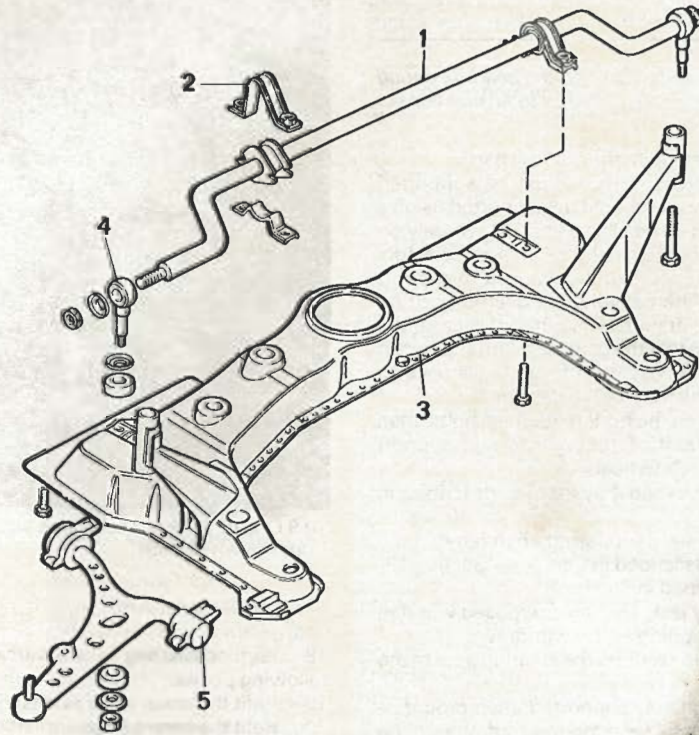


Fig. 9.6 Front anti-roll bar components (Sec 11)

1 Anti-roll bar  
2 Clamp

3 Subframe

4 Vertical link

5 Lower arm

3 If desired, the clamp rubber bushes can be renewed by sliding them from the anti-roll bar.

4 Refitting is a reversal of removal, but tighten the clamp bolts to the specified torque, and refit the subframe as described in Section 10.

## 12 Front anti-roll bar bushes - renewal

### Anti-roll bar vertical link-to-lower arm bushes

1 Proceed as described in Section 8, paragraphs 1 to 7 inclusive.

2 Fit the new bushes with reference to Section 8, paragraph 11 onwards, but note that there is no need to check the front wheel alignment.

### Anti-roll bar-to-front subframe clamp bushes

3 Remove the wheel trim and loosen the relevant front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands.

4 For improved access, remove the roadwheel.

5 Unscrew the nut securing the anti-roll bar vertical link to the lower arm. Recover the washer and the rubber bush.

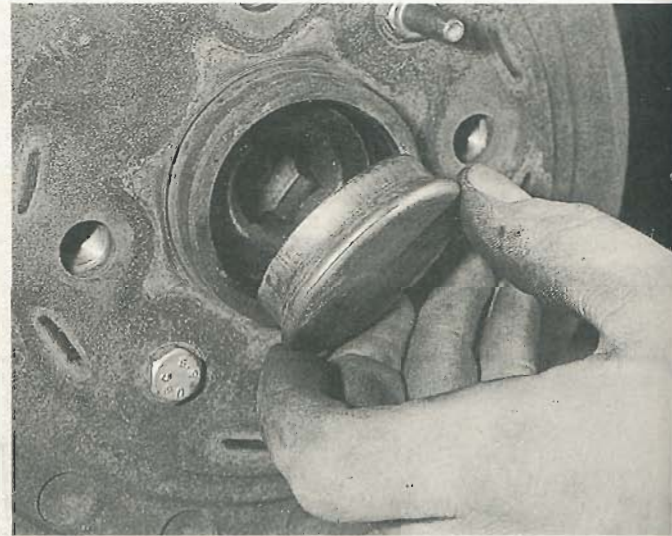
6 Unscrew the anti-roll bar-to-subframe clamp bolts, and manipulate the end of the anti-roll bar as necessary to enable removal of the clamping plates and bush.

7 Fit the new bush using a reversal of the removal procedure, bearing in mind the following points.

8 When reconnecting the anti-roll bar vertical link to the lower arm, note that the convex side of the washer should lie against the bush.

9 Tighten all fixings to the specified torque.

10 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.



13.2 Removing the dust cap from the centre of the rear hub

*newed. A suitable tool will be required to counterhold the stub axle as the hub nut is loosened - see text. A new rear hub nut must be used on refitting*

1 Remove the relevant wheel trim, then loosen the roadwheel bolts and chock the front wheels. Jack up the rear of the vehicle and support securely on axle stands. Remove the roadwheel.

2 Using a screwdriver, prise the dust cap from the centre of the hub (photo).

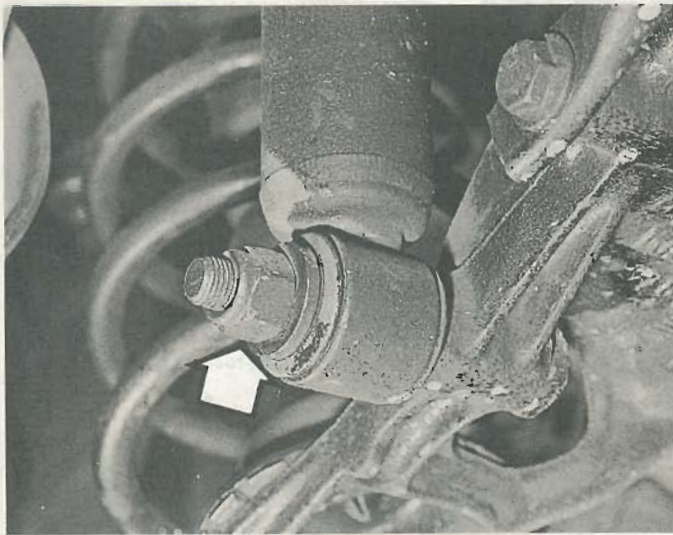
3 Remove the brake drum as described in Chapter 8.

4 A suitable tool will now be required to counterhold the stub axle as the hub nut is loosened. FIAT special tool No 1857508000 is available specifically for this purpose, but an alternative can be improvised using a short length of 19.0 mm ( $\frac{3}{4}$  inch) AF hexagon bar to fit into the end of

## 13 Rear wheel bearing - renewal

**Note:** The rear wheel bearings are integral with the rear hubs. If a wheel bearing has to be renewed, the complete hub assembly must be re-





15.3 Rear shock absorber lower mounting nut (arrowed)

the stub axle, and a corresponding socket to fit over the end of the bar.  
5 Using a suitable socket, unscrew the hub nut at the inboard end of the stub axle, counterholding the stub axle with the tool previously described. Note that the hub nut is extremely tight, and a suitable extension bar will probably be required to loosen it.

6 Remove the hub nut and recover the washers, then withdraw the stub axle and the hub from the trailing arm.

7 If necessary, tap the stub axle from the hub using a soft-faced mallet.

8 Examine the stub axle for signs of wear or damage, and renew if necessary.

9 Note that the bearings cannot be separated from the hub, and if bearing wear is evident, the complete hub must be renewed.

10 Refitting is a reversal of removal, bearing in mind the following points.

11 Use a new hub nut, and tighten it to the specified torque.

12 Refit the brake drum as described in Chapter 8.

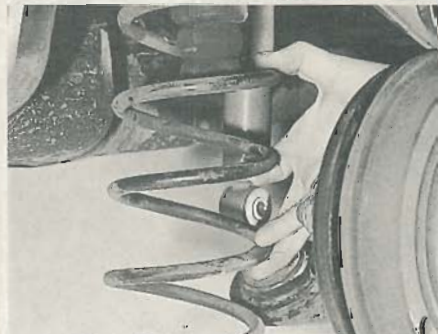
13 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.

#### 14 Rear hub - removal and refitting

Rear hub removal and refitting is described in Section 13 as part of the wheel bearing renewal procedure.

#### 15 Rear shock absorber - removal and refitting

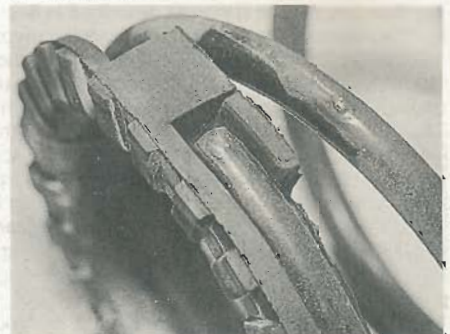
**Note:** Shock absorbers should be renewed in pairs, ie both rear shock absorbers should be renewed together



16.2 Removing a rear coil spring



16.3 Removing a rear coil spring lower mounting rubber



16.5 Top end of rear coil spring correctly located against lug on upper mounting rubber



15.4 Removing a rear shock absorber upper mounting bolt

1 Remove the relevant wheel trim, then loosen the roadwheel bolts and chock the front wheels. Jack up the rear of the vehicle and support securely on axle stands. Remove the roadwheel.

2 Place a hydraulic jack under the rear of the trailing arm, and raise the jack slightly to compress the coil spring. Ensure that the jack head is securely located.

3 Unscrew and remove the lower shock absorber mounting nut while counterholding the bolt using a second spanner (photo).

4 Working through the access hole in the side of the vehicle underbody, unscrew the upper shock absorber mounting bolt. Take care not to allow the bolt to drop into the underbody box section as it is withdrawn from the shock absorber (photo). Support the shock absorber as the bolt is withdrawn, as once the upper mounting bolt has been removed, the shock absorber is free to drop from the vehicle.

5 If necessary, compress the shock absorber slightly by hand, then pull it from the upper mounting.

6 The shock absorber can be tested by clamping the lower mounting in a vice, then fully extending and contracting the shock absorber several times. Any evidence of jerky movement or lack of resistance indicates the need for renewal.

7 Refitting is a reversal of removal, but tighten the lower mounting nut (counterhold the bolt as the nut is tightened), and the upper mounting bolt to the specified torque, and finally tighten the roadwheel bolts with the vehicle resting on its wheels.

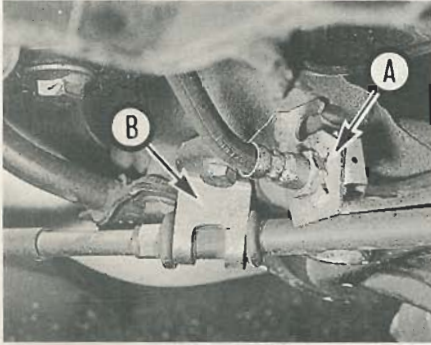
#### 16 Rear coil spring - removal and refitting

**Note:** Coil springs should be renewed in pairs, ie both rear coil springs should be renewed together

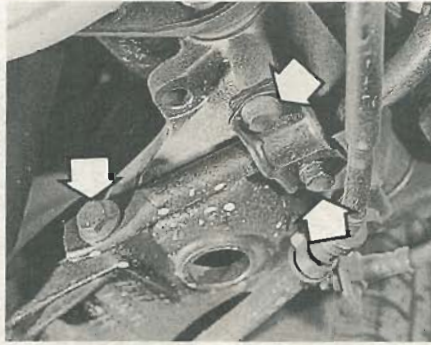
1 Proceed as described in Section 15, paragraphs 1 to 3 inclusive.

2 Slowly lower the jack supporting the trailing arm, until the coil

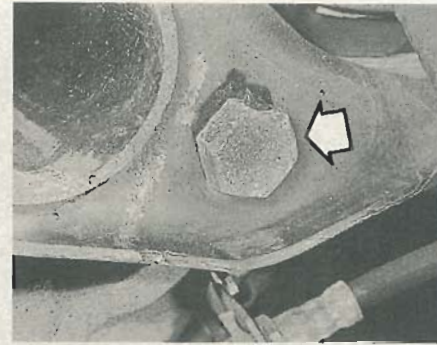




17.6 Brake pipe (A) and handbrake cable (B) brackets on trailing arm



17.7 Rear anti-roll bar-to-trailing arm securing bolts (arrowed)



17.9 Trailing arm-to-rear subframe pivot bolt (arrowed)

spring can be removed. Lever the trailing arm down slightly if necessary to remove the spring (photo).

3 Recover the spring mounting rubbers, and the bump stop rubber which fits on top of the lower spring mounting rubber (photo).

4 Refitting is a reversal of removal, bearing in mind the following points.

5 Ensure that the top end of the spring locates correctly against the lug on the upper mounting rubber (photo).

6 Ensure that the spring locates correctly between the trailing arm and the underbody.

7 Tighten the lower shock absorber mounting nut to the specified torque while counterholding the bolt.

8 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.

16 Refit the coil spring as described in Section 16.

17 After reconnecting the brake fluid pipe to the wheel cylinder, remove the polythene from the brake fluid reservoir filler neck, and bleed the relevant brake hydraulic circuit as described in Chapter 8.

18 Reconnect the handbrake cable to the operating lever on the brake shoe, and check the handbrake adjustment as described in Chapter 8.

19 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.

### 17 Trailing arm – removal and refitting

1 Remove the relevant wheel trim, then loosen the roadwheel bolts and chock the front wheels. Jack up the rear of the vehicle and support securely on axle stands. Remove the roadwheel.

2 Disconnect the handbrake cable from the operating lever on the brake shoe with reference to Chapter 8, Section 18.

3 Working under the bonnet, remove the filler cap from the brake fluid reservoir and secure a piece of polythene over the filler neck with a rubber band, or by refitting the cap. This will reduce the loss of fluid during the following procedure.

4 Unscrew the brake fluid pipe union nut from the rear of the wheel cylinder, and disconnect the pipe. Take care not to strain the pipe. Be prepared for fluid spillage, and plug the open ends of the pipe and wheel cylinder to prevent dirt ingress and further fluid loss.

5 Unclip the handbrake cable from the bracket on the trailing arm.

6 Unscrew the securing bolt and move the bracket securing the brake pipe to the trailing arm to one side (photo). Take care not to strain the brake pipe.

7 Unscrew and remove the three securing bolts and disconnect the end of the anti-roll bar from the trailing arm (photo).

8 Remove the coil spring as described in Section 16.

9 Counterhold the nut, and unscrew the pivot bolt securing the front end of the trailing arm to the rear subframe (photo).

10 With the pivot bolt withdrawn, lower the jack supporting the trailing arm, and withdraw the trailing arm from under the vehicle.

11 If desired, the brake components, and/or the rear hub and stub axle can be removed from the trailing arm as described in Chapter 8, and Section 13 of this Chapter respectively. Clamp the trailing arm securely in a vice before attempting to unscrew the rear hub nut.

12 Note that the trailing arm pivot bushes cannot be renewed, and if excessive wear is evident, the complete trailing arm must be renewed.

13 Refitting is a reversal of removal, bearing in mind the following points.

14 Where applicable, refit any brake components which were removed, and/or the rear hub and stub axle as described in Chapter 8 and Section 13 of this Chapter respectively.

15 Tighten the trailing arm pivot bolt to the specified torque while counterholding the nut.

### 18 Rear suspension assembly – removal and refitting

1 If desired, the complete rear suspension assembly can be removed as an assembly as follows.

2 Remove the rear wheel trims, then loosen the rear roadwheel bolts. Jack up the vehicle and support securely on axle stands. Remove the rear roadwheels.

3 Remove the exhaust system as described in Chapter 3.

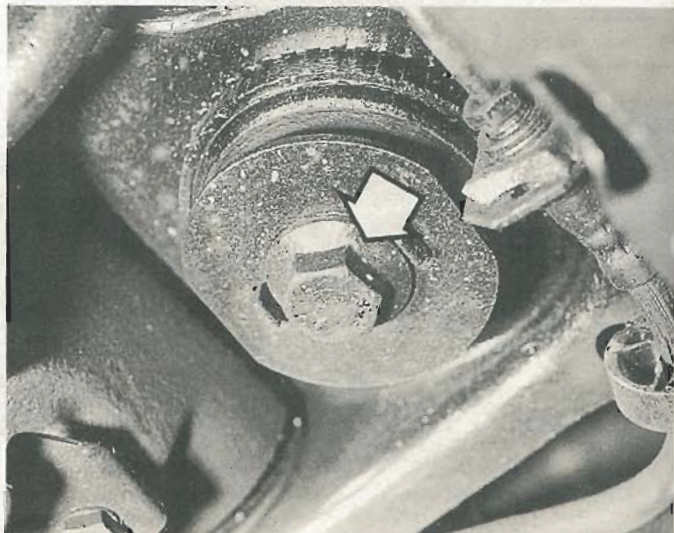
4 Remove the fuel tank as described in Chapter 3.

5 Disconnect the brake pipes which run to the rear subframe, from the 4-way connector block under the rear of the vehicle. Refer to Chapter 8, Section 16.

6 Disconnect the rear handbrake cables from the cable equaliser underneath the vehicle, with reference to Chapter 8, Section 18.

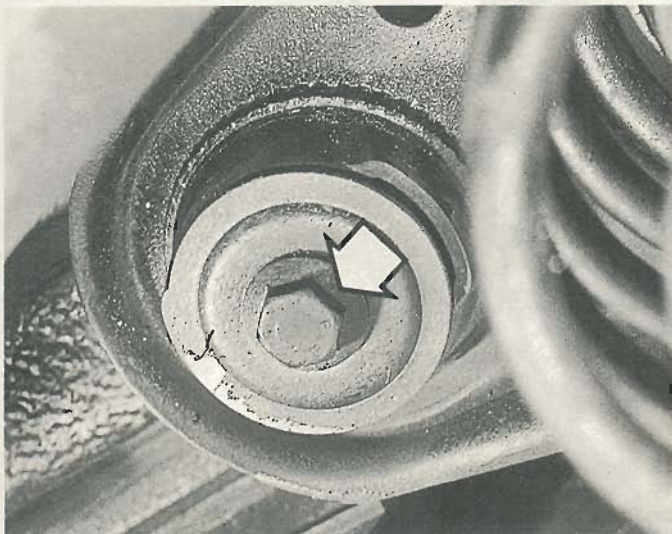
7 Position a trolley jack securely under the centre of the rear subframe crossmember, and support the rear suspension assembly.

8 Unscrew and remove the four bolts securing the subframe to the vehicle underbody (photos). It is advisable to have an assistant to



18.8A Rear subframe front securing bolt (arrowed)





18.8B Rear subframe rear securing bolt (arrowed)

ensure that the subframe crossmember does not slip from the jack as the securing bolts are unscrewed.

9 With the help of an assistant, lower the trolley jack and withdraw the rear suspension assembly from under the rear of the vehicle.

10 If desired, the suspension assembly can be dismantled with reference to the relevant Sections of this Chapter and Chapter 8, as applicable.

11 Commence refitting as follows.

12 Where applicable, refit any removed components with reference to the relevant Sections of this Chapter and/or Chapter 8, as applicable.

13 Support the subframe crossmember on the jack as during removal, and position the assembly under the rear of the vehicle.

14 Raise the jack, then fit the subframe securing bolts and tighten them to the specified torque.

15 Reconnect the rear handbrake cables to the cable equaliser, but do not adjust the handbrake at this stage.

16 Reconnect the brake pipes to the 4-way connector block, and bleed the brake hydraulic system as described in the relevant Sections of Chapter 8.

17 Adjust the handbrake as described in Chapter 8, Section 17.

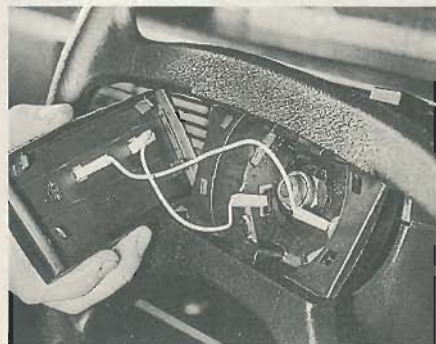
18 Refit the fuel tank as described in Chapter 3.

19 Refit the exhaust system as described in Chapter 3.

20 Refit the rear roadwheels, then lower the vehicle to the ground and finally tighten the roadwheel bolts. Refit the wheel trims.

### 19 Rear anti-roll bar – removal and refitting

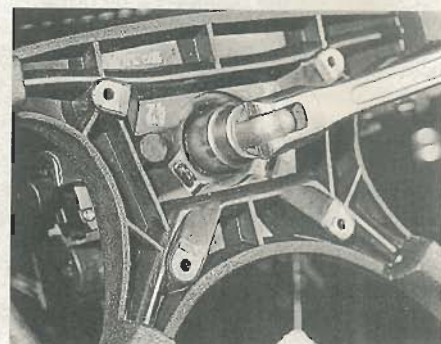
1 Chock the front wheels, jack up the rear of the vehicle, and support securely on axle stands.



20.3A Removing the horn-push pad – model with pad secured by clips



20.3B Removing a horn-push pad securing screw – DGT model



20.5 Unscrewing the steering wheel retaining nut

- 2 Remove the fuel tank as described in Chapter 3.
- 3 Unscrew the three anti-roll bar securing bolts from each trailing arm, then manipulate the anti-roll bar from under the vehicle.
- 4 Check that the anti-roll bar is not distorted, and that the mountings are not damaged. If either of these conditions is evident, the complete anti-roll bar must be renewed.
- 5 Commence refitting by lifting the anti-roll bar into position under the vehicle, and tightening the securing bolts to the specified torque.
- 6 Refit the fuel tank as described in Chapter 3.
- 7 Lower the vehicle to the ground.

### 20 Steering wheel – removal and refitting

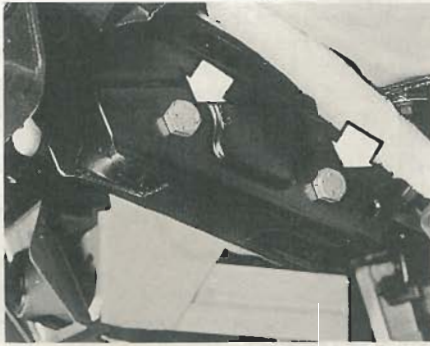
- 1 Disconnect the battery negative lead.
- 2 Set the front wheels in the straight-ahead position, and unless unavoidable, do not move them until the steering wheel has been refitted.
- 3 Remove the horn-push pad from the centre of the steering wheel, and disconnect the wiring. On some models, the pad is secured by clips, in which case it can be prised free, while on other models the pad is secured by four screws which are accessible from the rear of the steering wheel (photos).
- 4 Insert the ignition key, and turn it to position "MAR" to release the steering lock.
- 5 Unscrew and remove the steering wheel retaining nut (photo).
- 6 Make alignment marks between the steering wheel and the end of the column shaft.
- 7 Pull the steering wheel from the shaft. If the wheel is tight on the shaft, sit in the driver's seat and tap the wheel from behind with the palms of the hands (screw the nut back on the shaft two or three turns for safety).
- 8 Refitting is a reversal of removal, but align the marks made on the wheel and shaft before removal, and tighten the retaining nut to the specified torque.

### 21 Steering column – removal and refitting

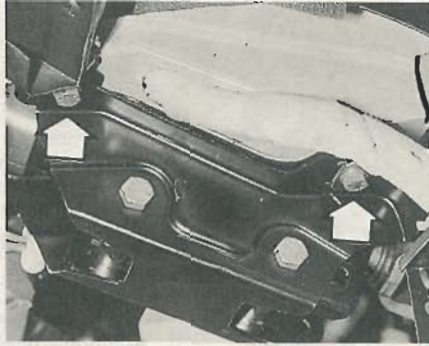
**Note:** A bolt extractor may be required if the ignition switch housing is removed – see text

- 1 Disconnect the battery negative lead.
- 2 Set the front wheels in the straight-ahead position.
- 3 Remove the steering wheel as described in Section 20.
- 4 Working in the driver's footwell, remove the lower facia trim panel as described in Chapter 10.
- 5 On models with an adjustable steering column, fully lower the column.
- 6 Remove the steering column shrouds. The lower shroud is secured by two screws through its underside, and the upper shroud is similarly secured by two screws which are accessible with the lower shroud removed.
- 7 Remove the two multi-function stalk switches as described in Chapter 11.





21.10 Bolts (arrowed) securing steering column to upper mounting bracket – fixed steering column



21.11 Two of the upper steering column mounting bracket-to-facia bracket mounting bolts (arrowed) – fixed steering column



21.15 Steering column tube-to-mounting bracket nuts (arrowed) – adjustable steering column



Fig. 9.7 Renewing a steering column bush (Sec 21)

8 Disconnect the wiring plugs from the ignition switch and the hazard warning flasher switch.

9 Working in the driver's footwell, unscrew and remove the nut and pinch-bolt securing the steering column lower universal joint to the steering gear pinion. If the original column is to be refitted, make alignment marks between the universal joint and the pinion.

10 On models up to Chassis No 2 020 769, unscrew and remove the two nuts and bolts securing the column to the upper mounting bracket, and withdraw the column assembly from the vehicle, pulling the lower universal joint from the pinion (photo).

11 On models from Chassis No 2 020 770, unscrew and remove the four bolts securing the upper steering column mounting bracket to the facia bracket, and withdraw the column assembly from the vehicle, pulling the lower universal joint from the pinion (photo).

12 If desired, the column can be dismantled as follows, otherwise proceed to paragraph 19.

13 To remove the ignition switch housing, the bolt securing the housing to the steering column tube must be removed. On early models, conventional bolts were used, while on later models, shear-head bolts have been used, which must be centre-punched, drilled and removed using a bolt extractor.

14 Remove the bolts and withdraw the ignition switch housing assembly.

15 Where applicable, if not already done, unscrew the two nuts, and withdraw the through-bolts securing the column tube to the mounting bracket (photo). Recover the spacer sleeves and where applicable, the column adjuster lever.

16 Mount the column tube in a soft-jawed vice, and using a soft-faced mallet, gently tap the shaft down out of the tube.

17 Where applicable relieve the staking on the tube, then prise the upper and lower bushes from the tube.

18 Examine the condition of the bushes, and renew if necessary.

19 Reassembly and refitting is a reversal of dismantling and removal, bearing in mind the following points.

20 Use new shear-head bolts to secure the ignition switch housing to the steering column tube.

21 Where applicable, align the marks made during removal on the universal joint and pinion, and where applicable, ensure that the clip on the end of the pinion is correctly located in the cut-out in the universal joint (photo).

## 22 Steering gear gaiters – renewal

1 Remove the track rod end as described in Section 31.

2 Unscrew and remove the track rod end locknut from the track rod.

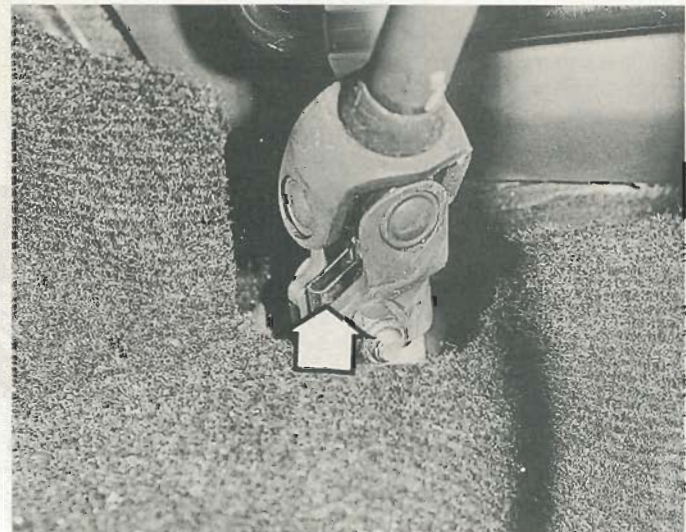
3 Remove the securing clips, and slide the gaiter from the track rod and steering gear. If there is evidence that any steering gear lubricant has been lost through leakage, then the correct type and quantity of grease (see Specifications) must be applied with the new gaiter.

4 Slide the new gaiter over the track rod and onto the steering gear. Make sure that the gaiter seats in the grooves in the track rod and steering gear.

5 Secure the gaiter with new clips. Before tightening the outboard gaiter retaining clips, check that the gaiters rotate freely on the track rods, and if necessary lubricate the contact areas between the track rods and the gaiters with silicone grease.

6 Refit the track rod end locknut to the track rod.

7 Refit the track rod end as described in Section 31.



21.21 Steering column lower universal joint – pinion clip arrowed



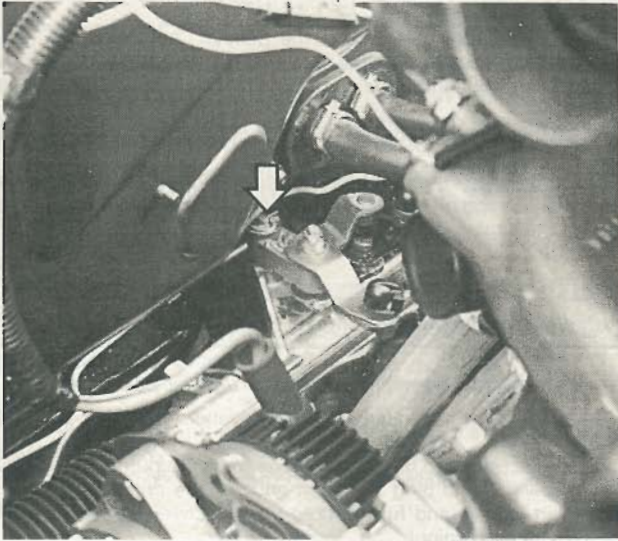


Fig. 9.8 Gear selector linkage pivot assembly (arrowed) on steering gear (Sec 23)

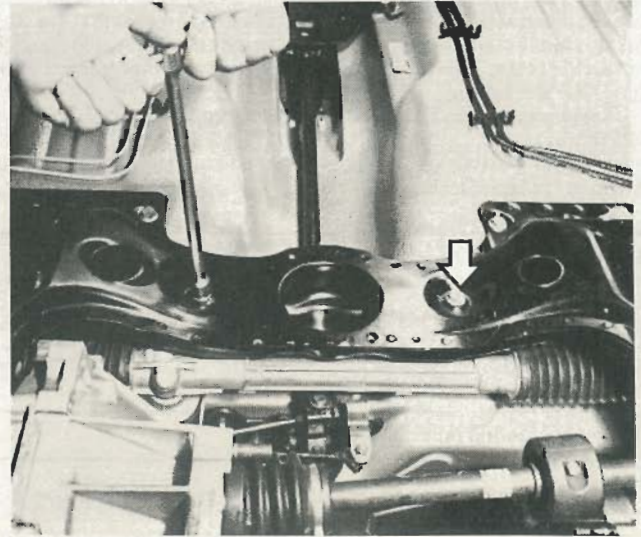


Fig. 9.9 Unscrewing the steering gear securing bolts (Sec 23)

### 23 Manual steering gear – removal and refitting

**Note:** A balljoint separator tool will be required for this operation

- 1 Set the front wheels in the straight-ahead position. Ensure that the steering lock is engaged, and remove the ignition key.
- 2 Remove the wheel trims and loosen the front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands. Remove the roadwheels.
- 3 Working in the engine compartment, remove the securing spring clip and washer, and slide the gear selector linkage pivot assembly from the bracket on the steering gear.
- 4 Working in the driver's footwell, remove the lower fascia trim panel as described in Chapter 10.
- 5 Unscrew and remove the nut and pinch-bolt securing the steering column lower universal joint to the steering gear pinion. If the original steering gear is to be refitted, make alignment marks between the universal joint and the pinion.
- 6 Working on one side of the vehicle, unscrew and remove the nut from the track rod end-to-hub carrier balljoint.
- 7 Using a balljoint separator, disconnect the track rod end-to-hub carrier balljoint.
- 8 Repeat the procedure on the remaining side of the vehicle.
- 9 Unscrew the two bolts securing the steering gear to the subframe, then carefully manipulate the steering gear out from underneath the vehicle.
- 10 Refitting is a reversal of removal, bearing in mind the following points.
- 11 If new steering gear is being fitted, the central pinion position can be ascertained by halving the number of turns required to move the rack from lock to lock.
- 12 Where applicable, align the marks made during removal when reconnecting the steering column lower universal joint to the steering gear pinion, and where applicable, ensure that the clip on the end of the pinion is correctly located in the cut-out in the universal joint.
- 13 Tighten all fixings to the specified torque.
- 14 Finally tighten the roadwheel bolts with the vehicle resting on its wheels.
- 15 On completion, check the front wheel alignment as described in Section 33.

### 24 Manual steering gear – overhaul

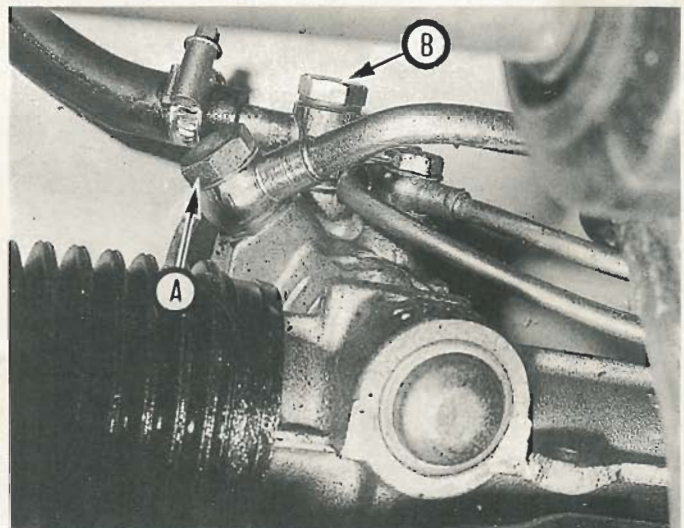
- 1 Overhaul of the steering gear is not recommended by the manufacturers, and no spares are available.

- 2 The track rods can be removed as described in Section 32, and the steering gear gaiters can be renewed as described in Section 22.
- 3 Adjustment of the steering gear should not be attempted.
- 4 Any faults with the steering gear should be referred to a FIAT dealer, although renewal of the complete assembly will probably be the only course of action available.

### 25 Power steering gear – removal and refitting

**Note:** A balljoint separator tool will be required for this operation. New sealing rings will be required for the fluid pipe unions

- 1 Proceed as described in Section 23, paragraphs 1 to 8 inclusive.
- 2 Position a suitable container beneath the steering gear to catch the fluid which will be released as the pipes are disconnected.
- 3 Disconnect the fluid supply and return pipe unions from the steering gear pinion housing (photo). Recover the union sealing rings (two for each union). Be prepared for fluid spillage, and plug the open ends of the pipes and the steering rack to prevent dirt ingress and further fluid loss.
- 4 Proceed as described in Section 23, paragraph 9 onwards, but in addition note the following.



25.3 Disconnect the fluid supply (A) and return (B) pipe unions from the steering gear pinion housing



5 If fluid has been leaking from the fluid pipe union(s) on the steering gear, the relevant union(s) should be disconnected in order to renew the sealing rings. The sealing rings should be renewed whenever the unions are disconnected. Tighten the union(s) to the specified torque after fitting new sealing rings.

6 Renew the sealing rings when reconnecting the fluid supply and return pipe unions.

7 On completion, top up the fluid level and bleed the fluid circuit as described in Section 27.

## 26 Power steering gear – overhaul

Refer to Section 24, but note that fluid leaks from the hydraulic fluid pipe unions can normally be rectified by renewing the union seals with the rack installed.

## 27 Power steering fluid circuit – bleeding

1 With the engine stopped, check that the fluid level is above the "LIVELLO" mark on the side of the reservoir.

2 Start the engine, and if the fluid level drops, top up immediately to the "LIVELLO" mark. Do not allow the reservoir to run dry at any time. The help of an assistant will greatly ease this operation.

3 With the engine running at idle speed, turn the steering wheel slowly several times from lock to lock. Do not hold the wheel on either lock, as this imposes strain on the hydraulic system.

4 Stop the engine and check the fluid level. The level should be above the "LIVELLO" mark. Top up if necessary.

5 Re-check the level when the engine and fluid have cooled, and top up if necessary.

## 28 Power steering pump drivebelt – checking, renewal and tensioning

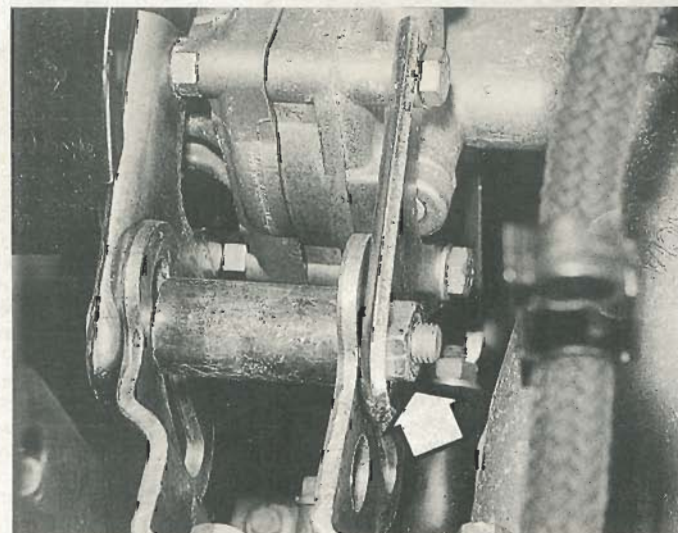
1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, the drivebelt should be checked and if necessary re-tensioned.

2 If desired, for improved access remove the air cleaner or the carburettor air box and air trunking, as applicable.

3 Check the full length of the drivebelt for cracks and deterioration. It will be necessary to turn the engine in order to check the portions of the drivebelt in contact with the pulleys. If a drivebelt is unserviceable, renew it as follows.

4 Remove the coolant pump/alternator drivebelt as described in Chapter 2.

5 Loosen the power steering pump pivot nut and bolt, and pivot the power steering pump downwards (photo).



28.5 Power steering pump pivot nut (arrowed)

6 Slip the drivebelt from the power steering pump and coolant pump pulleys.

7 Fit the new drivebelt around the pulleys, then lever the power steering pump upwards until the specified belt tension is achieved. It is helpful to partially tighten the pivot nut and bolt before tensioning the drivebelt.

8 When the specified tension has been achieved, tighten the pivot nut and bolt.

9 The drivebelt tension should be rechecked and if necessary adjusted after the engine has been run for approximately 30 seconds, but note that the engine should be cold before rechecking or adjustment is carried out.

## 29 Power steering pump – removal and refitting

**Note:** New sealing rings will be required for the fluid pipe unions.

1 Remove the power steering pump drivebelt as described in Section 28.

2 Disconnect the two fluid pipe unions from the pump. Be prepared for fluid spillage, and plug the open ends of the pump and pipes to prevent dirt ingress and further fluid loss. Recover the union sealing rings (two for each union).

3 Unscrew the pivot nut, withdraw the pivot bolt and spacer sleeve, and remove the pump.

4 If desired, the mounting brackets can be unbolted from the pump, and the drivebelt guard can be unbolted after removing the pulley.

5 No spare parts are available for the pump, and if faulty, the complete unit must be renewed.

6 Refitting is a reversal of removal, bearing in mind the following points.

7 Using new sealing rings when reconnecting the fluid pipe unions.

8 Tension the drivebelt as described in Section 28.

9 On completion, top up the fluid level and bleed the fluid circuit as described in Section 27.

## 30 Power steering fluid reservoir – removal and refitting

1 The power steering fluid reservoir is located at the rear right-hand side of the engine compartment.

2 Have a suitable container ready to catch the fluid, then disconnect the fluid hoses from the reservoir and drain the fluid. Plug the open ends of the hoses to prevent dirt ingress and further fluid loss.

3 The reservoir can be removed from the mounting bracket by loosening the clamp screw (photo).

4 If desired, the mounting bracket can be unbolted from the body panel and removed.

5 Refitting is a reversal of removal, but on completion, bleed the fluid circuit as described in Section 27.



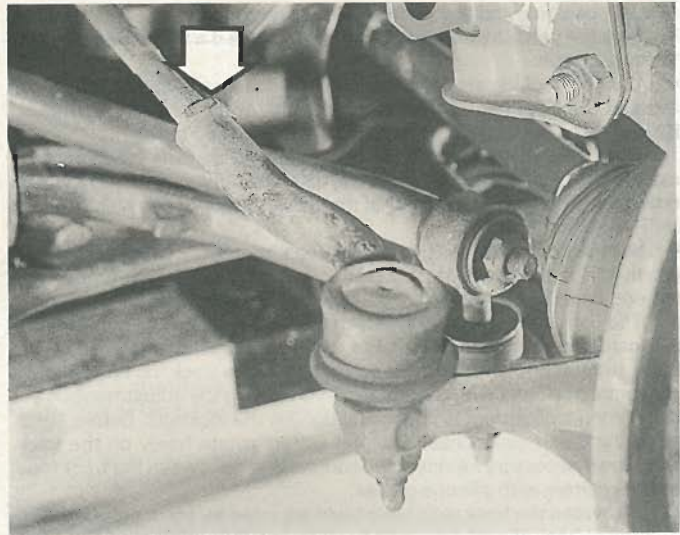
30.3 Power steering pump fluid reservoir clamp screw (arrowed)



### 31 Track-rod end – removal and refitting

**Note:** A balljoint separator tool will be required for this operation

- 1 Remove the wheel trim and loosen the relevant front roadwheel bolts, then apply the handbrake, jack up the front of the vehicle and support securely on axle stands. Remove the roadwheel.
- 2 Make alignment marks on the track rod end and track rod, then loosen the track rod end locknut (photo). Counterhold the track rod using a second spanner on the flats provided.
- 3 Unscrew and remove the nut from the track rod end-to-hub carrier balljoint.
- 4 Using a balljoint separator, disconnect the track rod end-to-hub carrier balljoint.
- 5 Unscrew the track rod end from the track rod, noting the number of turns necessary to remove it.
- 6 Refitting is a reversal of removal, bearing in mind the following points.
- 7 Screw the track rod end onto the track rod the number of turns noted before removal.
- 8 Tighten the track rod end-to-hub carrier balljoint nut to the specified torque (photo).

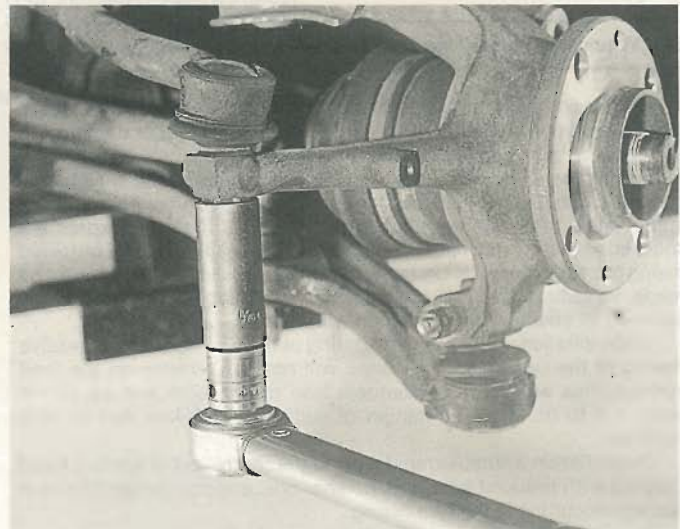


31.2 Track rod end locknut (arrowed)

### 32 Track-rod – removal and refitting

**Note:** A balljoint separator tool will be required for this operation

- 1 Remove the relevant steering gear gaiter as described in Section 22.
- 2 Where applicable, relieve the staking on the track rod balljoint seal.
- 3 Using a suitable spanner on the flats provided, unscrew the inboard end of the track rod from the steering rack, and withdraw the track rod.
- 4 Refitting is a reversal of removal, but stake the balljoint seal to the end of the steering rack, and refit the steering gear gaiter as described in Section 22.



31.8 Tightening the track rod end-to-hub carrier balljoint nut

### 33 Front wheel alignment – checking and adjusting

**Note:** A suitable wheel alignment gauge will be required for this operation – see text

- 1 Front wheel alignment is defined by camber, castor, steering axis inclination and toe setting. The first three factors are determined in production – only toe can be adjusted in service. Incorrect toe will cause rapid tyre wear.
- 2 Toe is defined as the amount by which the distance between the

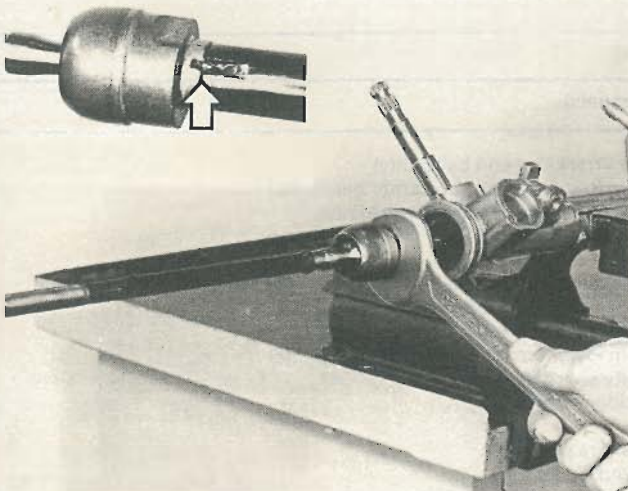


Fig. 9.10 Unscrewing a track-rod from the steering gear. Arrow (inset) shows staking of track-rod balljoint (Sec 32)

front wheels, measured at hub height, differs at the front edges from that at the rear edges. If the distance between the front edges is less than that at the rear, the wheels are said to toe-in – the opposite case is known as toe-out.

3 To measure toe, it will be necessary to obtain or manufacture a tracking gauge. These are available from motor accessory shops, or one can be made from a length of rigid pipe or bar with some kind of threaded adjustment facility at one end. Many tyre specialists will also check toe free or for a nominal sum.

4 Before measuring toe, check that all steering components are undamaged and that tyre pressures are correct. The vehicle must be at approximately kerb weight, with the spare wheel and jack in their

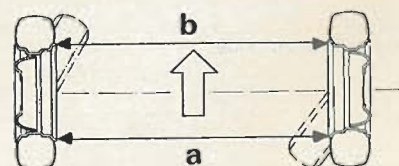


Fig. 9.11 Front wheel alignment (Sec 33)

$$a - b = \text{Toe setting}$$



normal positions, and any abnormal loads removed.

5 Park the vehicle on level ground and bounce it a few times to settle the suspension.

6 Use the tracking gauge to measure the distance between the inside faces of the front wheel rims, at hub height, at the rear of the wheels. Record this distance – call it measurement “a” (see Fig. 9.11).

7 Push the vehicle forwards or backwards so that the wheels rotate exactly 180° (half a turn). Measure the distance between the front wheel rims again, this time at the front of the wheels. Record this distance and call it measurement “b”.

8 Subtract measurement “b” from measurement “a”. If the answer is positive, it is the amount of toe-in – if negative, it is the amount of toe-out. Permissible values are given in the Specifications.

9 If adjustment is necessary, loosen the track rod end locknuts and the outboard steering gear gaiter clips, then rotate each track rod by an equal amount until the setting is correct. Hold the track rod ends in their horizontal positions with a spanner while making the adjustments.

10 When adjustment is complete, tighten the locknuts. Before tightening the gaiter clips, check that the gaiters rotate freely on the track rods, and if necessary lubricate the contact areas between the track rods and the gaiters with silicone grease.

11 Provided the track rods have been adjusted by equal amounts, the steering wheel should be central when moving straight-ahead. The amount of visible thread on each track rod should also be equal.

### 34 Wheels and tyres – general care and maintenance

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.

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.

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 consequent loss of adhesion and excessive wear, not to mention the danger of sudden tyre failure due to heat build-up.

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.

Regularly check the tyres for damage in the form of cuts or bulges, especially in the sidewalls. Remove any nails or stones embedded in 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.

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.

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.

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.

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.

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.

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.

In the UK, the Motor Vehicle 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 current legal requirements with regard to tyre condition, minimum tread depth, etc.

### 35 Fault diagnosis – suspension and steering

Symptom	Reason(s)
Excessive play at steering wheel	Worn track-rod end balljoint(s) Worn lower arm-to-hub carrier balljoint(s) Worn steering shaft universal joint(s) Worn steering gear
Vehicle wanders or pulls to one side	Uneven tyre pressures Incorrect wheel alignment Worn track-rod end balljoint(s) Worn lower arm-to-hub carrier balljoint(s) Faulty shock absorber(s) Accident damage
Steering heavy or stiff	Low tyre pressures Seized balljoint Incorrect wheel alignment Steering gear damaged or lacking lubricant



Symptom	Reason(s)
Wheel wobble or vibration	<ul style="list-style-type: none"> <li>Wheel bolts loose</li> <li>Wheel(s) out of balance or damaged</li> <li>Wheel bearing(s) worn</li> <li>Worn track-rod end balljoint(s)</li> <li>Worn lower arm-to-hub carrier balljoint(s)</li> <li>Faulty shock absorber(s)</li> </ul>
Excessive tyre wear	<ul style="list-style-type: none"> <li>Incorrect tyre pressures</li> <li>Wheels out of balance</li> <li>Incorrect wheel alignment</li> <li>Faulty shock absorber(s)</li> <li>Unsympathetic driving style</li> </ul>
Excessive pitching or rolling on corners or during braking	<ul style="list-style-type: none"> <li>Faulty shock absorbers or front strut</li> <li>Worn anti-roll bar rubber bushes or loose mounting clamps</li> </ul>
Lack of power assistance (where applicable)	<ul style="list-style-type: none"> <li>Low fluid level (check for leaks)</li> <li>Pump drivebelt slack or broken</li> <li>Faulty pump</li> <li>Faulty steering gear</li> </ul>
Noisy operation of power steering	<ul style="list-style-type: none"> <li>Air in system</li> <li>Low fluid level (check for leaks)</li> <li>Pump drivebelt slack</li> <li>Worn pump or steering gear</li> </ul>

**Note:** *This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice.*



# Chapter 10 Bodywork and fittings

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Nm	lbf ft
19	14
15	11
18	13
4	3
7	5
17	12

### 1 General description

The bodyshell is of all-steel welded construction. All models are based on the same 5-door Hatchback body style.

The body is of energy-absorbing monocoque construction, with all drive-train and suspension components mounted on subframes, which helps to ensure that the components remain aligned in the event of a moderate impact, so that the vehicle remains driveable.

Extensive corrosion protection is applied to all body panels. Seventy percent of the body panels are galvanised, and wax injection is employed in all box sections most exposed to the risk of corrosion.

The tailgate is manufactured from plastic reinforced with fibreglass, which eliminates any risk of corrosion and provides effective sound-proofing.

All glass panels are flush, and are bonded to the body to increase rigidity.

All models are fitted with comprehensive heating and ventilation system. Warm air is provided by passing cold air over the heater matrix, through which warm engine coolant is pumped.

A comprehensive range of interior equipment and trim options are

available across the model range. The procedures given in this Chapter apply only to original equipment fittings, and do not cover after-market products.

### 2 Maintenance – bodywork and underframe

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.

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.

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 the 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 FoamBrite, which can be brush applied. The dirt can then simply be 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.

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. 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 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 174 and 175 illustrates 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 – particularly 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 judge 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 a rust inhibiting paint like Turtle Wax Rust Master. If the back of the rusted area is accessible, treat this as well.

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 dents, deep scratches, 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, although daylight is required to cure it. Using the applicator, apply the filler paste to the prepared area; drawing 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 20-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 a 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, which 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, which 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, but note that 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 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).

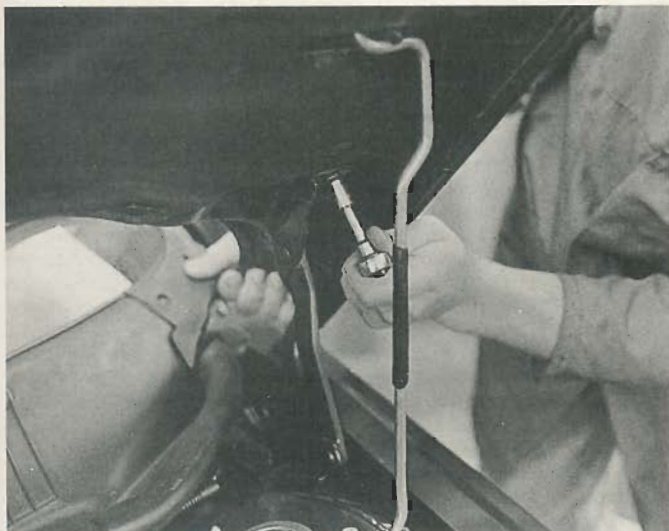
Damage of a less serious nature (abrasions, minor cracks etc) can be repaired by the DIY owner using a two-part epoxy filler repair material like Holts Body + Plus or Holts No Mix which can be used directly from the tube. Once mixed in equal proportions (or applied direct from the tube in the case of Holts No Mix), this is used in similar fashion to the bodywork filler used on metal panels. The filler is usually cured in 20 to 30 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 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.

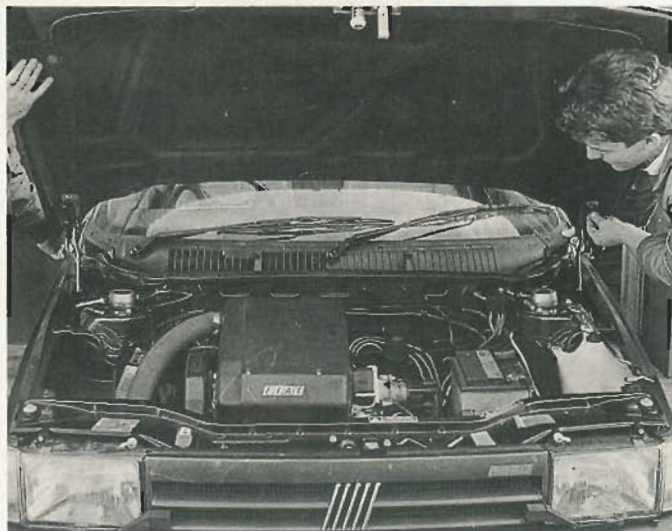
## 5 Major body damage – repair

Where serious damage has occurred, or large areas need renewal due to neglect, it means that complete new panels will need welding in, and this is best left to professionals. If the damage is due to impact, it will also be necessary to check completely the alignment of the bodyshell, and this can only be carried out accurately by a FIAT dealer using special jigs. If the body is left misaligned, it is primarily dangerous as the car will not handle properly, and secondly, uneven stresses will be imposed on the steering, suspension and possibly transmission, causing abnormal wear, or complete failure, particularly to such items as the tyres.





6.2 Loosening a bonnet hinge bolt



6.3 Lifting the bonnet from the vehicle

## 6 Bonnet – removal and refitting

- 1 Support the bonnet in its open position, and place protective covers (old rags or cardboard) beneath the corners of the bonnet, and over the front wings to prevent damage to the paintwork.
- 2 Mark the location of the hinges on the sides of the bonnet with a soft pencil or masking tape, then loosen the four hinge bolts (photo).
- 3 With the help of an assistant, remove the bolts and lift the bonnet from the vehicle (photo).
- 4 If desired, the underbonnet insulation can be removed by prising it away from the bonnet to release the securing clips.
- 5 Refitting is a reversal of removal, bearing in mind the following points.
- 6 Adjust the hinges to their original marked positions before tightening the bolts.
- 7 On completion, check that the bonnet is central within its aperture and aligned with the surrounding bodywork. Re-adjust the hinges to give satisfactory alignment if necessary.
- 8 Check that the bonnet lock striker engages fully in the lock, and if necessary adjust the position of the lock striker and/or the height of the bonnet rubber bump stops.

## 7 Bonnet lock release cable – removal and refitting

- 1 The bonnet lock release cable is in two sections. One section runs from the release lever under the fascia to the bellcrank assembly on the engine compartment bulkhead, and the remaining section runs from the bellcrank assembly to the bonnet lock.

### *Release lever-to-bellcrank cable*

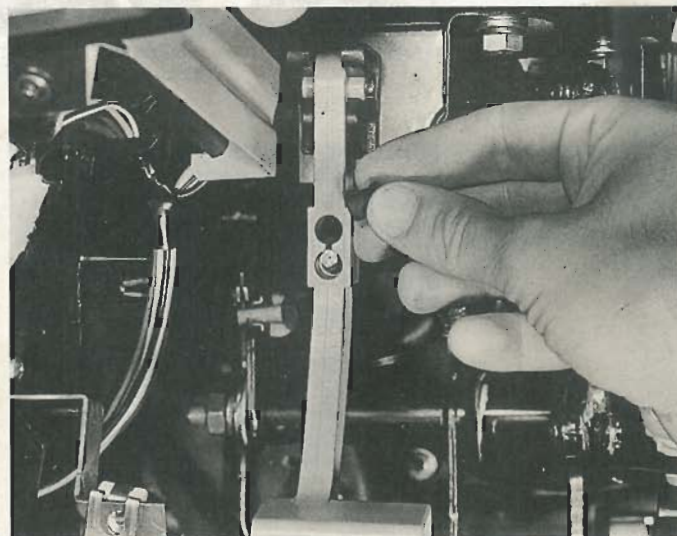
- 2 Remove the driver's side lower fascia panel as described in Section 32.
- 3 Working under the fascia, pull the rubber plug from the slot in the bonnet release lever, and slide the end of the release cable from the lever (photo).
- 4 Working in the engine compartment, for improved access remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- 5 Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead.
- 6 Turn the bonnet lock release cable bellcrank as necessary to allow the cable end to be slid free.
- 7 Withdraw the cable through the bulkhead grommet into the engine compartment.
- 8 Refitting is a reversal of removal, but ensure that the bulkhead grommet is correctly located.
- 9 On completion, check the bonnet lock release mechanism for satisfactory operation.

### *Bellcrank-to-bonnet lock cable*

- 10 Working under the fascia, pull the rubber plug from the slot in the bonnet release lever, and slide the end of the release cable from the lever.
- 11 Working in the engine compartment, pull the cable sheath from the bracket on the front crossmember, then unhook the cable from the lock lever.
- 12 For improved access, remove the air cleaner or the carburettor air box, as applicable, as described in Chapter 3.
- 13 Unscrew the two securing nuts, and remove the plastic cover from the cable bellcrank assembly on the engine compartment bulkhead.
- 14 Turn the bonnet lock release cable bellcrank as necessary to allow the cable end to be slid free.
- 15 Take careful note of the cable routing, then release the cable from any clips, and withdraw it from the engine compartment.
- 16 Refitting is a reversal of removal, but on completion, check the bonnet lock release mechanism for correct operation.

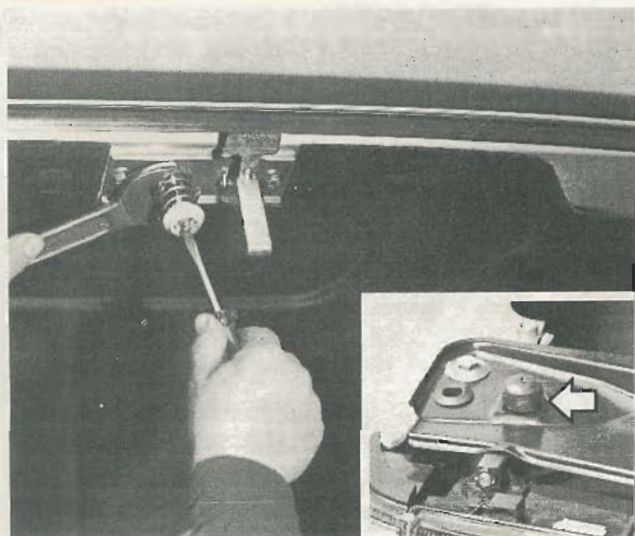
## 8 Bonnet lock – removal and refitting

- 1 Working under the fascia, pull the rubber plug from the slot in the bonnet release lever, and slide the end of the release cable from the lever.



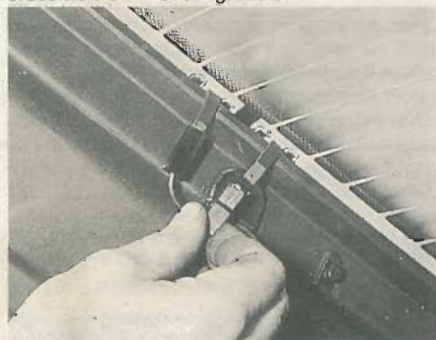
7.3 Removing the rubber plug from the bonnet release lever





**Fig. 10.1** Adjusting the length of the bonnet lock striker. Inset shows rubber buffer on front crossmember (Sec 8)

- 2 Working in the engine compartment, pull the cable sheath from the bracket on the front crossmember, then unhook the cable from the lock lever.
- 3 Unscrew the three securing bolts from the top of the front crossmember, and withdraw the lock.
- 4 Refitting is a reversal of removal, but on completion, check the bonnet lock release mechanism for correct operation.
- 5 If necessary, the bonnet closing action can be adjusted by altering the position and length of the lock striker on the bonnet, and also by raising or lowering the rubber buffers at the corners of the front crossmember – see Fig. 10.1.



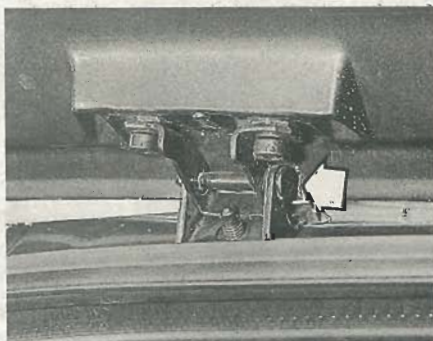
**9.3** Disconnecting a heated rear window wiring plug



**9.5** Removing a tailgate trim panel/lock securing screw



**9.11** Pulling the wiring harness cover/tailgate buffer from the tailgate



**9.16** Tailgate hinge pivot pin (arrowed)

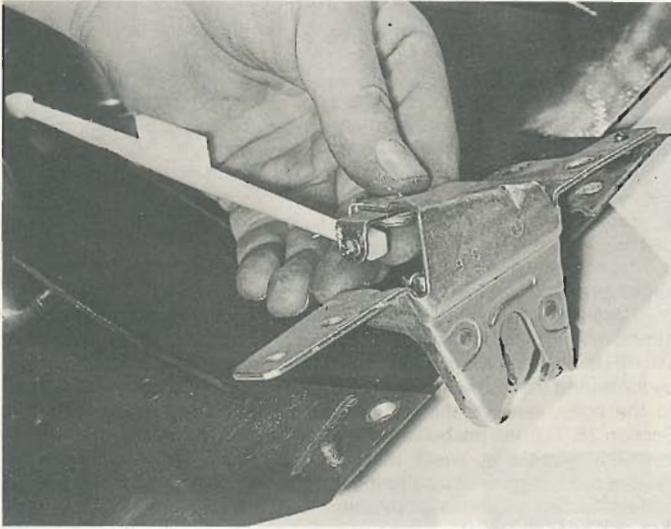


**9.19** Tailgate buffer rubber removed to expose buffer pin

## 9 Tailgate – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Fully open the tailgate.
- 3 Disconnect the heated rear window wiring plugs (photo).
- 4 Pull the weatherstrip at the lower edge of the rear window aperture away from the edge of the plastic trim panel.
- 5 Extract the five screws securing the plastic trim panel to the tailgate, noting that three of the screws also secure the tailgate lock (photo).
- 6 Carefully prise out the six clips securing the trim panel to the tailgate. This can be done using a screwdriver, but it is preferable to use a forked tool to minimise the possibility of damage to the trim panel and the clips.
- 7 Where applicable, disconnect the wiring plug from the lock motor, then withdraw the trim panel/lock assembly.
- 8 Disconnect the wiring plug from the rear window wiper motor.
- 9 Disconnect the wiring plugs from the number plate lamps.
- 10 Disconnect the washer fluid hose from the wiper arm.
- 11 Pull the wiring harness cover/tailgate buffer from the left-hand rear of the tailgate (photo). Take care not to break the retaining lugs.
- 12 Remove the rear window wiper motor and number plate lamp wiring plugs from the ends of their respective wires, noting the wire positions in the plugs.
- 13 If the original tailgate is to be refitted, to aid routing of the wires when refitting, tie lengths of string to the ends of the various wires and the washer hose.
- 14 Feed the wiring harness and the washer fluid hose through the aperture in the tailgate. Untie the lengths of string, leaving them in position in the tailgate to assist refitting.
- 15 Have an assistant support the weight of the tailgate, then prise out the spring clips and disconnect the upper ends of the tailgate struts from the balljoints on the tailgate.
- 16 Ensure that the tailgate is adequately supported, then remove the circlips from the ends of the hinge pivot pins, and carefully drive out the pivot pins using a suitable drift (photo). Withdraw the tailgate, and if it is to be refitted, rest it carefully on rags or cardboard to avoid damaging the paint. Unless they are to be renewed, **do not** unbolt the hinges from the body or the tailgate.





10.4 Withdrawing the tailgate lock from the trim plate

17 Refitting is a reversal of removal, bearing in mind the following points.

18 If the original tailgate is being refitted, draw the wiring and washer fluid hose through the tailgate, using the string.

19 If necessary, adjust the position of the rubber buffers at the bottom edges of the tailgate to obtain satisfactory closing. To adjust a buffer, pull off the rubber, then loosen the locknut and turn the buffer pin using a screwdriver (photo). Tighten the locknut and refit the rubber on completion.

20 If necessary, adjust the position of the lock striker on the body, to achieve satisfactory lock operation.

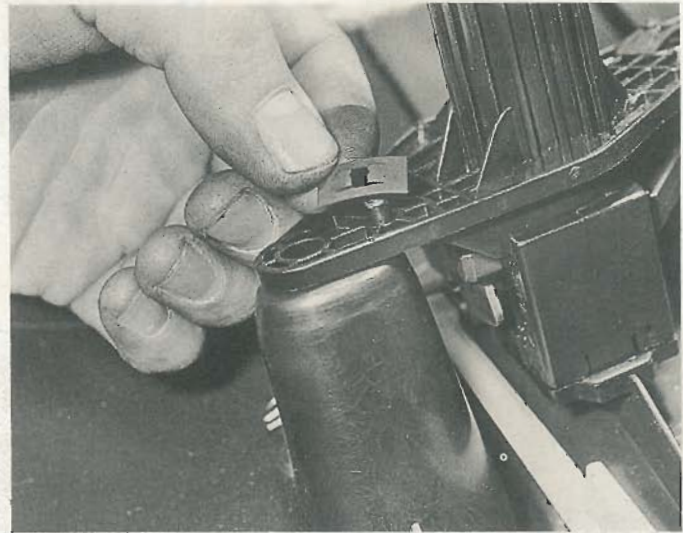
### 10 Tailgate lock – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Open the tailgate.
- 3 Proceed as described in Section 9, paragraphs 4 to 7 inclusive.
- 4 Disconnect the operating rod, and withdraw the lock from the trim plate (photo).

5 Refitting is a reversal of removal, but if necessary on completion, adjust the position of the lock striker on the body to give satisfactory lock operation.

### 11 Tailgate lock cylinder – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Open the tailgate.
- 3 Proceed as described in Section 9, paragraphs 4 to 7 inclusive.
- 4 Using a screwdriver, carefully prise off the two retaining spring clips, and withdraw the lock cylinder housing from the trim plate, disconnecting the lock operating rod, and manipulating the control lever from the lock solenoid where applicable (photos).
- 5 Using a screwdriver, depress the retaining tabs at the back of the lock cylinder housing and withdraw the endplate, spring and lock cylinder sleeve.
- 6 If desired, the lock lever can be slid from the rear of the lock cylinder sleeve.
- 7 To remove the lock barrel, prise the circlip from the lock cylinder sleeve, then insert the key, and withdraw the lock barrel.
- 8 Reassembly and refitting is a reversal of dismantling and removal, bearing in mind the following points.



11.4A Removing a retaining spring clip from the tailgate lock cylinder housing

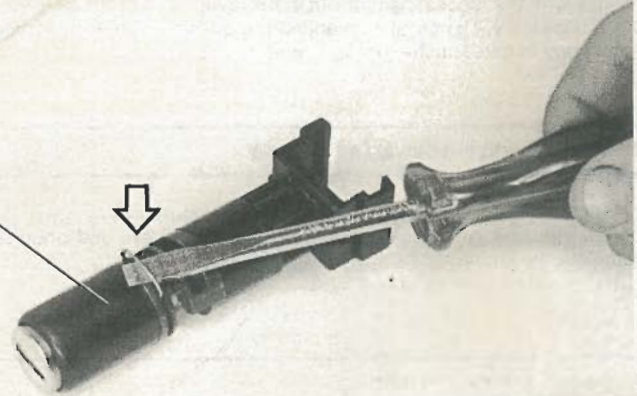
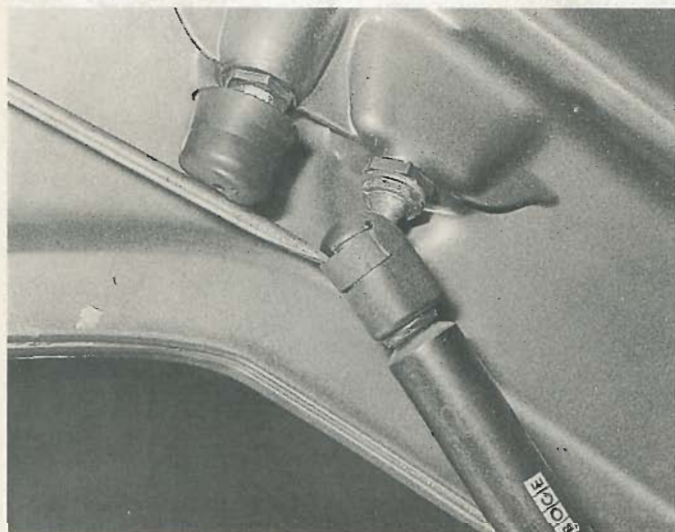


Fig. 10.2 Dismantling the tailgate lock (Sec 11)





11.4B Disconnecting the lock operating rod from the tailgate lock cylinder assembly



12.2 Prising out a tailgate strut balljoint spring clip

9 When refitting the lock lever, ensure that the tooth in the lock barrel engages with the rectangular cut-out in the lever.

10 If necessary, on completion adjust the position of the lock striker on the body to give satisfactory lock operation.

## 12 Tailgate strut - removal and refitting

- 1 Open the tailgate fully and have an assistant support it.
- 2 Release the strut from the balljoints on the tailgate and body by prising out the spring clips using a screwdriver (photo).
- 3 Refitting is a reversal of removal.

## 13 Door - removal and refitting

### Front door

- 1 On models with central locking and/or electric windows, remove the door inner trim panel as described in Section 14.
- 2 Where applicable, disconnect the battery negative lead, then disconnect the wiring from the central locking solenoid and/or the electric

window motor. Turn the wiring harness securing clips to release the wiring harness from the door subframe, then feed the wiring harness through the aperture in the front edge of the door.

- 3 Fully open the door.
- 4 Unscrew the bolts securing the two door hinge pins (photo).
- 5 Using a suitable punch, carefully drive out the door check arm pivot pin, taking care not to damage the paintwork (photo).
- 6 Lift the door to release the tapered hinge pins from their housings, and withdraw the door.
- 7 Refitting is a reversal of removal, bearing in mind the following points.
- 8 Do not fully tighten the door hinge pin securing bolts until the door check arm pivot pin has been refitted.
- 9 Refitting of the door check arm pivot pin will be greatly eased if an assistant holds the door so that the pivot pin holes are correctly aligned.
- 10 If desired, the alignment of the door in its aperture can be adjusted by loosening the bolts securing the door hinges to the body. For access to the bolts, remove the relevant wheel arch liner as described in Section 26. Tighten the bolts to the specified torque on completion.
- 11 On completion, check that the door closes satisfactorily. Door closure can be adjusted by altering the position of the lock striker on the body pillar. Special shims are available from FIAT dealers to enable door lock striker adjustment.

### Rear door

- 12 On models with central locking, disconnect the battery negative



13.4 Front door hinge securing bolt (arrowed)



13.5 Front door check arm pivot pin (arrowed)





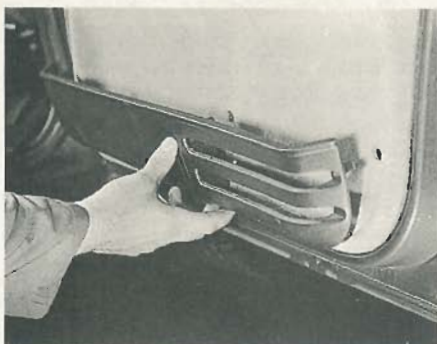
14.1 Removing a front door arm rest trim panel



14.2A Extracting a front door arm rest securing screw



14.2B Disconnecting the electric windows switch wiring plug



14.5 Removing a front door pocket



14.8 Removing a front door inner trim panel



14.14A Removing the rear door arm rest trim panel



14.14B Extracting a rear door arm rest securing screw



14.14C Rear door window regulator handle removed showing securing clip



14.14D Removing a rear door interior handle trim

lead, then pull the wiring harness sheath from the front edge of the door, and disconnect the wiring plug.

13 Proceed as described in paragraphs 3 to 9 inclusive.

14 If desired, the alignment of the door in its aperture can be adjusted by loosening the bolts securing the door hinges to the body. For access to the bolts, open the front door.

15 On completion, check that the door closes satisfactorily. Door closure can be adjusted by altering the position of the lock striker on the body pillar. Special shims are available from FIAT dealers to enable door lock striker adjustment.

#### 14 Door inner trim panel - removal and refitting

##### Front door

1 Remove the securing screw and withdraw the arm rest trim panel (photo).

2 Extract the two securing screws and remove the arm rest. Where applicable, disconnect the wiring plug from the electric windows switch (photos). Disconnect the battery negative lead before disconnecting the plug.

3 On models with manually-operated windows, release the securing clip and remove the window regulator handle. To release the securing clip, insert a length of wire with a hooked end between the handle and the trim bezel on the door trim panel, and manipulate it to free the securing clip from the handle. Recover the trim bezel.

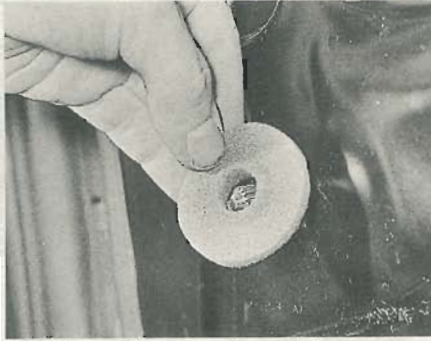
4 Unclip and remove the door interior handle trim.

5 Unscrew the six securing screws and remove the door pocket (photo).

6 Carefully prise the lock button trim from the top edge of the door trim panel and the weatherstrip. Take care not to damage the door trim panel.

7 The plastic clips securing the trim panel to the door must now be released. This can be done using a screwdriver, but it is preferable to use a forked tool, to minimise the possibility of damage to the trim panel and the clips. The clips are located around the outer edge of the trim panel.





14.14E Removing a rear door window regulator spindle foam surround



14.14F Removing a rear door plastic insulating sheet securing clip

8 Once the clips have been released, pull the trim panel away from the door, releasing the top edge from the weatherstrip (photo).

9 Where applicable, recover the foam surround from the window regulator spindle.

10 If desired, the plastic insulating sheet can be removed from the door in a similar manner to the door trim panel, noting that in addition to the plastic clips, the sheet is retained by adhesive sealant around its outer edge. Where applicable, feed the electric window switch wiring through the sheet as it is removed. Place the sheet to one side where the sealant cannot be damaged.

11 Refitting is a reversal of removal, bearing in mind the following points.

12 If the plastic sheet has been removed from the door, make sure that it is refitted intact, and ensure that the sealant around the edge of the sheet adheres to the door. If the sealant has lost its adhesive properties, the insulating sheet should be renewed in order to prevent the possibility of water ingress. Where applicable, ensure that the electric window switch wiring is fed through the sheet as it is fitted.

13 Where applicable, ensure that the electric window switch wiring is fed through the trim panel, and ensure that all the trim panel securing clips engage as the panel is refitted. If any of the clips were broken during removal, renew them on refitting.

### Rear door

14 Proceed as described in paragraphs 1 to 13 for the front door trim panel, but ignore the references to the door pocket and the electric window switch wiring (photos).

## 15 Door subframe – removal and refitting

### Front door

1 All the internal door components are mounted on a subframe which can be removed from the door as follows.

2 Remove the door inner trim panel and the plastic insulating sheet as described in Section 14, but on models with electric windows, do not

disconnect the battery negative lead.

3 On models with electric windows, reconnect the wiring to the electric windows switch after removing the trim panel and insulating sheet.

4 On models with manually-operated windows, loosely refit the window regulator handle.

5 On models with central locking, working inside the door, disconnect the wiring plugs from the lock motor (photo).

6 Where applicable, turn the wiring harness securing clips to release the wiring harness from the subframe (photos).

7 Disconnect the plastic lock operating rod from the door exterior handle, and disconnect the lock button operating rod from the lock (photo).

8 Unscrew and remove the three bolts securing the lock assembly to the rear edge of the door.

9 Unscrew and remove the five bolts and two nuts securing the subframe to the door (photo).

10 Partially lower the window.

11 Lower the subframe, and pull the rear edge of the window glass from the door channel.

12 Carefully withdraw the subframe from the door, front edge first, raising or lowering the window as necessary to facilitate removal (photo).

13 Where applicable, disconnect the wiring plugs from the electric windows switch and the electric window motor. If the subframe is to be removed for some time, disconnect the battery negative lead on models with electric windows.

14 If desired, the various components can be removed from the subframe with reference to the relevant Sections of this Chapter and Chapter 11.

15 Commence refitting as follows.

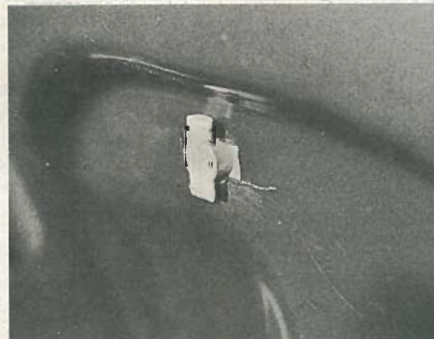
16 On models with electric windows, reconnect the wiring to the electric windows switch and reconnect the battery negative lead if not already done.

17 On models with manually-operated windows, loosely refit the window regulator handle if not already done.

18 Carefully offer the subframe into the door, rear end first, raising or lowering the window as necessary to facilitate refitting.



15.5 Disconnecting the wiring plugs from the front door central locking motor

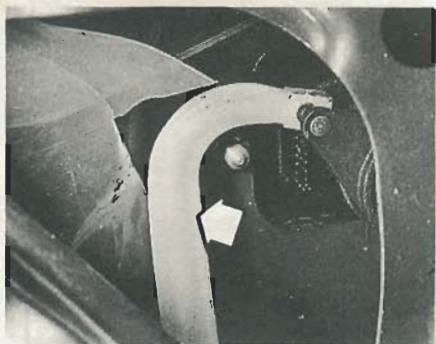


15.6A Turn the wiring harness securing clips ...

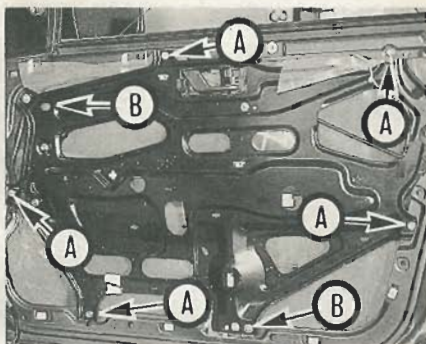


15.6B ... to release the wiring harness from the front door subframe





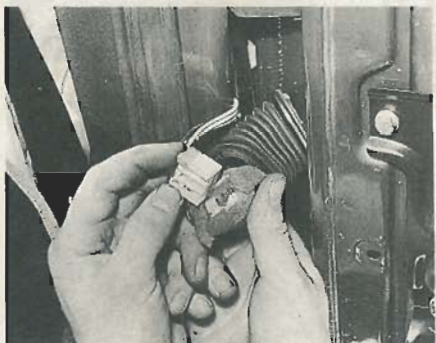
15.7 Disconnect the plastic lock operating rod (arrowed) from the front door exterior handle



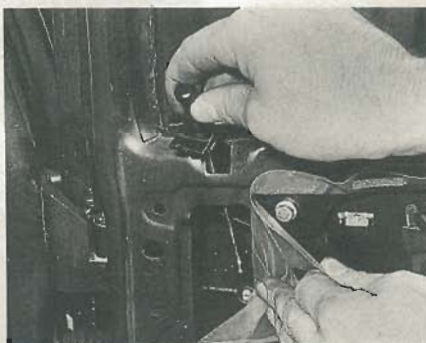
15.9 Removing the five bolts (A) and two nuts (B) securing the subframe to the front door



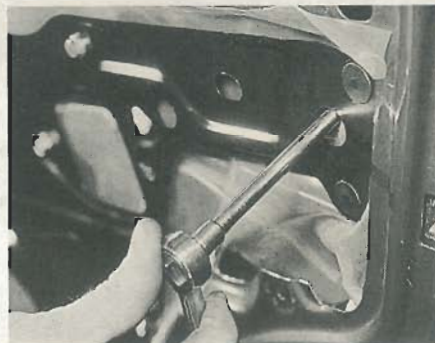
15.12 Withdrawing the subframe from the front door



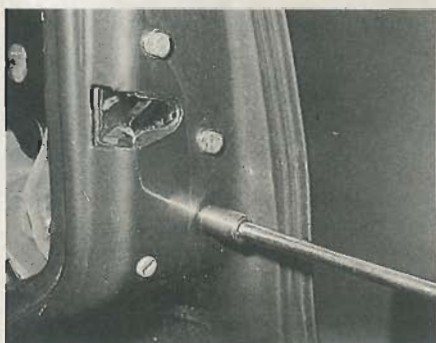
15.28 Disconnecting the rear door wiring plug



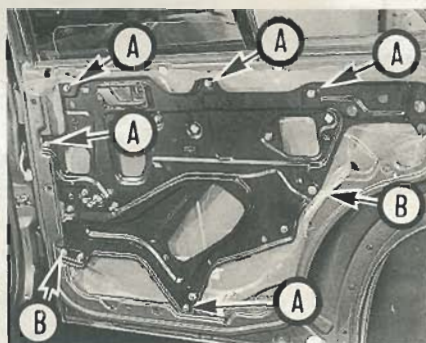
15.29 Disconnecting the lock button operating rod from the bellcrank on the rear door subframe



15.30 Unscrewing a rear door exterior handle securing nut



15.31 Unscrew the three bolts securing the lock assembly to the rear door



15.32 Remove the five bolts (A) and two nuts (B) securing the subframe to the rear door



15.35 Withdrawing the subframe from the rear door

- 19 Engage the rear edge of the window glass with the door channel.
- 20 Further refitting is a reversal of removal, bearing in mind the following points.
- 21 Ensure that the lock operating rod and the lock button operating rod are correctly reconnected.
- 22 Ensure that, where applicable, all wiring is correctly reconnected, and secure the wiring harness with the clips, making sure that the wiring does not foul any of the lock or window regulator components.
- 23 Before refitting the plastic insulating sheet and the door inner trim panel, check for satisfactory operation of the lock and window regulator mechanisms.
- 24 Refit the plastic insulating sheet and the door inner trim panel with reference to Section 14.

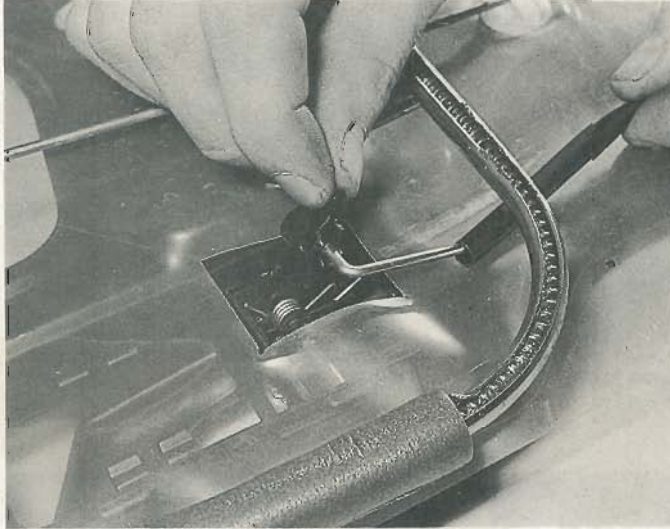
### Rear door

- 25 All the internal door components are mounted on a subframe

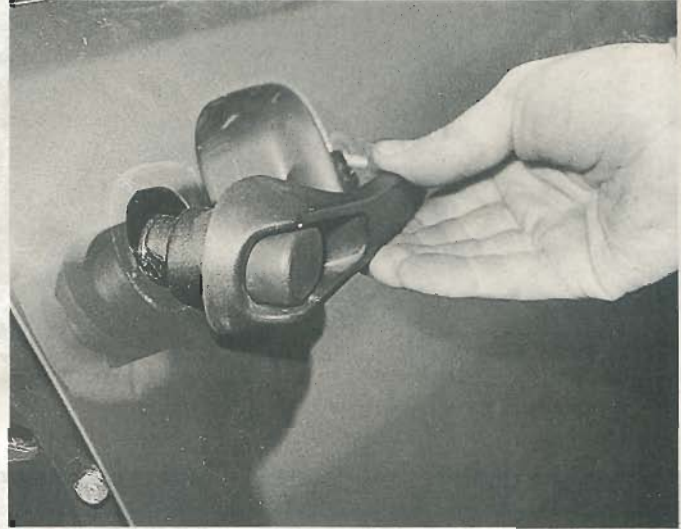
which can be removed from the door as follows.

- 26 Remove the door inner trim panel and the plastic insulating sheet as described in Section 14.
- 27 Loosely refit the window regulator handle.
- 28 On models with central locking, disconnect the battery negative lead, then pull the wiring harness sheath from the front edge of the door, and disconnect the wiring plug (photo). Feed the wiring through into the door.
- 29 Disconnect the lock button operating rod from the bellcrank on the subframe (photo).
- 30 Working through the aperture in the subframe, unscrew the two nuts securing the door exterior handle, and remove the handle (photo).
- 31 Unscrew and remove the three bolts securing the lock assembly to the rear edge of the door (photo).
- 32 Unscrew and remove the five bolts and two nuts securing the subframe to the door (photo).
- 33 Partially lower the window.





16.2 Disconnecting the lock operating rod from the rear door interior handle



17.3 Withdrawing the exterior handle from the rear door

34 Lower the subframe, and pull the rear edge of the window glass from the door channel.

35 Carefully withdraw the subframe from the door, front edge first, raising or lowering the window as necessary to facilitate removal (photo).

36 If desired, the various components can be removed from the subframe with reference to the relevant Sections of this Chapter and Chapter 11.

37 Commence refitting as follows.

38 Loosely refit the window regulator handle if not already done.

39 Carefully offer the subframe into the door, rear end first, raising or lowering the window as necessary to facilitate refitting.

40 Engage the rear edge of the window glass with the door channel.

41 Further refitting is a reversal of removal, bearing in mind the following points.

42 Before refitting the plastic insulating sheet and the door inner trim panel, check for satisfactory operation of the lock and window regulator mechanisms.

43 Refit the plastic insulating sheet and the door inner trim panel with reference to Section 14.

## 16 Door interior handle - removal and refitting

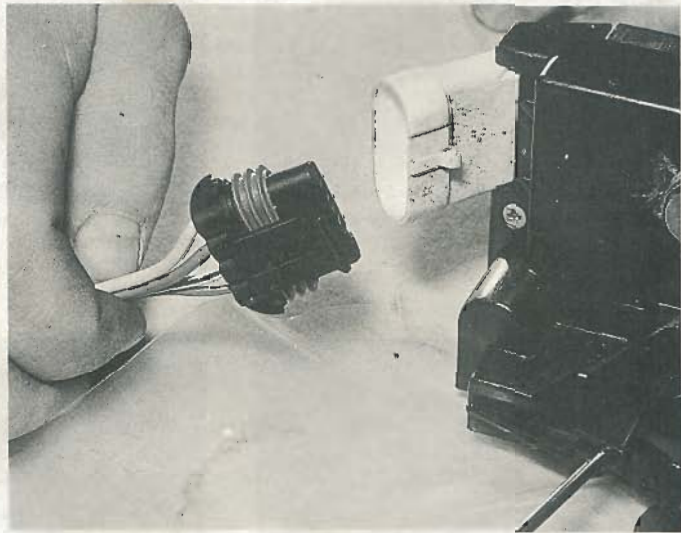
- 1 Remove the door subframe as described in Section 15.
- 2 Working at the rear of the subframe, release the securing clip and disconnect the lock operating rod from the handle (photo).
- 3 Unclip the handle assembly from the subframe and remove it.
- 4 Refitting is a reversal of removal. Refit the door subframe as described in Section 15.

## 17 Door exterior handle - removal and refitting

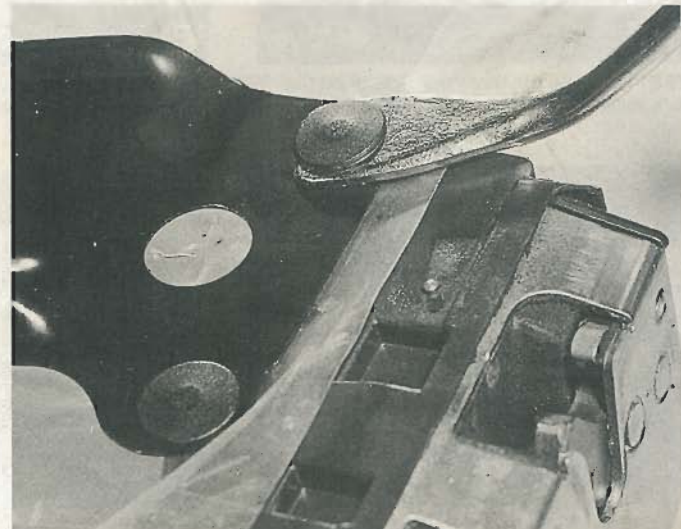
- 1 Remove the door inner trim panel and the plastic insulating sheet as described in Section 14.
- 2 Disconnect the lock operating rod from the handle.
- 3 Working through the apertures in the subframe, unscrew the two securing nuts, then withdraw the handle from outside the door (photo).
- 4 Refitting is a reversal of removal.

## 18 Door lock - removal and refitting

- 1 Remove the door subframe as described in Section 15.
- 2 Where applicable, disconnect the wiring plug from the lock motor (photo).

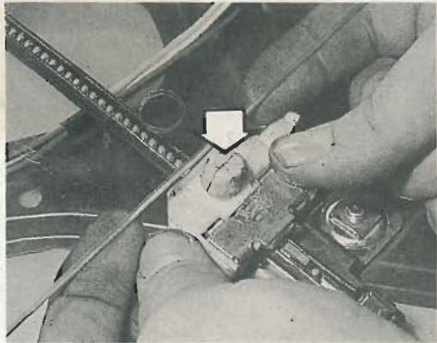


18.2 Disconnecting the wiring plug from the rear door lock motor

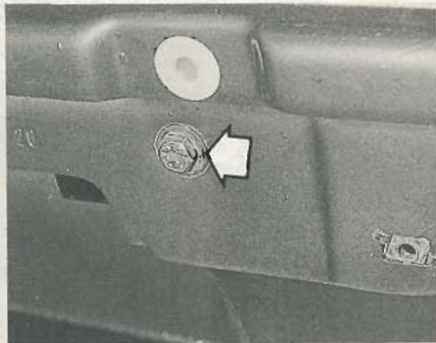


18.4 Using a forked tool to release the rear door lock assembly securing clips

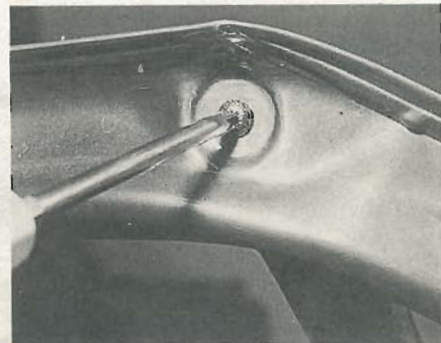




20.2 Prising the bottom edge of the rear door window glass from the plastic boss (arrowed) on the regulator



20.6 Bolt (arrowed) securing base of rear door window guide channel to door



20.7A Extract the top window guide channel securing screw ...



20.7B ... then withdraw the guide channel from the rear door



20.8 Withdrawing the fixed window from the rear door

3 Working at the rear of the subframe, disconnect the lock operating rods from the lock.

4 The two plastic clips securing the lock assembly to the subframe must now be released. This can be done using a screwdriver, but it is preferable to use a forked tool, to minimise the possibility of damage to the clips (photo).

5 Release the clips and withdraw the lock from the subframe.

6 Refitting is a reversal of removal. Refit the door subframe as described in Section 15.

### 19 Windscreen, rear window and rear quarter windows – removal and refitting

All fixed glass panels are direct glazed to the body using special adhesive. Special tools are required to remove the old glass and to fit the new glass, and the work is therefore best entrusted to a dealer or replacement glass specialist.

### 20 Door window – removal and refitting

#### Moveable windows

- 1 Remove the door subframe as described in Section 15.
- 2 Carefully prise the bottom edge of the glass from the plastic boss on the regulator, then slide the window from the guides and withdraw it from the subframe (photo).
- 3 Refitting is a reversal of removal. Refit the door subframe with reference to Section 15.

#### Fixed windows (rear doors)

- 4 Remove the door subframe as described in Section 15.
- 5 Pull the weatherstrips from the top and bottom of the window aperture.
- 6 Unscrew the bolt securing the base of the window guide channel to the door (photo).

7 Working at the top of the door, extract the screw securing the top of the window guide channel, then withdraw the guide channel (photos).

8 The fixed window can now be removed from the door (photo).

9 Refitting is a reversal of removal. Refit the door subframe with reference to Section 15.

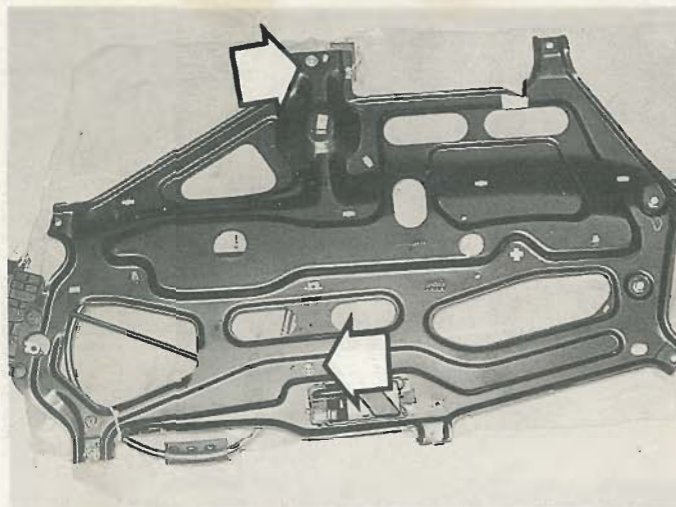
### 21 Door window regulator – removal and refitting

- 1 Remove the door subframe as described in Section 15.
- 2 Where applicable, on models with electric windows, pull back the plastic insulating sheet and unclip the motor from the subframe (photo).



21.2 Front door electric window motor clipped to subframe





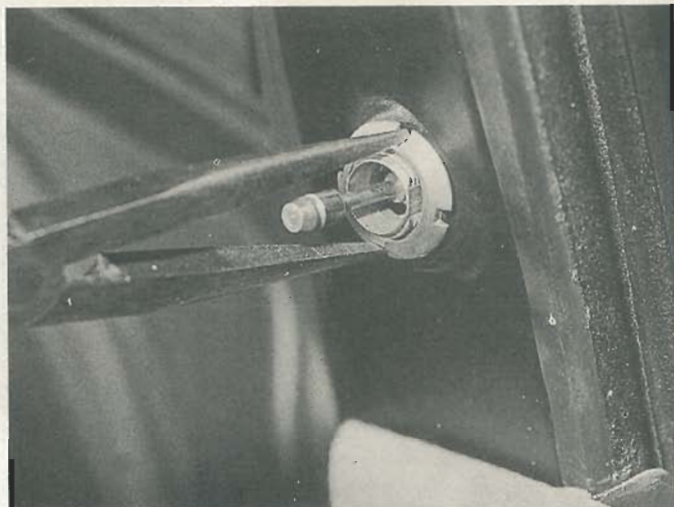
21.4 Front door window regulator securing nuts (arrowed) – model with electric windows

- 3 Where applicable, disconnect the lock operating rod to facilitate removal of the regulator mechanism.
- 4 Unscrew the four securing bolts on models with manually-operated windows, or the two securing nuts on models with electric windows, and withdraw the regulator mechanism from the subframe (photo).
- 5 Refitting is a reversal of removal.

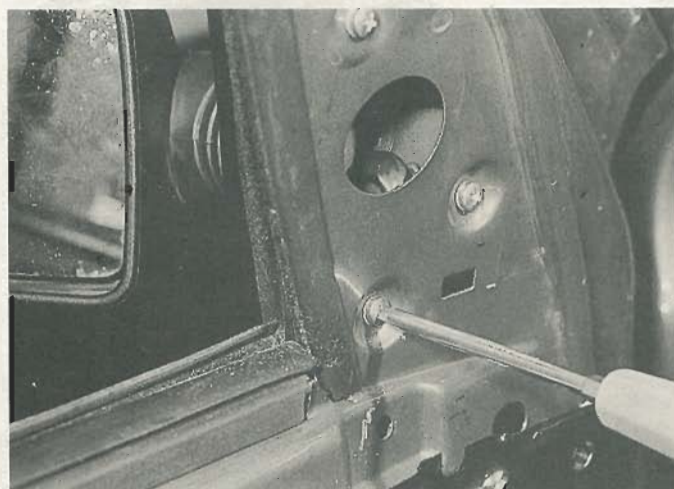
## 22 Door mirror – removal and refitting

**Note:** Replacement mirror glass is not available from the manufacturers. If the mirror glass is broken, the complete mirror assembly must be renewed

- 1 If working on an electrically-operated mirror, disconnect the battery negative lead, then remove the door inner trim panel as described in Section 14.
- 2 Where applicable, reach up from the footwell, and locate the mirror wiring plug(s), situated behind the edge of the facia assembly. Disconnect the plug(s) and feed the wiring through the wing into the door.
- 3 If working on a manually-adjustable mirror, pull the cover from the adjuster lever, then unscrew the lever surround using a suitable pair of pliers (photo).
- 4 Pull back the weatherstrip from the edge of the door, and prise the mirror trim plate from the inside edge of the door to expose the three mirror securing screws.
- 5 Extract the securing screws, and withdraw the mirror, feeding the wiring through the door, where applicable (photo).
- 6 Recover the foam sealing pad and the trim plate from the outer edge of the door.
- 7 Refitting is a reversal of removal, but where applicable refit the door trim panel with reference to Section 14.



22.3 Unscrewing a door mirror adjuster lever surround

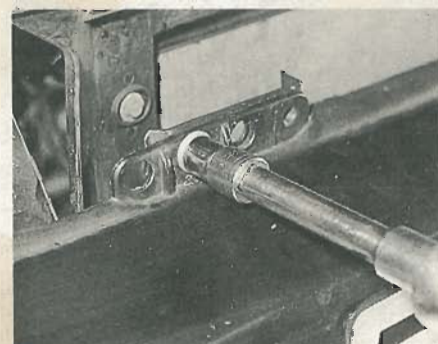


22.5 Extracting a door mirror securing screw – electrically-adjustable mirror

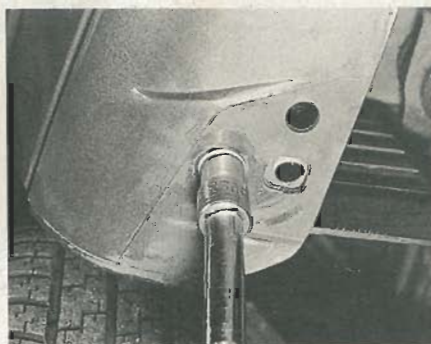
## 23 Bumper – removal and refitting

### Front bumper

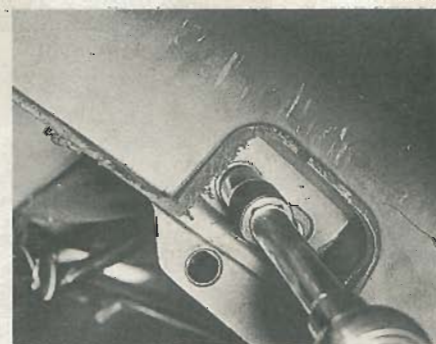
- 1 Remove the radiator grille panel as described in Section 24.
- 2 Unscrew the two now-exposed bumper securing bolts (photo).
- 3 Working under the wheel arches, prise out the plastic clips securing the wheel arch liners to the rear edges of the bumper.
- 4 Working under the front of the vehicle, unscrew the four remaining bumper securing bolts, two on each side (photos).
- 5 Slide the bumper forwards to disengage the ends of the bumper



23.2 Unscrewing a front bumper upper securing bolt



23.4A Unscrewing a front bumper lower side securing bolt ...

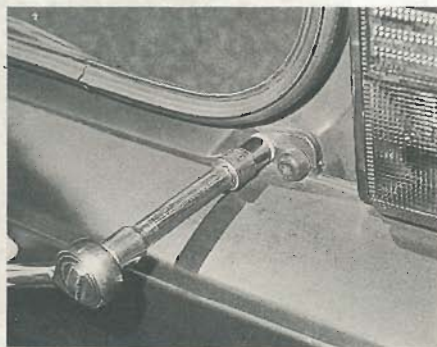


23.4B ... and lower front securing bolt





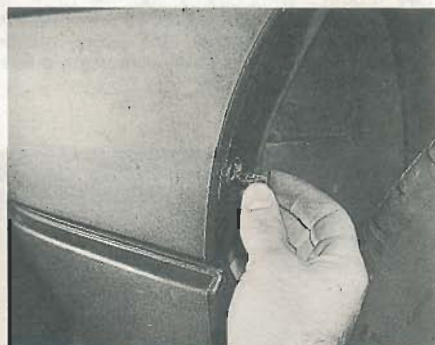
23.5 Withdrawing the front bumper



23.8 Unscrewing a rear bumper upper side securing bolt



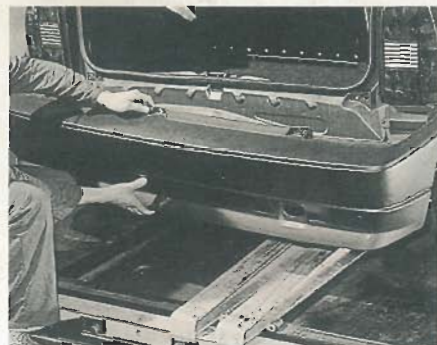
23.9 Withdrawing the expanding fastener and securing bolt from the rear bumper



23.10 Removing a wheel arch liner-to-rear bumper securing clip



23.11 Unscrewing a rear bumper lower securing bolt



23.12 Withdrawing the rear bumper

from the locating lugs on the body, with withdraw the bumper from the vehicle (photo).

6 Refitting is a reversal of removal.

### Rear bumper

7 Open the tailgate.

8 Unscrew the two now-exposed bumper securing bolts, one inboard of each rear lamp cluster (photo).

9 Partially unscrew the securing screw and withdraw the expanding fastener from the centre of the bumper (photo).

10 Working under the wheel arches, prise out the plastic clips securing the wheel arch liners to the front edges of the bumper (photo).

11 Working under the rear of the vehicle, unscrew the two remaining

bumper securing bolts (photo).

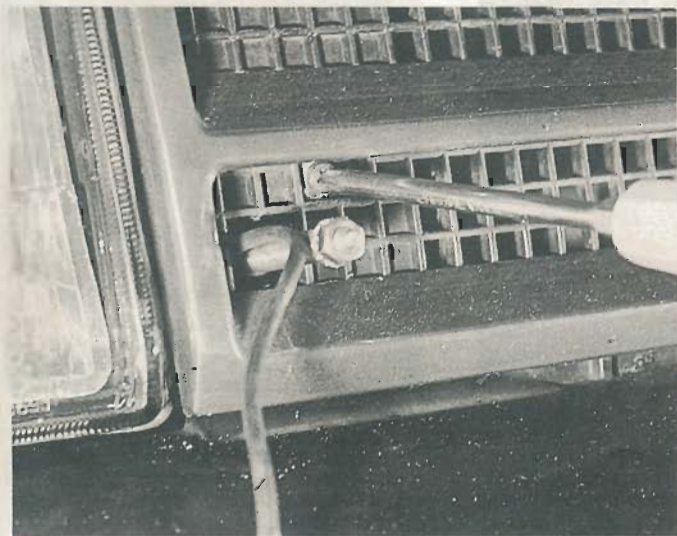
12 Slide the bumper back to disengage the ends of the bumper from the locating lugs on the body, then withdraw the bumper from the vehicle (photo).

13 Refitting is a reversal of removal.

### 24 Radiator grille panel – removal and refitting

1 Open the bonnet.

2 Where applicable, remove the headlamp wiper arms with reference to Chapter 11, Section 46.

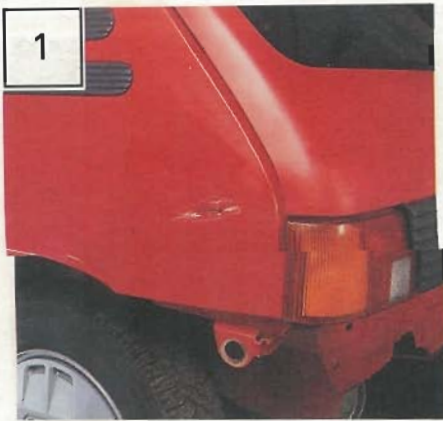


24.3 Removing a radiator grille panel securing screw



24.4 Withdrawing the grille panel – securing clip arrowed





1

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.



2

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.



3

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.



4

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.



5

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 ...



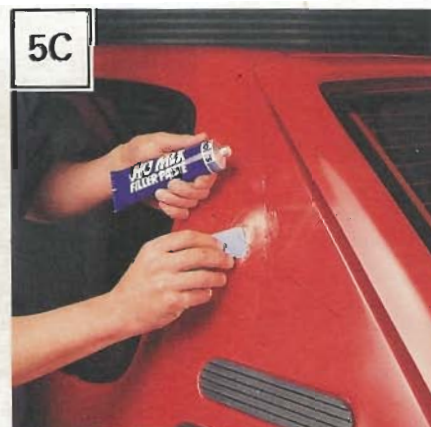
5A

... 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.



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.



5C

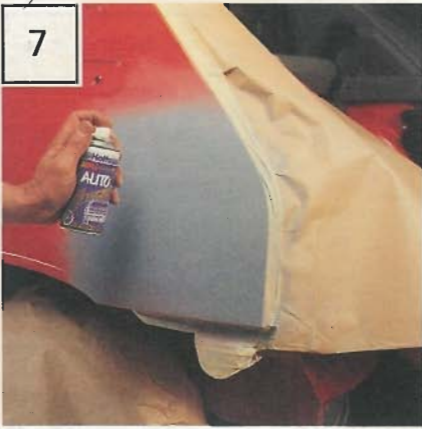
For small dents and scratches use Holts No Mix Filler Paste straight from the tube. Apply it according to the instructions in thin layers, using the spatula provided. It will harden in minutes if applied outdoors and may then be used as its own knitting putty.



6

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.

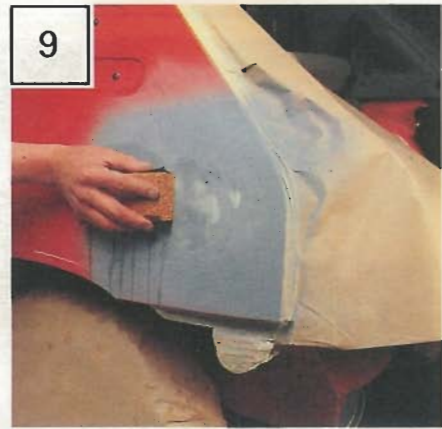




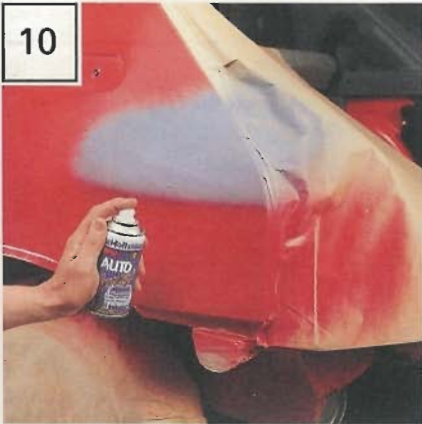
7  
Protect adjoining areas before spraying the whole repair area and at least one inch of the surrounding sound paintwork with Holts Dupli-Color primer.



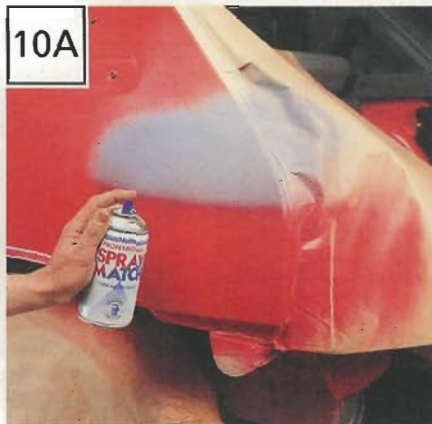
8  
Fill any imperfections in the filler surface with a small amount of Holts Body Plus Knifing Putty. Using plenty of clean water, rub down the surface with a fine grade wet-and-dry paper - 400 grade is recommended - until it is really smooth.



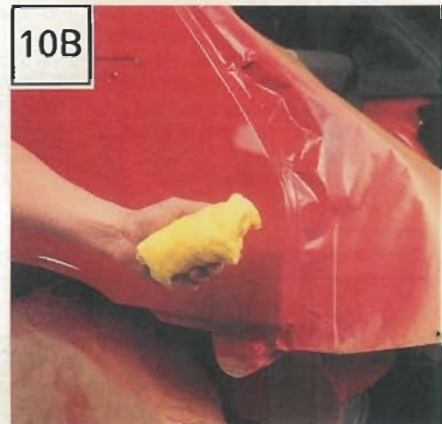
9  
Carefully fill any remaining imperfections with knifing putty before applying the last coat of primer. Then rub down the surface with Holts Body Plus Rubbing Compound to ensure a really smooth surface.



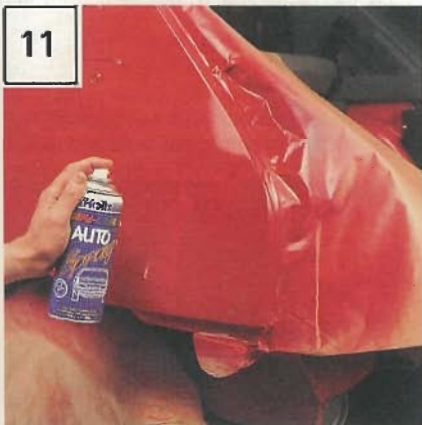
10  
Protect surrounding areas from overspray before applying the topcoat in several thin layers. Agitate Holts Dupli-Color aerosol thoroughly. Start at the repair centre, spraying outwards with a side-to-side motion.



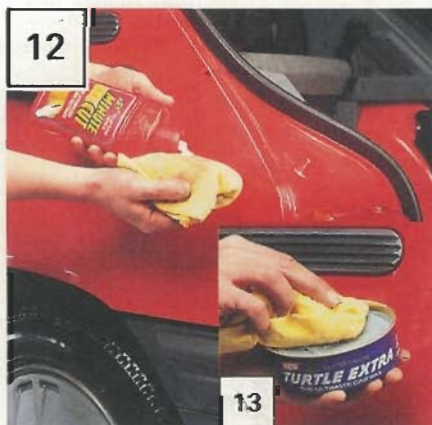
10A  
If the exact colour is not available off the shelf, local Holts Professional Spraymatch Centres will custom fill an aerosol to match perfectly.



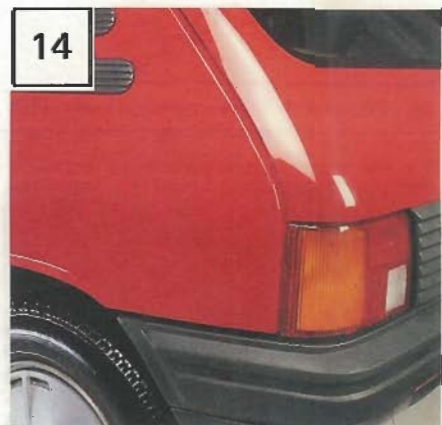
10B  
To identify whether a lacquer finish is required, rub a painted unrepaired part of the body with wax and a clean cloth.



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.

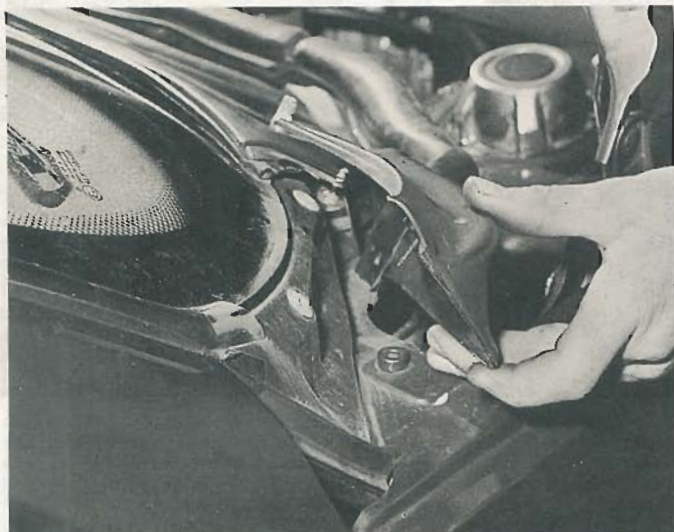


12  
The paint will take about two weeks to harden fully. After this time it can be 'cut' with a mild cutting compound such as Turtle Wax Minute Cut prior to polishing with a final coating of Turtle Wax Extra.



14  
When carrying out bodywork repairs, remember that the quality of the finished job is proportional to the time and effort expended.





25.3 Removing a windscreen cowl side trim panel

- 3 Remove the two grille panel securing screws, which are accessible through the front of the grille panel (photo).
- 4 Using a screwdriver, release the two securing clips which are located at the top corners of the grille panel, then carefully pull the grille panel from the vehicle (photo).
- 5 Refitting is a reversal of removal.

### 25 Windscreen cowl panel - removal and refitting

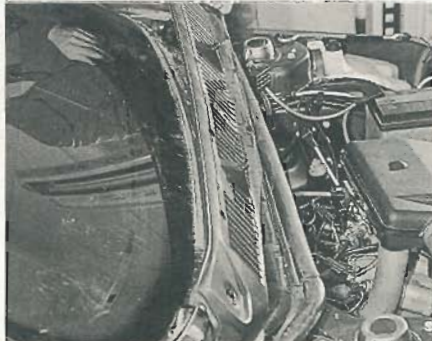
- 1 Open the bonnet.
- 2 Remove the wiper arms, with reference to Chapter 11, Section 46 if necessary.
- 3 Extract the securing screws and remove the two side trim panels from the windscreen cowl (photo).
- 4 Prise back the weatherstrip from the front edge of the cowl panel, then extract the three now-exposed cowl panel securing screws (photo).
- 5 Extract the four remaining securing screws from the top of the cowl panel, then carefully withdraw the cowl panel and disconnect the washer fluid hose connector (photos).
- 6 Refitting is a reversal of removal, but refit the wiper arms with reference to Chapter 11, Section 46.

### 26 Wheel arch liners - removal and refitting

- 1 The plastic wheel arch liners are secured by a combination of



25.4 Extracting a windscreen cowl panel lower securing screw



25.5A Withdraw the windscreen cowl panel ...



25.5B ... and disconnect the washer fluid hose connector

self-tapping screws and plastic clips. Removal and refitting is self-explanatory, bearing in mind the following points.

- 2 Some of the securing clips are held in place using a central pin which must be tapped out to release the clip.
- 3 The clips are easily broken during removal, and it is advisable to obtain a few spare clips for possible use when refitting.
- 4 Note that the engine and gearbox splash shields are attached to the front wheel arch liners.

### 27 Engine and gearbox splash shields - removal and refitting

Proceed as described for the wheel arch liners in Section 26, but note that the brake pad wear sensor wiring must be disconnected when removing the gearbox splash shield.

### 28 Fuel filler flap - removal and refitting

- 1 Open the flap for access to the two securing screws.
- 2 Remove the securing screws and withdraw the flap.
- 3 Refitting is a reversal of removal.

### 29 Sunroof - removal and refitting

**Note:** The sunroof is a complex piece of equipment, consisting of a large number of components. It is strongly recommended that the sunroof mechanism is not disturbed unless absolutely necessary. If the sunroof mechanism is faulty, or requires overhaul, consult a dealer for further advice

#### Glass panel - removal and refitting

- 1 Fully open the sunroof.
- 2 Remove the sunroof frame side trim mouldings by sliding them towards the rear of the frame - see Fig. 10.3.
- 3 Unscrew the four bolts (two on either side) securing the glass panel to the frame, then carefully lift the panel and withdraw it from the vehicle.
- 4 Refitting is a reversal of removal.

#### Operating handle (manual sunroof)

- 5 Fully close the sunroof, then position the handle as shown in Fig. 10.5. This is important to ensure that the handle is not damaged as it is removed.



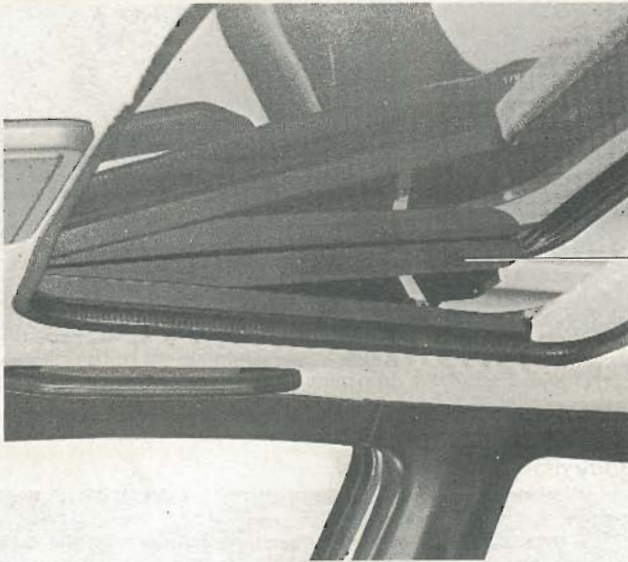


Fig. 10.3 Remove the sunroof side trim mouldings (Sec 29)

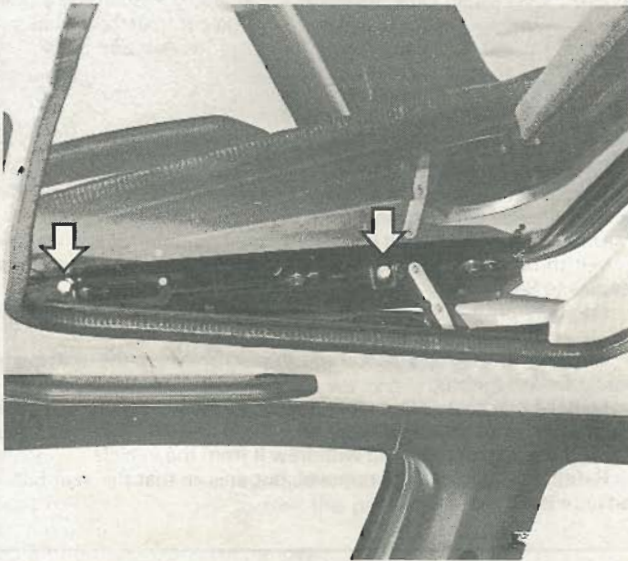
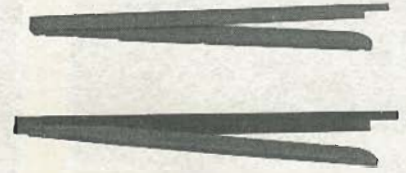


Fig. 10.4 Sunroof glass panel securing bolts (arrowed) (Sec 29)

- 6 Extract the securing screw and withdraw the handle.
- 7 Refitting is a reversal of removal, but ensure that the handle is positioned as shown in Fig. 10.5, before refitting and tightening the securing screw.

#### Sunroof motor – removal and refitting

- 8 Refer to Chapter 11, Section 58.

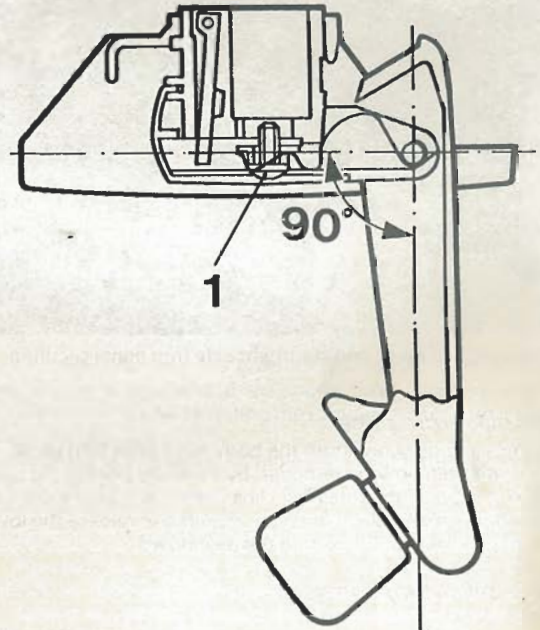


Fig. 10.5 Correct position of sunroof operating handle prior to removal and refitting (Sec 29)

1 Handle securing screw

in detail from model to model, and the procedures given in the following Sections should be treated as a guide.

### 30 Interior trim panels – general

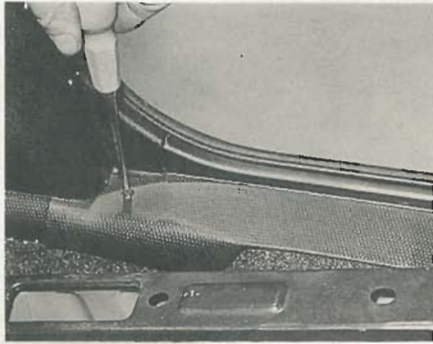
- 1 The various trim panels are secured by a variety of screws and plastic clips.
- 2 Where press-fit plastic fasteners are used, it is advisable to use a forked tool to remove them in order to avoid damage to the clips and the trim panel.
- 3 Removal and refitting of most of the trim panels is self-explanatory, but in all cases, care must be taken, as the panels are easily damaged by careless handling and the use of sharp instruments to release clips.
- 4 Note that the method of fixing of some of the trim panels may differ

### 31 Interior trim panels – removal and refitting

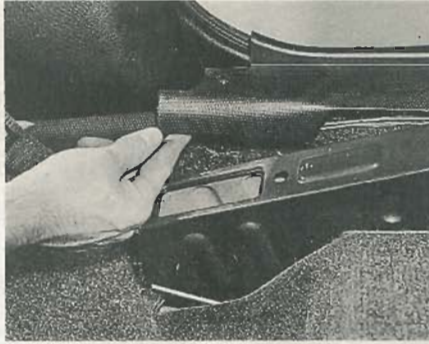
#### Sill trim panels

- 1 To remove a sill trim panel, simply remove the securing screws, and prise the trim panel from the sill (photo). If necessary, carefully pull the weatherstrip back from the edge of the trim panel to facilitate removal.
- 2 Refitting is a reversal of removal.

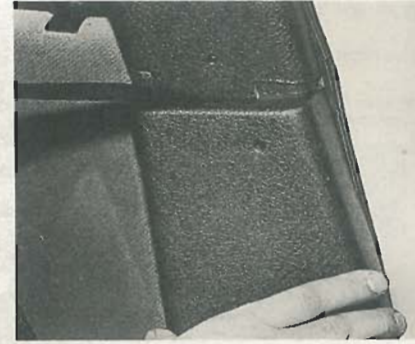




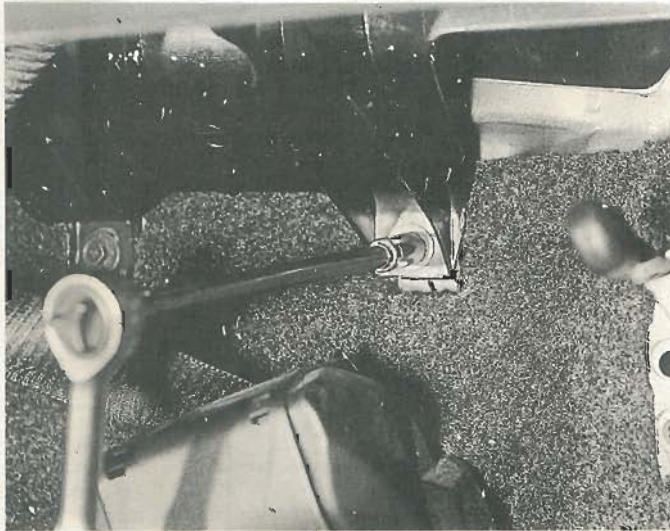
31.1 Extracting a front sill trim panel securing screw (front seat removed)



31.8A Manipulate the sill trim panels from the body centre pillar lower trim panel ...



31.8B ... then withdraw the centre pillar lower trim panel



31.24 Unscrewing a luggage compartment side trim panel securing screw

### Body front pillar trim panel

- 3 Extract the securing screw from the body front pillar trim panel.
- 4 The trim panel can now be removed by carefully prising the panel from the pillar to release the retaining clips. Take care, as the clips are easily broken. Some manipulation may be required to release the lower end of the trim panel which fits behind the dashboard.

### Body centre pillar trim panels

#### Lower panel

- 5 Extract the two securing screws nearest the body centre pillar from the front sill trim panel.
- 6 Similarly, extract the two securing screws nearest the centre pillar from the rear sill trim panel.
- 7 Remove the two securing screws from the centre pillar lower trim, noting that the upper screw also secures the centre pillar upper trim.
- 8 Carefully manipulate the sill trim panels as necessary and remove the centre pillar lower trim panel (photos).
- 9 Refitting is a reversal of removal.

#### Upper panel

- 10 Prise off the trim and unbolt the seat belt upper mounting from the body pillar. Recover the spacer.
- 11 Remove the upper securing screw from the centre pillar lower trim, noting that it also secures the upper trim.
- 12 Remove the securing screws from the centre pillar upper trim.
- 13 Remove the securing screw nearest the centre pillar from the body front pillar trim panel.
- 14 Carefully manipulate the surrounding trim panels as necessary to enable removal of the centre pillar upper trim panel.
- 15 Refitting is a reversal of removal.

### Body rear pillar trim panel

- 16 Working in the luggage compartment, extract the trim panel securing screw.
- 17 If necessary, extract the rear securing screws from the luggage compartment side trim panel, and manipulate the panel as necessary to improve access.
- 18 Carefully prise the trim panel from the body pillar, taking care not to break the retaining clips. If necessary, prise the tops of the body centre pillar upper trim panel and the luggage compartment side trim panel from the headlining to enable removal of the rear trim panel.
- 19 Refitting is a reversal of removal.

### Luggage compartment side trim panel

- 20 Open the tailgate.
- 21 Disconnect the battery negative lead, then disconnect the wiring from the panel-mounted loudspeaker, and where applicable, the panel-mounted luggage compartment lamp.
- 22 Unbolt the rear seat belt upper and lower mountings, and feed the seat belt through the trim panel into the luggage compartment with reference to Section 36.
- 23 Carefully prise the upper trim panel securing clip from the body pillar.
- 24 Working in the luggage compartment, unscrew the trim panel securing screws (photo).
- 25 Fold the rear seat cushion forwards, then fold down the seat back.
- 26 Carefully prise the panel away from the body pillar, taking care not to break the retaining clips, and withdraw it from the vehicle.
- 27 Refitting is a reversal of removal, but ensure that the seat belt is fitted untwisted.

## 32 Facia panels - removal and refitting

**Note:** Before removing any of the facia panels, the battery negative lead should be disconnected, as several permanently-live feed wires are routed behind the facia

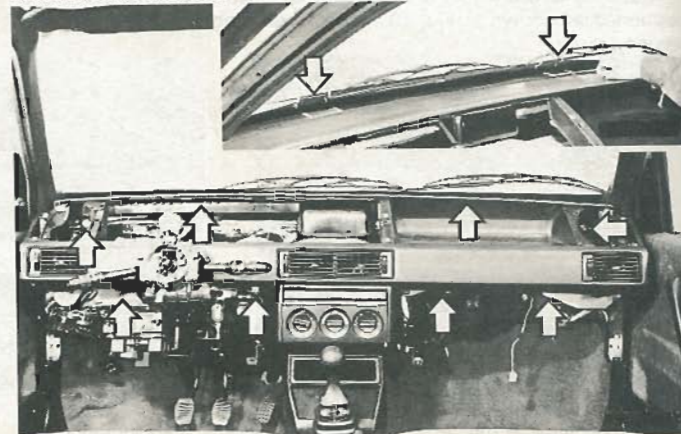
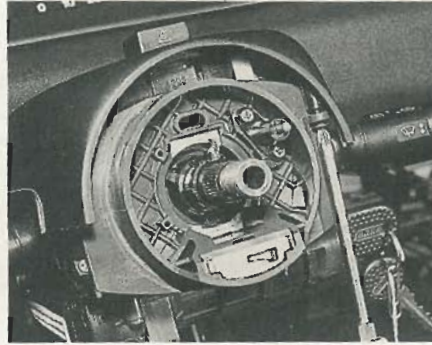


Fig. 10.6 Dashboard assembly securing bolt locations (arrowed) - left-hand drive model shown (Sec 32)

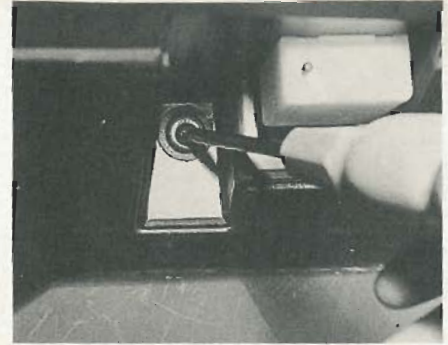




32.6 Extracting a lower steering column shroud securing screw



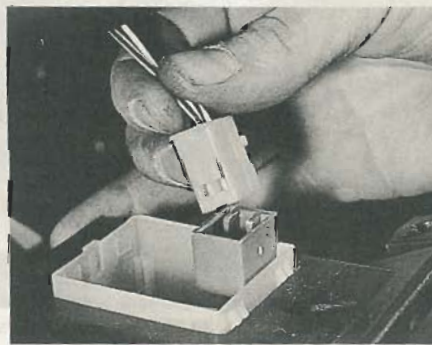
32.7 Extracting an upper steering column shroud securing screw (steering wheel removed)



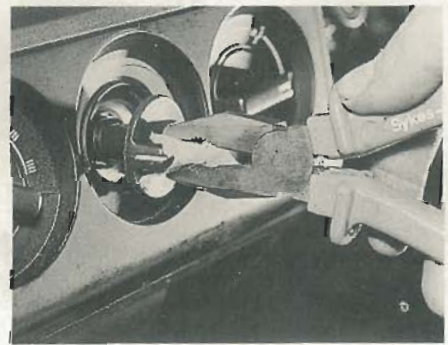
32.10 Extracting the glovebox securing screw next to the glovebox lamp



32.11A Withdraw the glovebox assembly ...



32.11B ... and disconnect the wiring plug from the glovebox lamp



32.20 Removing a heater control knob

### *Driver's side lower facia panel*

- 1 The panel is secured by five screws, one at each corner, and one to the right of the steering column lower shroud.
- 2 On models with an adjustable steering column, fully raise the column.
- 3 Extract the securing screws and withdraw the panel. Some manipulation may be necessary to free the panel from the lower steering column shroud.
- 4 Refitting is a reversal of removal.

### *Steering column shrouds*

- 5 On models with an adjustable steering column, fully lower the column.
- 6 Extract the two securing screws and remove the lower column shroud (photo).
- 7 Extract the two now-exposed securing screws and remove the upper column shroud (photo).
- 8 Refitting is a reversal of removal.

### *Glovebox assembly*

- 9 Extract the two lower glovebox securing screws (one at each bottom corner of the assembly).
- 10 Open the glovebox, and extract the three upper securing screws and the single securing screw located next to the glovebox lamp (photo).
- 11 Withdraw the glovebox assembly and disconnect the wiring plug from the glovebox lamp (photos).
- 12 Refitting is a reversal of removal.

### *Complete dashboard assembly*

- 13 Remove all the facia panels previously described in this Section, and the instrument panel as described in Chapter 11, Section 30.
- 14 Remove the steering wheel as described in Chapter 9.
- 15 Carefully prise the two demister grilles from the top edge of the

dashboard to expose the dashboard upper fixing bolts.

- 16 Unscrew the securing bolts shown in Fig. 10.6, noting that the figure shows a left-hand drive model, and carefully withdraw the dashboard from the facia, noting the routing of any wiring which passes through the dashboard.
- 17 Refitting is a reversal of removal, ensuring that all wiring is correctly routed.

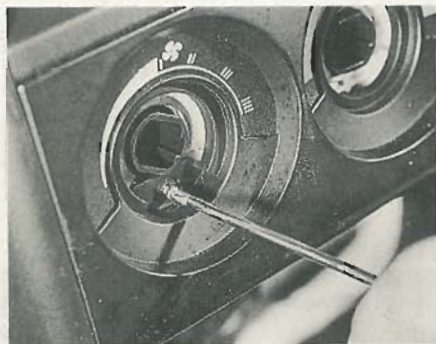
### *Heater control trim panel*

- 18 Remove the driver's side lower facia panel and the glovebox assembly as described previously in this Section.
- 19 Where applicable, remove the radio/cassette player as described in Chapter 11.
- 20 Carefully pull the knobs from the heater controls. If necessary, use a pair of pliers with a piece of card between the jaws to prevent damage to the knob (photo).
- 21 Extract the two now-exposed heater control panel securing screws from their locations beneath the left- and right-hand heater controls (photo).
- 22 Remove the two trim panel securing screws from each side of the panel, noting that the lower left-hand securing screw also secures the glovebox assembly mounting bracket, then carefully lower the trim panel and pull the heater control illumination bulbs from the rear of the panel (photos).
- 23 Where applicable, disconnect the wiring from the cigarette lighter.
- 24 The panel can now be withdrawn.
- 25 Refitting is a reversal of removal.

### *Facia ventilation nozzles*

- 26 Carefully prise the nozzle assembly from the facia, using a screwdriver with a piece of card under the blade to avoid damage to the facia trim (photo).
- 27 If desired, the nozzle housings can be removed in a similar manner by releasing the upper and lower retaining clips.

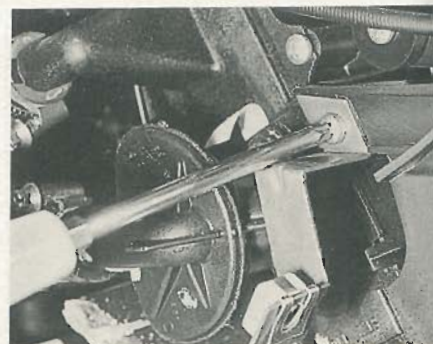




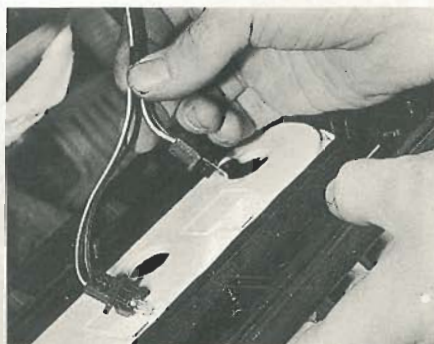
32.21 Extracting a heater control panel front securing screw



32.22A Extracting the upper right-hand heater control trim panel securing screw



32.22B Extracting the lower left-hand heater control panel securing screw



32.22C Heater control panel illumination bulbs pulled from rear of trim panel



32.26 Removing a fascia ventilation nozzle

### 33 Centre console – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Remove the radio/cassette player as described in Chapter 11.
- 3 Remove the single securing screw and withdraw the cover from the handbrake lever (photo).
- 4 Pull the lower end of the gearchange lever gaiter from the centre console, then pull the knob/gaiter moulding from the lever (photo).
- 5 Carefully prise the ashtray assembly from the rear of the centre console (photo).
- 6 Open the flap covering the front ashtray and the cigarette lighter, and prise the ashtray from its housing (photo).
- 7 Carefully prise the ashtray/cigarette lighter housing from the centre console, and disconnect the wiring from the cigarette lighter (photo).
- 8 Where applicable, prise the electric mirror operating switch from

the centre console and disconnect the wiring plug.

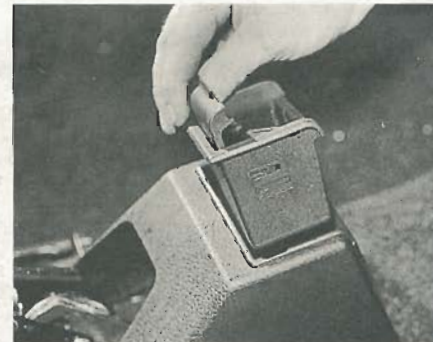
- 9 Unscrew the two console rear securing screws, accessible through the rear ashtray aperture (photo).
- 10 Unscrew the two centre console front securing screws, accessible through the front ashtray housing aperture (photo).
- 11 Unscrew the console centre securing screw from the oddments tray next to the handbrake lever (photo).
- 12 Fully release the handbrake, then fully slacken the cable adjuster nut on the underside of the handbrake lever.
- 13 Pull the handbrake lever upwards as far as possible, then manipulate the centre console over the handbrake lever and withdraw it from the vehicle (photo).
- 14 Refitting is a reversal of removal, ensuring that all wiring is positioned so that it can be reconnected once the centre console is in position.
- 15 On completion adjust the handbrake as described in Chapter 8.



33.3 Withdrawing the cover from the handbrake lever



33.4 Removing the gearchange lever knob/gaiter moulding



33.5 Removing the ashtray assembly from the rear of the centre console





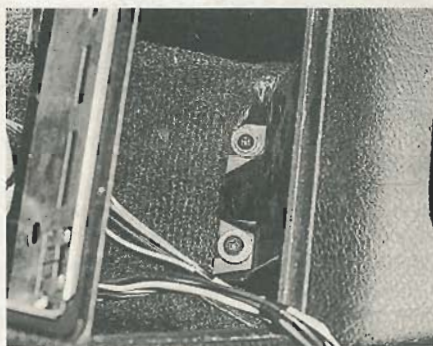
33.6 Removing the front ashtray from the centre console



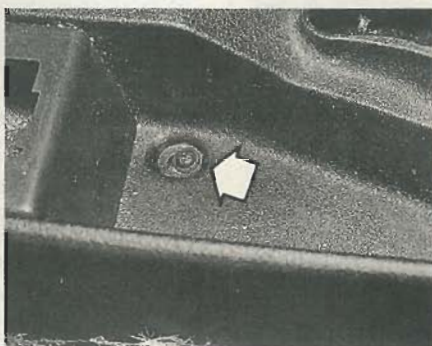
33.7 Removing the ashtray/cigarette lighter housing from the centre console



33.9 Centre console rear securing screws



33.10 Centre console front securing screws



33.11 Centre console centre securing screw



33.13 Removing the centre console

## 34 Headlining – removal and refitting

- 1 Extract the securing screws and remove the sun visors and their clips.
- 2 Extract the securing screws and remove the passenger grab handles.
- 3 Remove the courtesy lamp roof panel as described in Chapter 11, Section 22.
- 4 Where applicable, remove the sunroof motor as described in Chapter 11, Section 58.
- 5 Prise the blanking plugs from the driver's side of the headlining (fitted in place of a grab handle).
- 6 Prise the securing clips from the rear of the headlining.
- 7 Where applicable, prise the sunroof trim/sealing strip from the sunroof aperture in the headlining.
- 8 Extract the upper securing clip from the rear pillar trim panel, then carefully prise the top edge of the trim panel from the headlining.

9 Carefully prise the tops of the body centre pillar upper trim panel and the body rear pillar trim panel from the headlining, taking care not to break the retaining clips.

10 Open the tailgate, and then have an assistant support it while the tailgate struts are disconnected, with reference to Section 12 if necessary.

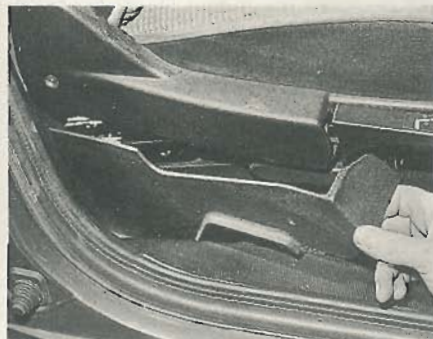
11 Carefully prise the securing clips from the sides of the headlining (exposed by pulling back the pillar trim panels), then manipulate the headlining as necessary and withdraw it through the tailgate aperture.

12 Refitting is a reversal of removal.

## 35 Seats – removal and refitting

### Front seats

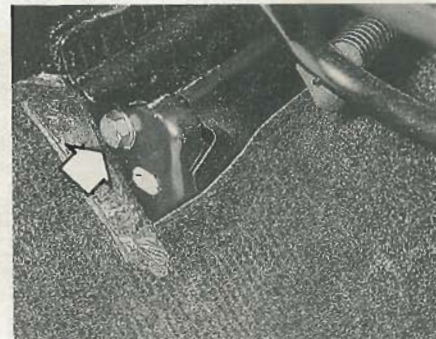
- 1 Remove the two securing screws from the outer seat rail trim (one at the rear, and one at the front side), then withdraw the trim (photo).



35.1 Removing the front seat outer rail trim ...



35.2A Removing the front seat inner rail trim ...



35.2B ... to expose the seat rail securing bolt (arrowed)





35.6 Rear seat cushion hinge securing bolt



35.9 Outer seat back hinge-to-body bolt (arrowed)

- 2 Remove the single securing screw from the inner seat rail trim and withdraw the trim (photos).
- 3 Where applicable, disconnect the battery negative lead, then disconnect the wiring from the seat heating pad under the base of the seat.
- 4 Unscrew the four bolts which secure the seat rails to the floor, then withdraw the seat complete with the rails.
- 5 Refitting is a reversal of removal.

#### Rear seat cushion

- 6 Working at the lower front edge of the cushion, unscrew the bolts securing the cushion hinges to the body (one at each end of the cushion) using a suitable Allen key or hexagon bit, then withdraw the cushion from the vehicle (photo).
- 7 Refitting is a reversal or removal.

#### Rear seat back

- 8 Fold the seat cushion forwards, then fold down the seat back.
- 9 Using a suitable Allen key, unscrew the bolt securing the outer seat back hinge to the body (photo).
- 10 Raise the seat as necessary, and carefully pull the seat cushion away from the hinge bracket on the seat back.
- 11 Unscrew the nut from the end of the pivot pin which secures the seat back bracket to the pivot assembly, then manipulate the seat back from the pivot pin.
- 12 The seat back can now be withdrawn from the vehicle.
- 13 Refitting is a reversal of removal.

- 3 Remove the two securing screws from the centre pillar lower trim, noting that the upper screw also secures the centre pillar upper trim.
- 4 Carefully manipulate the sill trim panels as necessary and remove the centre pillar lower trim panel to expose the inertia reel unit.
- 5 Prise off the trim and unbolt the seat belt upper mounting from the body pillar. Recover the spacer.
- 6 Unbolt the seat belt lower mounting.
- 7 Unscrew the securing bolt and lift the inertia reel unit from the body pillar (photo). The complete seat belt assembly can now be withdrawn.
- 8 Refitting is a reversal of removal, but ensure that the belt is fitted untwisted.

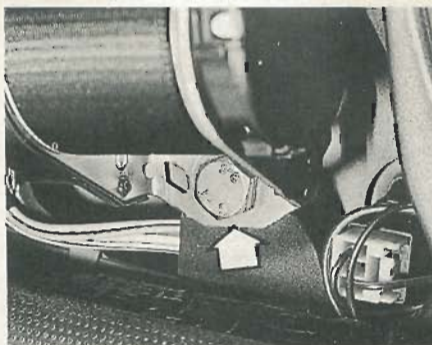
#### Rear seat belt

- 9 Fold the rear seat cushion forwards for access to the seat belt lower mountings, then unbolt the relevant lower mounting (photo).
- 10 Prise off the trim and unbolt the seat belt upper mounting from the body pillar (photo). Recover the spacer.
- 11 Working in the luggage compartment, unscrew the bolt securing the inertia reel unit to the body.
- 12 Carefully prise the seat belt surround from the luggage compartment side trim panel, then feed the seat belt through the aperture in the trim panel into the luggage compartment (photo). The seat belt can now be removed from the vehicle.
- 13 Refitting is a reversal of removal, but ensure that the seat belt is fitted untwisted.

### 36 Seat belts - removal and refitting

#### Front seat belt

- 1 Extract the two securing screws nearest the body centre pillar from the front sill trim panel.
- 2 Similarly, extract the two securing screws nearest the centre pillar from the rear sill trim panel.



36.7 Centre pillar lower trim panel removed to expose inertia reel securing bolt (arrowed)



36.9 Rear seat belt lower mounting (arrowed)

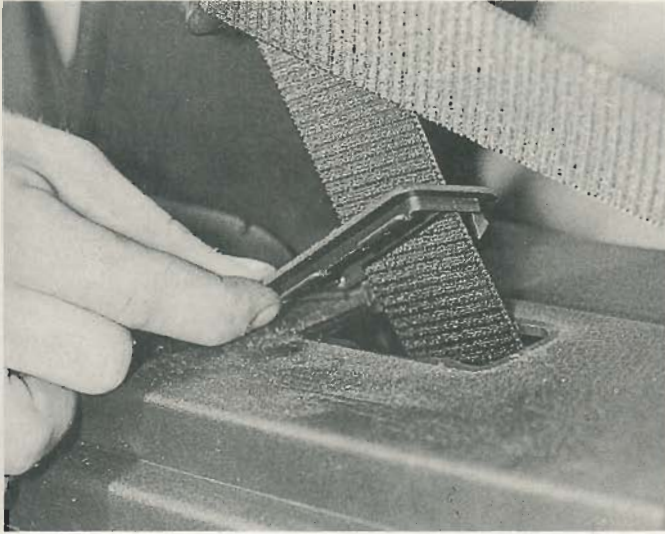


36.10 Removing the trim to expose the rear seat belt upper mounting bolt

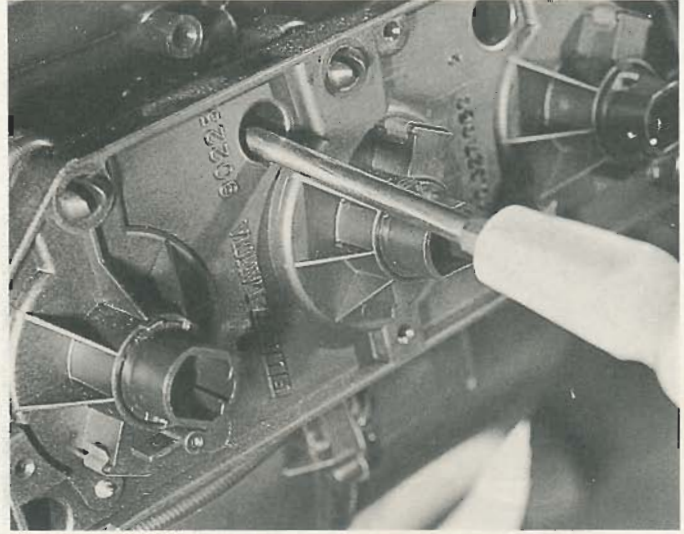
### 37 Heater control panel - removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Remove the heater control trim panel as described in Section 32.
- 3 Extract the four securing screws from the front of the control panel and lower the panel (photo).
- 4 Disconnect the wiring plug from the heater blower motor switch (photo).





36.12 Removing the seat belt surround from the luggage compartment side trim panel



37.3 Extracting a heater control panel securing screw

5 If desired, the heater blower motor switch can be removed after extracting the two securing screws.

6 Identify the control cables for location, then extract the screws securing the cable sheaths to the control panel, and disconnect the cables from the control levers. Where applicable, remove the spring clip(s) securing the cable end(s) to the control lever(s). The panel can now be withdrawn.

7 Refitting is a reversal of removal, but ensure that the control cables are reconnected to their correct levers, and before refitting the heater control trim panel, check the cable adjustment as described in Section 38.

### 38 Heater controls – adjustment

1 Remove the driver's side lower facia panel, the glovebox assembly, and the heater control trim panel as described in Section 32.

2 Turn the three heater control knobs fully anti-clockwise.

3 With the air distribution knob turned fully anti-clockwise, the air distribution flap toothed wheel and the toothed segment, visible on the left-hand side of the heater assembly, should be aligned as shown in Fig. 10.7.

4 If the wheel and segment are not correctly aligned, loosen the clamp screw securing the control cable to the segment, and adjust the cable until satisfactory alignment is achieved (photo).

5 Tighten the clamp screw, then turn the air distribution knob through its full range of movement, and check that the wheel and segment are still correctly aligned with the knob turned fully anti-clockwise. Readjust as necessary until satisfactory operation is achieved.

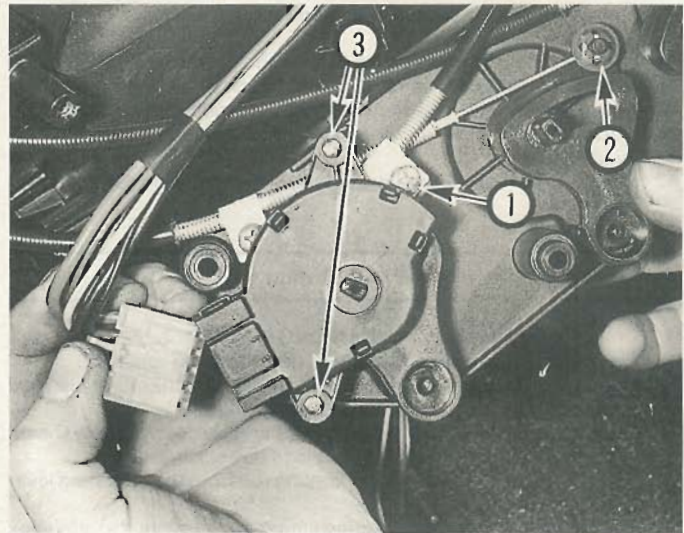
6 With the air temperature control knob turned fully anti-clockwise, the coolant valve operating lever on the left-hand side of the heater assembly (above the coolant outlet pipe) should be in its anti-clockwise end-of-travel position.

7 If the lever is not correctly positioned, loosen the clamp screw securing the control cable to the lever, and adjust the cable until satisfactory operation is achieved.

8 Tighten the clamp screw, then turn the air temperature control knob through its full range of movement, and check that the coolant valve operating lever is still correctly positioned with the knob turned fully anti-clockwise. Readjust as necessary until satisfactory operation is achieved.

9 With the air volume control knob turned fully anti-clockwise, the air intake flap lever on the right-hand side of the heater assembly should be in its anti-clockwise end-of-travel position.

10 If the lever is not correctly positioned, loosen the clamp screw securing the control cable to the lever, and adjust the cable until satisfactory operation is achieved.



37.4 Disconnecting the wiring plug from the heater blower motor switch

1 Cable sheath-to-control panel securing screw

2 Cable end securing spring clip

3 Switch securing screws

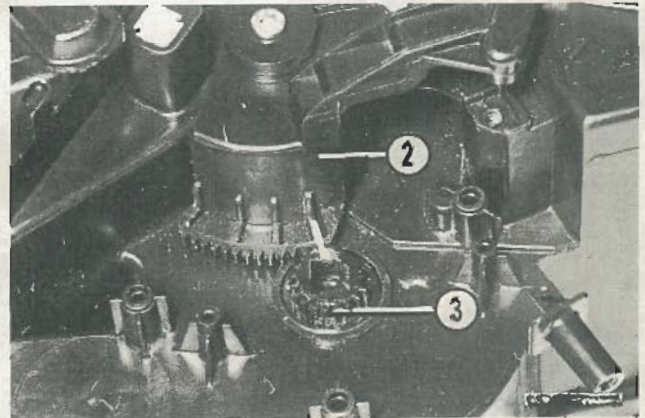
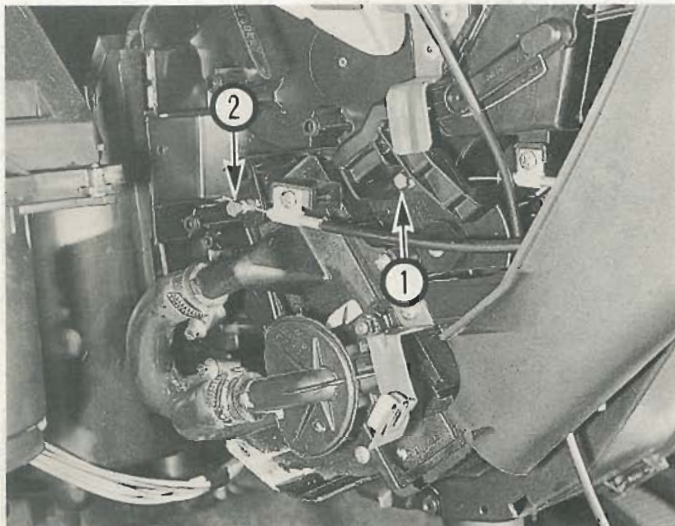


Fig. 10.7 Correct alignment of heater air distribution flap toothed wheel (3) and toothed segment (2) (Sec 38)





38.4 View of heater assembly with glovebox assembly removed

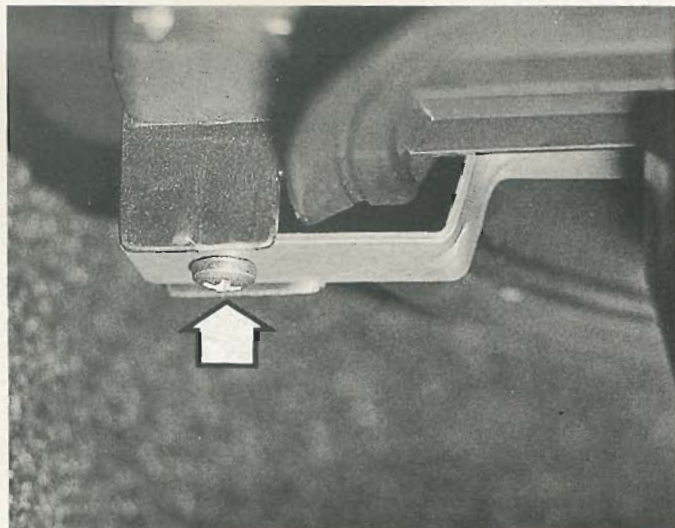
- 1 Air distribution control cable end clamp screw  
2 Air temperature control cable end clamp screw

11 Tighten the clamp screw, then turn the air volume control knob through its full range of movement, and check that the air intake flap lever is still correctly positioned with the knob turned fully anticlockwise. Readjust as necessary until satisfactory operation is achieved.

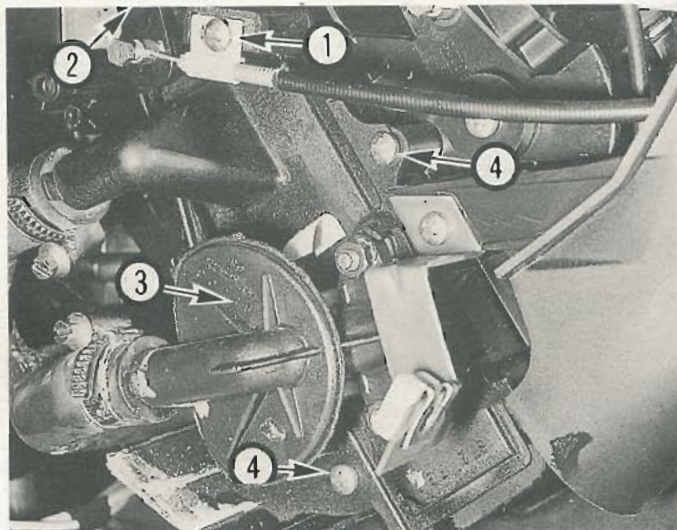
12 Refit the trim panels and the glovebox assembly on completion.

### 39 Heater matrix – removal and refitting

- 1 Drain the cooling system as described in Chapter 2.
- 2 Remove the glovebox assembly as described in Section 32.
- 3 Disconnect the coolant hoses from the heater matrix outlet pipe and the coolant valve. Be prepared for coolant spillage.
- 4 Extract the screw securing the air temperature control cable sheath to the heater matrix, and move the cable to one side (photo).
- 5 Disconnect the coolant valve operating rod from the operating lever above the heater matrix.
- 6 If necessary, extract the securing screw and remove the glovebox bracket from the heater control trim panel, noting that the screw also secures the trim panel.
- 7 Extract the two heater matrix securing screws, then carefully de-



41.2 Heater blower motor housing securing screw (arrowed)



39.4 View of heater matrix with glovebox assembly removed

- 1 Air temperature control cable sheath securing screw  
2 Coolant valve operating lever  
3 Coolant valve  
4 Heater matrix securing screws

press the four retaining tabs with a screwdriver, and slide the heater matrix from its housing.

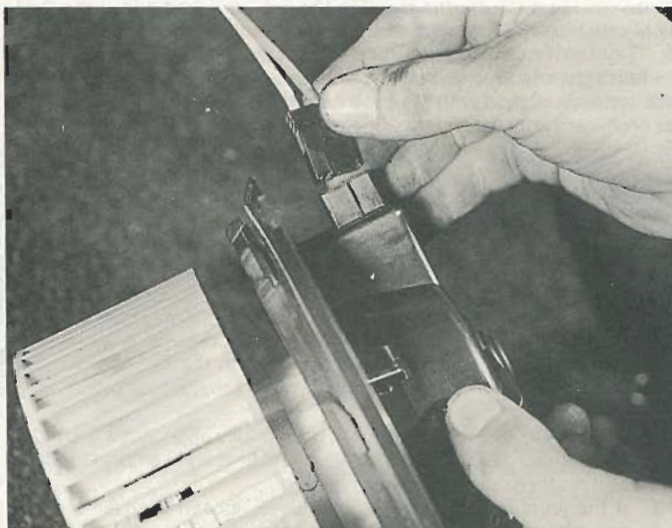
8 Check the condition of the gaskets around the edges of the heater matrix and renew if necessary. If desired, the coolant valve can be removed from the heater matrix with reference to Section 40.

9 Refitting is a reversal of removal, but ensure that the coolant hoses are securely reconnected.

10 On completion, refill the cooling system as described in Chapter 1.

### 40 Heater temperature control coolant valve – removal and refitting

- 1 Drain the cooling system as described in Chapter 2.
- 2 Remove the glovebox assembly as described in Section 32.
- 3 Disconnect the coolant hose from the coolant valve. Be prepared for coolant spillage.
- 4 Unscrew the two securing nuts, and slide the coolant valve from the heater matrix, then disconnect the operating lever from the valve, and withdraw the valve. Recover the gasket.



41.4 Disconnecting the heater blower motor wiring plug



- 5 Refitting is a reversal of removal, but examine the condition of the gasket and renew if necessary, and ensure that the coolant hose is securely reconnected.
- 6 On completion, refill the cooling system as described in Chapter 2.

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#### 41 Heater blower motor - removal and refitting

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- 1 Disconnect the battery negative lead.
- 2 Working in the passenger footwell, where applicable, remove the single screw securing the motor housing to the air ducting (photo). Alternatively, the motor housing may be secured to the air ducting by a plastic clip which must be released by pulling downwards (Fig. 10.8).
- 3 Turn the motor housing anti-clockwise, and withdraw it from the air ducting.
- 4 Disconnect the wiring plug and withdraw the motor assembly (photo).
- 5 No spare parts are available for the motor, and if faulty the complete assembly, including housing, must be renewed.
- 6 Refitting is a reversal of removal.

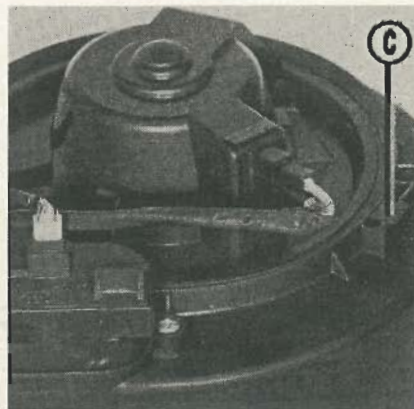


Fig. 10.8 Heater blower motor housing securing clip (C) - assembly shown inverted (Sec 41)



# Chapter 11 Electrical system

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## Specifications

### General

System type..... 12 volt, negative earth

### Battery

Type (production fitment)..... Low maintenance  
Capacity..... 40 Ah

### Alternator

Type..... Bosch, Lucas, Magnetti Marelli, or Mitsubishi  
Output..... 55 amps  
Regulated voltage at 7000 alternator rpm with 5 to 50 amp load:  
All except Magnetti Marelli alternators..... 14.0 to 14.3 volts  
Magnetti Marelli alternators..... 14.3 to 14.6 volts  
Minimum brush length..... 5.0 mm (0.2 in)  
Rotor winding resistance:  
Bosch alternators..... 3.06 to 3.74 ohms  
Lucas alternators..... 2.80 to 3.00 ohms  
Magnetti Marelli alternators..... 3.00 to 3.20 ohms  
Mitsubishi alternators..... 3.70 to 4.10 ohms



**Starter motor**

Type.....	
Rating:	
1.4 litre models .....	
1.6 litre models .....	
Minimum brush length.....	

Magnetti Marelli

0.8 kW  
1.0 kW  
10.0 mm (0.4 in)

**Fuses**

See Section 15 and Figs. 11.3 and 11.4

**Relays**

See Section 15 and Figs. 11.3 and 11.4

**Bulbs**

Courtesy lamp.....	
Luggage compartment lamp.....	
Glovebox lamp.....	
Headlamps.....	
Sidelamps.....	
Direction indicator lamps.....	
Direction indicator side repeater lamps.....	
Tail lamps.....	
Brake lamps.....	
Reversing lamps.....	
Rear foglamps.....	
Number plate lamps.....	

**Wattage**

5  
5  
5  
40/45  
5  
21  
5  
5  
21  
21  
21  
5

**Torque wrench settings**

Alternator adjuster nut.....	
Alternator mounting nut and bolt.....	

Nm	lbf ft
49	36
49	36

**1 General description**

**Warning:** Before carrying out any work on the vehicle electrical system, read through the precautions given in the "Safety first!" Section at the beginning of this manual, and in Section 2 of this Chapter

The electrical system is of the 12-volt negative earth type, and consists of a 12-volt battery, alternator with integral voltage regulator, starter motor and related electrical accessories, components and wiring.

The battery is of the low maintenance type, and is charged by an alternator which is belt-driven from the crankshaft pulley.

The starter motor is of the pre-engaged type, incorporating an integral solenoid. On starting, the solenoid moves the drive pinion into engagement with the flywheel ring gear before the starter motor is energised. Once the engine has started, a one-way clutch prevents the motor armature being driven by the engine until the pinion disengages from the flywheel.

Further details of the electrical systems are given in the relevant Sections of this Chapter.

**2 Electrical system - precautions**

*It is necessary to take extra care when working on the electrical system to avoid damage to semi-conductor devices (diodes and transistors), and to avoid the risk of personal injury. In addition to the precautions given in the "Safety first!" Section at the beginning of this manual, take note of the following points when working on the system*

1 Always remove rings, watches, etc before working on the electrical system. Even with the battery disconnected, capacitive discharge could occur if a component live terminal is earthed through a metal object. This could cause a shock or a nasty burn.

2 Do not reverse the battery connections. Components such as the alternator or any other having semi-conductor circuitry could be irreparably damaged.

3 If the engine is being started using jump leads and a slave battery, connect the batteries positive to positive and negative to negative. This also applies when connecting a battery charger.

4 Never disconnect the battery leads or the alternator wiring when the engine is running.

5 The battery leads and the alternator wiring must be disconnected before carrying out any electric welding on the vehicle.

6 Never use an ohmmeter of the type incorporating a hand-cranked generator for circuit or continuity testing.

**3 Routine maintenance**

**Note:** Refer to Section 2 before proceeding

1 At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, carry out the following maintenance operations and checks.

2 Check the operation of all the electrical equipment, ie wipers, washers, lamps, direction indicators, horn etc. Refer to the appropriate Section(s) of this Chapter if any components are found to be inoperative.

3 Visually check all accessible wiring connectors, harnesses and retaining clips for security, or any signs of chafing or damage. Rectify any problems encountered.

4 Check the coolant pump/alternator drivebelt for cracks, fraying or damage. Renew the belt if worn or, if satisfactory, check and adjust the belt tension. These procedures are covered in Chapter 2, Section 12.

5 Check the condition of the wiper blades and if they are cracked or show any signs of deterioration, renew them as described in Section 45. Check the operation of the windscreen and tailgate washers. Adjust the nozzles using a pin if necessary.

6 Check the battery terminals, and if there is any sign of corrosion, disconnect and clean them thoroughly. Smear the terminals and battery posts with petroleum jelly before reconnection. If there is any corrosion on the metal battery tray, remove the battery and unclip the plastic tray complete with its drain hose, then clean the deposits away and treat the affected metal with an anti-rust preparation. After treatment, repaint the tray in the original colour.

7 All Tipo models are fitted with a low maintenance type battery during production. There is no requirement for routine topping-up with distilled water. Periodically inspect the electrolyte level, which should be between the two reference marks on the battery casing. If necessary,



top up the level with distilled water after removing the plug(s) from the top of the casing, although it should be emphasised that this should not be necessary under normal operating conditions.

8 Check and if necessary top up the washer fluid level in the reservoir and check the security of the pump wires and water pipes.

9 It is advisable to have the headlamp aim checked and if necessary adjusted using optical beam setting equipment.

10 While carrying out a road test, check the operation of all the instruments and warning lamps, and the operation of the direction indicator self-cancelling mechanism.

#### 4 Battery – testing and charging

**Note:** The procedure given in this Section applies to the original-equipment battery fitted during manufacture. Follow the battery manufacturer's recommendations when working with replacement batteries of an alternative type. Refer to Section 2 before proceeding

1 If a discharged battery is suspected, leave it disconnected for at least two hours, then measure the voltage using a sensitive voltmeter connected across the battery terminals. Compare the reading obtained with the following:

Voltmeter reading	Charge condition
12.30 volts.....	50% charged
12.48 volts.....	75% charged
12.66 volts.....	100% charged

2 If the battery is to be charged, remove it from the vehicle, and charge it as follows.

3 The manufacturers recommend the use of a trickle charger, which charges at a low current (around 1.5 amps), and can be used safely overnight.

4 Specially rapid "boost" charges which are claimed to restore the power of the battery in 1 to 2 hours are not recommended, as they can cause serious damage to the battery plates through overheating. **Never** subject the battery to rapid boost charging at voltages higher than 15.5 volts, or to high charging currents.

5 Before commencing charging, remove the plug(s) from the top of the battery cells to allow the gases which will be produced during charging to escape from the battery casing. This will prevent a possible build-up of gas pressure inside the battery which may occur if the cell vent holes are blocked. Charging should be carried out in a well-ventilated area.

6 Connect the battery charger leads to the battery, ensuring that the leads are connected *positive to positive* and *negative to negative*, then switch on the charger.

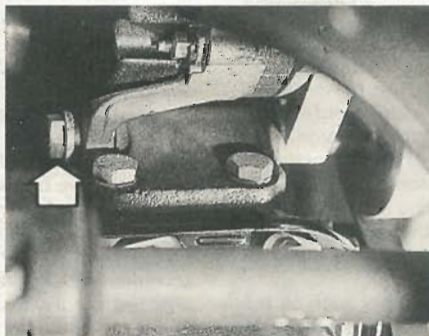
7 When charging is complete, turn the charger off before disconnecting the leads from the battery.

#### 5 Battery – removal and refitting

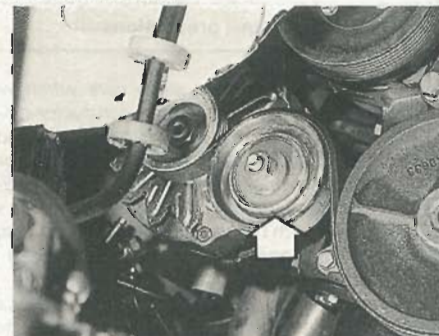
1 The battery is located at the front left-hand side of the engine compartment.



8.2 Disconnecting the alternator wiring plug



8.7A Alternator mounting bolt (arrowed) viewed from underneath ...



8.7B ... and idler pulley (arrowed) – model with power steering

2 Loosen the clamp screw and disconnect the negative (earth) leads from the battery. Lift the plastic cover and repeat the procedure for the positive leads.

3 Unscrew the clamp bolt sufficiently to enable the battery to be lifted from its location. Keep the battery in an upright position to avoid spilling electrolyte on the bodywork.

4 Refitting is a reversal of removal, but smear petroleum jelly on the terminals when reconnecting the leads, and always connect the positive leads first and the negative leads last.

#### 6 Alternator – description

1 One of a number of different makes of alternator may be fitted, depending on model.

2 The alternator is belt-driven from the crankshaft pulley. Cooling is provided by a fan mounted outside the casing on the end of the rotor shaft. An integral voltage regulator is incorporated to control the output voltage.

3 The alternator provides a charge to the battery even at very low engine speeds and basically consists of a coil-wound stator in which a rotor rotates. The rotor shaft is supported in bearings and slip rings are used to conduct current to and from the field coils through the carbon brushes.

4 The alternator generates AC (alternating current) which is rectified by an internal diode circuit to DC (direct current) for supply to the battery.

#### 7 Alternator drivebelt – checking, renewal and tensioning

Refer to Chapter 2, Section 12.

#### 8 Alternator – removal and refitting

1 Disconnect the battery negative lead.

2 Disconnect the wiring from the rear of the alternator. It will be necessary to unscrew the securing nut in order to disconnect the main output wire (photo).

3 Remove the coolant pump/alternator drivebelt as described in Chapter 2, Section 12.

4 Unscrew and remove the alternator adjuster nut, then extract the adjuster bolt from its location in the alternator casing. Note the position(s) of any washer(s) on the adjuster bolt.

5 On models with manual steering, unbolt and remove the alternator adjuster bracket from the cylinder block.

6 On models with power steering, if desired, the engine splash shield can be removed for improved access as described in Chapter 10, Section 27.

7 Support the alternator, then unscrew and remove the alternator mounting through-bolt and nut, noting the positions of the washers, and on models with power steering the idler pulley and spacer on the bolt (improved access is available working underneath the vehicle). The alternator can now be withdrawn (photos).



8 Refitting is a reversal of removal, ensuring that any washers are fitted to their correct locations on the alternator mounting and pivot bolts. On models with power steering, ensure that the drivebelt idler pulley and spacer are correctly positioned as noted during removal.

9 On completion, tension the drivebelt as described in Chapter 2, Section 12.

## 9 Alternator - fault finding and testing

**Note:** Refer to Section 2 before proceeding

1 Check that the battery is at least 75% charged as described in Section 4.

2 Check the drivebelt tension as described in Chapter 2, Section 12.

3 Check the security of the battery leads, alternator wiring, and associated wiring.

4 To check the alternator output proceed as follows.

5 Disconnect the output wire from the alternator (the output wire is the thickest of the three wires connected to the alternator).

6 Connect an ammeter between the alternator output wire and the battery positive terminal, and connect a voltmeter between the alternator output wire and the battery negative terminal.

7 Start the engine and run it at a speed of 3000 to 4000 rpm.

8 Progressively switch on all available electrical loads (headlamps, heater blower, heated rear window etc).

9 **Note** the ammeter reading when the voltmeter reading falls below 13.5 volts. If the ammeter reading is less than 50 amps, then the alternator should be overhauled.

10 Disconnect the test instruments, and reconnect the alternator output wire on completion.

## 10 Alternator brushes - removal, inspection and refitting

1 Remove the alternator as described in Section 8.

### Bosch type alternators

2 Remove the two securing screws and withdraw the regulator/brush box assembly from the rear of the alternator.

3 If the length of either brush is less than the minimum given in the Specifications, unsolder the wiring and remove the brushes and the springs.

4 Wipe the slip rings clean with a fuel-moistened cloth. If the rings are very dirty, use fine glass paper to clean them, then wipe with the cloth.

5 Refitting is a reversal of removal, but make sure that the brushes move freely in their holders.

6 On completion, refit the alternator as described in Section 8, and adjust the drivebelt tension as described in Chapter 2, Section 12.

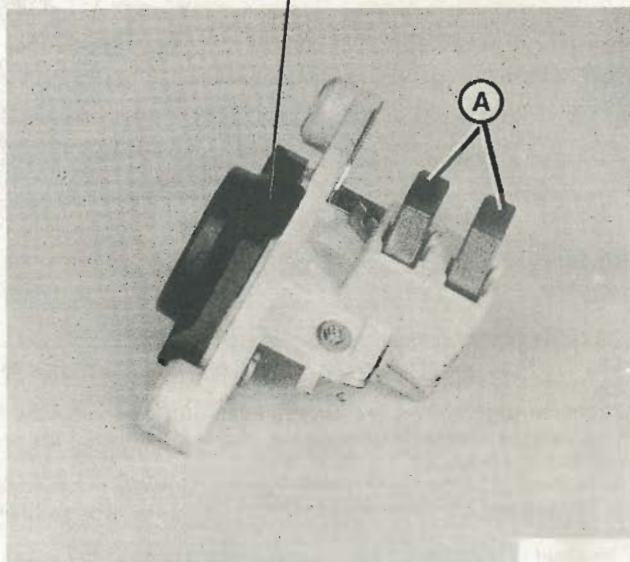
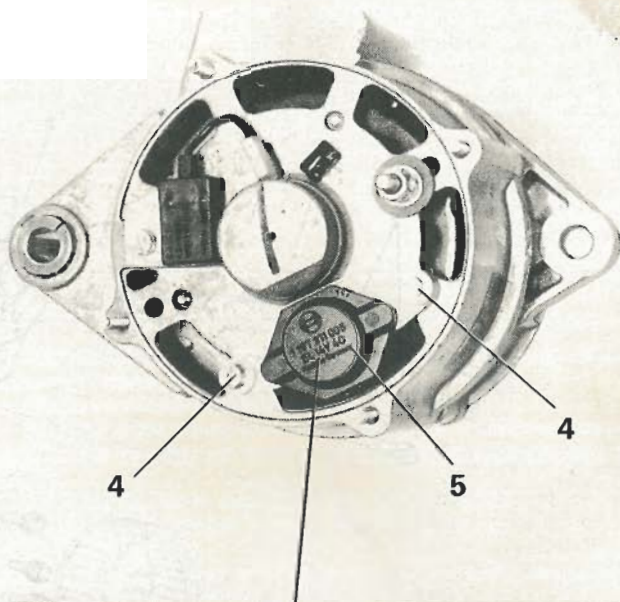
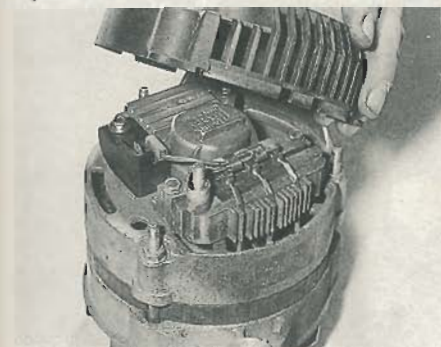


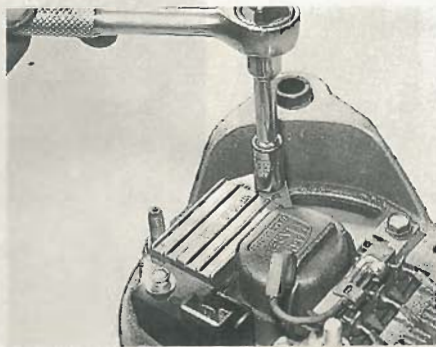
Fig. 11.1 Bosch type alternator regulator/brush box assembly (Sec 10)

4 Regulator/brush box securing screws

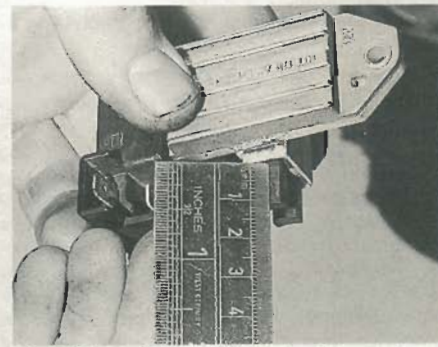
5 Regulator  
A Brushes



10.11 Removing the alternator rear cover - Magnetti Marelli type alternator



10.12 Unscrewing a regulator/brushbox assembly securing screw - Magnetti Marelli type alternator



10.13 Measuring brush length - Magnetti Marelli type alternator



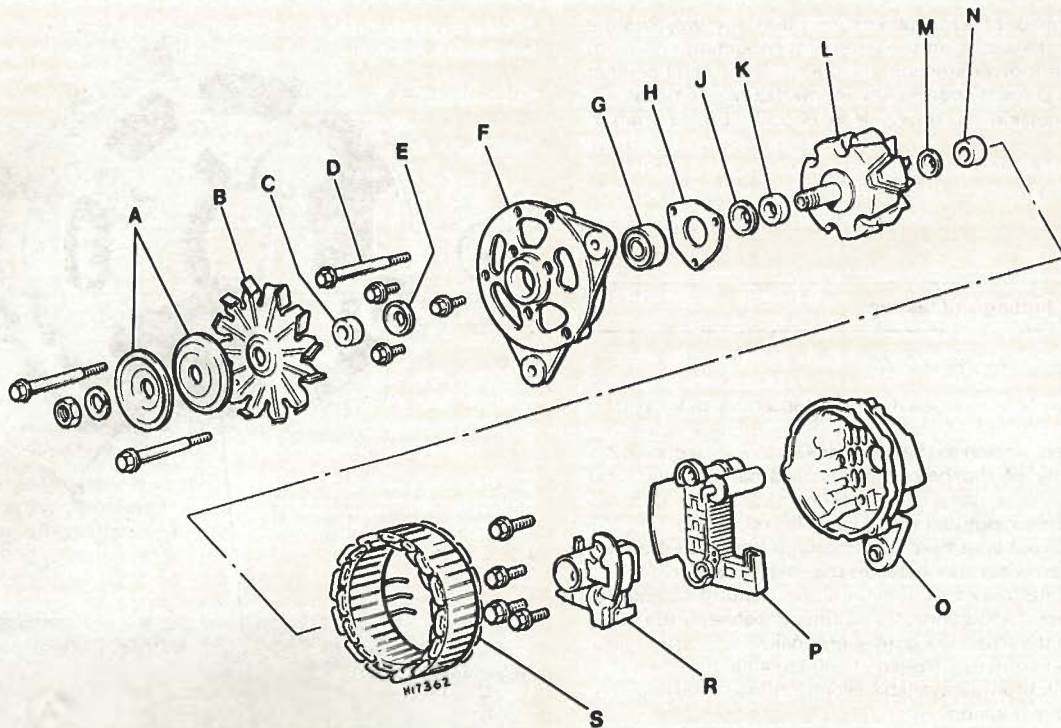


Fig. 11.2 Exploded view of Mitsubishi type alternator (Sec 10)

A Pulley	F Drive end housing	K Thin spacer	O Rear end housing
B Fan	G Bearing	L Rotor	P Diode pack
C Thick spacer	H Bearing retainer	M Seal	R Brush box
D Through-bolt	J Dust cap	N Bearing	S Stator
E Dust shield			

### Lucas type alternators

- 7 Remove the three screws securing the regulator/brush box assembly to the rear of the alternator.
- 8 Tip the outside edge of the assembly upwards, and withdraw it from its location. Disconnect the wiring plug and withdraw the assembly from the alternator.
- 9 If the length of either brush is less than the minimum given in the Specifications, the complete regulator/brush box assembly must be renewed.
- 10 Proceed as described in paragraphs 4 to 6 inclusive.

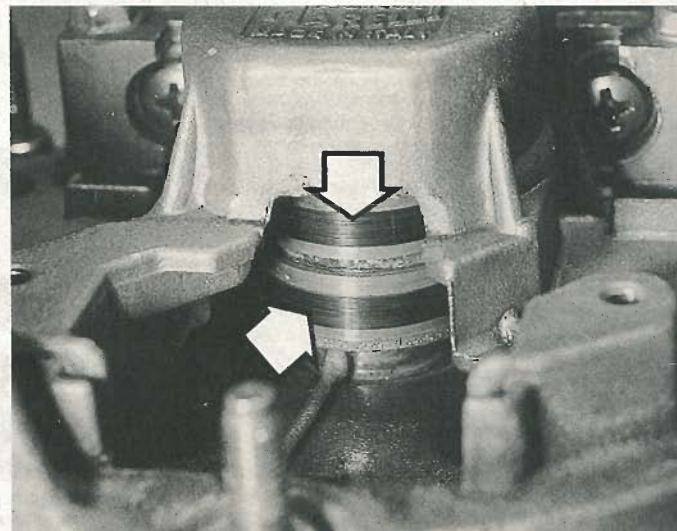
### Magnetti Marelli type alternators

- 11 Unscrew the securing nuts and remove the rear cover from the alternator (photo).
- 12 Remove the two securing screws and withdraw the regulator/brush box assembly (photo).
- 13 If the length of either brush is less than the minimum given in the Specifications, the complete regulator/brush box assembly must be renewed (photo).
- 14 Proceed as described in paragraphs 4 to 6 inclusive (photo).

### Mitsubishi type alternators

- 15 Unscrew the pulley nut. To prevent the shaft rotating, insert an Allen key in the end of the shaft.
- 16 Remove the spring washer, pulley, fan, spacer and dust shield.
- 17 Scribe an alignment mark along the length of the alternator to facilitate reassembly of the drive end housing, stator and rear housing.
- 18 Unscrew the through-bolts and withdraw the drive end housing from the rotor shaft.
- 19 Remove the seal and spacer from the rotor shaft.
- 20 Remove the rotor from the rear housing and the stator. This may require the application of local heat to the rear housing using a large soldering iron. Do not use a heat gun, as this may result in damage to the diodes.
- 21 Unscrew the four securing bolts and withdraw the diode pack/stator assembly from the rear housing.

- 22 Unsolder the stator leads from the diode pack terminals. Use a pair of pliers when unsoldering to act as a heat sink, otherwise damage to the diodes may occur.
- 23 If the length of either brush is less than the minimum given in the Specifications, the brush box must be renewed.
- 24 To renew the brush box, unsolder the connection to the diode pack, and solder the connection to the new brush box. Use a pair of pliers as a heat sink to avoid damage to the diodes.
- 25 Examine the surfaces of the slip rings. Clean them with a fuel-moistened cloth, or if necessary fine glasspaper and then the cloth.
- 26 Solder the stator leads to the diode pack terminals, again using a pair of pliers as a heat sink.



10.14 Slip rings (arrowed) – Magnetti Marelli type alternator



- 27 Refit the diode pack/stator assembly to the rear housing and tighten the securing bolts.
- 28 Insert a thin rod (an Allen key is ideal) through the hole in the rear housing to hold the brushes in the retracted position.
- 29 Fit the rotor to the rear housing and then remove the temporary rod to release the brushes.
- 30 Reassemble the remaining components by reversing the dismantling operations. Make sure that the scribed marks made during dismantling are aligned.
- 31 Proceed as described in paragraph 6.

### 11 Starter motor – general description

The starter motor is mounted at the front of the cylinder block, and is of the pre-engaged type, ie the drive pinion is brought into mesh with the flywheel ring gear before the main current is applied.

When the starter switch is operated, current flows from the battery to the solenoid which is mounted on the starter motor body. The plunger in the solenoid moves inwards, so causing a centrally pivoted lever to push the drive pinion into mesh with the flywheel ring gear. When the solenoid plunger reaches the end of its travel, it closes an internal contact and the full starting current flows to the starter field coils. The armature is then able to rotate the crankshaft, so starting the engine.

A special freewheel clutch is fitted to the starter drive pinion, so that as soon as the engine starts up, it does not drive the starter motor.

When the starter switch is released, the solenoid is de-energised, and a spring moves the plunger back to its rest position. This operates the pivoted lever to withdraw the drive pinion from engagement with the flywheel ring gear.

### 12 Starter motor – testing in the vehicle

*Note: Refer to Section 2 before proceeding*

1 If the starter motor fails to turn the engine when the switch is operated, assuming that engine seizure is not the problem, there are several other possible reasons:

- (a) *The battery is faulty*
- (b) *The electrical connections between the switch, solenoid, battery and starter motor are somewhere failing to pass the necessary current from the battery through the starter to earth*
- (c) *The solenoid switch is faulty*
- (d) *The starter motor is mechanically or electrically defective*
- (e) *The starter motor pinion and/or flywheel ring gear is badly worn, and in need of replacement*

2 To check the battery, switch on the headlamps. If they dim after a few seconds, then the battery is in a discharged state. If the lamps glow brightly, operate the starter switch and see what happens to the lamps. If they dim, then power is reaching the motor, but failing to turn it. If the starter turns slowly, proceed to the next check.

3 If, when the starter switch is operated, the lamps stay bright, then insufficient power is reaching the motor. Disconnect the battery and the starter/solenoid power connections, and the engine earth strap, then thoroughly clean and refit them. Smear petroleum jelly around the battery connections to prevent corrosion. Corroded connections are the most common cause of electrical malfunctions.

4 If the preceding checks and cleaning tasks have been carried out without success, a clicking noise will probably have been heard each time the starter switch was operated. This indicates that the solenoid switch was operating, but it does not necessarily follow that the main contacts were closing properly (if no clicking has been heard from the solenoid, it is certainly defective). The solenoid can be checked by connecting a voltmeter across the main cable connection on the solenoid and earth. When the switch is operated, there should be a reading on the voltmeter. If there is no reading, the solenoid unit is faulty, and should be renewed.

5 If the starter motor operates, but does not turn the engine, then it is likely that the starter pinion and/or flywheel ring gear are badly worn, in which case the starter motor will normally be noisy in operation.

6 Finally, if it is established that the solenoid is not faulty, and that twelve volts is reaching the starter, then the motor itself is faulty, and should be removed for inspection.

### 13 Starter motor – removal and refitting

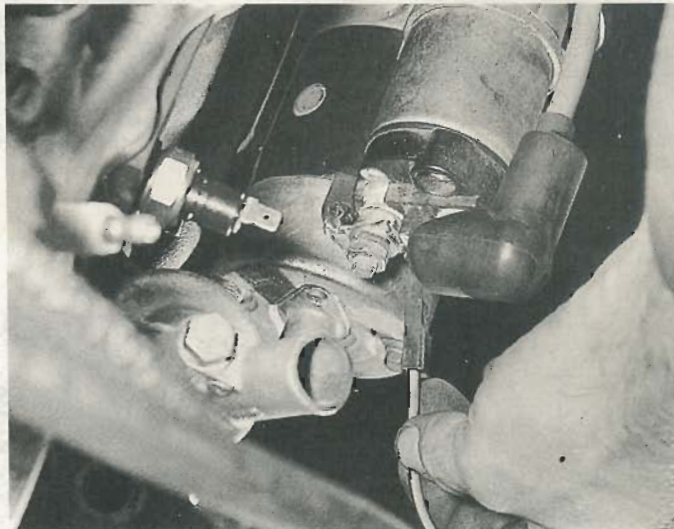
1 The starter motor is located at the front of the cylinder block. To remove the motor, proceed as follows.

2 Disconnect the battery negative lead.

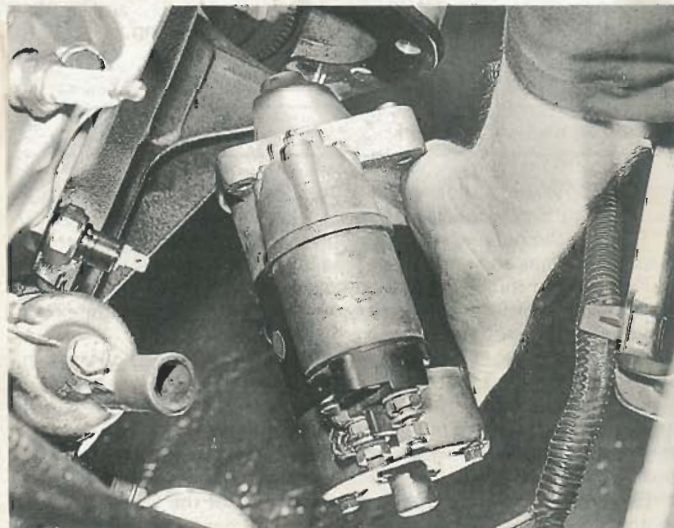
3 Disconnect the wiring from the starter motor. It will be necessary to unscrew the securing nut in order to disconnect the main feed wire (photo).

4 Unscrew the three securing bolts, noting that the top bolt also secures a wiring harness bracket, and withdraw the starter motor (photo).

5 Refitting is a reversal of removal, ensuring that the wiring harness bracket is in position on the relevant securing bolt.

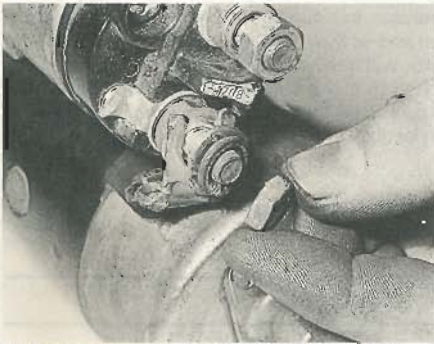


13.3 Disconnecting the starter motor wiring plug



13.4 Withdrawing the starter motor

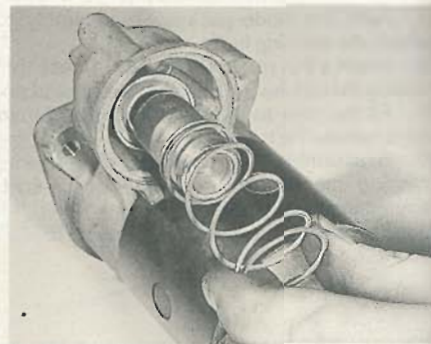




14.2 Disconnecting the field winding lead from the solenoid terminal



14.3A Withdraw the solenoid yoke ...



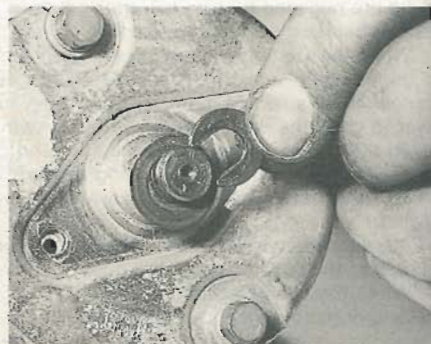
14.3B ... and return spring, ...



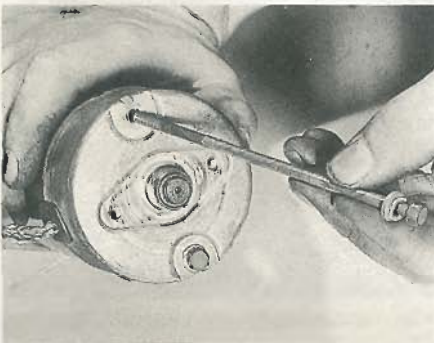
14.3C ... then unhook the armature from the actuating arm



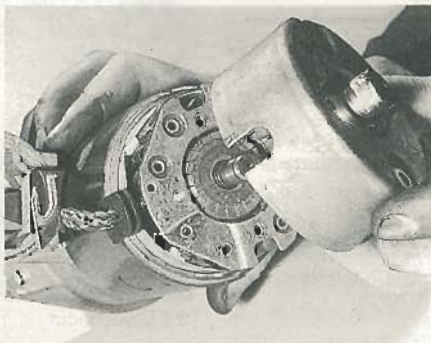
14.4 Removing the commutator end housing cap



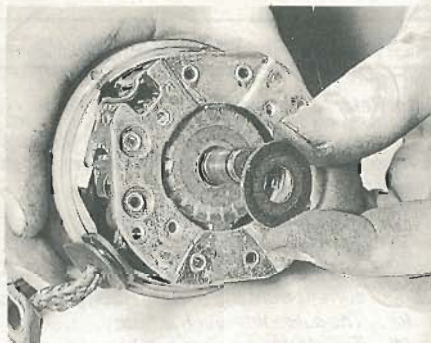
14.5 Removing the C-clip from the end of the armature shaft



14.6A Remove the through-bolts ...



14.6B ... and lift off the commutator end housing



14.7 Recover the ceramic washer from the end of the armature

## 14 Starter motor - overhaul

- 1 With the starter motor removed from the vehicle, clean all dirt from the exterior, then proceed as follows.
- 2 Remove the nut and washer securing the field winding lead to the solenoid terminal, and unhook the lead from the terminal (photo).
- 3 Remove the three securing nuts and withdraw the solenoid yoke and the solenoid return spring, then unhook the solenoid armature from the actuating arm and remove the armature (photos).
- 4 Remove the two screws securing the commutator end housing cap, then remove the cap (photo).
- 5 Wipe any grease from the armature shaft, and remove the C-clip and shim(s) from the end of the shaft (photo).
- 6 Unscrew the two through-bolts and lift off the commutator end housing (photos).
- 7 Recover the ceramic washer from the end of the armature shaft (photo).
- 8 Carefully separate the drive end housing and armature from the

yoke, tapping apart with a soft-faced hammer if necessary.

9 Remove the rubber insert from the drive end housing, then withdraw the armature assembly, complete with the actuating arm, from the drive end housing (photo).

10 Unhook the actuating arm from the drive pinion flange.

11 To remove the brushes, carefully unhook the springs from the brush plate using a pair of pliers, then slide the brushes from the brush plate (photos).

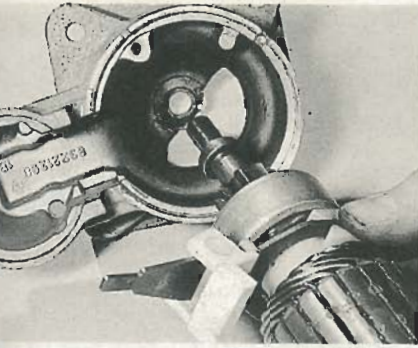
12 To remove the drive pinion from the armature shaft, drive the collar down the shaft using a suitable drift, to expose the C-clip. Remove the clip from its groove, and slide the collar and drive pinion from the shaft (photos).

13 Examine the components and renew as necessary.

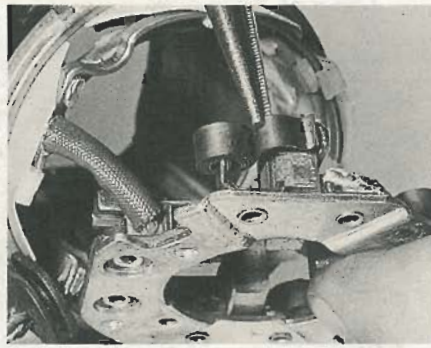
14 If the brushes have worn to less than the specified minimum length, renew them as a set. To renew the brushes, the leads must be unsoldered from the terminals on the brush plate, and the leads of the new brushes must be soldered to the terminals. Do not refit the brush springs at this stage.

15 The commutator face should be clean and free from burnt spots.

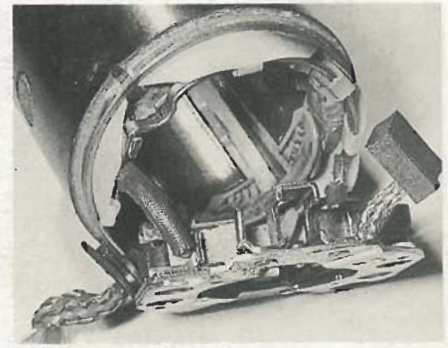




14.9 Withdrawing the armature assembly from the drive end housing



14.11A Unhook the springs, ...



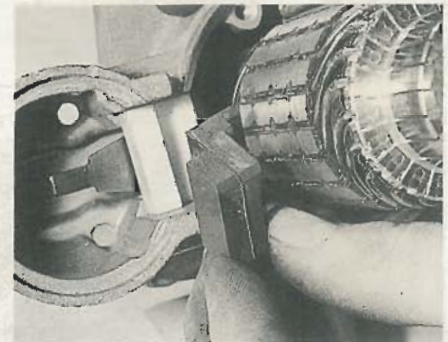
14.11B ... and slide the brushes from the brush plate



14.12A Drive the collar down the shaft ...



14.12B ... and remove the drive pinion retaining C-clip



14.19 Refitting the rubber insert to the drive end housing

Where necessary burnish with fine glasspaper (**not** emery) and wipe with a fuel-moistened cloth. If the commutator is in very bad condition it can be skimmed on a lathe provided its diameter is not reduced excessively. If recutting the insulation slots, take care not to cut into the commutator metal.

16 Accurate checking of the armature, commutator and field coil windings and insulation requires the use of special test equipment. If the starter motor was inoperative when removed from the vehicle, and the previous checks have not highlighted the problem, then it can be assumed that there is a continuity or insulation fault and the unit should be renewed.

17 Commence reassembly by sliding the drive pinion and collar onto the armature shaft. Fit the C-clip into its groove, and then use a suitable puller to draw the collar over the clip.

18 Refit the actuating arm to the drive pinion flange, then refit the armature assembly and actuating arm to the drive end housing.

19 Refit the rubber insert to the drive end housing (photo).

20 Guide the yoke and brush plate over the armature.

21 Guide the brush plate correctly located, tap the yoke into position on the drive end housing, ensuring that the lug on the yoke engages with the corresponding cut-out in the drive end housing (photo).

22 Refit the ceramic washer to the end of the armature shaft.

23 Refit the commutator end housing into position, at the same time sliding the rubber insulator into the cut-out in the housing. Secure the commutator end housing with the two through-bolts.

24 Refit the shims and the C-clip to the end of the armature shaft.

25 Apply a little lithium-based grease to the end of the armature shaft, then refit the commutator end housing cap and secure with the two screws.

26 Hook the solenoid armature over the actuating arm in the drive end housing.

27 Refit the solenoid return spring, ensuring that it is correctly located, then guide the solenoid yoke over the armature, noting that the terminals on the rear of the yoke should be positioned one above the



14.22 The lug on the yoke must engage with the cut-out in the drive end housing

other when the starter motor is fitted to the engine. Secure the yoke with the three nuts.

29 Reconnect the field winding lead to the solenoid terminal and secure with the nut and washer.

## 15 Fuses and relays - general

1 The fuses and main relays are located in a panel positioned beneath the driver's side lower fascia panel (photo).



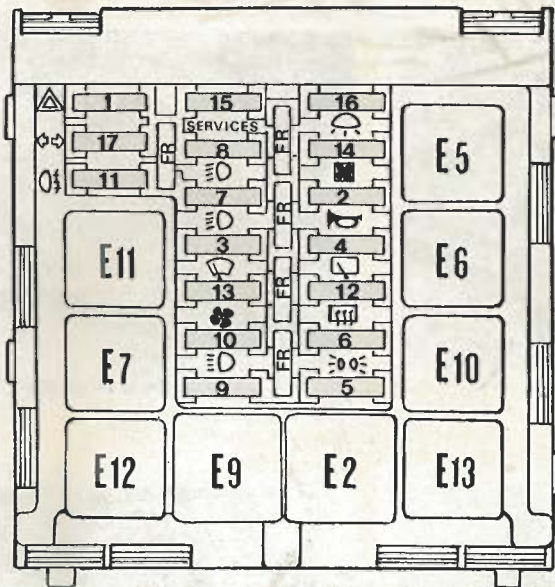


Fig. 11.3 Fuse and relay locations in main panel - non-DGT models (Sec.15)

Fuse No	Rating	Circuit protected
1	10A	Hazard warning lamps
2	20A	Horn, cigarette lighter, brake lamps
3	20A	Windscreen wipers
4	20A	Tailgate wiper
5	10A	Instrument panel illumination, left-hand tail lamp, right-hand number plate lamp, right-hand sidelamp, right-hand trailer tail lamp
6	10A	Instrument panel illumination,

Fuse No	Rating	Circuit protected
7	10A	right-hand tail lamp, left-hand number plate lamp, left-hand sidelamp, left-hand trailer tail lamp
8	10A	Right-hand headlamp dipped beam
9	10A	Left-hand headlamp dipped beam
10	10A	Right-hand headlamp main beam
11	7.5A	Left-hand headlamp main beam, main beam warning lamp
12	20A	Rear fog lamps, trailer rear fog lamps, rear fog lamps warning lamp
13	20A	Heated rear window, heated rear window warning lamp, heated door mirror elements
14	25A	Heater blower motor
15	10A	Radiator cooling fan
16	7.5A	Instrument panel power supply, windscreen and tailgate washer pumps, multi-function stalk switch illumination, reversing lamps, fuel cut-off solenoid
17	7.5A	Courtesy lamp, luggage compartment lamp
18	20A	Direction indicator lamps
19	Not fitted to UK models	Central door locking system

Relay	Circuit protected
E2	Direction indicator/hazard warning flasher lamps
E5	Horn(s)
E6	Heated rear window
E7	Starter motor
E9	Intermittent windscreen wipe
E10	Rear fog lamps
E11	Headlamp dipped beam
E12	Headlamp main beam
E13	Sidelamps

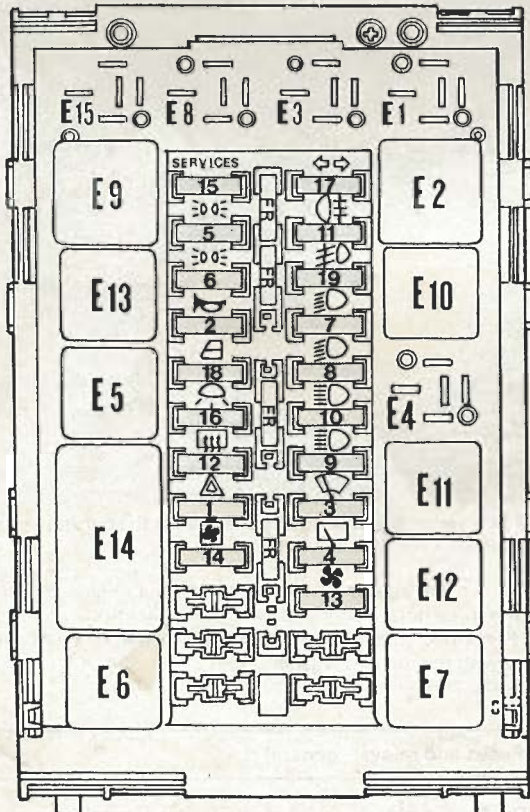
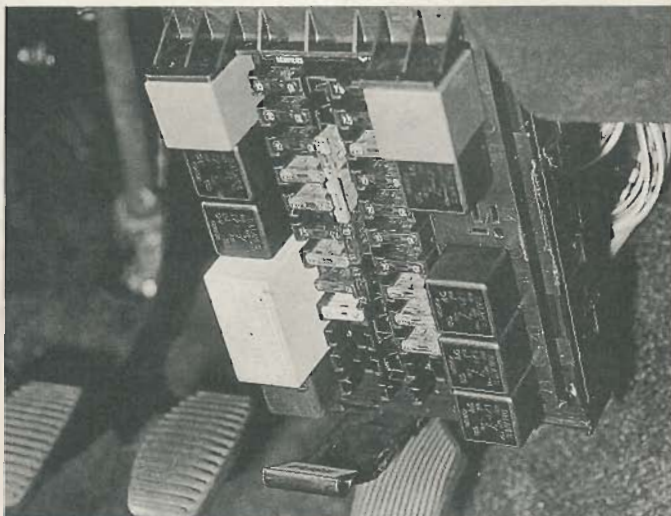


Fig. 11.4 Fuse and relay locations in main panel - DGT models (Sec 15)

For details of fuses refer to key for Fig. 11.3

Relay	Circuit protected
E1	Not used
E2	Direction indicator/hazard warning flasher lamps
E3	Not used
E4	Not used
E5	Horn(s)
E6	Heated rear window
E7	Starter motor
E8	Not used
E9	Intermittent windscreen wipe
E10	Rear fog lamps
E11	Headlamp dipped beam
E12	Headlamp main beam
E13	Sidelamps
E14	Central door locking control module
E15	Not used





15.1 Main fuse and relay panel

- 2 The fuse/relay panel can be lowered for access by pulling the lever at the rear of the panel.
- 3 The circuits protected by the various fuses are marked on the inside of the panel cover, and are shown in Figs. 11.3 and 11.4, together with the relay locations.
- 4 To remove a fuse or relay, lower the panel and pull the relevant fuse or relay from the panel.
- 5 Before renewing a blown fuse, trace and rectify the cause, and always fit a fuse of the correct rating. Never substitute a fuse of a higher rating, or make temporary repairs using wire or metal foil, as more serious damage or even fire could result.
- 6 On certain models, additional fuses and relays, including those for the inlet manifold heater, electric windows power supply, and headlamp wash/wipe circuits are located in a secondary panel to the right of the main panel (photo).
- 7 Where applicable, the sunroof motor relay is located behind the sunroof motor in the roof. The relay can be unplugged after removing the courtesy lamp roof panel with reference to Section 22.

## 16 Ignition switch and lock cylinder – removal and refitting

### Ignition switch

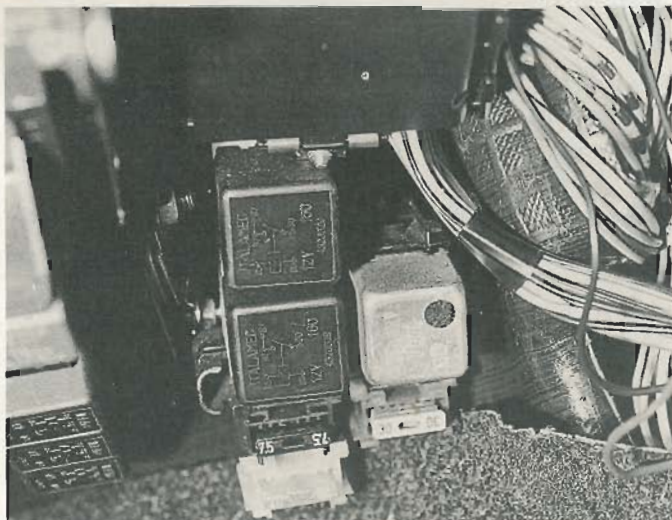
- 1 Disconnect the battery negative lead.
- 2 Remove the lower steering column shroud, with reference to Chapter 10, Section 32 if necessary.
- 3 Insert the ignition key and turn it to position "MAR".
- 4 Extract the two ignition switch securing screws, then withdraw the switch and disconnect the wiring plugs (photo).
- 5 **Do not** turn the key or the switch operating pin in the column switch housing whilst the switch is removed.
- 6 Refitting is a reversal of removal.

### Lock cylinder

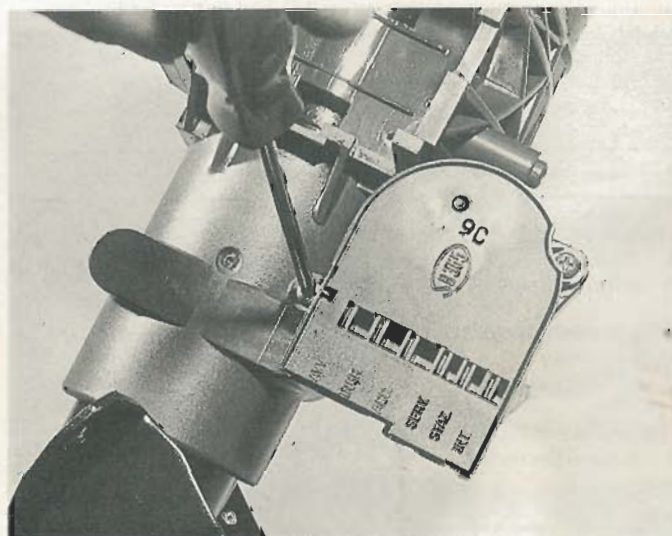
- 7 Proceed as described in paragraphs 1 and 2.
- 8 Insert the ignition key and turn it to position "MAR".
- 9 Using a screwdriver, working through the slot in the rear of the lock housing, depress the retaining lug and withdraw the lock cylinder using the key (photo).
- 10 **Do not** turn the ignition switch operating pin in the column switch housing whilst the lock cylinder is removed.
- 11 If desired, the cylinder can be removed from its housing after removing the circlip from the end of the cylinder.
- 12 Reassembly and refitting is a reversal of dismantling and removal.

## 17 Multi-function stalk switches – removal and refitting

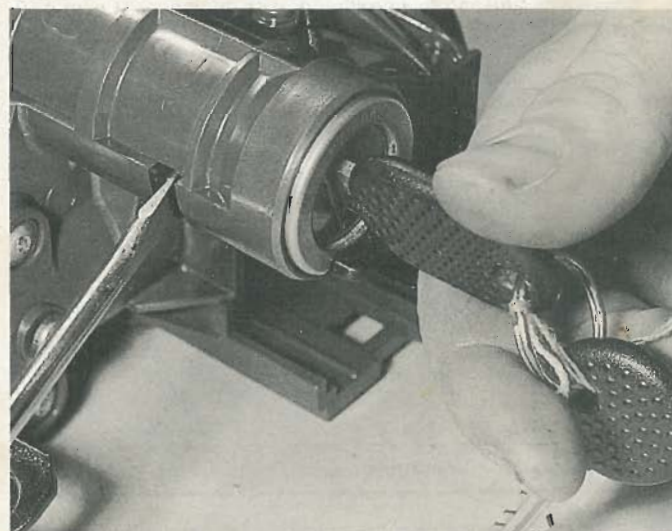
- 1 Disconnect the battery negative lead.
- 2 Remove the steering column shrouds with reference to Chapter 10, Section 32 if necessary.



15.6 Secondary fuse and relay panel

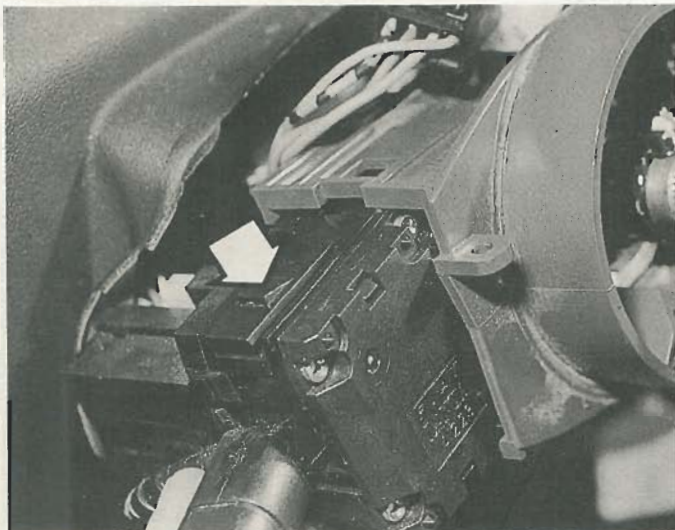


16.4 Extracting an ignition switch securing screw (steering column removed)



16.9 Removing the ignition switch lock cylinder (steering column removed)

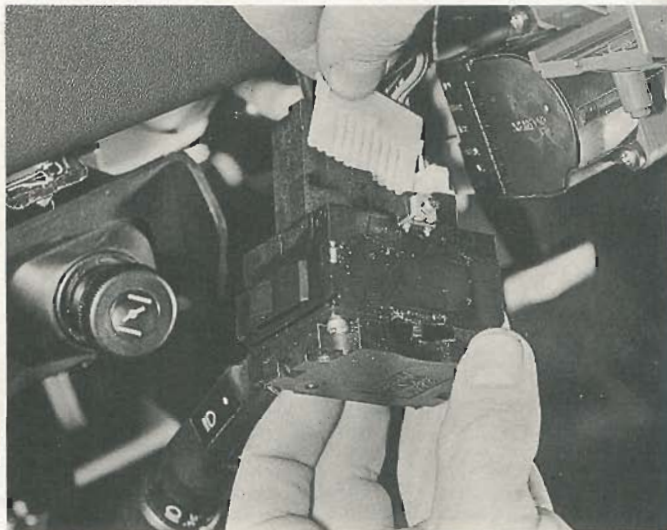




17.3A Removing a multi-function stalk switch (retaining lug arrowed) ...

3 Depress the retaining lugs at the top and bottom of the relevant switch, then pull the switch from the housing and disconnect the wiring plug (photos).

4 Refitting is a reversal of removal.



17.3B ... and disconnecting the wiring plug

## 18 Facia panel switches – removal and refitting

### *Heater blower motor switch*

1 Removal and refitting of the heater blower motor switch is described in Chapter 10, Section 37.

### *Instrument panel switches (models with digital instrument panel)*

2 Refer to Section 31.

### *Hazard warning flasher switch*

3 Refer to Section 19.

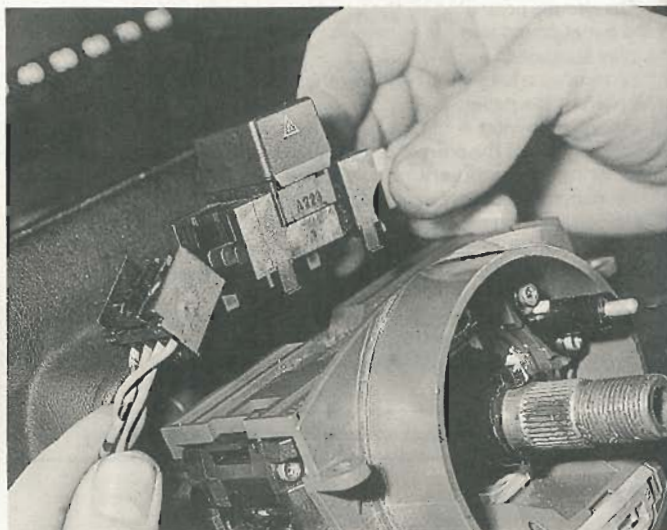
## 19 Hazard warning flasher switch – removal and refitting

1 Disconnect the battery negative lead.

2 Remove the steering column shrouds with reference to Chapter 10, Section 32 if necessary.

3 Pull the switch from the housing on the steering column, then disconnect the wiring plugs from the switch (photo). Use a thin-bladed screwdriver to depress the securing clips if the switch is reluctant to move.

4 Refitting is a reversal of removal.



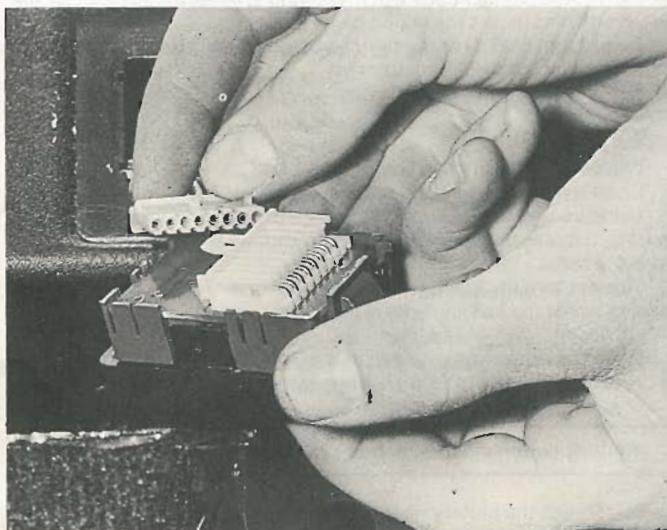
19.3 Removing the hazard warning flasher switch

## 20 Electric door mirror switch – removal and refitting

1 Disconnect the battery negative lead.

2 Using a screwdriver, carefully prise the switch from the centre console, and disconnect the wiring plug (photo).

3 Refitting is a reversal of removal.



20.2 Disconnecting the wiring plug from the electric door mirror switch

## 21 Electric door mirror motor – removal and refitting

The motor is integral with the mirror, and if faulty, the complete mirror assembly must be renewed. Removal and refitting of the mirror is described in Chapter 10, Section 22.



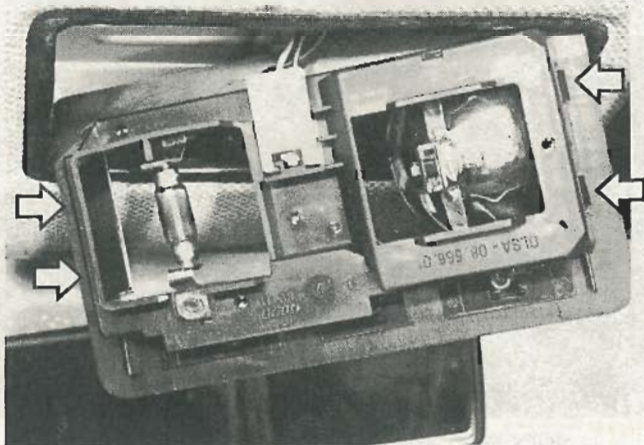


Fig. 11.5 Courtesy lamp/roof panel assembly – model without sunroof (Sec 22)

*Retaining clips arrowed*

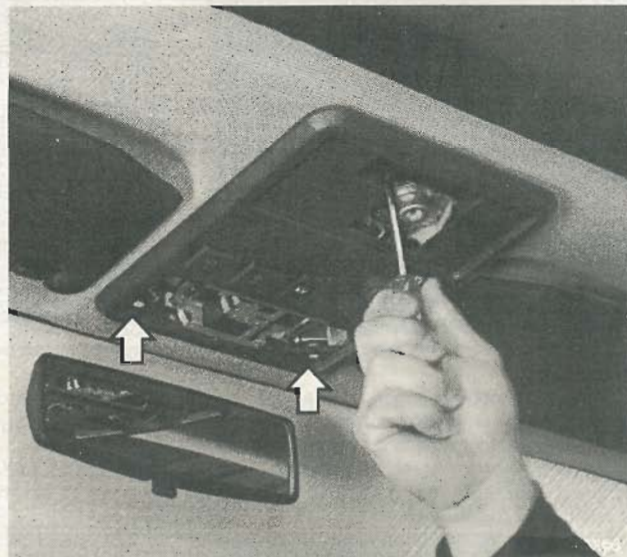


Fig. 11.6 Roof panel securing screws – model with sunroof (Sec 22)

## 22 Courtesy lamp switch – removal and refitting

### Door-operated switches

- 1 These switches are located at the lower rear edges of the front door apertures. To remove a switch, proceed as follows.
- 2 Disconnect the battery negative lead.
- 3 Fully open the relevant front door.
- 4 Pull the rubber dust cover from the switch, then carefully prise the switch from the body panel using a screwdriver, and disconnect the wiring plug (photo).
- 5 Refitting is a reversal of removal, but note that it is easier to fit the rubber dust cover before pushing the switch into the body panel.

### Roof panel-mounted switch

- 6 This switch is integral with the roof panel, and if faulty, the complete roof panel assembly must be renewed. To remove the panel, proceed as follows.
- 7 Disconnect the battery negative lead.

#### Models without sunroof

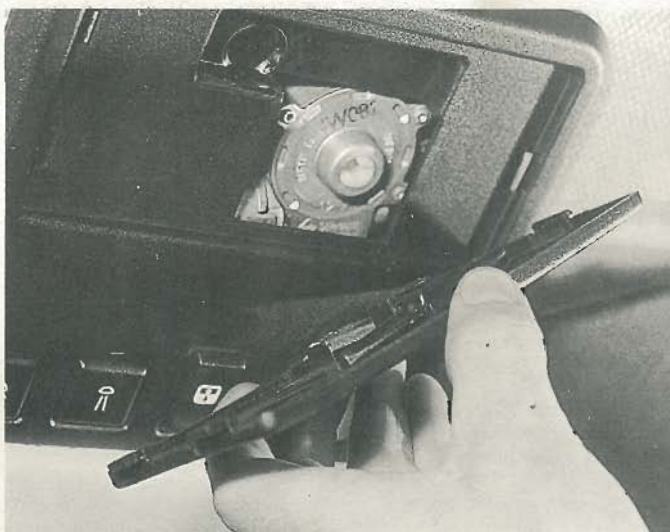
- 8 Using a screwdriver, carefully prise the panel assembly from the roof, and disconnect the wiring plug.
- 9 Refitting is a reversal of removal.

#### Models with sunroof

- 10 Using a screwdriver, carefully prise the courtesy lamp lens from the roof panel.
- 11 On models with a manual sunroof, remove the operating handle with reference to Chapter 10, Section 29.
- 12 Using a screwdriver, carefully prise the rear cover plate from the roof panel (photo).
- 13 Extract the three now-exposed securing screws (two at the front of the panel and one at the rear) and lower the roof panel from the roof.
- 14 Disconnect the wiring plugs and withdraw the panel.
- 15 Refitting is a reversal of removal, but where applicable, refit the sunroof operating handle with reference to Chapter 10, Section 29.



22.4 Disconnecting the wiring plug from a door-operated courtesy lamp switch



22.12 Prising the rear cover plate from the roof panel

## 23 Map reading lamp switch(es) – removal and refitting

The map reading lamp switch(es) is/are integral with the roof panel, and if faulty the complete roof panel must be renewed with reference to Section 22, paragraph 7 onwards.

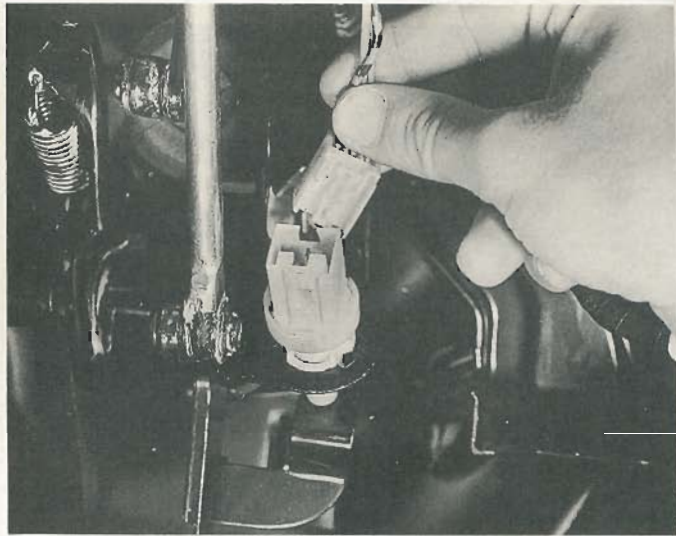


**24 Sunroof operating switch – removal and refitting**

- 1 Disconnect the battery negative lead.
- 2 Remove the roof panel with reference to Section 22, paragraph 7 onwards.
- 3 Carefully prise the switch from its location in the roof panel.
- 4 Refitting is a reversal of removal.

**25 Brake lamp switch – removal and refitting**

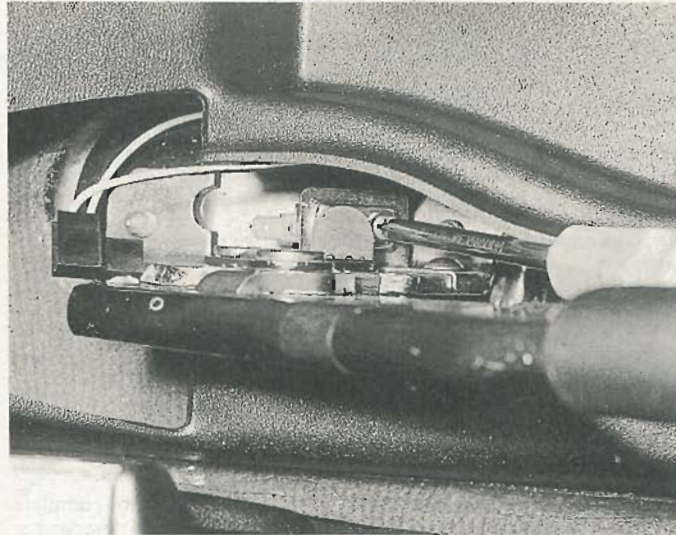
- 1 Disconnect the battery negative lead.
- 2 Working in the driver's footwell, disconnect the wiring plug from the switch (photo).
- 3 Using a suitable spanner on the flats provided, twist the switch through approximately 60° anti-clockwise to release the retaining lugs, then withdraw it from the bracket on the pedal box assembly.
- 4 Refitting is a reversal of removal, but keep the brake pedal depressed until refitting is complete, then release the pedal to set the rest position of the switch.
- 5 If a new switch has been fitted, on completion remove the protective spacer from the end of the switch.



25.2 Disconnecting the wiring plug from the brake lamp switch

**26 Handbrake "on" warning lamp switch – removal and refitting**

- 1 Disconnect the battery negative lead.
- 2 Extract the securing screw and remove the cover from the handbrake lever.
- 3 Disconnect the wiring plug from the switch.
- 4 Remove the securing screw and withdraw the switch from its bracket (photo).
- 5 Refitting is a reversal of removal.



26.4 Removing the handbrake "on" warning lamp switch securing screw

**27 Reversing lamp switch – removal and refitting**

- 1 The reversing lamp switch is located in the front of the gearbox casing in the engine compartment.
- 2 Disconnect the battery negative lead, then disconnect the wiring plug from the switch.
- 3 Unscrew the switch and withdraw it from the gearbox.
- 4 Refitting is a reversal of removal.

**28 Oil pressure warning lamp switch – removal and refitting**

- 1 The oil pressure warning lamp switch is located at the front of the engine cylinder block, next to the crankcase ventilation oil separator.
- 2 Disconnect the battery negative lead, then disconnect the wiring plug from the switch.
- 3 Unscrew the switch and withdraw it from the cylinder block.
- 4 Refitting is a reversal of removal.

**29 Cigarette lighter – removal and refitting**

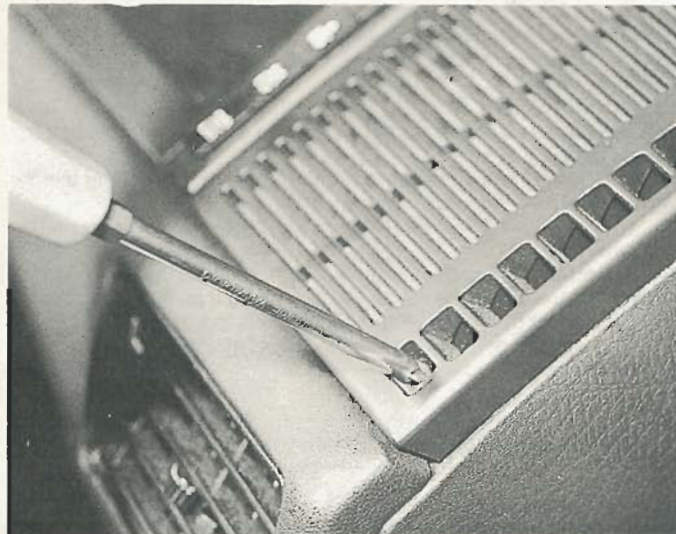
- 1 Disconnect the battery negative lead.

**Models without centre console**

- 2 Remove the heater control trim panel as described in Chapter 10, Section 32.
- 3 The cigarette lighter assembly can now be removed from the rear of the panel after depressing the two retaining tabs.
- 4 Refitting is a reversal of removal.

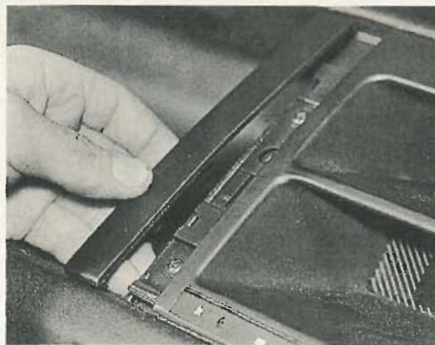
**Models with centre console**

- 5 Open the flap covering the ashtray and the cigarette lighter, and prise the ashtray from its housing.

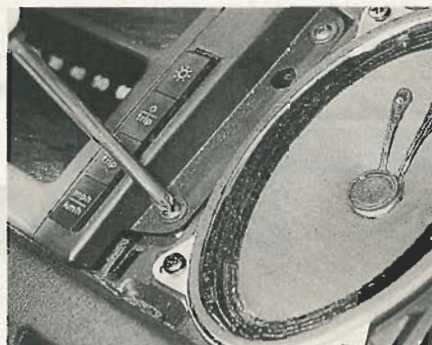


30.2 Extracting a loudspeaker trim panel securing screw





30.3 Removing the instrument panel securing screw cover plate



30.4A Remove the instrument panel securing screws ...



30.4B ... and lift the instrument panel from the fascia

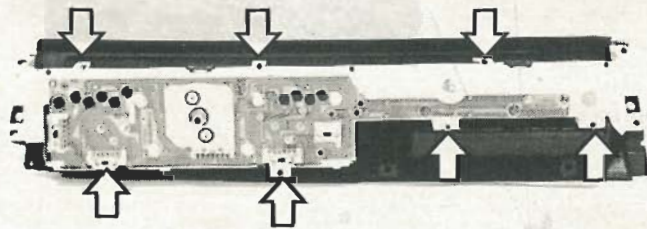


Fig. 11.7 Instrument panel surround securing screws (Sec 31)

- 6 Carefully prise the ashtray/cigarette lighter housing from the centre console, and disconnect the wiring plug from the rear of the cigarette lighter.
- 7 The cigarette lighter assembly can now be removed from the rear of the panel after depressing the two retaining tabs.
- 8 Refitting is a reversal of removal.

### 30 Instrument panel – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Extract the two securing screws and remove the loudspeaker trim panel from the right-hand side of the fascia (photo).
- 3 Working at the left-hand side of the instrument panel, remove the securing screw cover plate by sliding it from its clips towards the left-hand side of the vehicle (photo).
- 4 Remove the four securing screws and carefully lift the instrument panel from the fascia (photos).
- 5 Disconnect the wiring plugs, and where applicable the speedometer cable and the economy gauge vacuum pipe from the rear of the instrument panel, then withdraw the panel.
- 6 Refitting is a reversal of removal.

### 31 Instrument panel components – removal and refitting

- 1 Remove the instrument panel as described in Section 30.

#### *Analogue instrument panel*

##### **Panel illumination and warning bulbs**

- 2 Twist the relevant bulbholder anti-clockwise and withdraw it from the rear of the instrument panel.
- 3 The bulbs are a push fit in the bulbholders.
- 4 Refitting is a reversal of removal.

##### **Economy gauge**

- 5 Remove the securing screws and withdraw the instrument panel illumination bulbholder from the lower rear edge of the instrument panel.

- 6 Pull off the trip meter reset knob and the clock adjustment knob, then remove the securing screws shown in Fig. 11.7, and withdraw the instrument panel surround.
- 7 Release the retaining clips and remove the instrument shroud.
- 8 Unscrew the single securing nut and withdraw the gauge through the front of the instrument panel. Take care not to damage the seal at the rear of the instrument panel.
- 9 Refitting is a reversal of removal.

##### **Clock**

- 10 Remove the economy gauge as described previously in this Section.
- 11 Unscrew the three securing nuts and withdraw the clock.
- 12 Refitting is a reversal of removal.

##### **Speedometer**

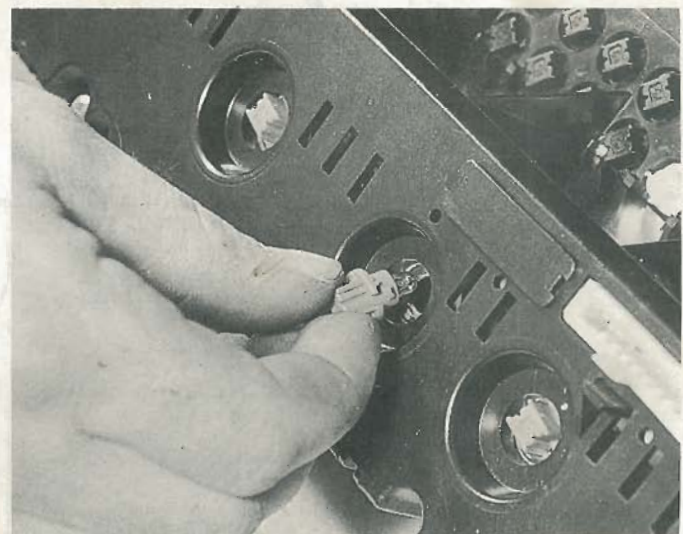
- 13 Proceed as described in paragraphs 5 to 7 inclusive.
- 14 Extract the two securing screws and withdraw the speedometer through the front of the instrument panel.
- 15 Refitting is a reversal of removal.

##### **Fuel and coolant temperature gauges**

- 16 Remove the speedometer as described previously in this Section.
- 17 Unscrew the three securing nuts and withdraw the relevant gauge through the front of the instrument panel.
- 18 Refitting is a reversal of removal.

##### **Printed circuit board**

- 19 Remove all bulbs and instruments as described previously in this Section.
- 20 Carefully peel the printed circuit board from the instrument panel.



31.23A Removing an instrument panel illumination bulbholder ...



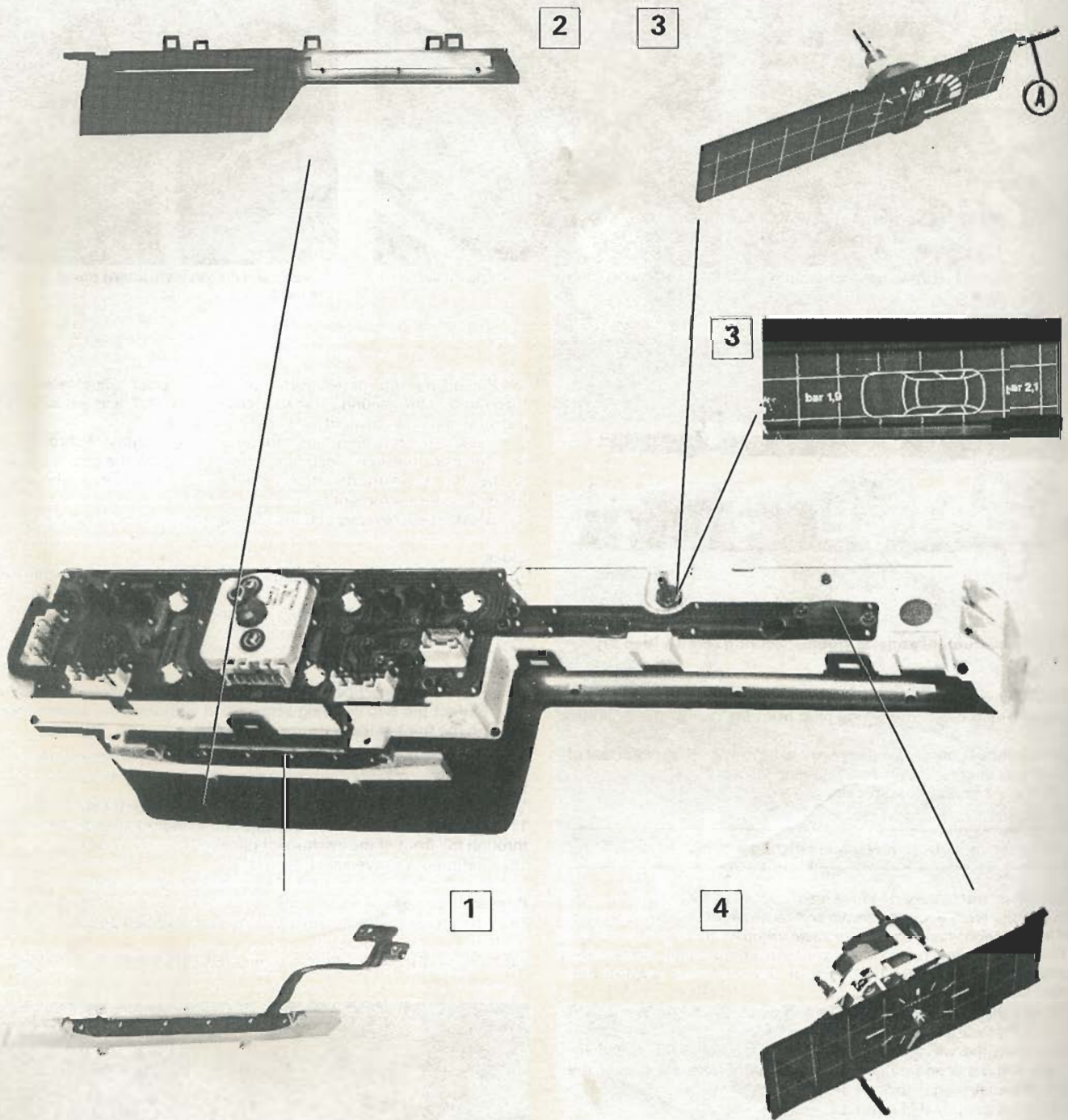


Fig. 11.8 Analogue instrument panel components (Sec 31)

1 Illumination bulbholder  
2 Instrument shroud

3 Econometer or tyre  
pressure symbol,  
depending on model

4 Clock

A Seal

21 Refitting is a reversal of removal, but ensure that the printed circuit board is seated correctly on the rear of the instrument panel.

### Digital instrument panel

22 The instrument panel is a sealed unit, and the only removable items are the illumination and warning bulbs and the trip meter, illumination and clock switches.

### Panel illumination and warning bulbs

23 Proceed as described in paragraphs 2 to 4 inclusive (photos).

### Trip meter, illumination and clock switches

24 The trip meter and illumination switches are combined into one unit, and if any of the switches are faulty, the complete assembly must be renewed.

25 Remove the securing screws shown in Fig. 11.7, and withdraw the



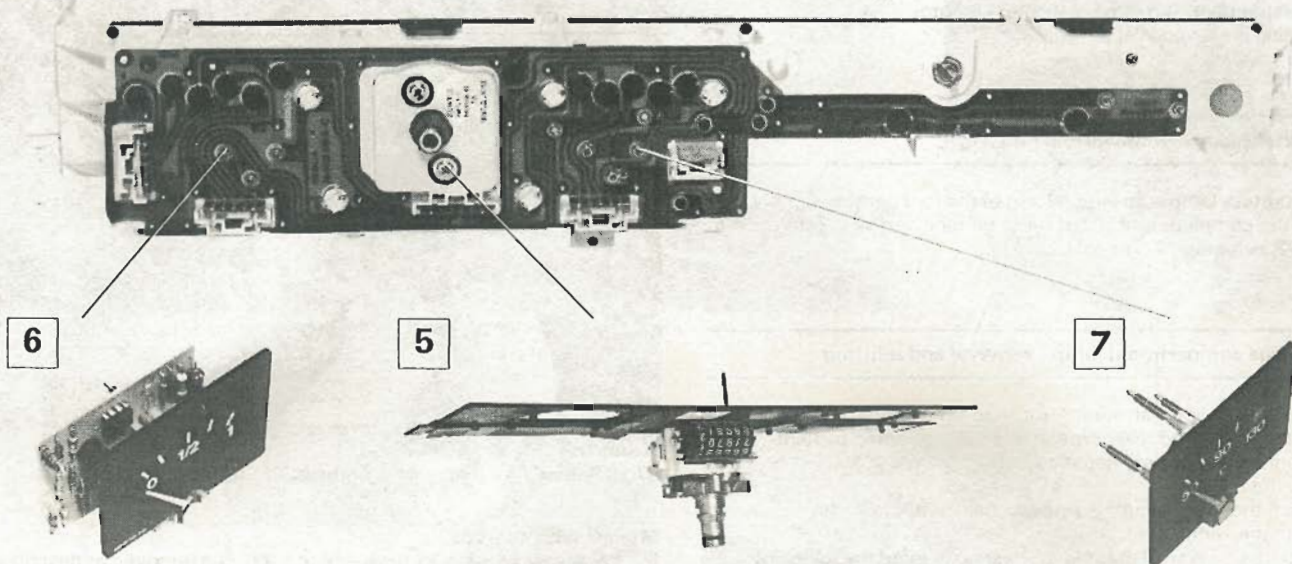


Fig. 11.9 Analogue instrument panel components (Sec 31)

5 Speedometer

6 Fuel gauge

7 Coolant temperature gauge

faulty, the complete instrument panel must be renewed. Instrument panel removal and refitting is described in Section 30.

#### "Door ajar" sensors

5 The sensors are an integral part of the door locks, and if faulty, the complete lock assembly must be renewed. Door lock removal and refitting is described in Chapter 10, Section 18.

#### "Tailgate ajar" sensor

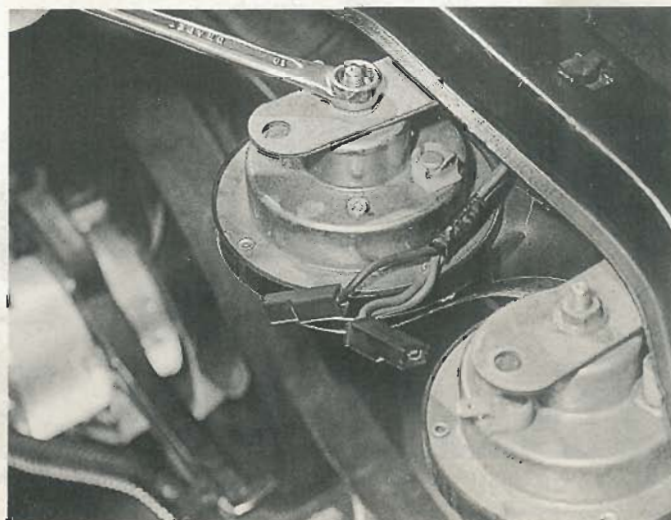
6 The system uses the luggage compartment lamp switch as a sensor. If faulty, the complete lamp should be renewed as described in Section 35.

### 33 Horn(s) - removal and refitting

1 The horn(s) is/are located under the front crossmember on the right-hand side of the engine compartment.

2 Disconnect the battery negative lead, then disconnect the wiring from the horn.

3 UnscREW the nut securing the horn to its mounting bracket, or



33.3 Unscrewing a horn securing nut



31.23B ... the bulb is a push-fit in the bulbholder - digital instrument panel

instrument panel surround.

26 Extract the two securing screws from the rear of the instrument panel, and withdraw the relevant switch from the front of the panel.

27 Refitting is a reversal of removal.

### 32 Check control system components - removal and refitting

#### Electronic control module

1 The electronic control module is plugged into the rear of the main fuse/relay panel (see Section 15), just below the panel pivot, and access is most easily obtained with the panel in the raised position.

2 To remove the module, disconnect the battery negative lead, then disconnect the three wiring plugs from the module, and unplug the module from the panel.

3 Refitting is a reversal of removal.

#### Display panel

4 The display panel is an integral part of the instrument panel, and if



alternatively unscrew the nut securing the horn mounting bracket to the front crossmember, and remove the horn (photo).

4 Refitting is a reversal of removal.

### 34 Courtesy lamp – removal and refitting

The courtesy lamp is an integral part of the roof panel assembly, and if faulty, the complete roof panel must be renewed with reference to Section 22, paragraph 7 onwards.

### 35 Luggage compartment lamp – removal and refitting

- 1 The luggage compartment lamp has an integral switch, and is located at the left-hand rear corner of the luggage compartment.
- 2 Disconnect the battery negative lead.
- 3 Open the tailgate.
- 4 Extract the two securing screws, then withdraw the lamp and disconnect the wiring plug.
- 5 Refitting is a reversal of removal, bearing in mind the following.
- 6 After refitting the lamp, pull the switch plunger fully outwards, then close the tailgate, and check that the luggage compartment lamp and, where applicable, the "tailgate open" warning lamp. If not, readjust the switch plunger as described previously. Note that on later models, fine adjustment of the plunger is possible by turning the plunger pushrod.

### 36 Map reading lamp – removal and refitting

The map reading lamp is an integral part of the roof panel assembly, and if faulty, the complete roof panel must be renewed with reference to Section 22, paragraph 7 onwards.

### 37 Interior lamp bulbs – renewal

- 1 Disconnect the battery negative lead.

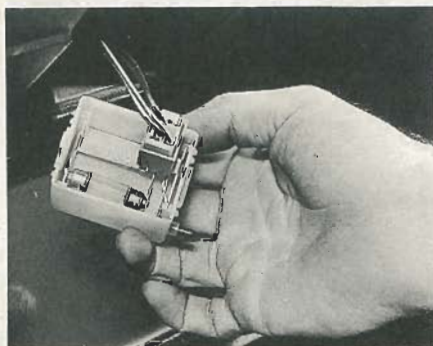
#### *Courtesy lamp*

- 2 Using a thin-bladed screwdriver, prise the lens from the lamp.
- 3 Carefully prise the bulb from its retaining clips
- 4 Refitting is a reversal of removal.

#### *Map reading lamp*

##### **Models without sunroof**

- 5 Using a thin-bladed screwdriver, prise the lens from the lamp.
- 6 The bulb is a bayonet fit in the bulbholder.
- 7 Refitting is a reversal of removal.



37.12 Glovebox lamp removed for bulb renewal



37.14 Removing the luggage compartment lamp bulb



37.10 Renewing a map reading lamp bulb – model with sunroof

##### **Models with sunroof**

- 8 For access of the bulb, the roof panel must be removed as described in Section 22, paragraph 7 onwards.
- 9 Working at the rear of the roof panel, twist the bulbholder anti-clockwise and withdraw it from the lamp.
- 10 The bulb is a push fit in the bulbholder (photo).
- 11 Refitting is a reversal of removal.

#### *Glovebox lamp*

- 12 Carefully prise the lamp assembly from the glovebox, and prise the bulb from its retaining clips (photo).
- 13 Refitting is a reversal of removal.

#### *Luggage compartment lamp*

- 14 Carefully pull the lens from the lamp, and prise the bulb from its retaining clips (photo).
- 15 Refitting is a reversal of removal.

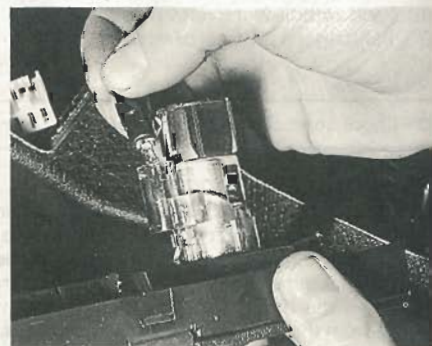
#### *Cigarette lighter illumination lamp*

##### **Models without centre console**

- 16 Remove the heater control trim panel as described in Chapter 10, Section 32.
- 17 Pull the bulbholder from the cigarette lighter housing.
- 18 The bulb is integral with the bulbholder and must be renewed as an assembly.
- 19 Refitting is a reversal of removal.

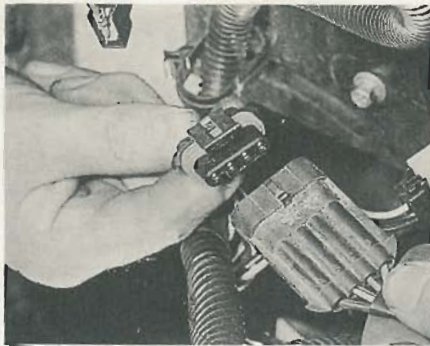
##### **Models with centre console**

- 20 Open the flap covering the ashtray and the cigarette lighter, and prise the ashtray from its housing.
- 21 Carefully prise the ashtray/cigarette lighter housing from the centre console, and pull the bulbholder from the cigarette lighter housing (photo).

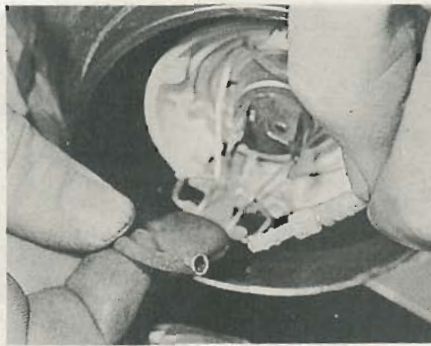


37.21 Pulling the bulbholder from the cigarette lighter housing – model with centre console

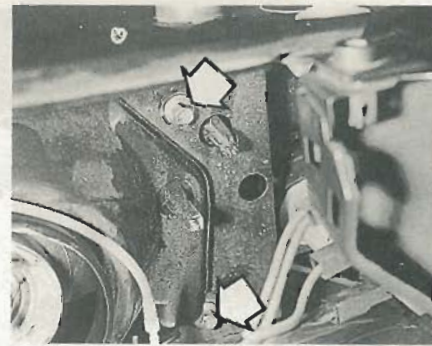




38.2 Disconnecting the headlamp wiper motor wiring plug



38.3 Disconnecting the headlamp washer fluid hose connector



38.4A Two of the headlamp securing bolts (arrowed)



38.4B Unscrewing a headlamp securing bolt



38.4C Withdrawing a headlamp assembly

22 The bulb is integral with the bulbholder and must be renewed as an assembly.

23 Refitting is a reversal of removal.

#### Heater control panel illumination lamps

24 For access to the bulbs, the heater control trim panel must be removed.

25 Refer to Chapter 10, Section 32. The bulbs are a push-fit in the bulbholders.

#### Multi-function stalk switch illumination lamps

26 The bulbs are an integral part of the switches, and cannot be renewed independently. Removal and refitting of the switches is described in Section 17.

#### Hazard warning flasher switch illumination lamp

27 The bulb is an integral part of the switch, and cannot be renewed independently. Removal and refitting of the switch is described in Section 19.

#### Instrument panel illumination lamps

28 Refer to Section 31.

### 38 Headlamp - removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Disconnect the wiring plugs from the headlamp, sidelamp, direction indicator lamp, and if applicable the headlamp wiper motor (photo).
- 3 Where applicable, disconnect the washer fluid hose connector in the engine compartment, and remove the headlamp wiper arm with reference to Section 46 (photo).
- 4 Working in the engine compartment, unscrew the four securing bolts and withdraw the lamp assembly, complete with wiper motor where applicable, from the vehicle (photos).
- 5 Refitting is a reversal of removal.

### 39 Headlamps - alignment

1 Correct alignment of the headlamp beams is most important, not only to ensure good vision for the driver, but also to protect other drivers from being dazzled.

2 Accurate alignment should be carried out using optical beam setting equipment.

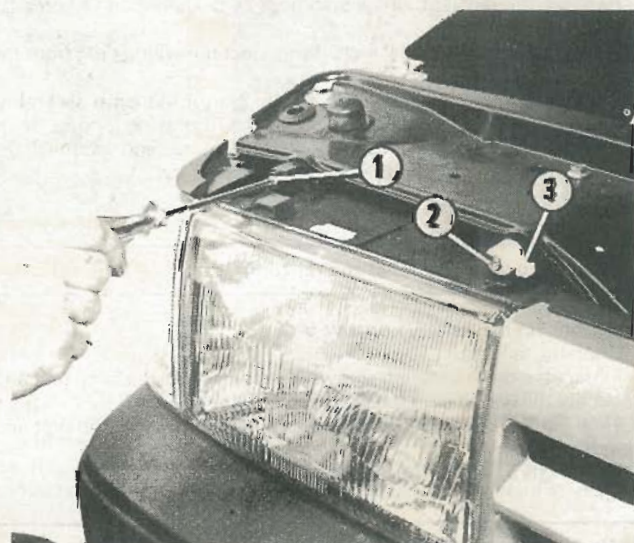


Fig. 11.10 Headlamp alignment adjustment screws (Sec 39)

- |                               |                                      |
|-------------------------------|--------------------------------------|
| 1 Horizontal adjustment screw | 3 Load compensation adjustment lever |
| 2 Vertical adjustment screw   |                                      |





41.4 Removing a front direction indicator side repeater lamp assembly

3 A lever is fitted to the front of each headlamp to enable beam adjustment to compensate for heavy loads carried in the rear of the vehicle. The levers have two positions, one for normal loads and one for heavy loads – see Fig. 11.10. Both levers should be set to the same position.

4 In an emergency, adjustments may be made by turning the adjustment screws shown in Fig. 11.10. If an adjustment is made, the alignment should be checked using suitable beam setting equipment at the earliest opportunity.

#### 40 Front direction indicator lamp – removal and refitting

The front direction indicator lamp is an integral part of the headlamp assembly. Removal and refitting of the headlamp assembly is described in Section 38.

#### 41 Front direction indicator side repeater lamp – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Remove the relevant wheel arch liner as described in Chapter 10, Section 26.
- 3 Working inside the wheel arch, disconnect the wiring plug from the lamp.
- 4 Depress the two retaining clips on the rear of the lamp assembly, then withdraw the assembly from outside the front wing (photo).
- 5 Remove the lens by twisting it anti-clockwise, and examine the condition of the lens sealing ring. Renew if necessary.
- 6 Refitting is a reversal of removal.

#### 42 Rear lamp unit – removal and refitting

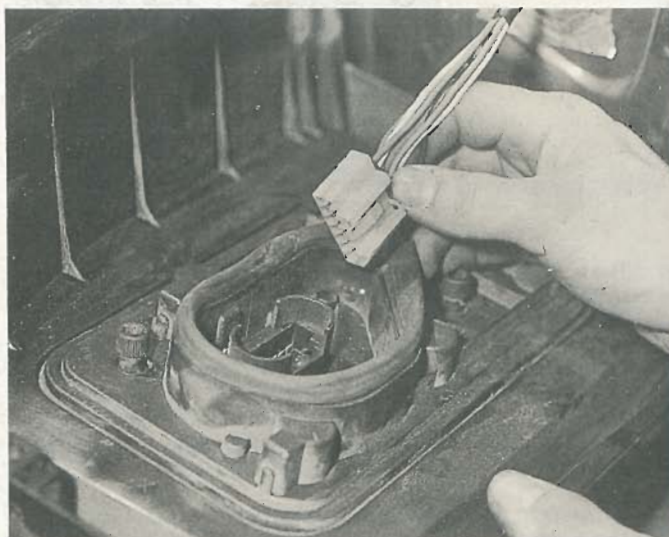
- 1 Disconnect the battery negative lead.
- 2 Open the tailgate.
- 3 Extract the three securing screws, then withdraw the lamp unit and disconnect the wiring plug (photos).
- 4 Examine the condition of the seal on the rear of the lamp unit and renew if necessary.
- 5 Refitting is a reversal of removal.

#### 43 Rear number plate lamp assembly – removal and refitting

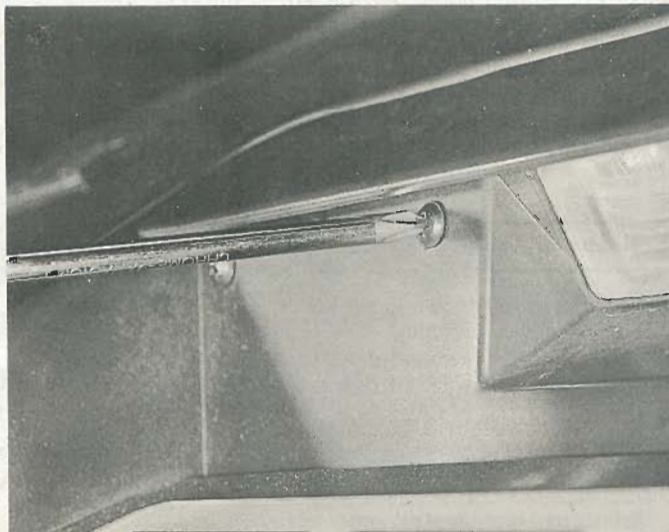
- 1 Disconnect the battery negative lead.
- 2 For improved access open the tailgate, then working under the lip of the lamp trim panel, extract the six lamp assembly securing screws (photo).



42.3A Extracting a rear lamp unit securing screw

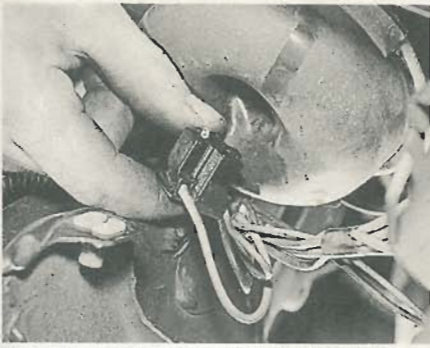


42.3B Disconnecting a rear lamp unit wiring plug

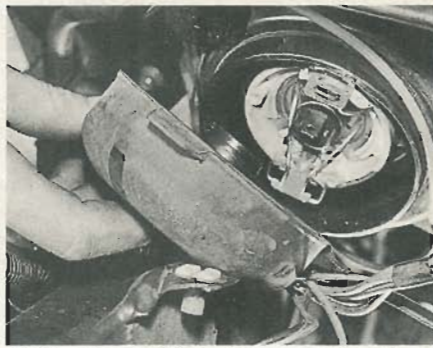


43.2 Extracting a rear number plate lamp assembly securing screw

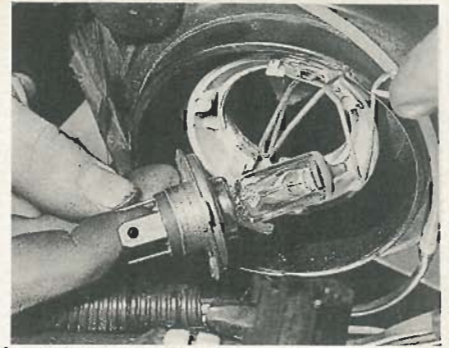




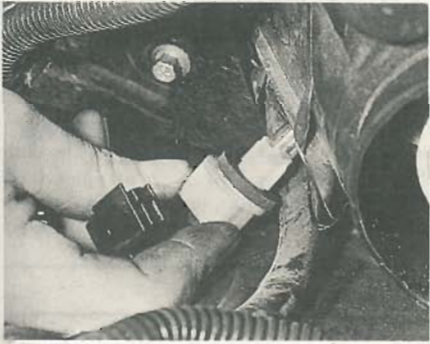
44.2A Disconnect the wiring plug from the rear of the headlamp bulb ...



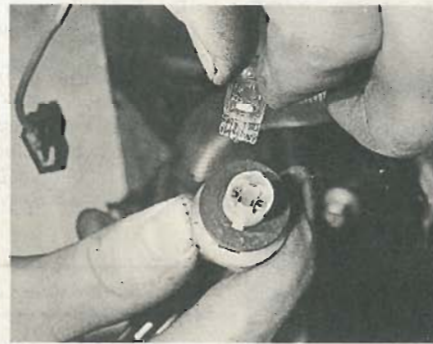
44.2B ... then pull the rubber cover from the rear of the headlamp



44.3 Removing a headlamp bulb



44.5 Removing a sidelamp bulbholder



44.6 The sidelamp bulb is a push-fit in the bulbholder



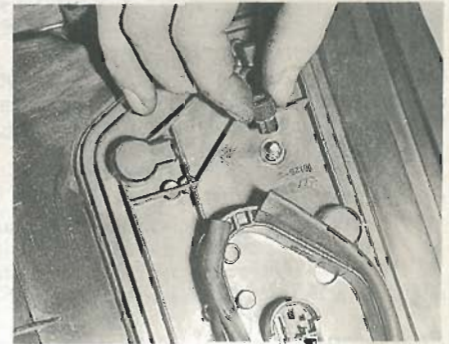
44.8 Removing a front direction indicator lamp bulbholder



44.9 The front direction indicator lamp bulb is a push-fit in the bulbholder



44.12 Removing a front direction indicator side repeater lamp bulb



44.15A Unscrew the two securing nuts ...

- 3 Withdraw the lamp assembly, and disconnect the wiring plugs.
- 4 Refitting is a reversal of removal.

#### 44 Exterior lamp bulbs – renewal

**Note:** The glass envelopes of the headlamp bulbs must not be touched with the fingers. If the glass is accidentally touched, it should be cleaned with methylated spirit and dried with a soft cloth. Failure to observe this procedure may result in premature bulb failure

- 1 Disconnect the battery negative lead.

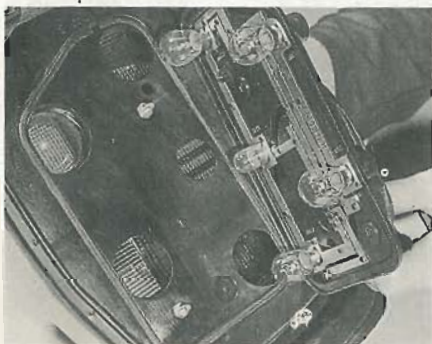
#### Headlamps

- 2 Working in the engine compartment, disconnect the wiring plug from the rear of the headlamp bulb, then pull the rubber cover from the rear of the headlamp (photos).
- 3 Release the bulb retaining spring clip, then grasp the bulb by its contacts and carefully withdraw it (photo). Do not touch the bulb glass.
- 4 Refitting is a reversal of removal.

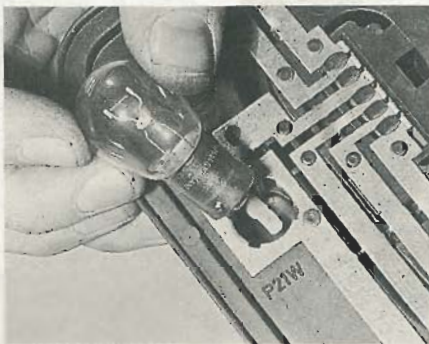
#### Sidelamps

- 5 Working in the engine compartment, disconnect the wiring plug from the sidelamp bulbholder, then twist the bulbholder anti-clockwise, and withdraw it from the headlamp assembly (photo).
- 6 The bulb is a push fit in the bulbholder (photo).
- 7 Refitting is a reversal of removal.

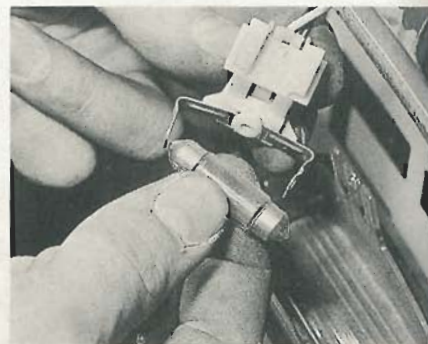




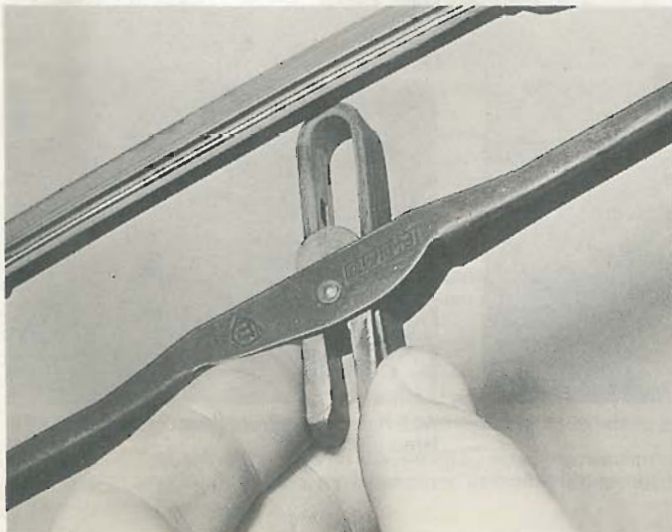
44.15B ... and withdraw the bulbholder from the rear of the lamp unit



44.16 The rear lamp bulbs are a push-fit in the bulbholder



44.19 Removing a rear number plate lamp bulb



45.3 Depressing the retaining clip to remove a windscreen wiper blade

#### Front direction indicator lamps

- 8 Working in the engine compartment, twist the bulbholder anti-clockwise and withdraw it from the headlamp assembly (photo).
- 9 The bulb is a bayonet fit in the bulbholder (photo).
- 10 Refitting is a reversal of removal.

#### Front direction indicator side repeater lamps.

- 11 Twist the lamp lens anti-clockwise, and pull it from the lamp.
- 12 The bulb is a push fit in the lamp (photo).
- 13 Refitting is a reversal of removal, but ensure that the rubber sealing ring is correctly seated between the lens and the body panel.

#### Rear lamps

- 14 Remove the rear lamp unit as described in Section 42.



46.2 Removing a windscreen wiper arm securing nut



46.6A Removing the cover from the headlamp wiper arm securing nut



46.6B Disconnecting the washer fluid hose from the headlamp wiper arm

- 15 Unscrew the two securing nuts and withdraw the bulbholder from the rear of the lamp unit (photos).
- 16 The bulbs are a bayonet fit in the bulbholder (photo).
- 17 Refitting is a reversal of removal.

#### Rear number plate lamps

- 18 Remove the rear number plate lamp assembly as described in Section 43, but note that there is no need to disconnect the wiring plugs.
- 19 Unclip the bulbholder from the lamp assembly, and pull the bulb from the bulbholder (photo).
- 20 Refitting is a reversal of removal.

---

#### 45 Wiper blades - renewal

---

- 1 The wiper blades should be renewed when they no longer clean the glass effectively.
- 2 Lift the wiper arm away from the glass.
- 3 With the blade at 90° to the arm, depress the clip and slide the blade from the hook on the arm (photo).
- 4 If desired, release the retaining tags from the cut-outs in the wiper rubber, and withdraw the rubber from the arm.
- 5 Refitting is a reversal of removal.

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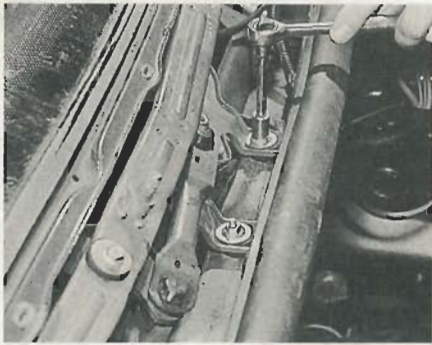
#### 46 Wiper arms - removal and refitting

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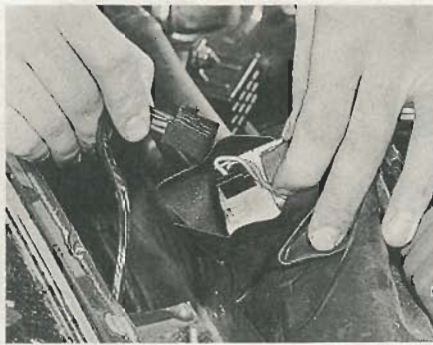
##### Windscreen wipers

- 1 Open the bonnet.
- 2 Unscrew the nut and washer securing the arm to the spindle (photo).
- 3 Mark the arm and the spindle in relation to each other, then prise off the arm, using a screwdriver if necessary. Take care not to damage the paintwork.
- 4 Refitting is a reversal of removal, but align the previously made marks on the arm and spindle.

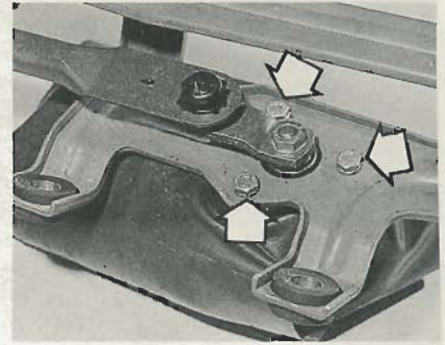




48.4A Removing a windscreen wiper motor/linkage assembly securing nut



48.4B Disconnecting the windscreen wiper motor wiring plug



48.5 Windscreen wiper motor-to-linkage securing bolts (arrowed)

### Tailgate wiper

5 The procedure is as described in paragraphs 1 to 4, but a hinged cover must be lifted to expose the securing nut, and the washer fluid hose must be disconnected from the wiper arm.

### Headlamp wipers

6 The procedure is as described in paragraphs 1 to 4, but a plastic cover must be prised from the arm for access to the securing nut, and the washer fluid hose must be disconnected from the jet on the arm (photos).

## 47 Washer nozzles – removal and refitting

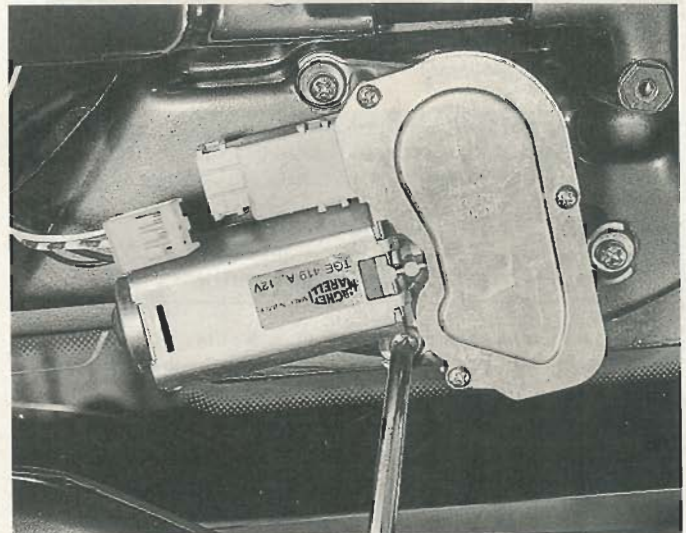
- 1 Remove the windscreen cowl panel as described in Chapter 10, Section 25.
- 2 Push out the nozzle from underneath the panel and disconnect the fluid hose.
- 3 Refitting is a reversal of removal.
- 4 The nozzles can be adjusted by inserting a pin into the jet, and swivelling it to the required position.

## 48 Windscreen wiper motor and linkage – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Remove the wiper arms as described in Section 46.
- 3 Remove the windscreen cowl panel as described in Chapter 10, Section 25.
- 4 Remove the two nuts and two bolts securing the wiper motor/linkage assembly to the wiper body, then disconnect the wiring plug (photos).
- 5 If desired, the motor can be separated from the linkage by unscrewing the three securing bolts (photo). The linkage can be dismantled to a limited extent for component renewal, and this procedure is self-explanatory. If necessary, the nylon drivegear can be renewed. No spare parts are available for the motor itself, and if faulty the complete unit must be renewed.
- 6 Refitting is a reversal of removal.

## 49 Tailgate wiper motor – removal and refitting

- 1 Disconnect the battery negative lead.
- 2 Remove the tailgate wiper arm as described in Section 46.
- 3 Fully open the tailgate.



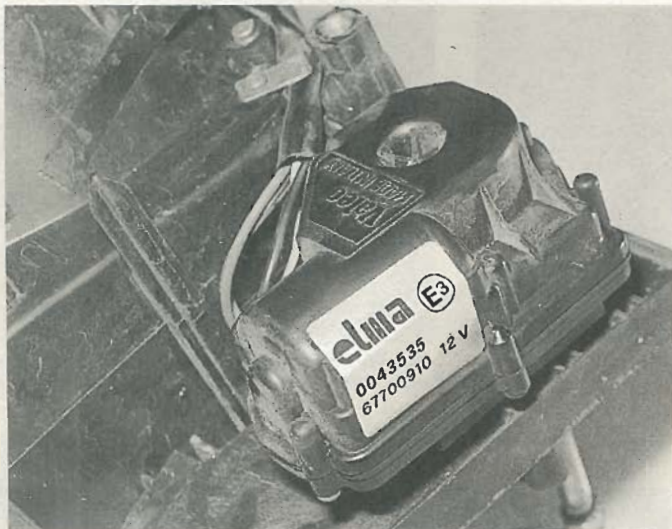
49.9 Removing a tailgate wiper motor securing screw

- 4 Pull the weatherstrip at the lower edge of the rear window aperture away from the edge of the plastic trim panel.
- 5 Extract the five screws securing the plastic trim panel to the tailgate, noting that three of the screws also secure the tailgate lock.
- 6 Carefully prise out the six clips securing the trim panel to the tailgate. This can be done using a screwdriver, but it is preferable to use a forked tool, to minimise the possibility of damage to the trim panel and the clips.
- 7 Where applicable, disconnect the wiring plug from the lock motor, then withdraw the trim panel/lock assembly.
- 8 Disconnect the wiring plug from the motor.
- 9 Remove the three securing screws and withdraw the motor assembly from the tailgate (photo).
- 10 Examine the condition of the spindle seal in the tailgate, and renew if necessary.
- 11 No spare parts are available for the motor assembly, and if faulty, the complete assembly must be renewed.
- 12 Refitting is a reversal of removal.

## 50 Headlamp wiper motor – removal and refitting

- 1 Remove the headlamp as described in Section 38.
- 2 Unscrew the nut from the front of the motor spindle, and withdraw





50.2A Headlamp wiper motor at rear of headlamp assembly

the motor from the headlamp (photos). If necessary, loosen the screw securing the wiring retaining plate to enable the wiring to be withdrawn.

3 Refitting is a reversal of removal.

### 51 Washer fluid reservoir – removal and refitting

1 The washer fluid reservoir is located at the front left of the engine compartment, and serves the windscreen, tailgate, and where applicable, the headlamp washer circuits.

2 Disconnect the battery negative lead.

3 Disconnect the wiring plugs from the washer fluid pumps.

4 Remove the three screws securing the reservoir to the body, then withdraw the reservoir and disconnect the fluid hoses from the pumps. Be prepared for fluid spillage.

5 Refitting is a reversal of removal.

### 52 Washer fluid pumps – removal and refitting

1 Disconnect the battery negative lead, then disconnect the wiring plug from the motor.

2 Pull the pump from the reservoir, and disconnect the fluid hose. Be prepared for fluid spillage.

3 Examine the condition of the sealing grommet, and renew if necessary.

4 Refitting is a reversal of removal.

### 53 Electric window components – removal and refitting

#### Electronic control module

1 The electronic control module is mounted under the driver's side fascia, behind the main fuse/relay panel.

2 Disconnect the battery negative lead.

3 Remove the driver's side lower fascia panel as described in Chapter 10, Section 32.

4 Working behind the main fuse/relay panel, disconnect the wiring plugs, then remove the two securing screws and withdraw the module.

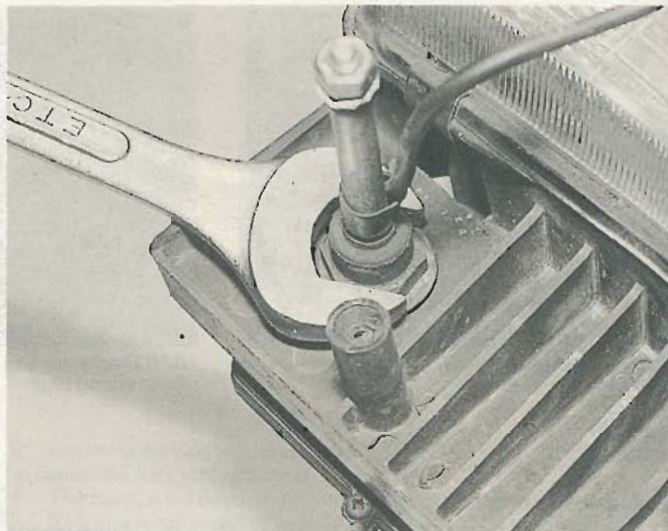
5 Refitting is a reversal of removal.

#### Door-mounted switches

6 Disconnect the battery negative lead.

7 Remove the securing screw and withdraw the arm rest trim panel.

8 Extract the two securing screws, then remove the arm rest and



50.2B Unscrewing the headlamp wiper motor securing nut

disconnect the wiring plug from the switch.

9 Remove the two securing screws and withdraw the switch from the armrest.

10 Refitting is a reversal of removal.

#### Operating motors

11 The window operating motors are integral with the regulator assemblies. No spares are available, and if faulty, the complete regulator assembly must be renewed. Removal and refitting of the regulators is described in Chapter 10, Section 21.

### 54 Central door locking components – removal and refitting

#### Electronic control module

1 The electronic control unit is mounted in the main fuse/relay panel – see Fig. 11.4.

2 To remove the unit, disconnect the battery negative lead, and pull the unit from its location in the panel.

3 Refitting is a reversal of removal.

#### Operating switches

4 The operating switches are integral with the front door locks. No spares are available, and if faulty, the complete relevant lock assembly must be renewed. Removal and refitting of the lock assemblies is described in Chapter 10, Section 18.

#### Door lock operating motor

5 The lock operating motors are integral with the door locks. No spares are available, and if faulty, the complete relevant lock assembly must be renewed. Removal and refitting of the lock assemblies is described in Chapter 10, Section 18.

#### Tailgate lock operating motor

6 Disconnect the battery negative lead.

7 Open the tailgate.

8 Pull the weatherstrip at the lower edge of the rear window aperture away from the edge of the plastic trim panel.

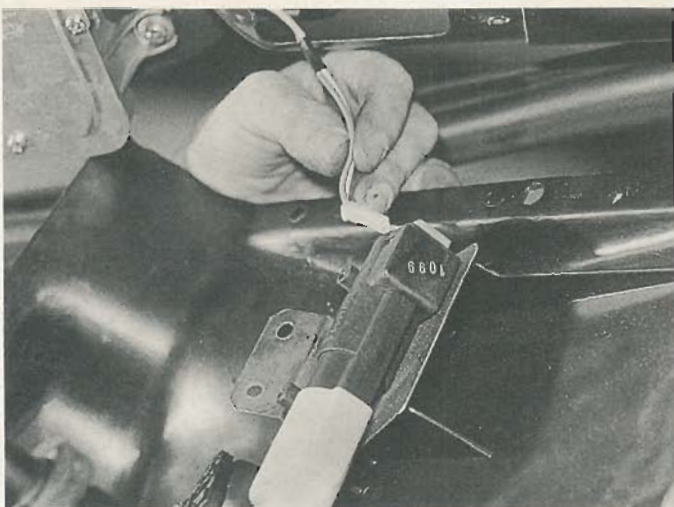
9 Extract the five screws securing the plastic trim panel to the tailgate, noting that three of the screws also secure the tailgate lock.

10 Carefully prise out the six clips securing the trim panel to the tailgate. This can be done using a screwdriver, but it is preferable to use a forked tool, to minimise the possibility of damage to the trim panel and the clips.

11 Disconnect the wiring plug from the lock motor, then withdraw the trim panel/lock assembly (photo).

12 Unscrew the two securing nuts, and withdraw the motor and its mounting plate from the trim panel, unhooking the end of the motor





54.11 Disconnecting the wiring plug from the tailgate lock operating motor

from the lock operating arm (photo).

13 The motor can be removed from the mounting plate after extracting the two securing screws.

14 Refitting is a reversal of removal.

## 55 Radio aerial - removal and refitting

### Aerial assembly

- 1 Remove the courtesy lamp roof panel as described in Section 22.
- 2 Disconnect the now-exposed end of the aerial lead from the base of the aerial.
- 3 Unscrew the aerial securing nut, then withdraw the aerial from outside the roof panel.
- 4 Refitting is a reversal of removal.

### Aerial lead

- 5 Proceed as described in paragraphs 1 and 2.
- 6 Remove the radio/cassette player as described in Section 57, and disconnect the aerial lead from the rear of the unit.
- 7 Tie a length of string to the end of the aerial lead in the roof, then carefully pull the aerial lead down into the fascia, and withdraw it. Leave the string in position to aid refitting.
- 8 If the aerial lead is reluctant to move, do not use excessive force. It may be necessary to reach up behind the fascia and free the cable. If absolutely necessary, the relevant trim and fascia panels can be removed for improved access with reference to the relevant Sections of this Chapter. Note that the cable runs down the passenger side front body pillar.
- 9 Refitting is a reversal of removal.

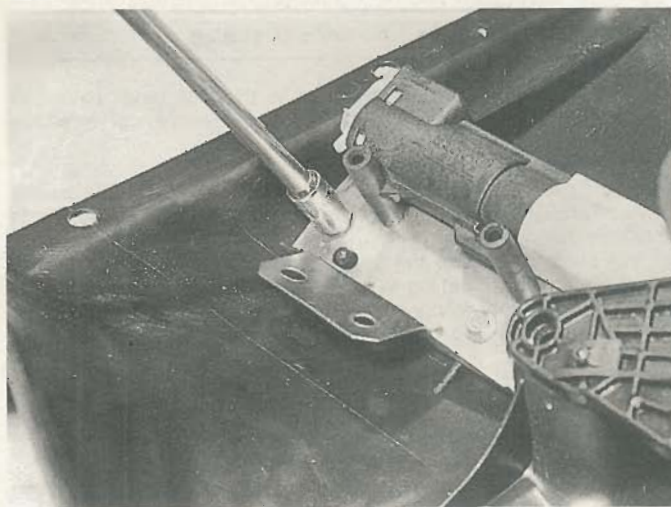
## 56 Loudspeakers - removal and refitting

### Facia-mounted loudspeaker

- 1 Disconnect the battery negative lead.
- 2 Extract the two securing screws and remove the loudspeaker trim panel from the fascia (photo).
- 3 Remove the four securing screws, then withdraw the loudspeaker and disconnect the wiring.
- 4 Refitting is a reversal of removal.

### Rear loudspeaker

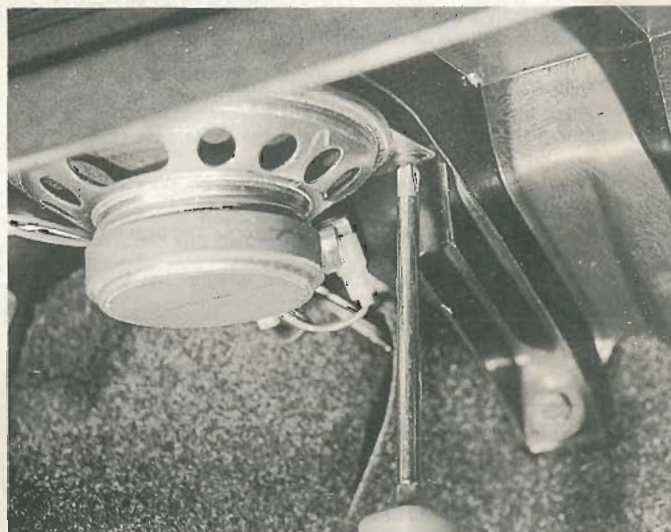
- 5 Disconnect the battery negative lead.
- 6 Open the tailgate.
- 7 Working under the luggage compartment side trim panel, disconnect the wiring plugs from the loudspeaker.
- 8 Remove the four securing screws and withdraw the loudspeaker (photo).
- 9 Refitting is a reversal of removal.



54.12 Unscrewing a tailgate lock operating motor securing nut



56.2 Removing the trim panel to expose the facia-mounted loudspeaker



56.8 Removing a rear loudspeaker securing screw



**57 Radio/cassette player – removal and refitting**

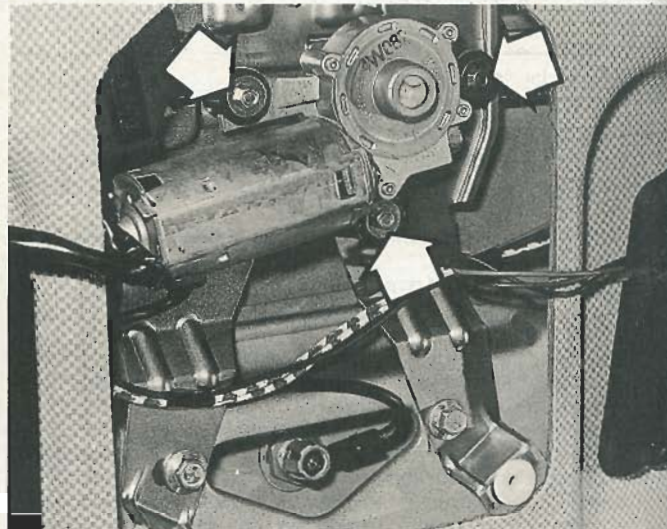
- 1 All the radio/cassette players fitted to the Tipo range have DIN standard fixings. Two special bolts, obtainable from in-car entertainment specialists, are required for removal.
- 2 Disconnect the battery negative lead.
- 3 Insert the tools into the holes in either side of the radio/cassette player, and push them until they snap into place. Pull the tool forwards to release the unit (photo).
- 4 Pull the unit forwards and withdraw it from the fascia, then disconnect the wiring plugs and the aerial.
- 5 To refit the unit, reconnect the wiring plugs and the aerial, then simply push the unit into the fascia until the retaining lugs snap into place.



57.3 Using DIN tools to remove the radio/cassette player

**58 Sunroof motor – removal and refitting**

- 1 Fully close the sunroof.
- 2 Disconnect the battery negative lead.
- 3 Carefully prise the cover plate and the courtesy lamp lens from the control panel in the roof.
- 4 Unscrew the three now-exposed control panel securing screws, then lower the control panel, disconnect the wiring plugs, and withdraw the panel.
- 5 Uncrew the three securing screws, then withdraw the motor and disconnect the wiring plug (photo).
- 6 Refitting is a reversal of removal.



58.5 Sunroof motor securing screws (arrowed)

**59 Speedometer cable instrumentation – removal and refitting**

- 1 The speedometer cable has two sections joined at an intermediate coupling in the engine compartment.

***Speedometer-to-intermediate coupling cable***

- 2 Working in the passenger compartment, withdraw the instrument panel as described in Section 30, and disconnect the cable from the rear of the speedometer.
- 3 Working in the engine compartment, disconnect the cable from the intermediate coupling.
- 4 Carefully feed the cable through the engine compartment bulkhead into the engine compartment and withdraw it from the vehicle.
- 5 Examine the condition of the intermediate coupling sealing ring, and renew if necessary.
- 6 Refitting is a reversal of removal, but ensure that the bulkhead grommet is correctly positioned, and ensure that the cable run to the rear of the speedometer is as straight as possible.

***Gearbox-to-intermediate coupling cable***

- 7 Working in the engine compartment, unscrew the securing sleeve, and disconnect the end of the cable from the drive assembly on the gearbox.
- 8 Disconnect the cable from the intermediate coupling, then withdraw the cable, noting its routing.
- 9 Examine the condition of the intermediate coupling sealing ring, and renew if necessary.
- 10 Refitting is a reversal of removal, but ensure that the cable is routed as noted during removal.

- 3 Using a suitable Allen key or hexagon bit, unscrew the sender retaining pinch-bolt from the side of the gearbox casing, then withdraw the sender.
- 4 Recover the sender drivegear.
- 5 Examine the condition of the drivegear and the sealing O-ring on the sender and renew if necessary.
- 6 Refitting is a reversal of removal.

**60 Speedometer sender digital instrumentation – removal and refitting**

- 1 The sender unit is located in the rear of the gearbox casing.
- 2 Disconnect the battery negative lead, then disconnect the wiring plug from the sender.

**61 Economy gauge sender unit – removal and refitting**

- 1 On models with analogue instruments, the sender unit is incorporated in the gauge. Gauge removal and refitting is described in Section 31.
- 2 On models with digital instruments, the economy gauge sender unit is located on a bracket attached to the rear of the battery tray in the engine compartment. To remove the sender unit, proceed as follows.
- 3 Disconnect the battery negative lead, then disconnect the wiring plug from the sender unit (photo).



- 4 Disconnect the vacuum pipe from the sender unit.
- 5 Unscrew the securing nut and withdraw the sensor, complete with the bracket, from the battery tray.
- 6 Refitting is a reversal of removal.



61.3 Disconnecting the wiring plug from the economy gauge sender unit

## 62 Wiring diagrams – explanatory notes

The wiring diagrams are more or less self-explanatory.

Each component is identified by a number, which appears in the key with a description of the relevant component.

The letters appearing in the wire "breaks" are colour codes – refer to the key for details.

The white letters in black boxes which appear next to some of the connectors refer to the wiring junction box connectors shown in Fig. 11.30 or 11.31, as applicable.

Note that some of the components shown on the diagrams are fitted only to Diesel models which are not covered by this manual, and some of the components shown are not fitted to UK market vehicles.

## 63 Fault diagnosis – electrical system

Symptom	Reason(s)
Starter fails to turn engine	Battery discharged Battery defective internally Loose wiring connections at starter motor Engine earth strap loose, broken or missing Starter motor faulty or solenoid not functioning Starter motor brushes worn Starter motor armature faulty Commutator dirty or worn Field coils earthed
Starter turns engine very slowly	Battery discharged Starter brushes badly worn, sticking or brush wires loose Loose wires in starter motor circuit
Starter spins but does not turn engine	Pinion or flywheel gear teeth broken or worn
Starter motor noisy or excessively rough engagement	Pinion or flywheel gear teeth broken or worn Starter motor retaining bolts loose
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 Alternator drivebelt slipping Battery terminal connections loose or corroded Alternator not charging Short-circuit causing continual battery drain Faulty voltage regulator
Ignition warning lamp fails to go out, battery loses charge in a few days	Alternator drivebelt loose and slipping or broken Alternator brushes worn, sticking, broken or dirty Alternator brush springs weak or broken Alternator defective internally
<b>Failure of individual items of electrical equipment to function correctly is dealt with below</b>	
<b>Horn</b> 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 connection loose, broken or disconnected Horn defective internally
Horn emits intermittent or unsatisfactory noise	Cable connection loose



Symptom	Reason(s)
<b>Lamps</b>	
Lamps do not come on	Blown fuse If engine not running, battery discharged Wire connections loose, disconnected or broken Lamp switch shorting or otherwise faulty Lamp bulb filament burnt out or bulbs broken
Lamps give poor illumination	Lamp glasses dirty Lamps badly out of adjustment
Lamps work erratically, flashing on and off, especially over bumps	Battery terminal or earth connection loose Lamps not earthing properly Contacts in lamp switch faulty
<b>Wipers</b>	
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 Armature badly worn or faulty Armature bearings dirty or misaligned
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 blades remain static	Wiper motor gearbox parts badly worn
<b>Electrically-operated windows</b>	
Glass will only move in one direction	Faulty switch
Glass slow to move	Stiff regulator or glass guide channels
Glass will not move:	
With motor running	Binding glass guide channels Faulty regulator Faulty control module
Motor not running	Blown fuse Faulty motor Broken or disconnected wire
<b>Central door locking system</b>	
Complete failure	Blown fuse Faulty master switch Faulty control module Broken or disconnected wire
Latch locks but will not unlock, or unlocks but will not lock	Faulty master switch Faulty control module Poor circuit connection(s)
One motor will not operate	Poor circuit connection(s) Broken wire Faulty motor Binding lock linkage Faulty lock
<b>Instruments</b>	
Instrument readings increase with engine speed	Faulty voltage stabiliser
Fuel or temperature gauge gives no reading	Wiring open circuit Faulty sender unit Faulty gauge
Fuel or temperature gauge gives maximum reading all the time	Wiring short circuit Faulty gauge

**Note:** This Section is not intended as an exhaustive guide to fault diagnosis, but summarises the more common faults which may be encountered during a vehicle's life. Consult a dealer for more detailed advice



## Key to wiring diagrams

Not all items fitted to all models

No	Description	No	Description
1	Left front light cluster	49C	Connection with cut-off module
2	Reversing lights switch	50	Instrument panel
3	Electric horn	A	Direction indicators warning light
3A	Left electric horn	B	Side lights warning light
4	Radiator cooling fan	C	Main beam headlamps warning light
5	Coolant temperature sensor	D	Heated rear windscreen warning light
6	Connection between right longitudinal cable and right rear door	E	Rear fog lamps warning light
7	Right front earth	F	Hazard warning lights warning light
8	Right front light cluster	G	Battery recharging warning light
9	Right electric horn	H	Insufficient oil pressure warning light
10	Windscreen and rear screen electric washer pump	I	Trip meter warning light
11	Front brake pad wear sensor	J	Brake pad wear warning light
12	Ignition coil	K	Handbrake warning light
12A	Ignition coil with power module	L	Choke warning light
13A	Digiplex electronic ignition connection	M	A.B.S. failure warning light
13B	Digiplex electronic ignition connection	N	Instrument panel light
13C	Digiplex electronic ignition connection	O	Fuel gauge
13D	Digiplex electronic ignition connection	P	Coolant temperature gauge
14	Left front earth	Q	Clock
15	Battery earth	R	Heater plugs warning light
16	Coolant temperature sender unit	S	Electronic speedometer
17	Battery	T	Rev counter
18	Ignition distributor	U	Econometer
19	Spark plug	V	Turbocharging pressure gauge
20	Spark plug	W	Check Panel
21	Spark plug	X	Water in fuel warning light
22	Spark plug	Y	S.P.I. failure warning light
23	TDC and rpm sensor	51	Ignition switch
24	Alternator	52	Choke warning light switch
25	Engine oil pressure sender unit	53	Radio wiring
26	Connector	54	Hazard warning lights switch
27	Brake fluid level sensor	55	Steering column switch unit
28	Left side direction indicator	A	Rear fog lamps switch
29	Dashboard/engine electronic earth connection	B	External lights switch
30	Idle cut-off	C	Instrument panel light bulbs
31	Starter motor	D	Flasher push button
32	Closed butterfly valve sensor	E	Direction indicators switch
33	Speedometer impulse generator	F	Main beam/dipped headlamps switch
34	Windscreen wiper	G	Electric horn push button
35	Right side direction indicator	H	Windscreen wiper switch
36	P.T.C. fuel duct heater	I	Rear screen wash/wipe switch
37	Thermal switch for P.T.C.	L	Heated rear windscreen switch
38	Vacuum gauge vacuum sensor	M	Rear screen wash/wipe switch
39	Junction box	56	Dashboard cable joint with right rear door cable
E4	Fog lamps relay	57	Glove compartment light bulb
E5	Electric horn relay	58	Dashboard cable joint with right front door cable
E6	Heated rear windscreen relay	59	Dashboard cable joint with right front door cable
E7	Exhaust switch relay	60	Right front speaker wiring
E10	Rear fog lamps relay	61	Left push button for courtesy light and electric windows
E11	Main beam headlamps relay	62	Rear cable joint with left rear door
E12	Dipped headlamps relay	63	Rear cable joint with left front door
E13	Side light relay	64	Left front door lock (complete with locking/unlocking geared motor, micro-switch and switch signalling door not properly shut)
40	P.T.C. engagement relay	65	Left front electric window geared motor
41	P.T.C. circuit protective fuse	66	Left and right electric front window buttons
42	Electric windows control unit protective fuse	67	Cigar lighter
43	Dashboard cable joint with heater cable	68	Brake lights switch
44	Earth on left side dashboard cross member	69	Courtesy light
44A	Earth right side dashboard cross member	70	Handbrake warning light switch
45	Dashboard cable joint with left front door cable	71	Heater fan switch
46	Electric windows electronic control unit	71A	Car interior heating/ventilation control
47	Left front speaker wiring	72	Heating/ventilation fan speed adjustment resistor
48	Additional earth point	73	Heater fan
49A	Connection with cut-off module		
49B	Connection with cut-off module		



## Key to wiring diagrams (continued)

No	Description	No	Description
75	Right front door lock (complete with locking/unlocking geared motor, micro-switch and switch signalling door not properly shut)	130	Right side electrically adjusted rear view mirror with de-icer
76	Right front electric window geared motor	131	Left headlamp wash/wipe motor
77	Right front electric window push button	132	Right headlamp wash/wipe motor
78	Right push button for courtesy lights and electric window	133	Electric headlamp washer pump
79	Luggage compartment courtesy light and switch signalling tailgate not properly shut	134	Headlamp wash/wipe relay
80	Left rear earth	135	Heated seat
80A	Right rear earth	136	Connection
81A	Tailgate cable connection	137	Connection
81B	Tailgate cable connection	138	Air conditioning system connection
81C	Tailgate cable connection	139	Three stage pressure switch
81D	Tailgate cable connection	140	Connection
82	Left rear light cluster	141	Actuator motor for recirculated air/outside air
83	Left rear door lock (complete with locking/unlocking geared motor and switch signalling doors not properly shut)	142	Air conditioning system control switch
84	Fuel gauge	143	Outside/recirculated air switch
85	Tailgate locking/unlocking geared motor	144	30A protective fuse for air conditioning system
86	Left number plate light	145	50A protective fuse for air conditioning system
87	Right number plate light	146	Air conditioning system control unit
88	Windscreen wiper motor	A	Radiator cooling fan protective fuse
89	Heated rear windscreen	B	Heater fan protective fuse and recirculated air actuator motor
90	Right rear light cluster	C	Compressor and fast idle solenoid valve protective fuse
91	Right rear door lock (complete with locking/unlocking geared motor and switch signalling doors not properly shut)	D	Heater fan relay and recirculation air actuator motor
92	Pre-heating control unit	E	Compressor and fast idle solenoid valve twin contact relay
93	Heater plugs	F	Radiator cooling fan fastest speed relay
94	Additional resistor for engaging 1st speed of radiator cooling fan	G	Electronic module for delayed engagement of radiator cooling fan fastest speed
95	Radiator cooling fan protective fuse	H	Compressor engagement relay
96	Thermostatic switch for cold injection automatic extra advance device (K.S.B.)	147	Fast idle splenoid valve
97	Electro-magnet coupling for cold injection automatic extra advance device (K.S.B.)	148	Additional resistor for DIM-DIP circuit
98	Engine cut-out solenoid valve on injection pump	149	DIM-DIP circuit relay
99	Relay for engaging radiator cooling fan 2nd speed	150	DIM-DIP circuit protective fuse
100	Dashboard cable connection/electric fuel pump cable	151	Electric fuel pump relay
101	Electro-magnetic sensor for rev counter signal	152	Injector supply and S.P.I. electronic control unit relay
102	Turbocharger air pressure switch	153	Petrol vapour N.C. cut out device solenoid valve
103	Turbo pressure gauge air pressure transducer	154	Petrol vapour N.O. cut out device solenoid valve
104	Anti-lock braking system protective fuse	155	Electric fuel pump protective fuse
105	Anti-lock braking system joint	156	Air temperature sensor and injector
106	Connection with brake pad wear sensor cable	157	Resistor
107	Cut-off control module	158	Lambda sensor protective fuse
108	Radiator cooling/air conditioning circuit joint	159	Water temperature sender unit
109	Connection	160	Potentiometer
110	Connection	161	Engine cable/dashboard for S.P.I. system joint
111	Connection	162	Dashboard cable/Bosch S.P.I. system cable joint
112	Sensor on left front wheel	163	Bosch S.P.I. system control unit
113	Sensor on right front wheel	164	FIAT tester diagnostic socket
114	Sensor on left rear wheel	165	Electric fuel pump
115	Sensor on right rear wheel	166	Heated Lambda sensor
116	Electro-hydraulic control unit	167	Step motor
117	Main relay	168	Fuse holder
118	Anti-lock brakes (A.B.S.) electronic control unit	169	Solenoid valve
119	Heated filter device	170	Thermal switch
120	Heated filter relay	171	Air temperature sender unit
121	Heater filter circuit protective fuse	172	Injector
122	Water in fuel detector device	173	Butterfly valve position sensor
123	Left fog lamp	174	Absolute pressure sender unit
124	Right fog lamp	175	Air adjustment actuator
125	Connection	176	G.M. S.P.I. control unit
126	Fog lamps switch	177	Dashboard cable/G.M. S.P.I. system cable joint
127	Sun roof switch	178	Lambda sensor
128	Left side rear view mirror de-icer resistor	179	Air conditioning cable/G.M. S.P.I. control unit joint
129	Right side rear view mirror adjustment switch	180	Connection
		181	Side lights remote control switch
		182	Side lights remote control switch
		183	P.T.C. circuit joint
		184	Power earth
		185	Electronic earth
		187	Sun roof circuit joint



## Key to wiring diagrams (continued)

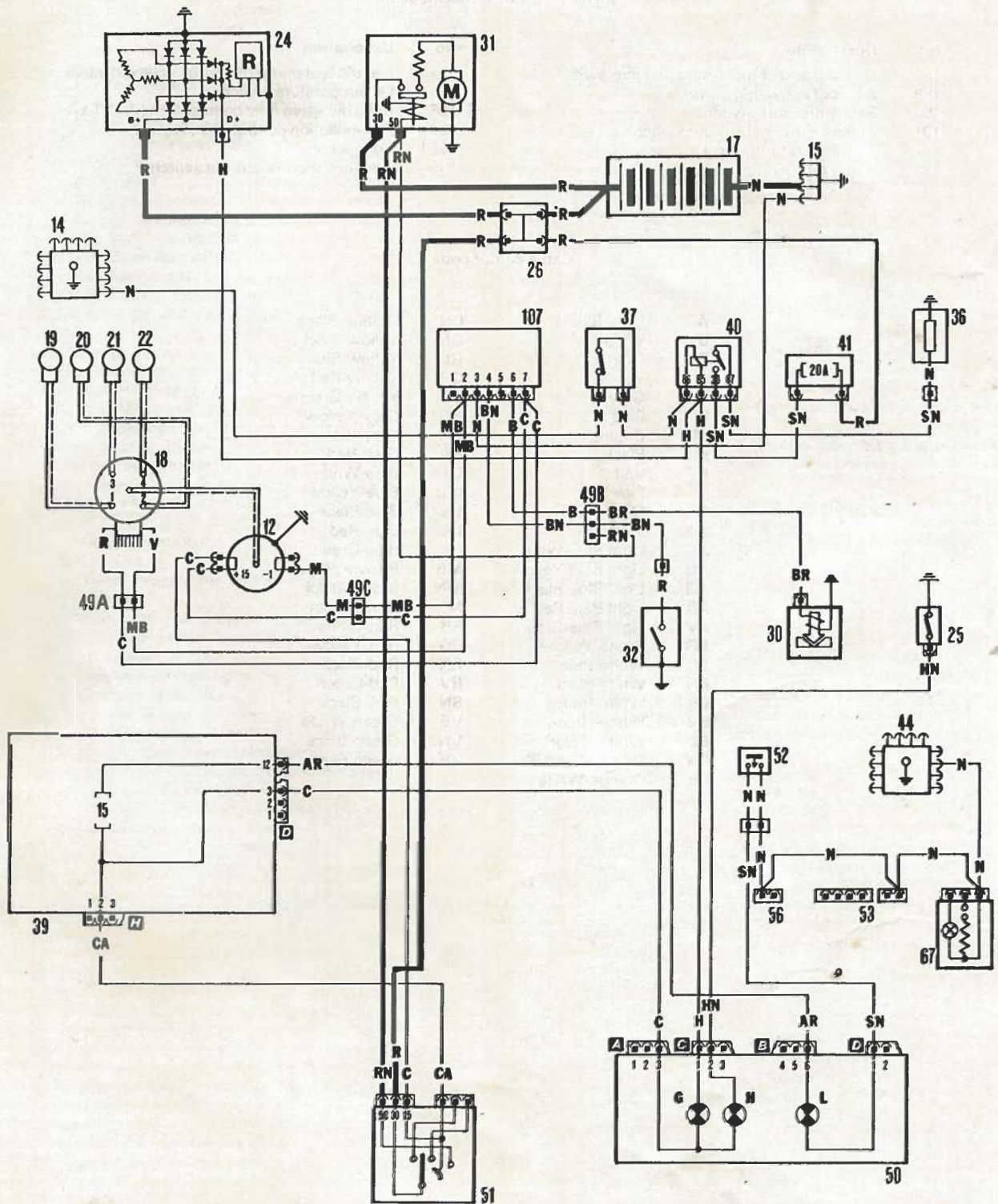
*Not all items fitted to all models*

No	Description	No	Description
188	Sun roof end of travel sensor micro-switch	194	Electric fuel pump discharge solenoid valve
189	Sun roof activating motor	195	Oil temperature switch
190	Safety pressure switch	196	Butterfly valve fully open switch (W.O.T.)
191	Advance thermal cut-out switch	197	Anti-pollution control unit (Ecobox)
192	Air temperature sensor	198	Connection
193	Water temperature switch	199	Advance thermal cut-out switch

## Cable colour code

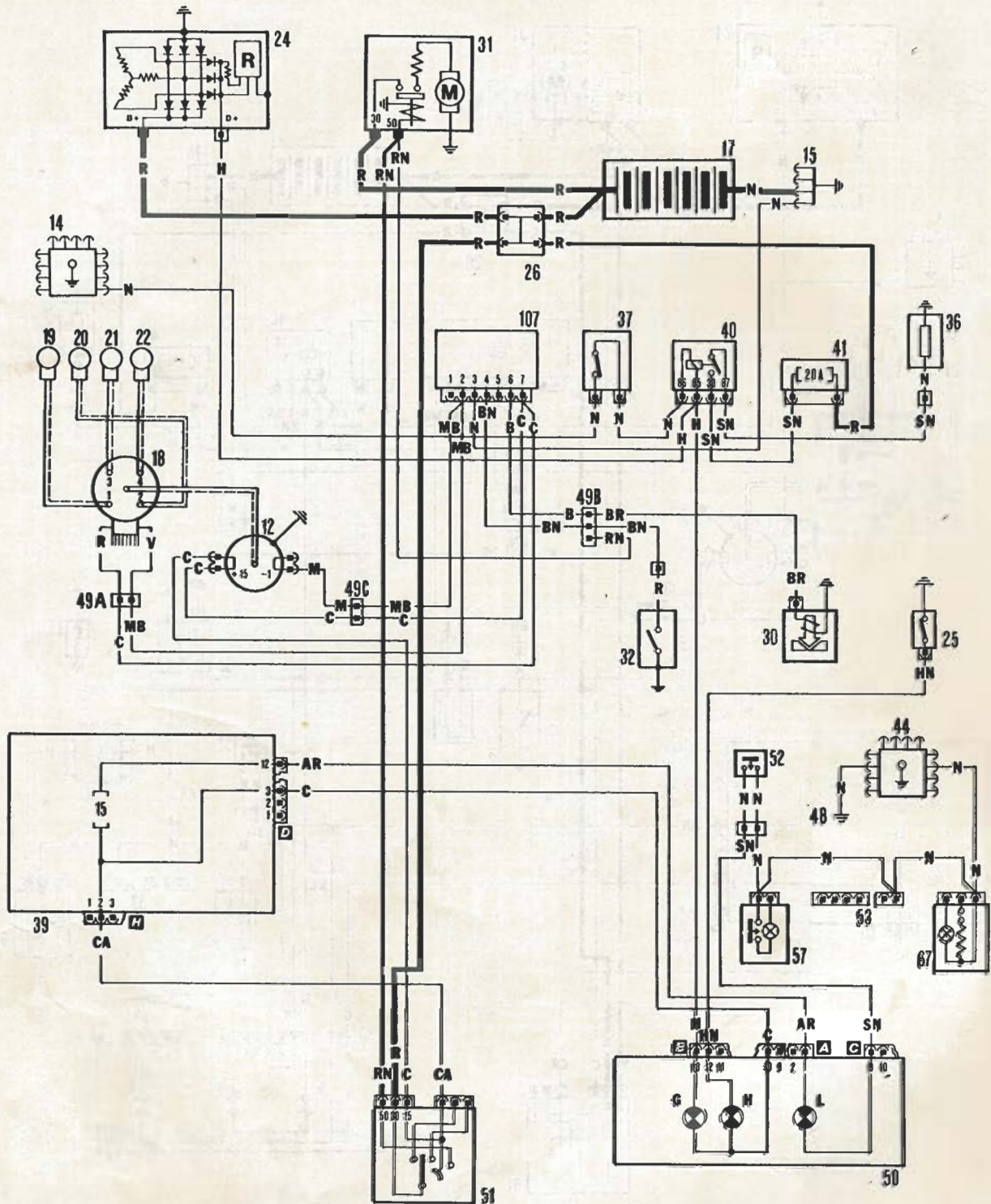
<b>A</b>	Light Blue	<b>CN</b>	Orange-Black
<b>B</b>	White	<b>GN</b>	Yellow-Black
<b>C</b>	Orange	<b>GL</b>	Yellow-Blue
<b>G</b>	Yellow	<b>GR</b>	Yellow-Red
<b>H</b>	Grey	<b>GV</b>	Yellow-Green
<b>L</b>	Blue	<b>HG</b>	Grey-Yellow
<b>M</b>	Brown	<b>HN</b>	Grey-Black
<b>N</b>	Black	<b>HR</b>	Grey-Red
<b>R</b>	Red	<b>LB</b>	Blue-White
<b>S</b>	Pink	<b>LG</b>	Blue-Yellow
<b>V</b>	Green	<b>LN</b>	Blue-Black
<b>Z</b>	Violet	<b>LR</b>	Blue-Red
<b>AB</b>	Light Blue-White	<b>LV</b>	Blue-Green
<b>AG</b>	Light Blue-Yellow	<b>MB</b>	Brown-White
<b>AN</b>	Light Blue-Black	<b>MN</b>	Brown-Black
<b>AR</b>	Light Blue-Red	<b>NZ</b>	Black-Violet
<b>AV</b>	Light Blue-Green	<b>RB</b>	Red-White
<b>BG</b>	White-Yellow	<b>RG</b>	Red-Yellow
<b>BL</b>	White-Blue	<b>RN</b>	Red-Black
<b>BN</b>	White-Black	<b>RV</b>	Red-Green
<b>BR</b>	White-Red	<b>SN</b>	Pink-Black
<b>BV</b>	White-Green	<b>VB</b>	Green-White
<b>BZ</b>	White-Violet	<b>VN</b>	Green-Black
<b>CA</b>	Orange-Light Blue	<b>VR</b>	Green Red
<b>CB</b>	Orange-White		





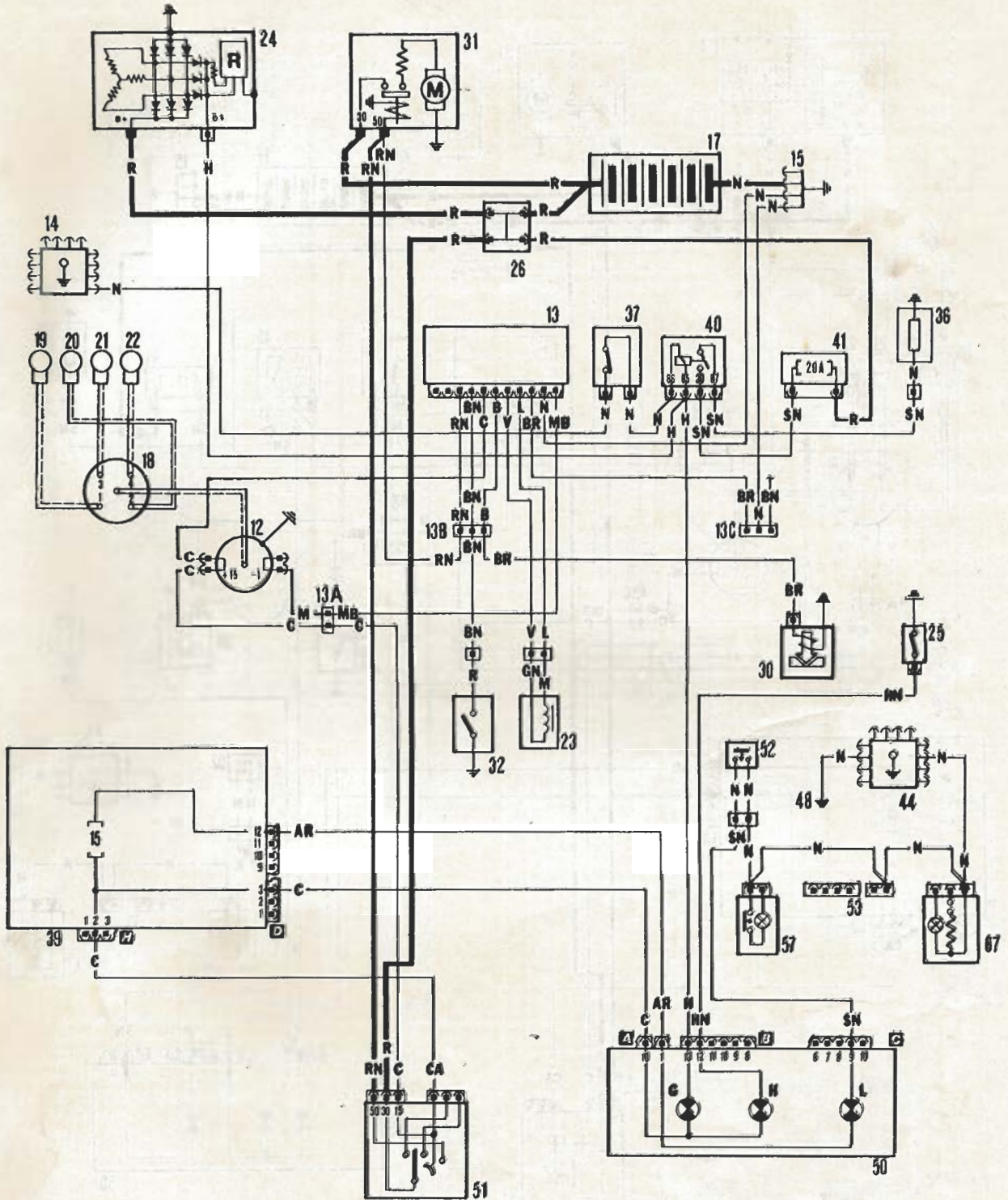
11.11 Wiring diagram - Starting, ignition, charging, fuel cut-off system, low oil pressure warning lamp, choke warning lamp (1.4 litre non-DGT models)





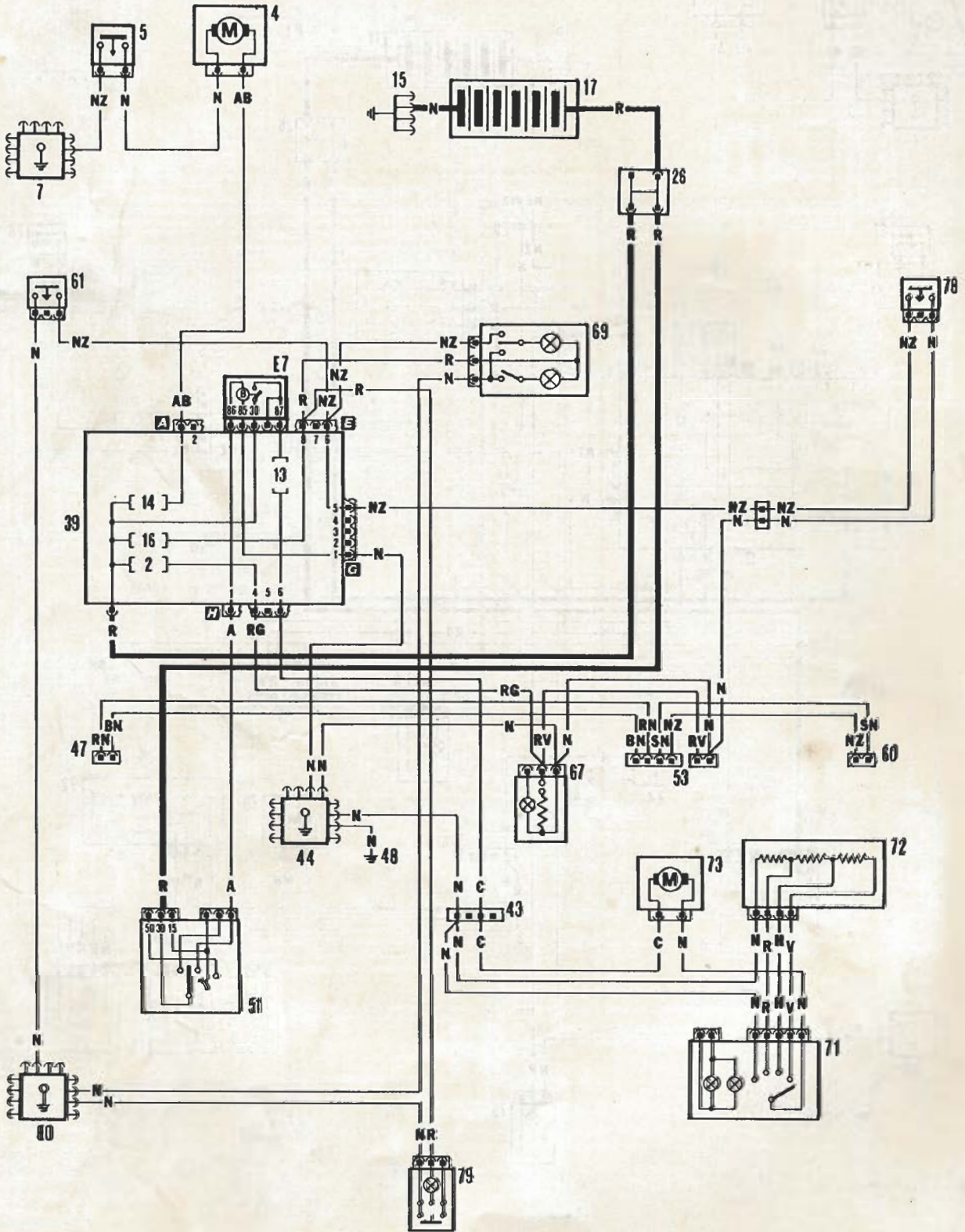
11.12 Wiring diagram - Starting, ignition, charging, fuel cut-off system, low oil pressure warning lamp, choke warning lamp (1.4 litre DGT models)





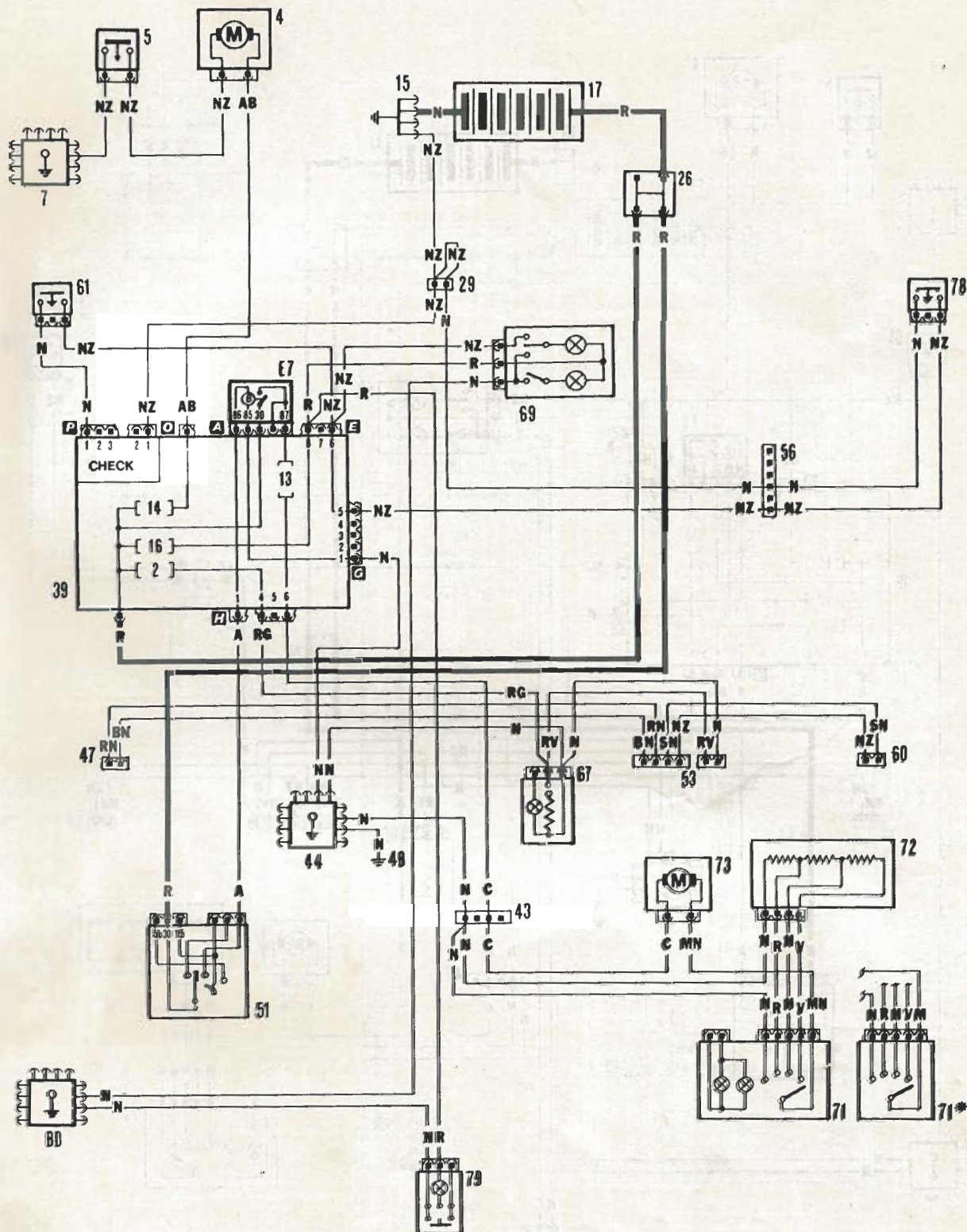
11.13 Wiring diagram - Starting, Digiplex 2 ignition, charging, low oil pressure warning lamp, choke warning lamp (1.6 litre DGT models)





11.14 Wiring diagram - Radiator cooling fan, heater blower motor, radio/cassette player, cigarette lighter, courtesy lamp (1.4 litre non-DGT models)

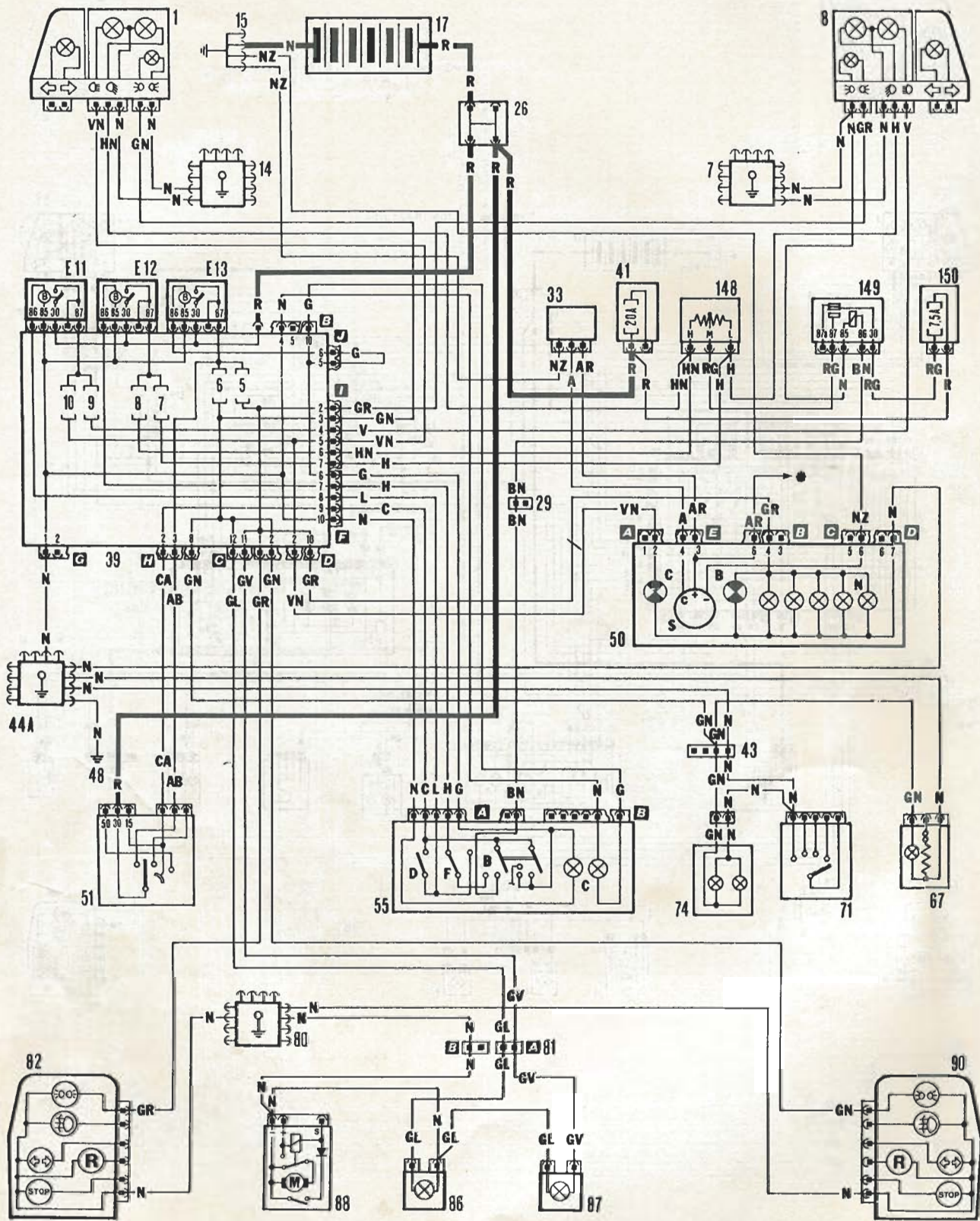




\* Digit 1400 - 1600

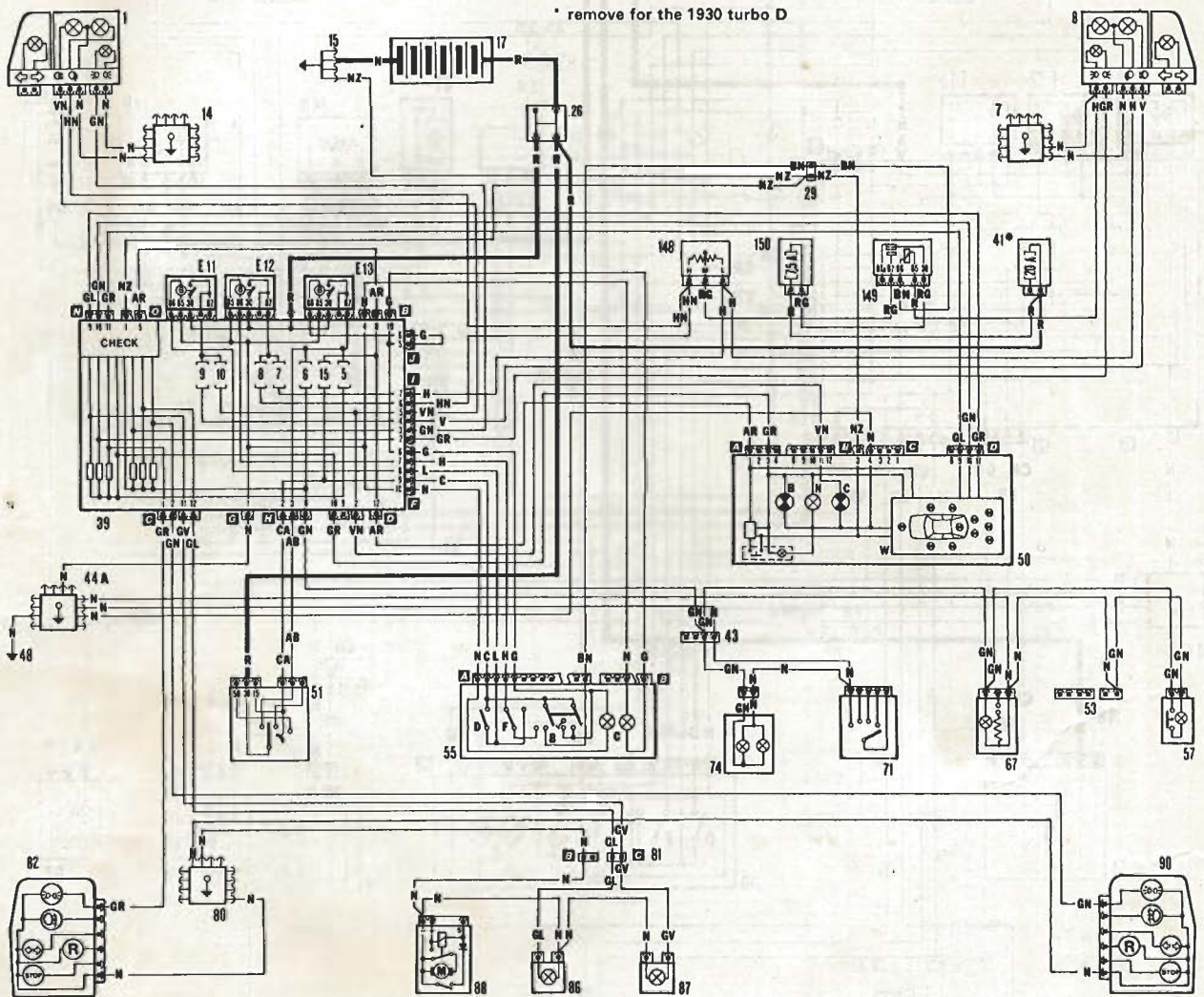
11.15 Wiring diagram - Radiator cooling fan, heater blower motor, radio/cassette player, cigarette lighter, courtesy lamp  
(1.4 and 1.6 litre DGT models)





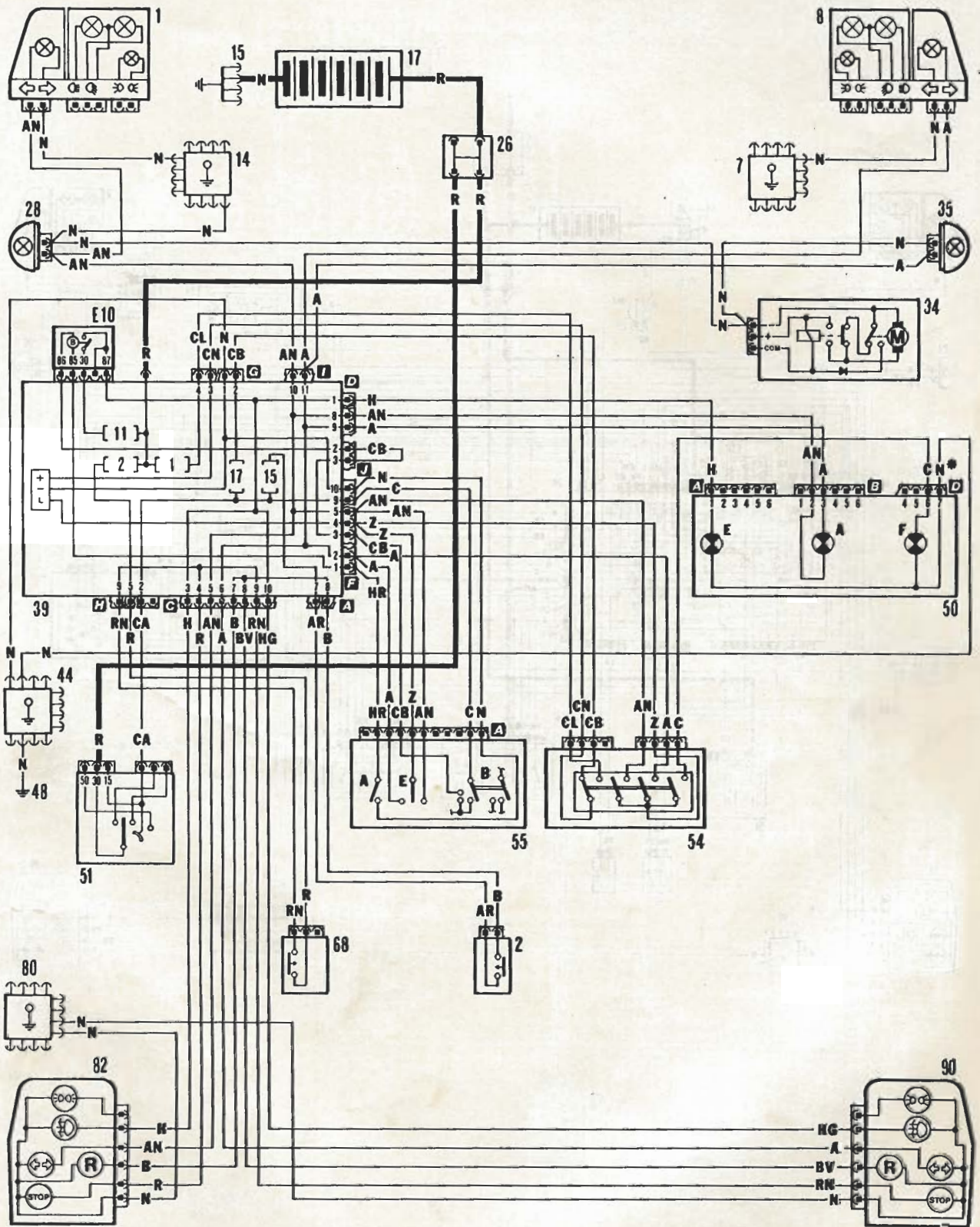
11.16 Wiring diagram - Sidelamps, headlamps, rear number plate lamps (1.4 litre non-DGT models)





11.17 Wiring diagram – Sidelamps, headlamps, rear number plate lamps (1.4 and 1.6 litre DGT models)

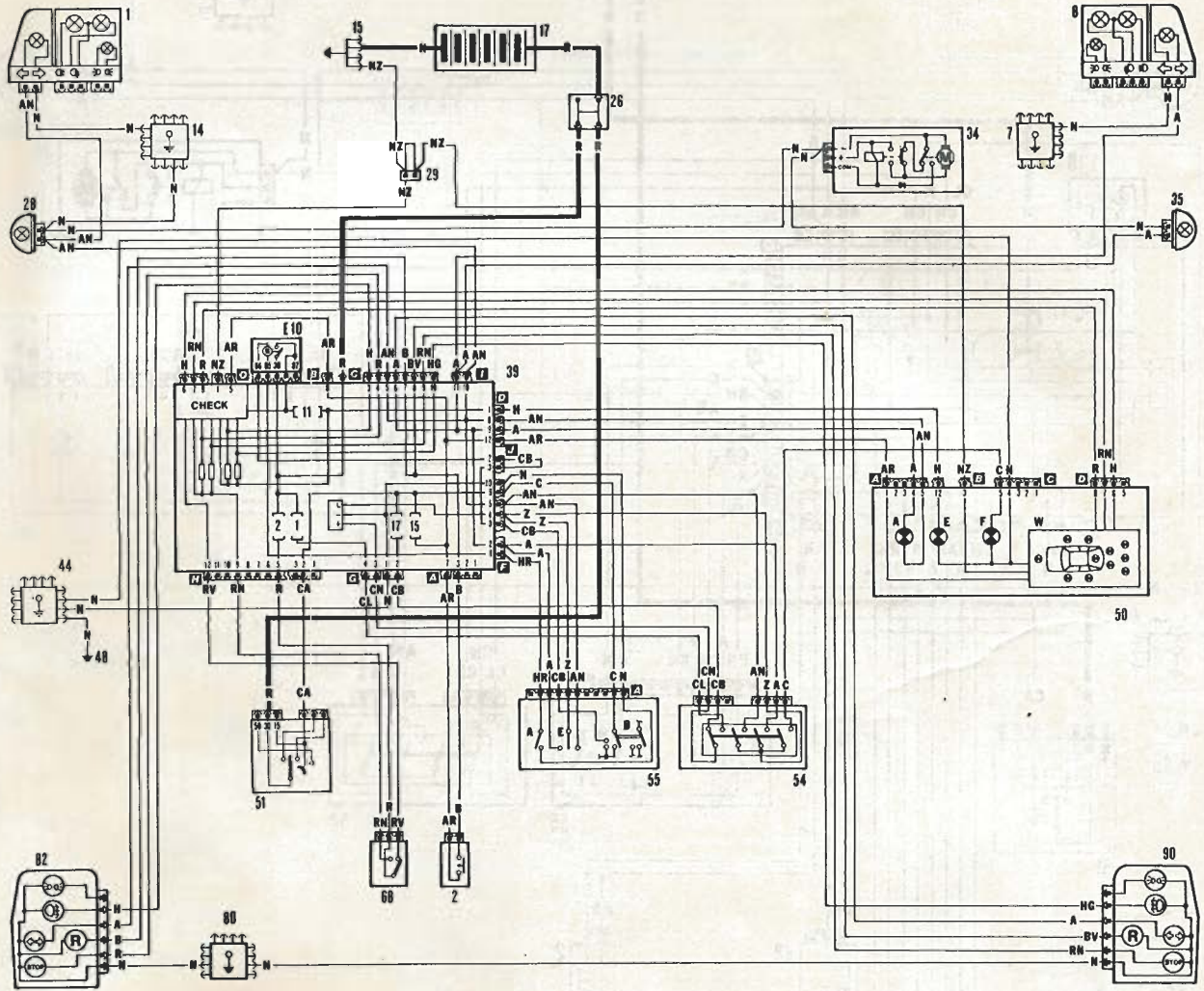




\* NZ on 1400

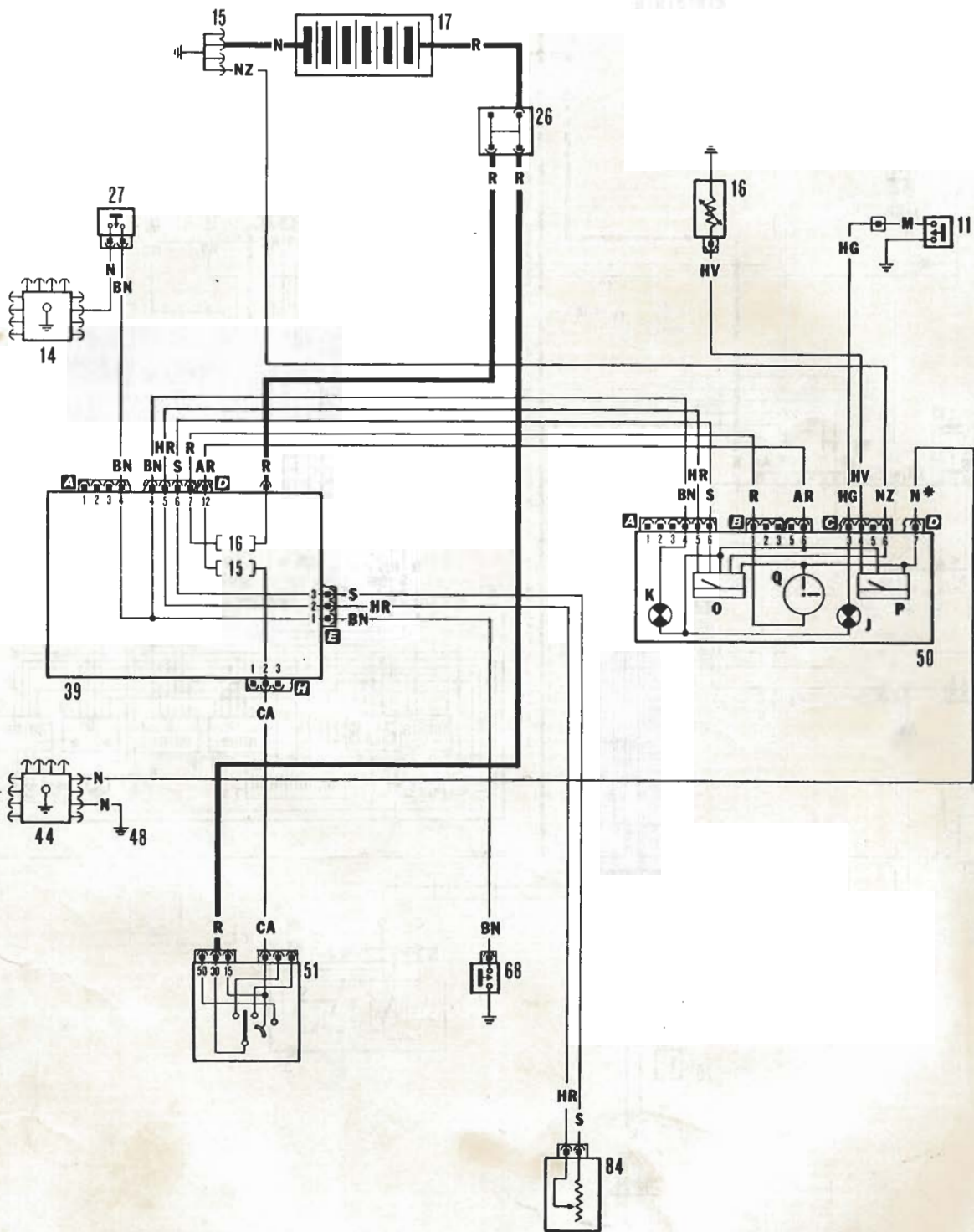
11.18 Wiring diagram - Rear foglamps, reversing lamps, direction indicator/hazard warning flasher lamps, brake lamps (1.4 litre non-DGT models)





11.19 Wiring diagram – Rear foglamps, reversing lamps, direction indicator/hazard warning flasher lamps, brake lamps (1.4 and 1.6 litre DGT models)

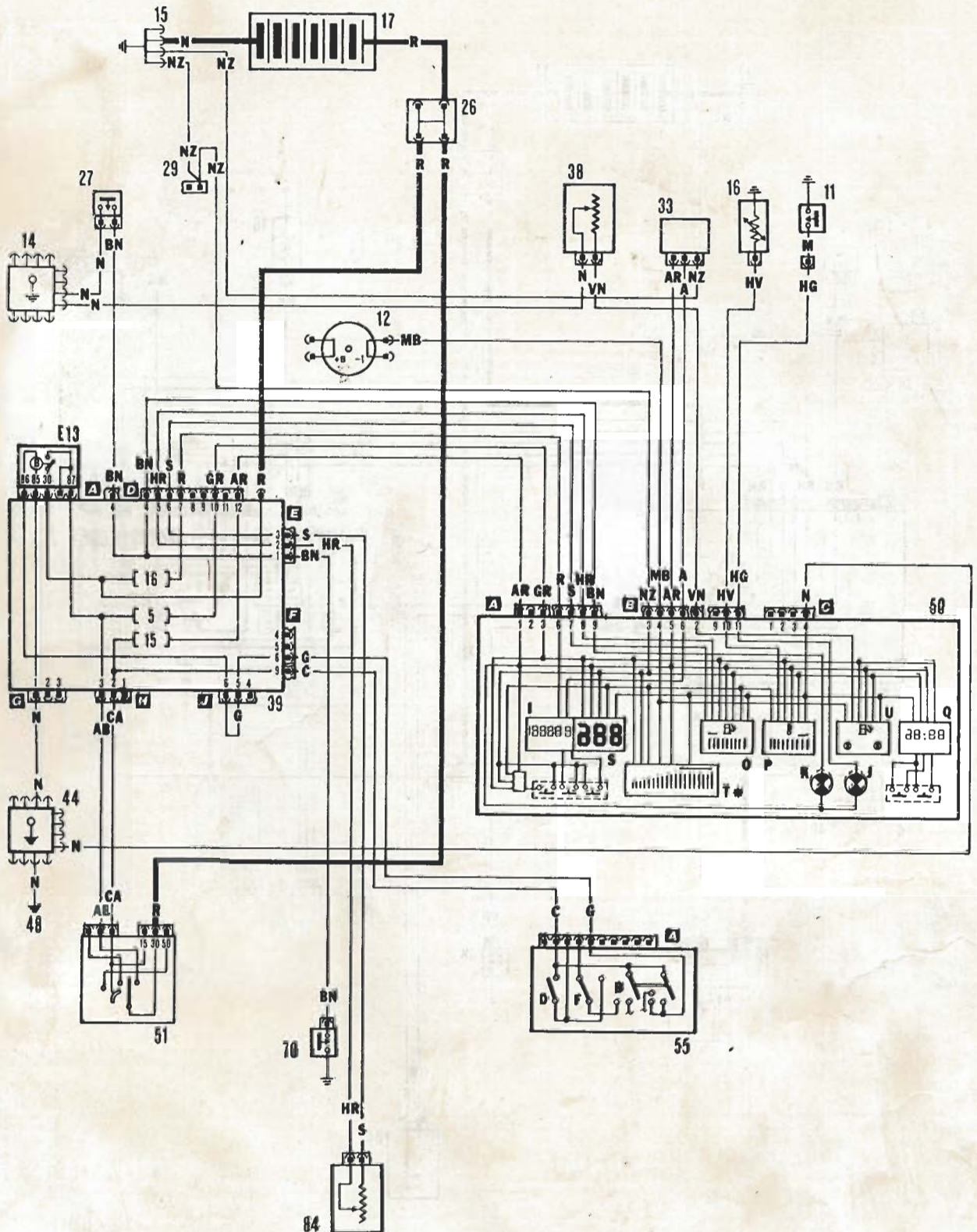




\* NZ on 1400

11.20 Wiring diagram - Fuel gauge, low brake fluid level and handbrake warning lamp, coolant temperature gauge, brake pad wear warning lamp, clock (1.4 litre non-DGT models)

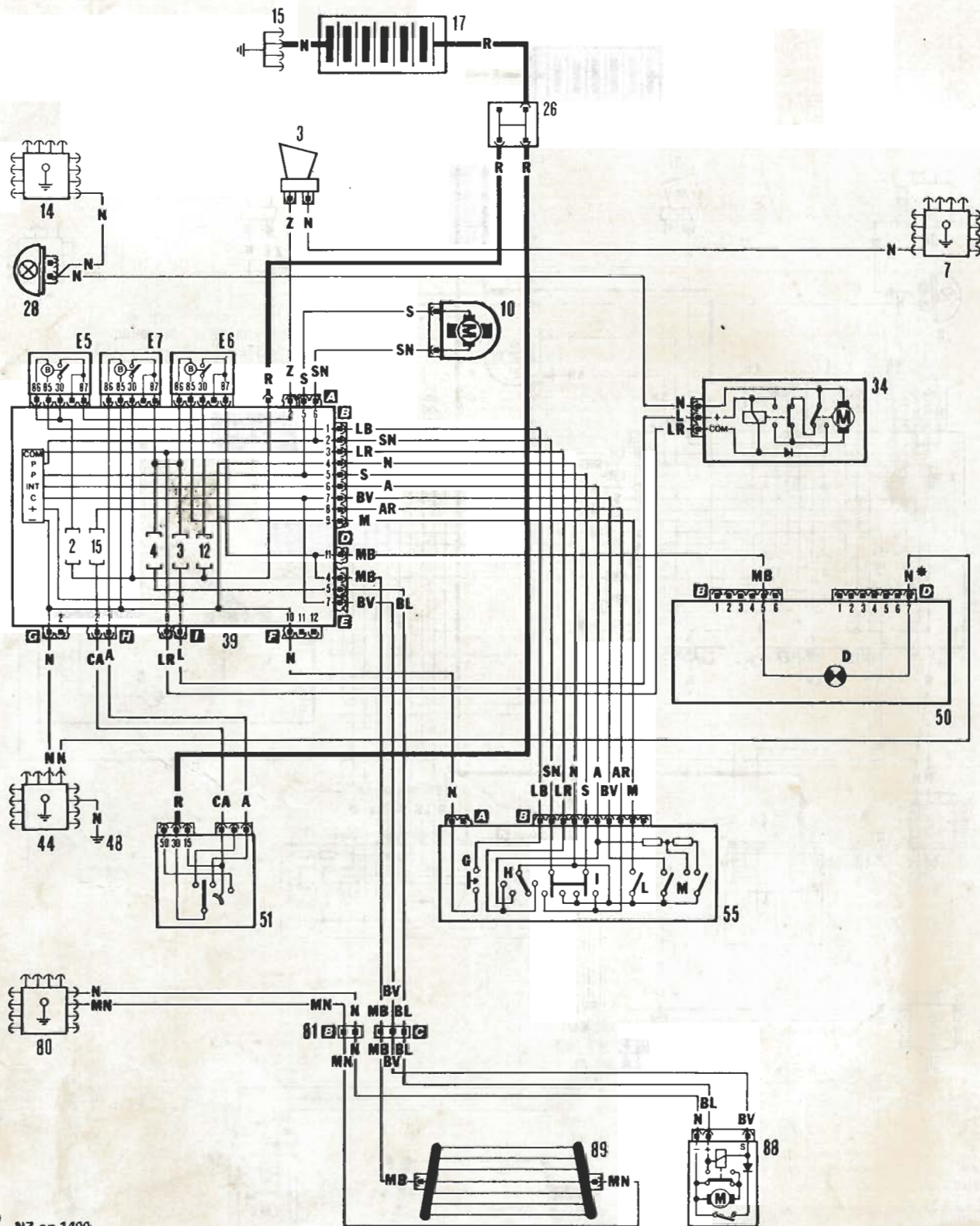




\* Digit 1400 - 1600

11.21 Wiring diagram - Fuel gauge, econometer, low brake fluid level and handbrake warning lamp, coolant temperature gauge, clock, speedometer, tachometer, instrument panel illumination (1.4 and 1.6 litre DGT models)

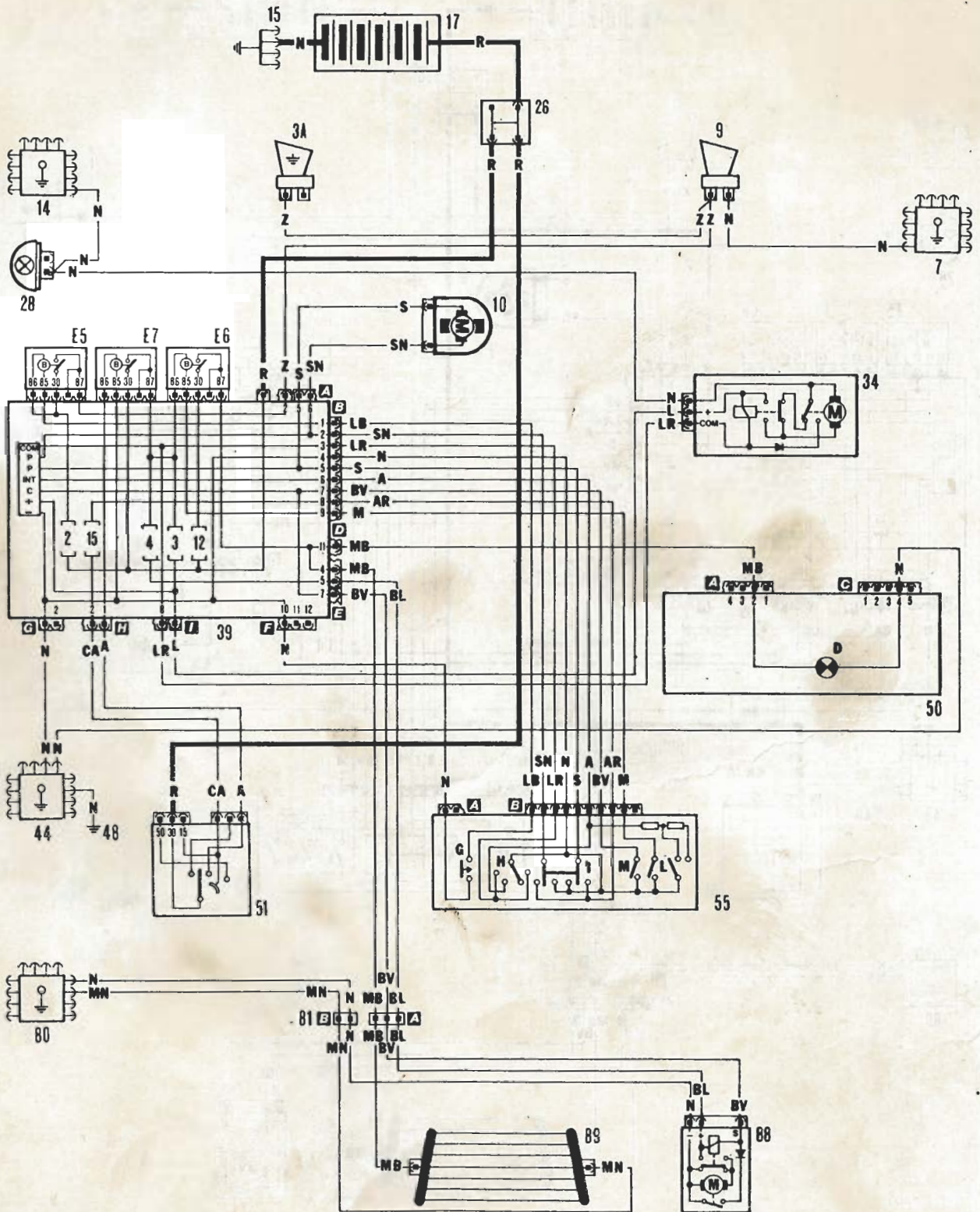




\* NZ on 1400

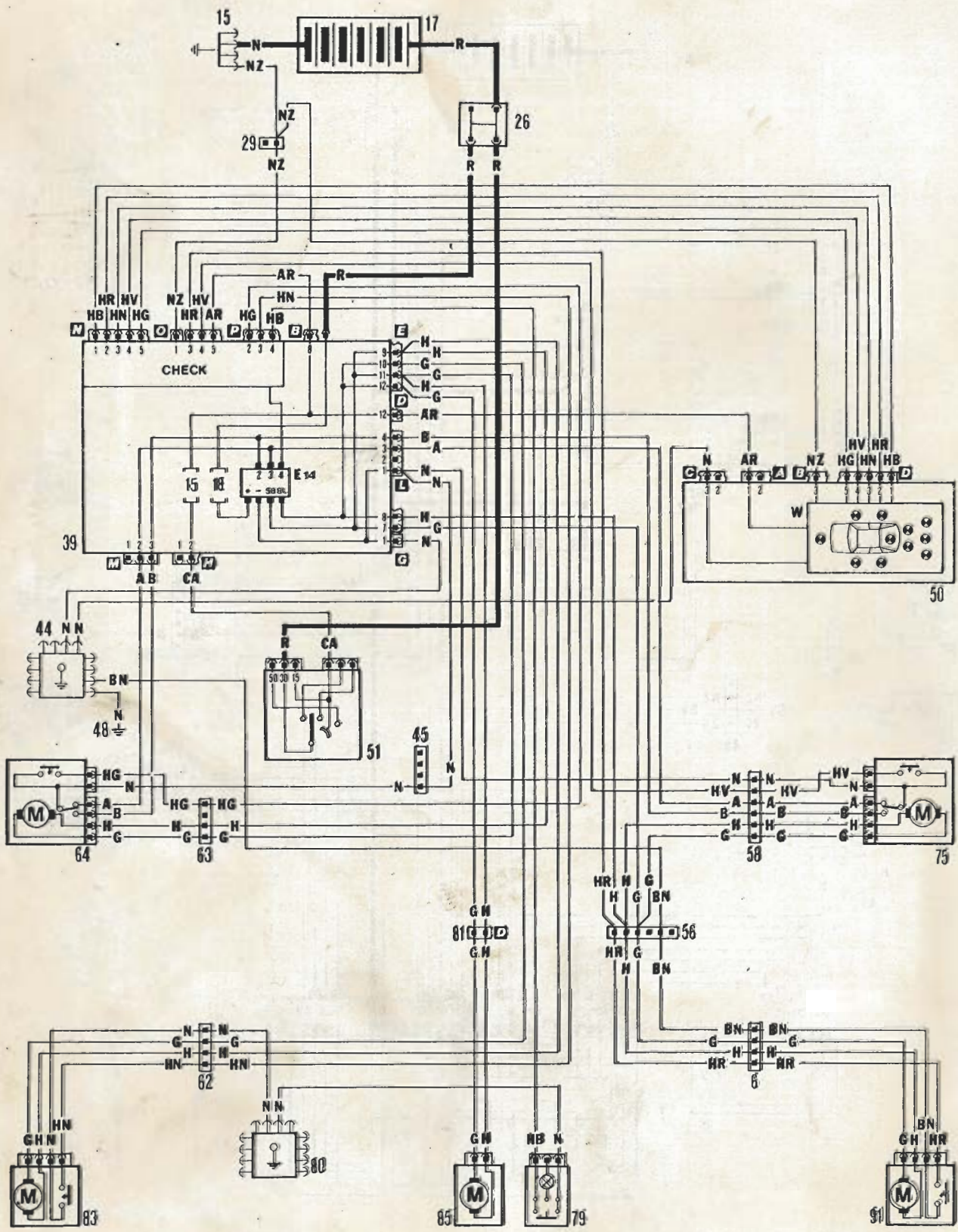
11.22 Wiring diagram – Horn, heated rear window, windscreen wipers, tailgate wiper, windscreen and tailgate washer fluid pumps (1.4 litre non-DGT models)





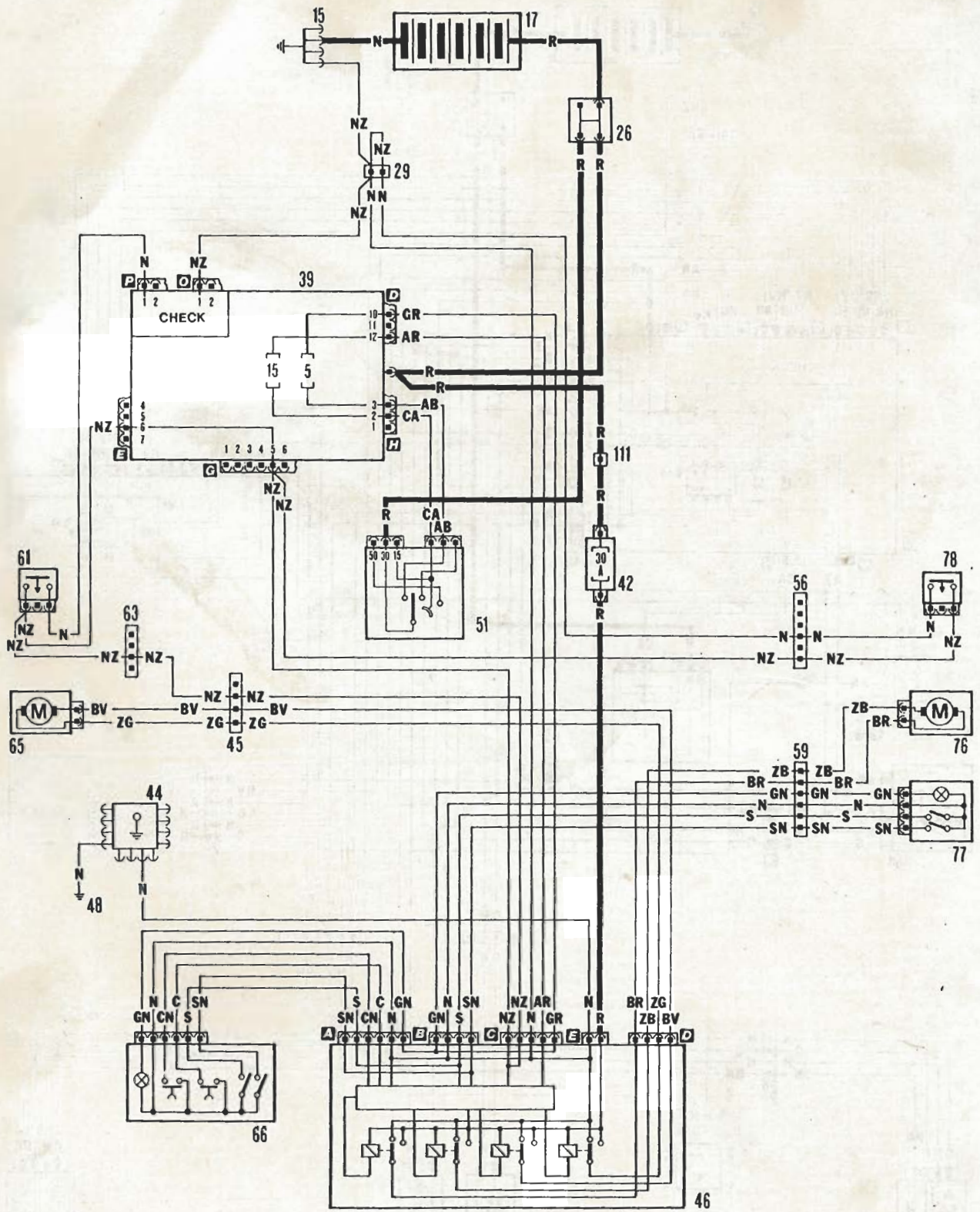
11.23 Wiring diagram - Horn, heated rear window, windscreen wipers, tailgate wiper, windscreen and tailgate washer fluid pumps (1.4 and 1.6 litre DGT models)





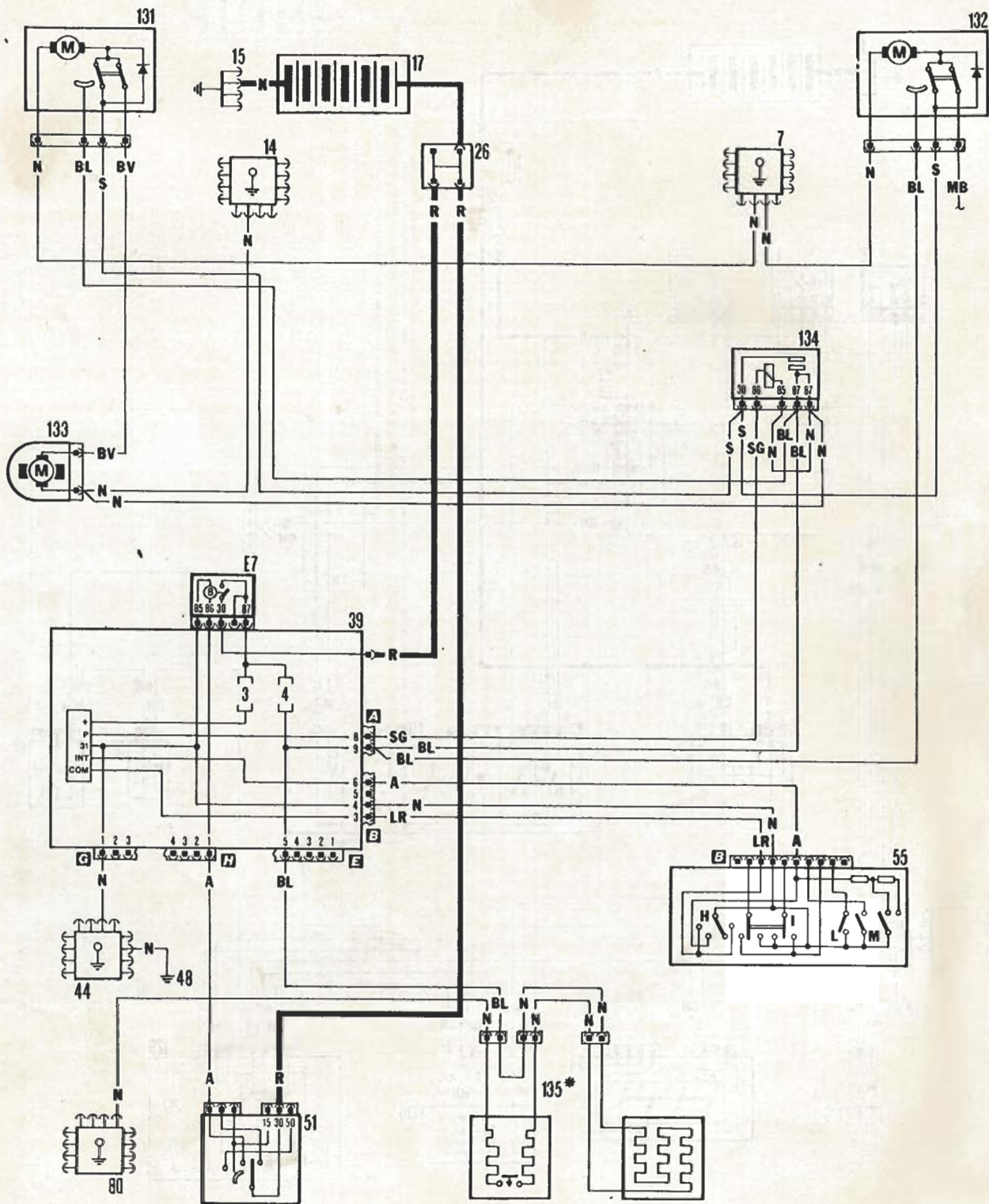
11.24 Wiring diagram - Central door locking system, door ajar warning system (1.4 and 1.6 litre DGT models)





11.25 Wiring diagram - Electric windows system (1.4 and 1.6 litre DGT models)





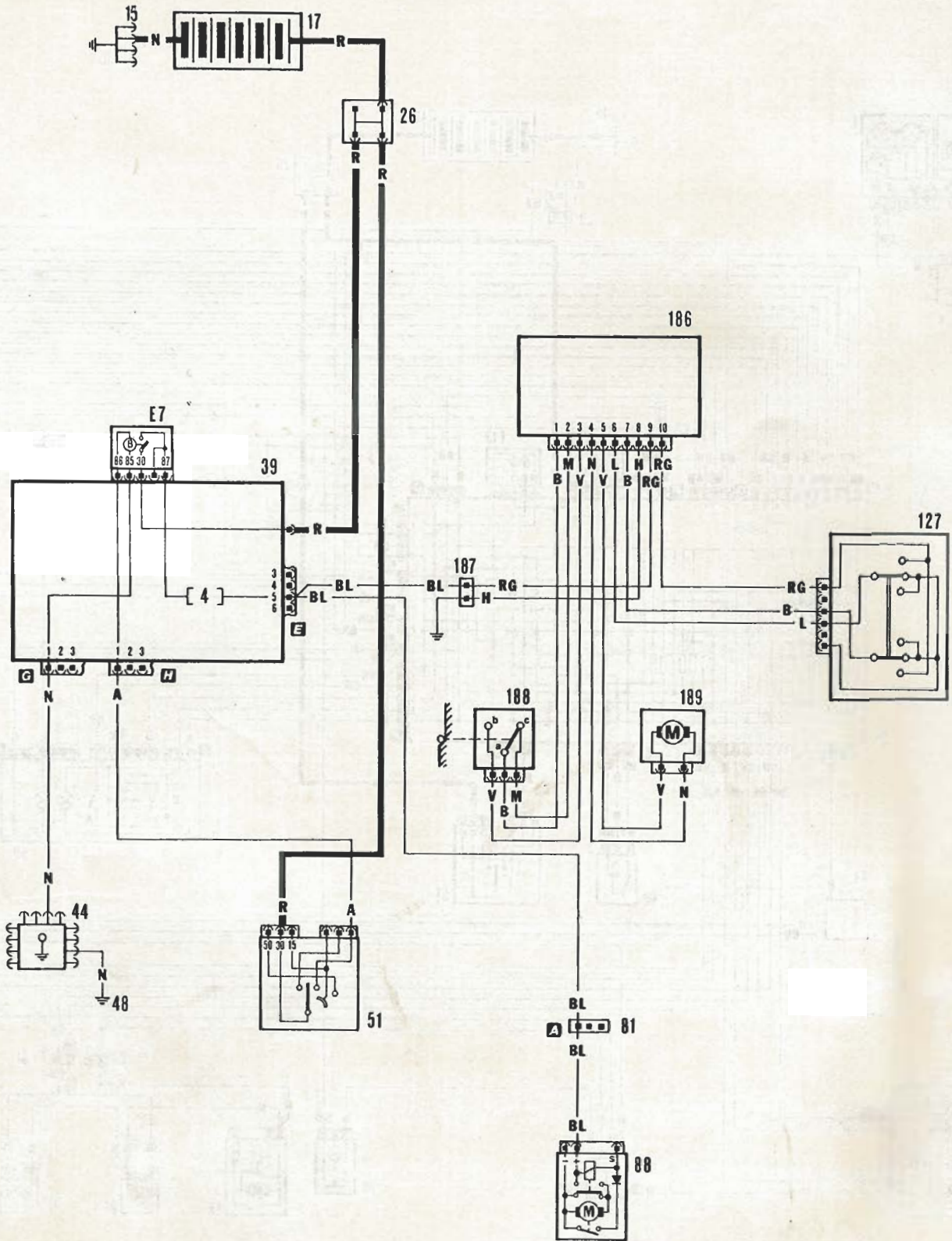
\* SWEDISH versions only

11.26 Wiring diagram - Headlamp wash/wipe, heated driver's seat (1.4 and 1.6 DGT models)



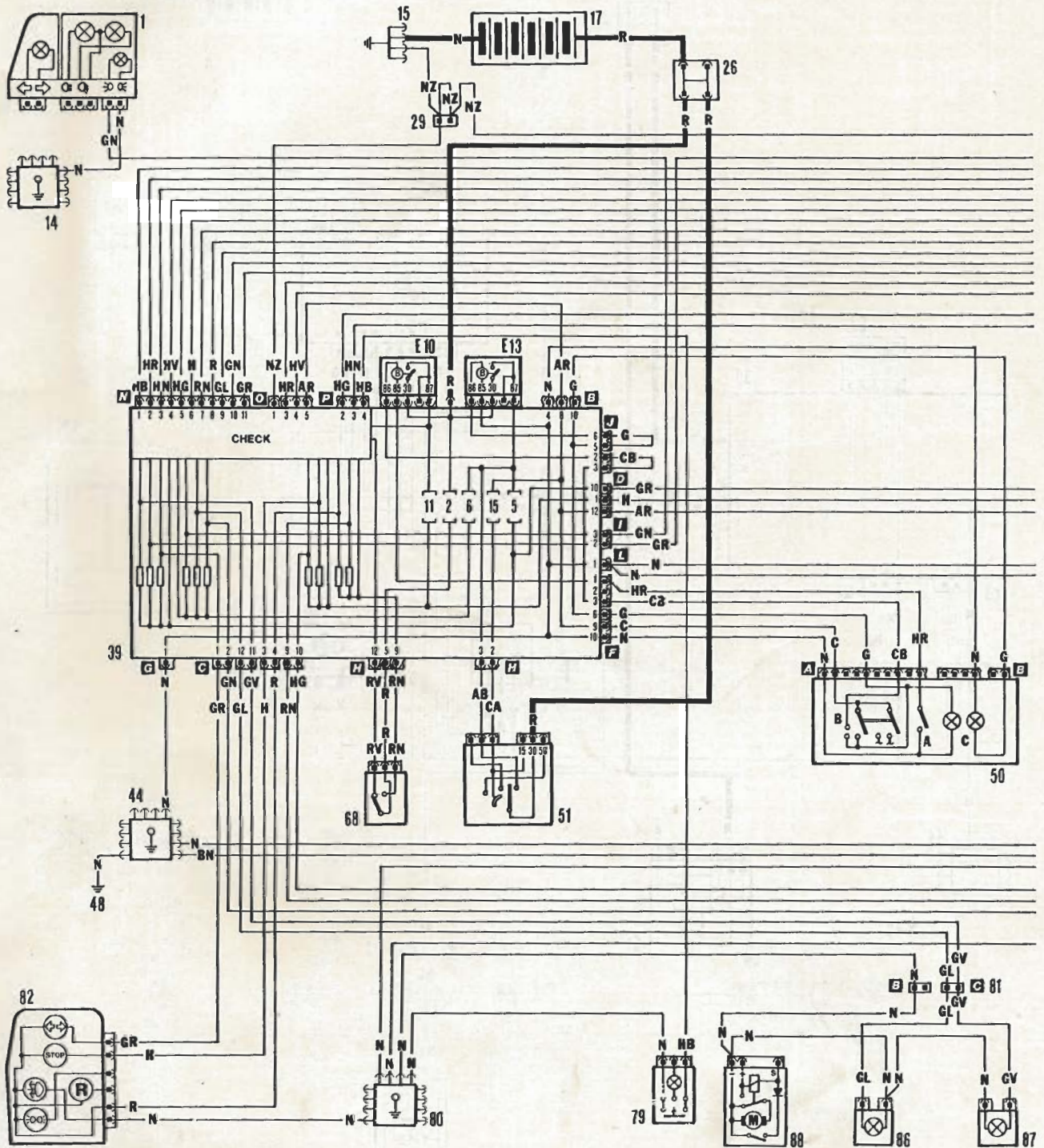






11.28 Wiring diagram - Sunroof (1.4 and 1.6 litre DGT models)

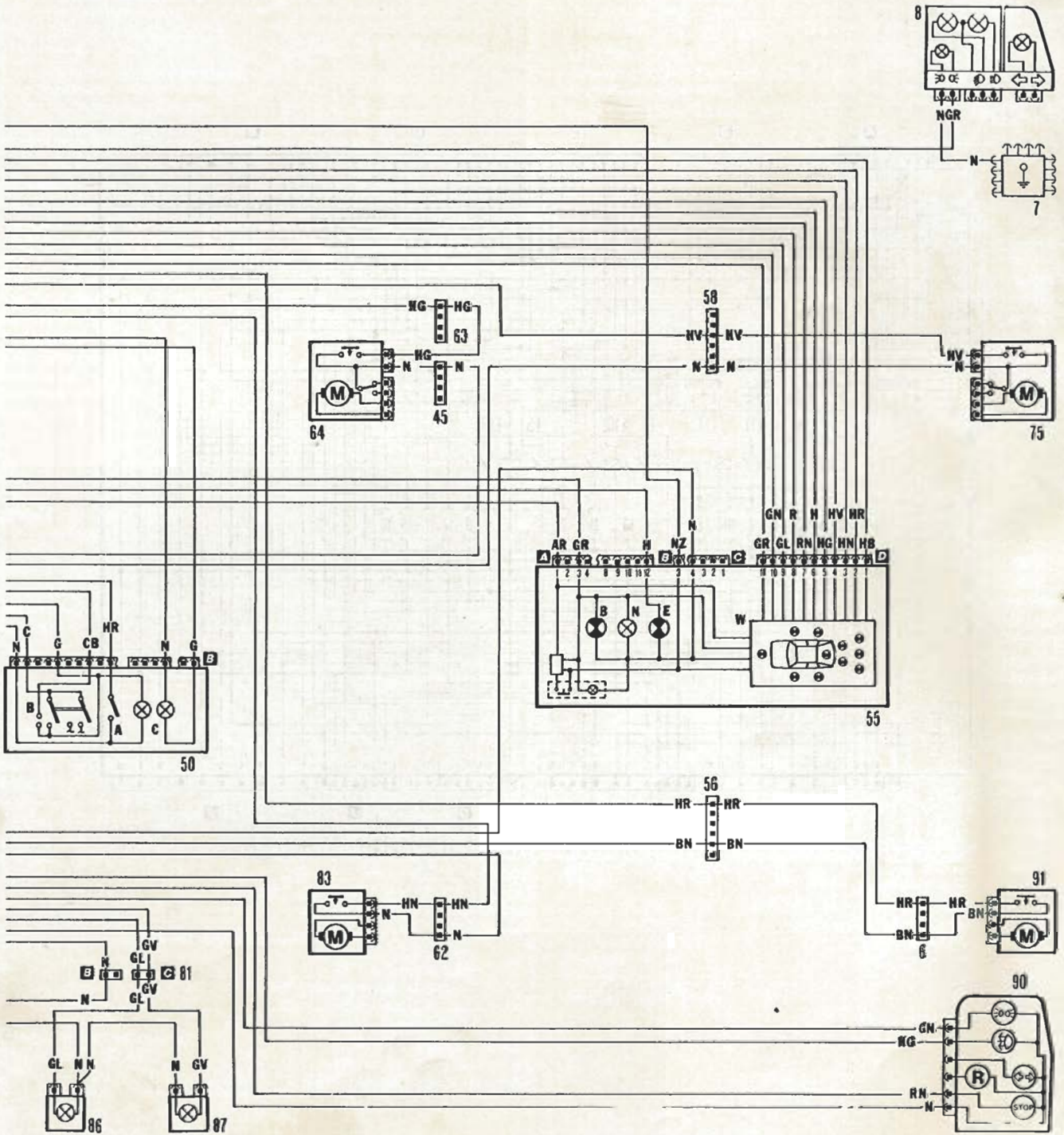




1100i Drgset

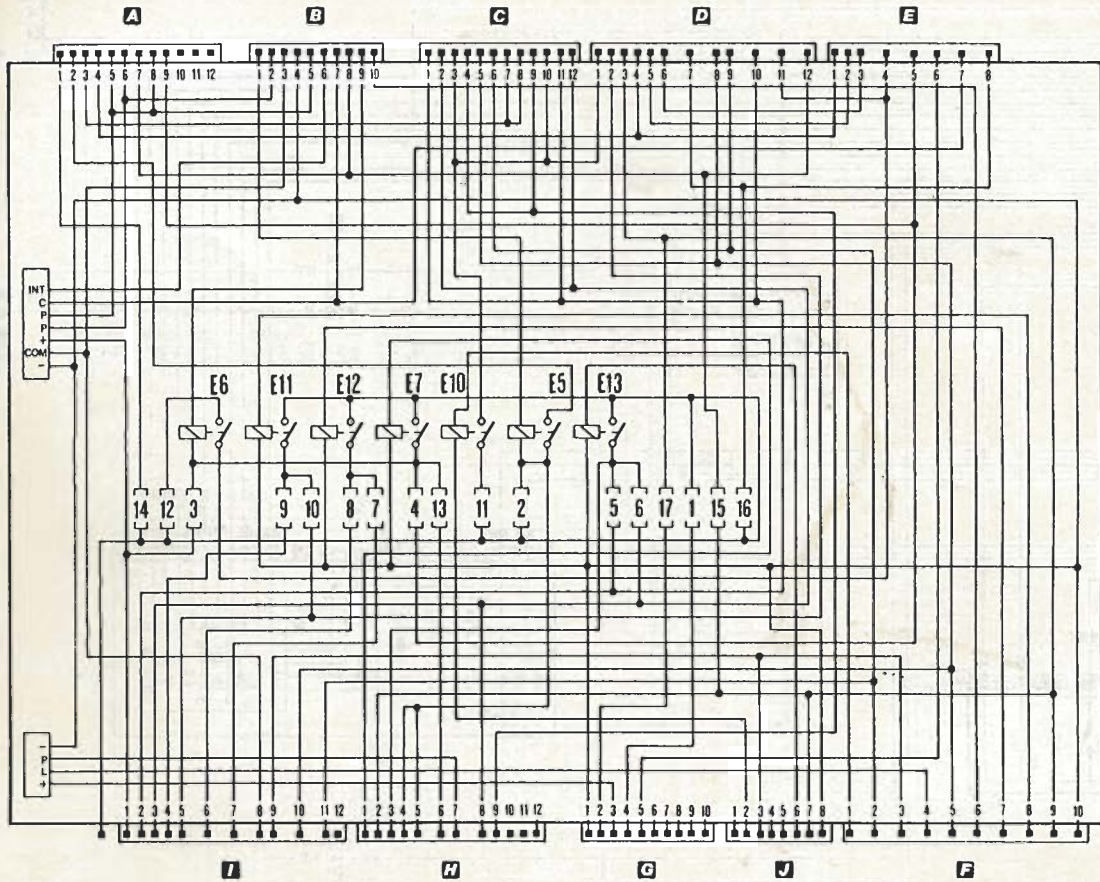
11.29 Wiring diagram - Check control system (1.4 and 1.6 litre DGT models)





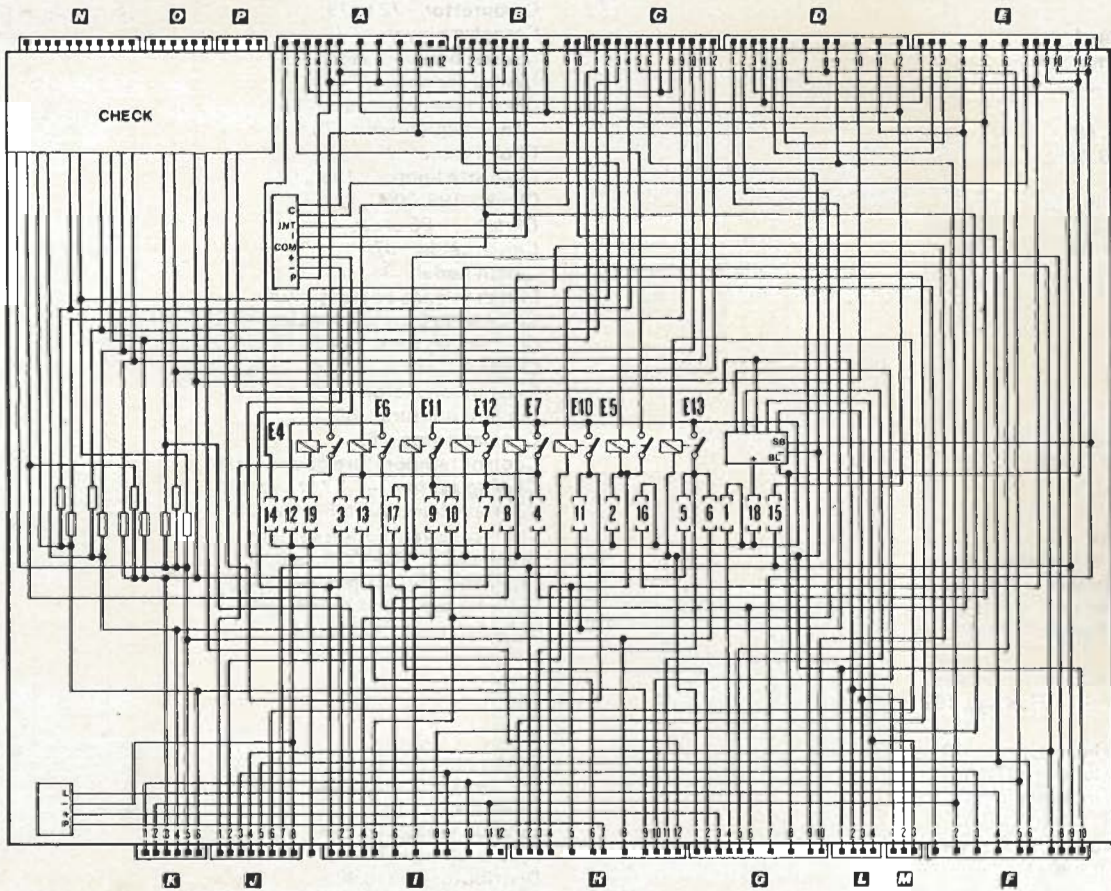
11.29 Wiring diagram - Check control system (1.4 and 1.6 litre DGT models) (continued)





11.30 Wiring diagram - Wiring junction/fuse/relay box (1.4 litre non-DGT models)





11.31 Wiring diagram - Wiring junction/fuse/relay box (1.4 and 1.6 litre DGT models)



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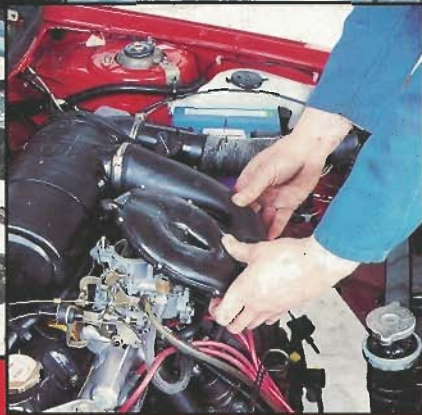
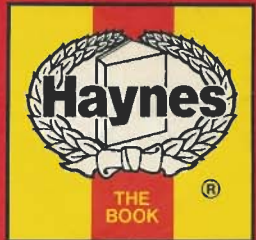
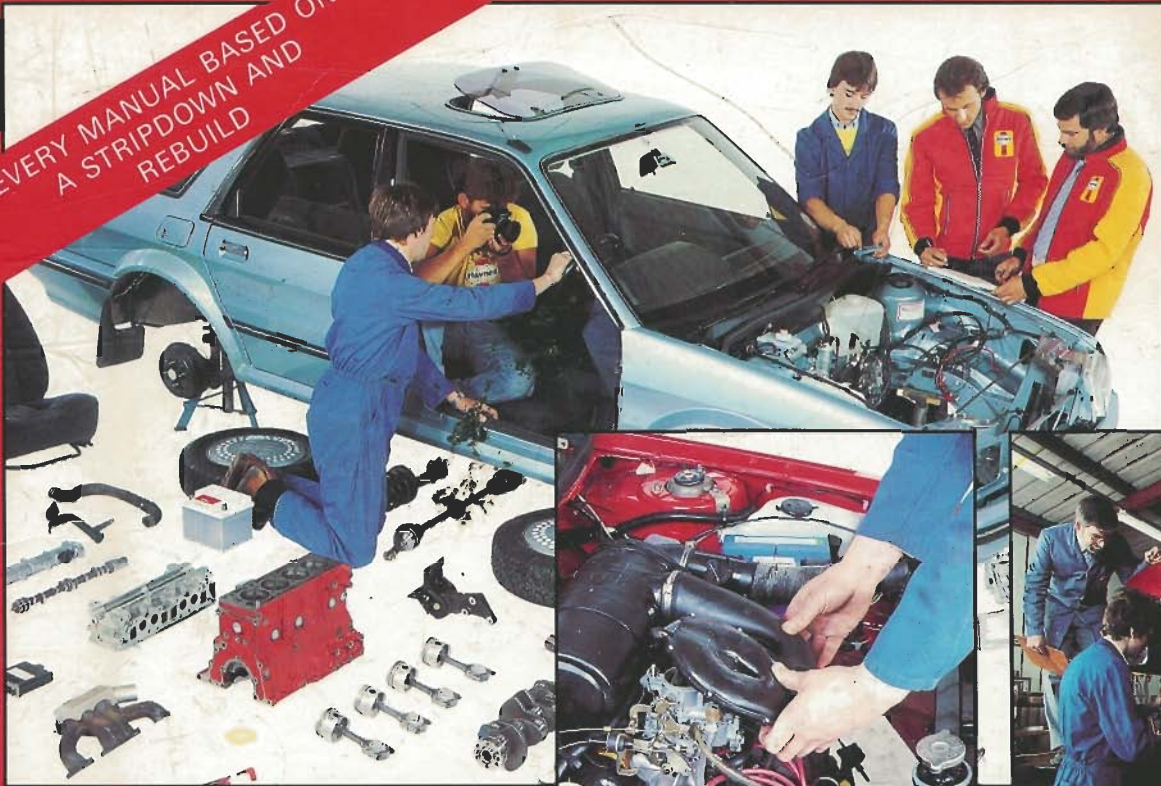
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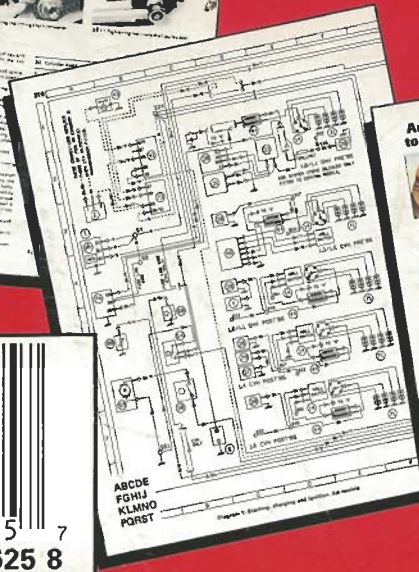
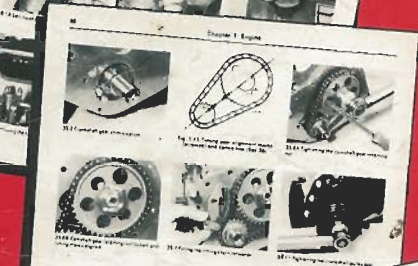
## Models covered by this Manual

All FIAT Tipo models with 1.4 litre and 1.6 litre petrol engines and manual transmissions, including special/limited editions; 1372 cc & 1580 cc

Does not cover 1756 cc DOHC petrol engine (1.8 ie), Diesel engine or automatic transmission (Selecta) models

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