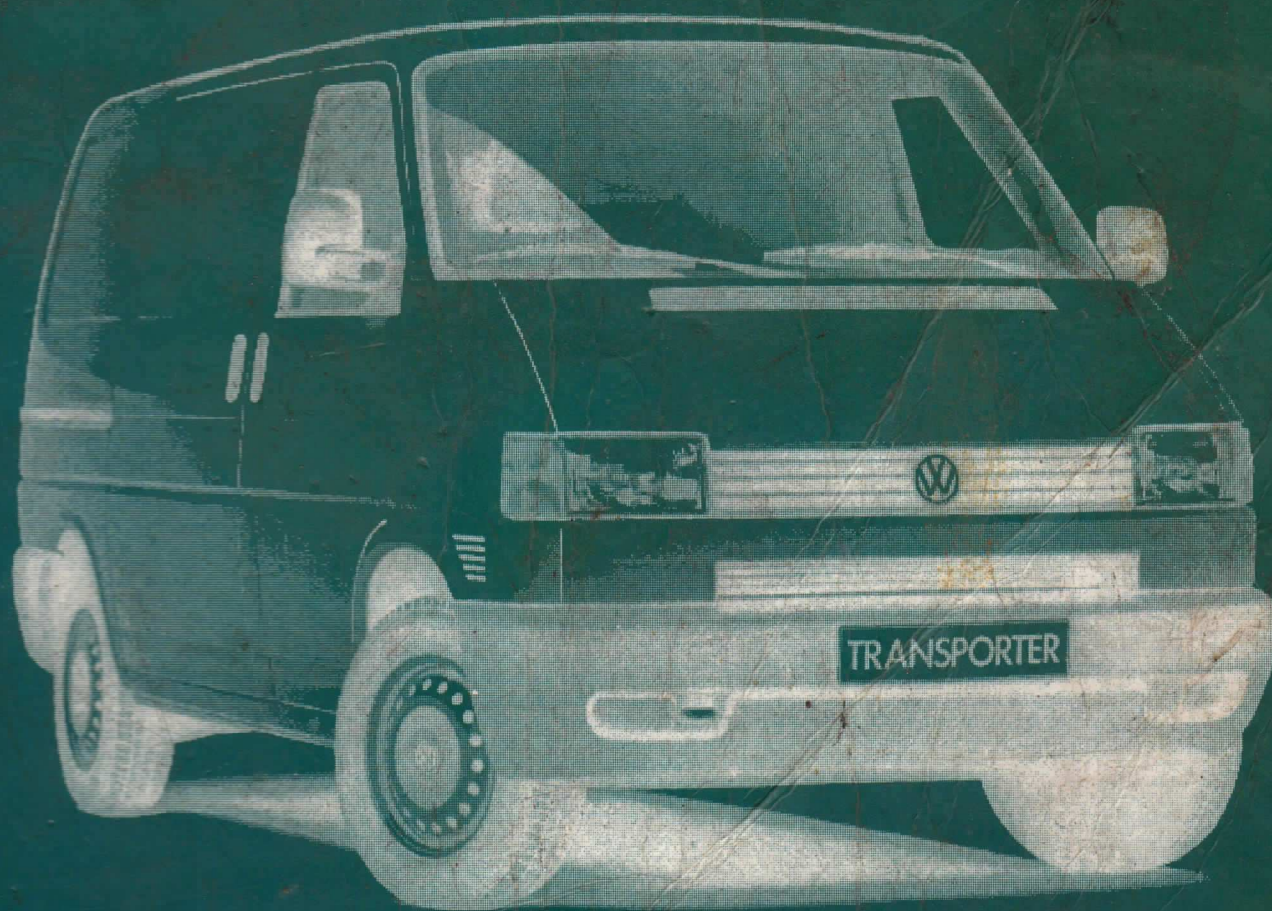


**VW**

# **VOLKSWAGEN TRANSPORTER T4 WORKSHOP MANUAL**

*( Powered by 2.0 & 2.5 petrol and 1.9 & 2.4 diesel engines)*

**Petrol & Diesel models - 1990 to 1995**



**OWNERS EDITION**



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**(Powered by 2.0 & 2.5 petrol and 1.9 & 2.4 diesel engines)**

**Petrol & Diesel models - 1990 to 1995**

**OWNERS' EDITION**

**COVERING**

**SHORT & LONG WHEELBASE • VAN • CARAVELLE • BUS  
2.0 & 2.5L PETROL AND 1.9 & 2.4L DIESEL ENGINES  
MANUAL TRANSMISSION & DRIVE SHAFTS • CLUTCH  
FUEL, IGNITION, LUBRICATION & COOLING SYSTEMS  
SUSPENSION • STEERING • BRAKING • ELECTRICS  
BODYWORK • PLUS WIRING DIAGRAMS**



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## FOREWARD

This Owners' Edition - Workshop Manual covers the VW Transporter Type 4 (T4) which was introduced in December 1990 fitted with 2.0 and 2.5 litre petrol engines and 1.9 and 2.4 litre diesel engines. It has been specially written for the practical owner who wants to maintain a vehicle in first-class condition and carry out the bulk of his or her own servicing and repairs. Comprehensive step-by-step instructions are provided for service and overhaul operations to guide the reader through what might otherwise be unfamiliar and complicated tasks. Numerous drawings are included to amplify the text.

With the aid of this manual, many aspects of service, overhaul and repair are within the scope of an owner with a reasonable degree of mechanical aptitude. Some operations however demand more skill. Other jobs require the use of special tools and in some cases testing facilities and techniques that are not generally available. Only you can judge whether a job is within your capabilities. We do however try to assist the reader to come to an informed decision. Whilst every effort has been made to ensure that the information provided is correct, it is obviously not possible to guarantee complete freedom from errors or omissions.

Information to be found in the driver's handbook is not necessarily duplicated here and it is not possible within this volume to cover every aspect to be found in the manufacturer's own workshop manual which is of much greater size and complexity. However, it should be consulted if more detailed information is needed.

Always remember that you are responsible for your own safety and that of others when working on a vehicle. Take particular care with safety-related systems like the brakes and steering, and seek professional advice if in any doubt. Never work under a vehicle unless it is properly supported (a single jack is not enough). Take care with power tools, also regard as potentially harmful fuel, lubricants, solvents and sealers which should always be and kept in labelled, sealed containers.

With care and common sense, the practical owner can make an excellent job of maintenance and overhaul. The benefits include money saved and the satisfaction of work well done. You will be adding to your knowledge, too: knowing more about the vehicle you own will help you to make logical decisions about what needs to be done, even if it does in some instances have to go into a professional repair shop.

The Volkswagen Transporter T4 is a vehicle that will respond to careful regular servicing and is built to a standard that will ensure a long life if this is remembered.



## 0. INTRODUCTION

### 0.0. General Information

This Manual covers the models in the Volkswagen Transporter range from 1990, generally referred to as Type T4 vehicles, with a choice of two water-cooled fuel injection engines or two diesel engines. The information in this manual is based on the original conception of the vehicle. The following engines are covered in this manual:

- The 2.0 litre fuel injection engine has the type designation "AAC". The engine has a performance of 62 kW (DIN) at 5200 rpm. A "Digifant" system, combining the fuel injection and ignition system, is fitted to the engine.
- The 1.9 litre diesel engine is a four-cylinder engine and has the type designation "1X". The engine has a performance of 45 kW at 3700 rpm.
- The 2.4 litre diesel engine is a five-cylinder engine and has the type designation "AAB". The engine has a performance of 57 kW at 3700 rpm.
- A further engine in the T4 range is a five-cylinder engine with fuel injection. This engine is covered in its own chapter, but is similar in construction to the 2.4 litre diesel engine, i.e. the crankcase, crankshaft and piston assemblies are of a similar design.

The front suspension consists of an upper and lower wishbones, torsion bars and a stabiliser bar (anti-roll bar), together with double-acting, hydraulic shock absorbers. The individual parts of the front suspension can be removed from the vehicle without dismantling the complete assembly. All parts of the front suspension are mounted to a strong crossmember, which can be removed as a complete unit in order to remove

the individual units, if major repairs are necessary.

The rear suspension consists of suspension arms with coil springs and hydraulic shock absorbers and a stabiliser (anti-roll) bar. The suspension arms are rubber-mounted on the chassis. The wheel hub carrier is bolted to the outside of the suspension arm. The connection to the rear drive shafts takes place at the inside of each rear wheel hub carrier.

A rack and pinion steering, fitted with power-assistance, is used.

Disc brakes at the front wheels and drum brakes at the rear wheels with a brake servo unit as standard fitment, make up the brake system.

A four-speed, a five-speed or an automatic transmission can be fitted to the vehicles covered in this manual.

With regards to the range of models covered in the manual it must be pointed out that not all of these will be available in any particular country and that the manufacturer reserves the right to make modifications to standard equipment, optional extras and trim as may be necessary for any territory.

Since the variations between certain models are only in fittings and trim it will be unnecessary in some parts of this manual to refer to individual model designations.

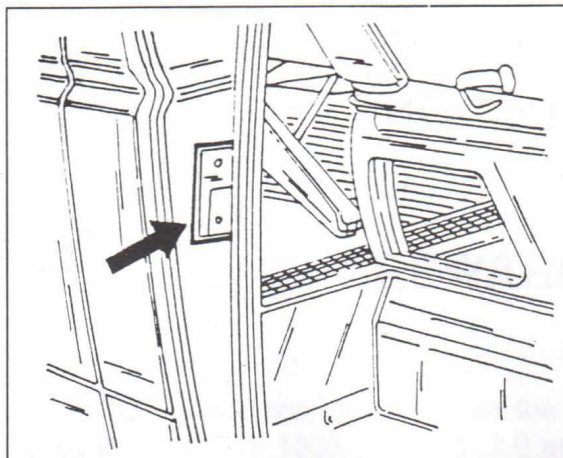
***Note: Always identify your engine by means of the code letters before ordering spare or replacement parts or carrying out any repairs. The chassis number is important for other parts of the vehicle.***

### 0.1. Identification

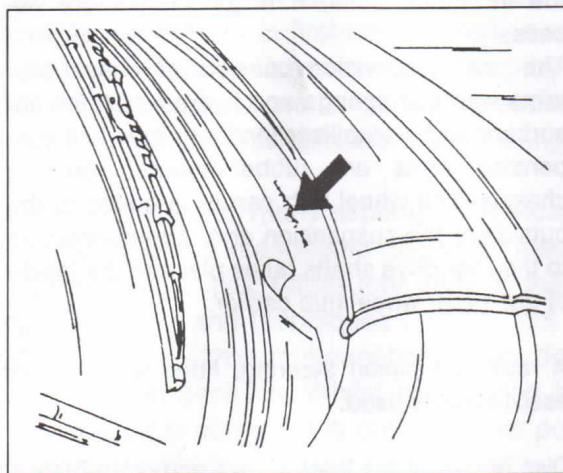
The type identification plate can be found near the front door pillar, close to the door striker plate, at the position shown in Fig. 0.1. The chassis number is stamped into the the right-hand side, below the windscreen, and is visible



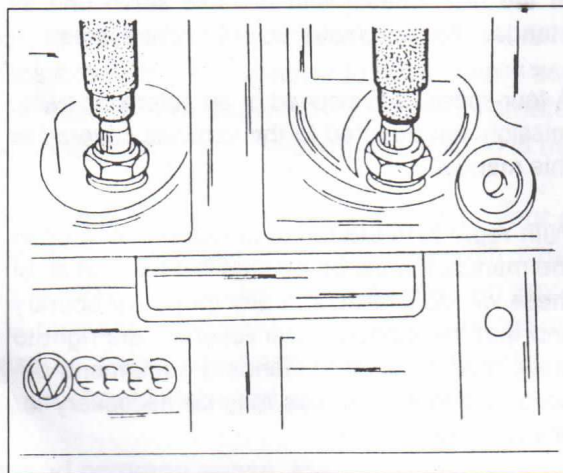
## 0 Introduction



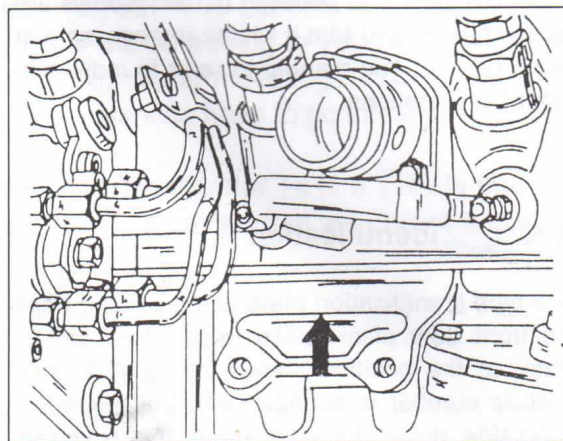
**Fig. 0.1.**  
The location of the type  
identification plate on the  
passenger side of the ve-  
hicle.



**Fig. 0.2.**  
The location of the vehicle  
identification number at the  
bottom of the windscreen.



**Fig. 0.3.**  
The location of the engine  
number on the petrol  
engine.



**Fig. 0.4.**  
The position of the engine  
number on the diesel  
engine.

from the outside of the vehicle (arrow, Fig. 0.2). The chassis number can have the following appearance:

WVW2 ZZZ 370 Z M H 00001

which relates to the following data:

- The first three letters with the "2" refer to the code letters of the manufacturer.
- The next three letters (ZZZ) are filler letters.
- The number "370" refers to the model designation.
- The single "Z" is a filler letter.
- The letter "M" refers to the model year, in this case 1991. Following model years are identified by subsequent letters.
- The "H" refers to the manufacturing plant in Germany.
- The last numbers are the actual serial number of the vehicle.

The engine number is stamped into the front of the cylinder block. In the case of the petrol engine the number is located below two of the spark plugs and gives the code letters of the engine and the actual engine serial number. The engine number is also shown on the timing belt cover and on a sticker, attached to the engine. Fig. 0.3 shows where the number can be found on this engine. The engine code is also given in the type identification plate on the door pillar.

The engine number of a diesel engine is stamped into the cylinder block between the injection pump and the vacuum pump, at the position shown in Fig. 0.4. Again the engine code and engine serial number are quoted. A sticker with the engine code and the engine number is attached to the upper timing belt cover.

These numbers are the essential information needed whenever spares or replacement parts are required. The vehicle manufacturer operates a policy of constant improvement and updating and it is only by quoting the vehicle and engine numbers that your dealer can provide you with the correct spares and replacements.

### 0.2. Dimensions (typical)

Wheelbase: ..... 2920 mm (116.0 in.)  
or 3320 mm (131.9 in.)

Front track:  
14" rims: ..... 1575 mm (62.6 in.)  
15" rims: ..... 1589 mm (63.13 in.)



## 0 Introduction

Rear Track:  
14" rims: .....1540 mm (61.2 in.)  
15" rims: .....1554 mm (62.75 in.)  
Min. ground clearance:  
Standard version: .....180 mm (7.15 in.)  
GTI version: .....160 mm (6.36 in.)

Turning circle:  
Short wheelbase: .....11.7 metres (38.6 ft.)  
Long wheelbase: .....12.9 metres (42.6 ft.)

### 0.3. Capacities

Engine Oil — Petrol Engine:  
Four-cylinder/Five-cylinder — Without filter: ....3.5 litres (6.1 Imp. pt.)/5.0 litres (8.77 Imp. pts.)  
— With filter: .....4.0 litres (7.0 Imp. pts.)/5.5 litres (9.7 Imp. pts.)  
Four-cylinder diesel engine — Without filter .....4.5 litres (8.00 Imp. pts.)  
— With filter: .....5.0 litres (8.75 Imp. pts.)  
Five-cylinder diesel engine — Without filter: .....5.0 litres (8.8 Imp. pts.)  
— With filter: .....5.5 litres (9.6 Imp. pts.)  
Manual transmission: .....2.0 litres (3.5 Imp. pts.)  
Automatic transmission: .....6.0 litres (10.4 Imp. pts.)  
Initial filling: .....3.0 litres (5.25 Imp. pts.)  
Fluid change: .....  
Differential and Final Drive: .....1.25 litres (2.2 Imp. pts.)  
Automatic: .....  
Cooling system: .....9.0 litres (2 Imp. gall.), all engines

### 0.4. General Servicing Notes

The servicing and overhaul instructions in this Workshop Manual are laid out in an easy-to-follow step-by-step fashion and no difficulty should be encountered if the text and diagrams are followed carefully and methodically. The "Technical Data" sections form an important part of the repair procedures and should always be referred to during work on the vehicle.

In order that we can include as much data as possible, you will find that we do not generally repeat in the text the values already given under the technical data headings. Again, to make the best use of the space available, we do not repeat at each operation the more obvious steps necessary — we feel it to be far more helpful to concentrate on the difficult or awkward procedures in greater detail. However, we summarise below a few of the more important procedures and draw your attention to various points of general interest that apply to all operations.

Always use the torque settings given in the various main sections of the manual. These are grouped together in separate sub-sections for convenient reference.

Bolts and nuts should be assembled in a clean

and very lightly oiled condition and faces and threads should always be inspected to make sure that they are free from damage, burrs or scoring. DO NOT degrease bolts or nuts.

All joint washers, gaskets, tabs and lock washers, split pins and "O" rings must be replaced on assembly. Oil seals will, in the majority of cases, also need to be replaced, if the shaft and seal have been separated. Always lubricate the lip of the seal before assembly and take care that the seal lip is facing the correct direction.

References to the left-hand and right-hand sides are always to be taken as if the observer is at the rear of the vehicle, facing forwards, unless otherwise stated.

Always make sure that the vehicle is adequately supported, and on firm ground, before commencing any work on the underside of the car. A small jack or a make shift prop can be highly dangerous and proper axle stands are an essential requirement for your own safety.

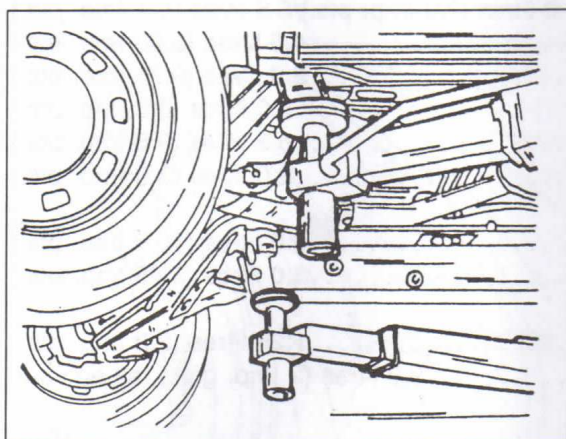
Dirt, grease and mineral oil will rapidly destroy the seals of the hydraulic system and even the



## 0 Introduction

smallest amounts must be prevented from entering the system or coming into contact with the components. Use clean brake fluid or one of the proprietary cleaners to wash the brake hydraulic system parts. An acceptable alternative cleaner is methylated spirit, but if this is used, it should not be allowed to remain in contact with the rubber parts for longer than necessary. It is also important that all traces of the fluid should be removed from the system before final assembly.

Always use genuine manufacturer's spares and replacements for the best results.



**Fig. 0.5.**  
Jacking up the front end of the vehicle. The illustration shows a garage-type jack, but a mobile or hydraulic jack is applied at the same position.

Since the manufacturer uses metric units when building the cars it is recommended that these are used for all precise units. Inch conversions are given in most cases but these are not necessarily precise conversions, being rounded off for the unimportant values.

Removal and installation instructions, in this Workshop Manual, cover the steps to remove or replace the unit or part in question. Other instructions, usually headed "Servicing", will cover the dismantling and repair of the unit once it has been stripped from the vehicle. It is pointed out that the major instructions cover a complete overhaul of all parts but, obviously, this will not always be necessary and should not be carried out needlessly.

There are a number of variations in unit parts on the range of vehicles covered in this Workshop Manual. We strongly recommend that you take care to identify the precise model, and the year of manufacture, before obtaining any spares or replacement parts.

**Std.:** To indicate sizes and limits of components as supplied by the manufacturer. Also to indicate the production tolerances of new unused parts.

**O/S** Parts supplied as Oversize or Undersize,

**U/S** or recommended limits for such parts, to enable them to be used with worn or re-machined mating parts. **O/S** indicates a part that is larger than Std. size. **U/S** may indicate a bore of a bushing or female part that is smaller than Std.

**Max.:** Where given against a clearance or dimension indicates the maximum allowable. If in excess of the value given it is recommended that the appropriate part is fitted.

**TIR:** Indicates the Total Indicator Reading as shown by a dial indicator (dial gauge).

**HT:** High Tension (ignition) wiring or terminals.

**TDC:** Top Dead Centre (No. 1 piston on firing stroke).

**MP:** Multi-Purpose grease.

### 0.5. Jacking up of the Vehicle

For small jobs, jack up the vehicle as described in the Owner's Manual, with the jack supplied in the vehicle. If a mobile jack is used, make sure it can be inserted between the lowest point of the vehicle and the ground. If necessary, use the vehicle jack to lift the vehicle slightly, until the mobile jack can be inserted. Due to the construction of the vehicle, a mobile jack and/or chassis stands should only be placed under the vehicle as follows, noting that a piece of rubber or wood should always be inserted between the jack head and the jacking point to protect the part in question.

Never apply a mobile jack or a hydraulic jack underneath the engine oil sump, the transmission, the rear axle, the front axle or underneath the front crossmember, as these parts or surrounding parts can either be damaged or distorted.

The recommendation is to first jack up one side of the vehicle, placing a chassis stand underneath the body and then jacking up the other side.

To jack-up the front of the vehicle, place the jack underneath the crossmember at the position shown in Fig. 0.5. Chock the front and rear wheels on the other side of the vehicle with a brick, to prevent the vehicle from rolling off the jack. Also apply the handbrake.

To jack up the rear end of the vehicle, place the jack head underneath the mounting bracket of the rear suspension arm, as shown in Fig. 0.6. Engage a

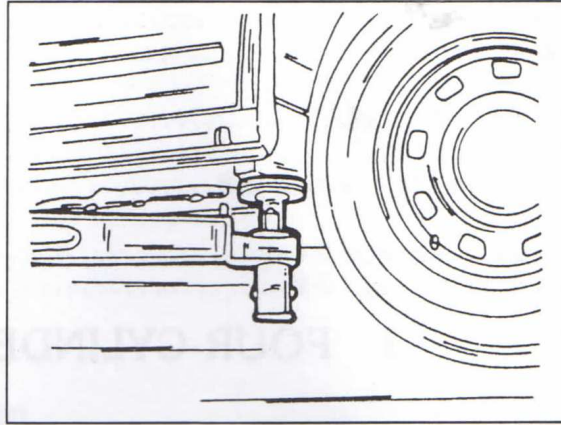


## 0 Introduction

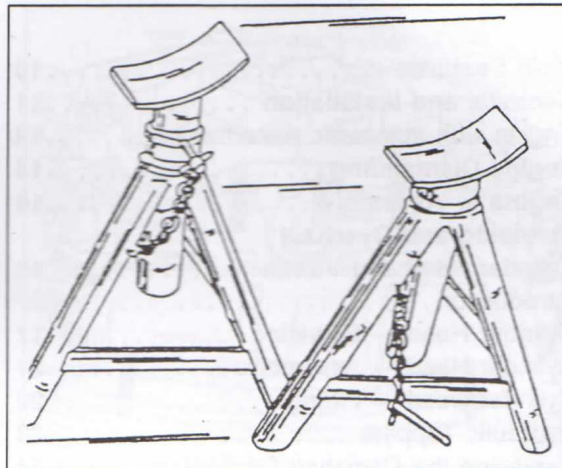
gear and chock the front and rear wheels on the other side. Also apply the handbrake.

Strong chassis stands must be placed underneath the sides of the body. The bolt, used for the height adjustment of the stands (Fig. 0.7) must be strong enough to carry the weight of the vehicle — remember this — make-shift bolts of small diameter will not do.

*It is always difficult to raise a vehicle first on one side and then on the other. Take care that the vehicle cannot tip-over when the first side is lifted. Ask a helper to support the vehicle from the other side.*



**Fig. 0.6.** Jacking up the rear end of the vehicle. The illustration shows a garage-type jack, but a mobile or hydraulic jack is applied at the same position.



**Fig. 0.7.** "Three-legged" axle or chassis stands are a "must" when supporting the vehicle during operations underneath.



# 1 FOUR-CYLINDER PETROL ENGINE

## Index

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## 1.0. Main Features

|                       |                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type:                 | 4-cylinder, in-line, water cooled engine. Distributor drive from auxiliary shaft. Engine fitted transversely to the front of the vehicle.             |
| Valve gear:           | Overhead camshaft, timing belt drive to camshaft and auxiliary shaft. Camshaft operating directly onto inverted bucket-type tappets (hydraulic type). |
| Engine Details:       |                                                                                                                                                       |
| Engine code:          | AAC                                                                                                                                                   |
| Max. power:           | 62 kW (85 BHP) at 5200 rpm                                                                                                                            |
| Max. torque:          | 12.7 kgm (91 ft.lb.) at 2600 rpm                                                                                                                      |
| Bore and stroke:      | 82.5 x 92.8 mm (3.2777 x 3.6869 in.)                                                                                                                  |
| Compression ratio:    | 8.8 : 1                                                                                                                                               |
| Valve Timing:         |                                                                                                                                                       |
| Inlet valve opens:    | 3° before top dead centre                                                                                                                             |
| Inlet valve closes:   | 19° after bottom dead centre                                                                                                                          |
| Exhaust valve opens:  | 27° before bottom dead centre                                                                                                                         |
| Exhaust valve closes: | 5° after top dead centre                                                                                                                              |
| Fuel supply:          | "Digifant" fuel injection system                                                                                                                      |



# 1 Four-cylinder Petrol Engine

|                                             |                               |
|---------------------------------------------|-------------------------------|
| Firing order: .....                         | 1—3—4—2                       |
| Idle speed: .....                           | 880 ± 50 rpm                  |
| CO Content:                                 |                               |
| With Lambda probe (oxygen sensor): .....    | 0.7 ± 0.2 %                   |
| Without Lambda probe (oxygen sensor): ..... | 1.0 ± 0.5 %                   |
| Ignition timing point: .....                | See Section "Ignition System" |
| Oil Pressure:                               |                               |
| Min.: .....                                 | 1.0 kg/sq.cm. (14.2 psi.)     |
| Max.: .....                                 | 7.0 kg/sq.cm. (99.6 psi.)     |

## 1.1. Engine — Removal and Installation

The engine is removed together with the transmission from below the vehicle. A strong mobile jack must be available. VW workshops use a special device to guide the engine. As this will obviously not be available to the average D.I.Y. man, we recommend that a helper holds the engine on the jack whilst it is lowered.

Before the engine is removed, it is necessary to tilt the radiator and the bonnet lock carrier towards the front. This operation will also be necessary for various maintenance and service operations and the following description will be referred to at various stages when required.

- From underneath the vehicle unscrew the noise dampening panels. To do this, unscrew the screws and nuts shown in Fig. 1.1, unlock the locking lever, lower the panel assembly and take it out of its mountings. Tighten the screws and nuts to 0.9 kgm (7 ft.lb.) during installation.

- To tilt the radiator towards the front, in the direction shown by the arrow in Fig. 1.2, remove the two screws (1) on the L.H. and R.H. side and then pivot the radiator and the lock plate towards the front. Lock the lock carrier plate in position.

The removal of the engine can now proceed as follows:

- Disconnect the battery terminals. The battery can now be removed from the vehicle since this will avoid any possibility of damage or inadvertent short-circuiting.

- Place the heater operating lever into the "Warm" position and remove the cap from the expansion tank. The engine must be cold. Observe the necessary precautions if the engine is hot.

- Drain the cooling system. To do this, refer to Fig. 1.3 and slacken the hose clips securing the

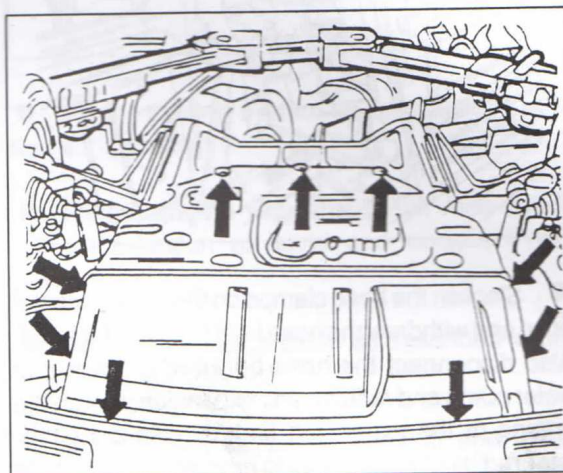


Fig. 1.1.  
The arrows show where the noise dampening panel is secured underneath the vehicle.

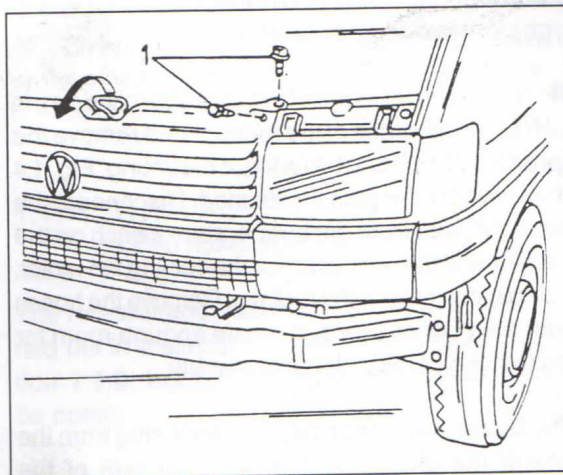


Fig. 1.2.  
After removal of the screws (1) on each side of the vehicle, tilt the complete front end of the vehicle in the direction of the arrow.

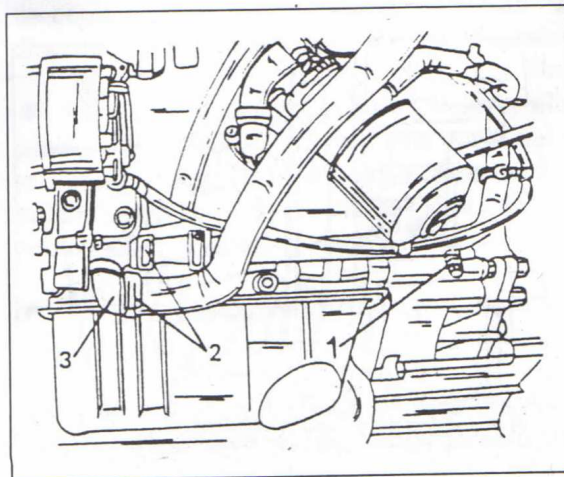
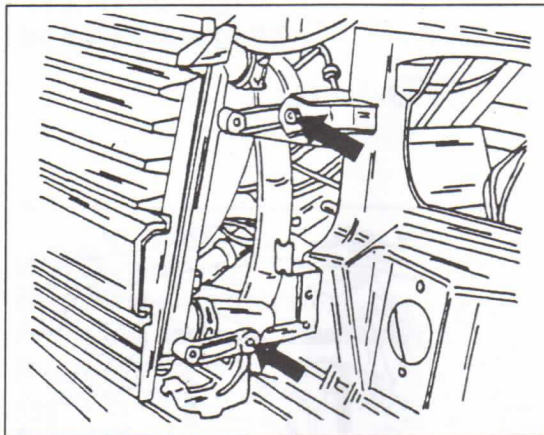


Fig. 1.3.  
Draining the cooling system. The numbers are referred to in the text.



## 1 Four-cylinder Petrol Engine

two hoses (2) or unscrew the water pump flange (3). It is also possible to remove the drain plug (1) to drain the cooling system, depending where the work is carried out. As anti-freeze is contained in the cooling system, check the condition of the solution before deciding whether to drain it or to collect it in a suitable container.

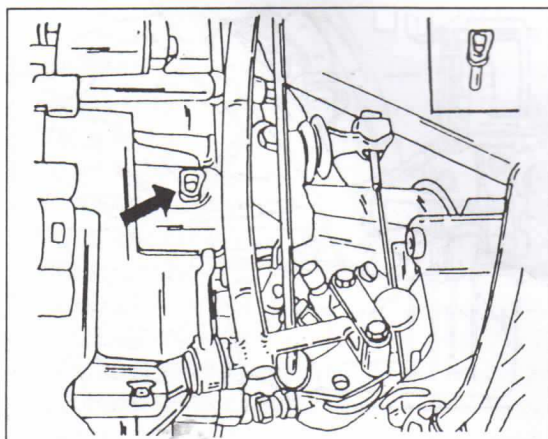


**Fig. 1.4.**  
The radiator is secured on the left- and right-hand sides at the positions shown by the arrows.

- Slacken the hose clamps on the upper radiator hose and withdraw the hose from the cylinder head. Also disconnect the hose between radiator and water pump and radiator and expansion tank on the engine or the expansion tank. Hoses are either secured by means of spring clamps or screw-type clamps. Spring clamps can be replaced with screw-type clamps during installation.

- Knock the pins out of the spreader clips on the L.H. and R.H. sides of the radiator and remove the spreader clips from the radiator mounting. Fig. 1.4 shows where the pins are located. Disconnect the electrical lead from the temperature switch on the radiator and the connector for the cooling fan motor. Completely remove the radiator. Remove the hoses from their connections to create enough room for the removal of the radiator assembly.

- Disconnect the cable connector plug from the rear of the alternator and from the side of the ignition distributor.



**Fig. 1.5.**  
Unscrew the plug at the position shown from the transmission and secure the clutch release lever by inserting an M8 x 22 mm bolt.

- Disconnect the fuel inlet and return pipes from their connections.

- Unhook the throttle operating cable from the throttle valve operating segment and detach it from the bracket. Do not remove the clip securing the cable to the bracket, but unscrew the bracket.

- Disconnect the electrical leads from the 1.8 bar oil pressure switch and push the lead to one side. Also disconnect the leads of all remaining switches, connections, etc. and all vacuum hoses, after marking their terminals and/or connections. These include the H.T. cable in the centre of the distributor, the temperature sender unit for the water temperature gauge, the 0.3 bar oil pressure switch, and others.

- If any of the radiator hoses have been left on the engine connections, remove them now.

- Remove the rubber plug from the hole in the transmission, shown by the arrow in Fig. 1.5, and secure the clutch release lever with a pin. The illustration shows the special pin used by VW workshops (top right), but an M8 x 22 mm bolt will do.

- Remove the coolant pipe between the thermostat housing and the heat exchanger for the heater.

- Place mobile jack underneath the centre of the engine. A block of wood must be placed between oil sump and jack head. Operate the jack until the engine is slightly under tension.

- Remove all bolts between engine and transmission from below the vehicle.

- Remove the rear engine mounting.

- Release the steering pump belt tension and unscrew the pump from the engine. Place the pump to one side where it is out of the way.

- Remove the drive shafts (Chapter 10) and front exhaust pipe.

- Check that engine and transmission are securely supported on the jack and remove the centre bolt securing the engine mounting on the R.H. side. Completely unscrew the engine mounting bracket.

- Remove all bolts connecting the engine to the transmission at the top.

- Withdraw the engine from the transmission,



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taking care all the time that the engine cannot drop off the jack. A second person must operate the jack slowly. Make sure that none of the connections have been left in position and take care that no damage is done when the engine is lowered from the engine compartment. Also make sure that the engine cannot rest on the clutch shaft.

Install the engine and transmission in the reverse sequence to removal, noting the following points below:

- Check the clutch release bearing before installation of the engine. Slightly coat the contact face of the release bearing and the clutch shaft with grease. The guide sleeve for the release bearing must not be lubricated.

- Check that the two dowel pins, shown in Fig. 1.6, are located in the cylinder block. Sometimes they will remain in the transmission, but must be transferred before the engine is fitted. In this case, fit new dowel pins, as the original ones may be damaged when removed from the transmission.

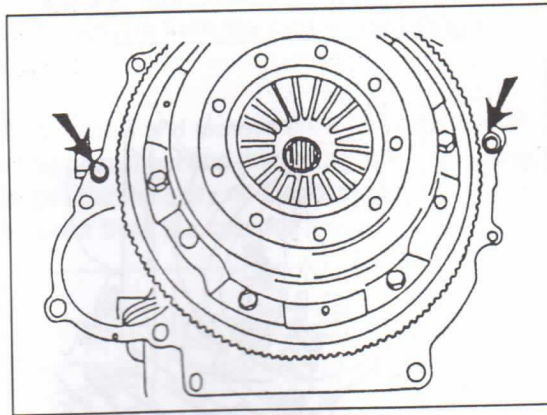
- Coat the intermediate plate on the engine side with grease and place it over the two dowel pins and against the engine.

- Lift the engine into position in the engine compartment. Again a helper must operate the jack as the engine is guided in. When level with the clutch shaft, push the engine against the transmission and engage the clutch shaft with the clutch driven plate. If engagement does not take place immediately, move the crankshaft to and fro by pulling on the alternator drive belt. Push the engine fully against the transmission before fitting the upper bolts. The gap must be nearly closed before the bolts are inserted and tightened.

- Refit all engine mountings and tighten the bolts to the following torques:

|                                             |                           |
|---------------------------------------------|---------------------------|
| Engine mounting bracket to engine mounting: | 6.5 kgm (47 ft.lb.)       |
| Engine support, right, on cylinder block:   | 5.0 kgm (36 ft.lb.) + 90° |
| Engine to Transmission:                     |                           |
| M8 threads:                                 | 2.0 kgm (15 ft.lb.)       |
| M10 threads:                                | 6.0 kgm (43 ft.lb.)       |
| M12 threads:                                | 8.0 kgm (58 ft.lb.)       |
| Engine support, rear, on cylinder block:    | 4.5 kgm (32.5 ft.lb.)     |
| Engine support, rear, on transmission:      | 2.0 kgm (15 ft.lb.)       |
| Steering pump/cylinder block:               | 2.5 kgm (18 ft.lb.)       |

- Re-connect the exhaust pipe to the manifold as described in the relevant section.



**Fig. 1.6.**  
The arrows show where the two dowel pins must be fitted to the cylinder block.

- Fill the cooling system as described in Section 4. "Cooling".

- Fill the engine with engine oil. Also check the transmission oil level and correct if necessary.

- Adjust the throttle cable as described in the fuel section.

- If necessary adjust the ignition and idling speed after the engine has been restarted.

- Check the headlamp adjustment or have it professionally checked.

### 1.1.1. WITH AUTOMATIC TRANSMISSION

The removal and installation of the engine is carried out in a similar manner as described in Section 1.1.0, but the following differences should be noted:

- Unscrew the complete bracket for the throttle cable either from the cylinder head. Do not disconnect the throttle cable from the bracket.

- Place the transmission selector lever into position "P" and slacken the clamp nut in order to release the gearchange cable. Release the throttle cable by pressing the ball joint connection off the pin, carefully using a screwdriver.

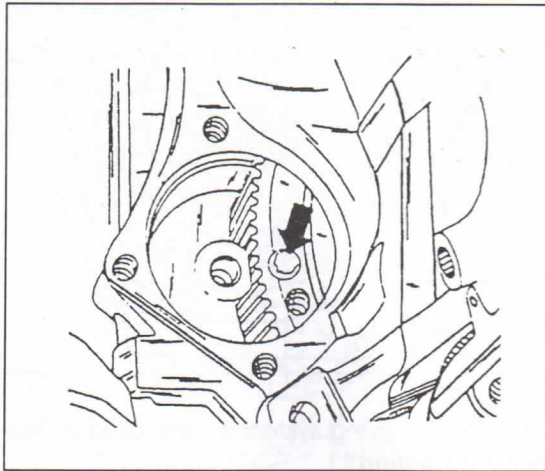
- Release the throttle pedal cable from the lever connection and unscrew the bracket.

- Unbolt the torque converter from the drive plate. The converter is secured by three bolts, which will be visible through the opening for the



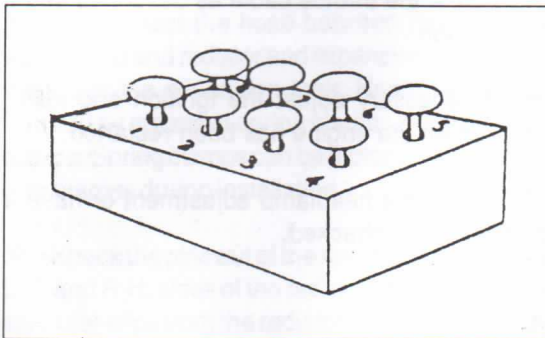
# 1 Four-cylinder Petrol Engine

starter motor. Rotate the engine until the bolts appear one after the other, as shown in Fig. 1.7 and unscrew them.



**Fig. 1.7.**  
The drive plate to torque converter bolts will appear in the starter motor opening when the engine is rotated.

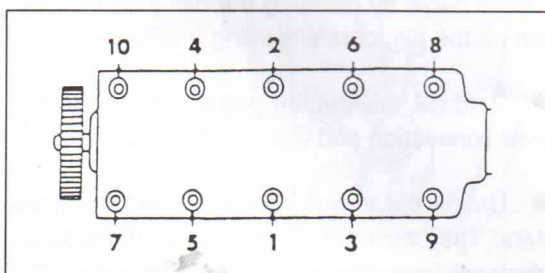
● Refer to Section 1.1.0 when installing the engine and transmission. The installation is a reversal of the removal procedure, including the connection of the torque converter to the drive plate.



**Fig. 1.8.**  
Valves can be pierced through an upside-down cardboard box with the valve number written against each valve.

## 1.2. Engine — Dismantling

Before commencing dismantling of the engine, all exterior surfaces should be cleaned, as far as possible, to remove dirt or grease. Plug the engine openings with clean cloth first to prevent any foreign matter entering the cavities and openings. Detailed information on engine dismantling and assembly is given in the sections dealing with servicing and overhaul (sections commencing at 1.4.) and these should be followed for each of the sub-assemblies or units to be dealt with.



**Fig. 1.9.**  
The tightening sequence for the cylinder head bolts. Slacken the bolts in reverse order.

Follow the general dismantling instructions given below:

● Dismantling must be carried out in an orderly fashion to ensure that parts, such as valves, pistons, bearing caps, shells, tappets and so on, are replaced in the same positions as they occupied originally. Mark them clearly, but take care not to scratch or stamp on any rotating or bearing surfaces. A good way to keep the valves in order is by piercing them through an upside-down cardbox, as shown in Fig. 1.8 and writing the number against each valve. Segregate together the tappets, the springs and retainers with collets for each valve, if possible in small plastic bags for each individual valve.

● If a proper engine dismantling stand is not available, it will be useful to make up wooden support blocks to allow access to both the top and bottom faces of the engine. The cylinder head, once removed from the block, should be supported by a metal strap, screwed to the manifold face and secured by two nuts onto the manifold studs.

● The normal order of removal of parts for a complete engine strip-down is given below but this may, of course, be modified if only partial dismantling is required.

● Remove all engine auxiliary parts, i.e. ignition distributor, inlet manifold, exhaust manifold, parts of the fuel injection system, as applicable.

● Unscrew the timing belt guards and remove the timing belt as described under the relevant heading further on in the engine section. Remove the timing belt tensioner.

● Remove the crankshaft pulley together with the crankshaft timing wheel from the crankshaft end.

● Remove the cylinder head cover and discard the gasket. Remove the cylinder head together with the gasket. Slacken the cylinder head bolts in reverse order to the one shown in Fig. 1.9 and lift off. Remove the cylinder head gasket. **Note that a special polygon-socket head wrench is required to remove the cylinder head bolts.** Your VW Dealer may have these in stock and no attempt should be made to remove the bolts with make-shift tools.

● Remove the water pump and the oil filter. The oil filter can also be unscrewed together with the filter bracket, if this is preferred. To remove the filter, use a strap-type tool. Otherwise pierce a screw-



## 1 Four-cylinder Petrol Engine

driver through the side of the filter and use the handle as lever to unscrew the filter. The filter should be replaced during assembly.

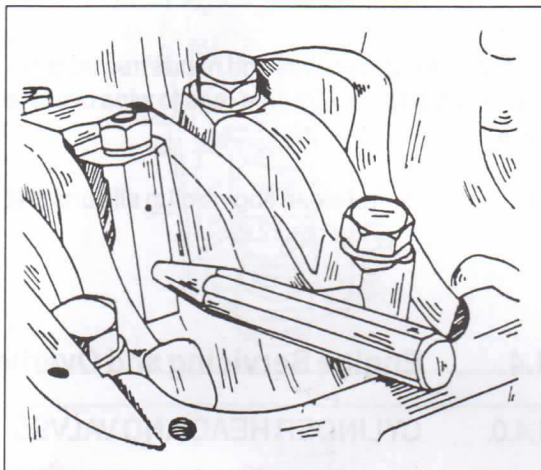
- Turn over the engine and remove the oil sump. Check that the engine oil has been drained previously. Unscrew the oil pump from the crankcase and withdraw from the engine.

- Check if there are any markings on the big end bearing caps and if this is not the case, mark the cylinder number with paint on each of the big end bearing caps, starting with number one at the front end of the engine. Fig. 1.10 shows the marking of the connecting rod and bearing cap with a centre punch. Turn over the engine so that two of the connecting rod big end bearings are at the bottom dead centre position and unscrew the bearing caps. Remove the caps and the bearing shells and keep them together, marked with their cylinder number. Push the connecting rod and the piston through the top of the cylinder bore, using a hammer handle. Turn the crankshaft until the other two connecting rod bearings are at the bottom dead centre and remove in the same manner. Note that stretch bolts are fitted to the connecting rods which must not be re-used.

- Straight away after removal, refit the big end bearing caps and the bearing shells to the connecting rods. Make sure that the bearing shells inside the connecting rods have also been removed.

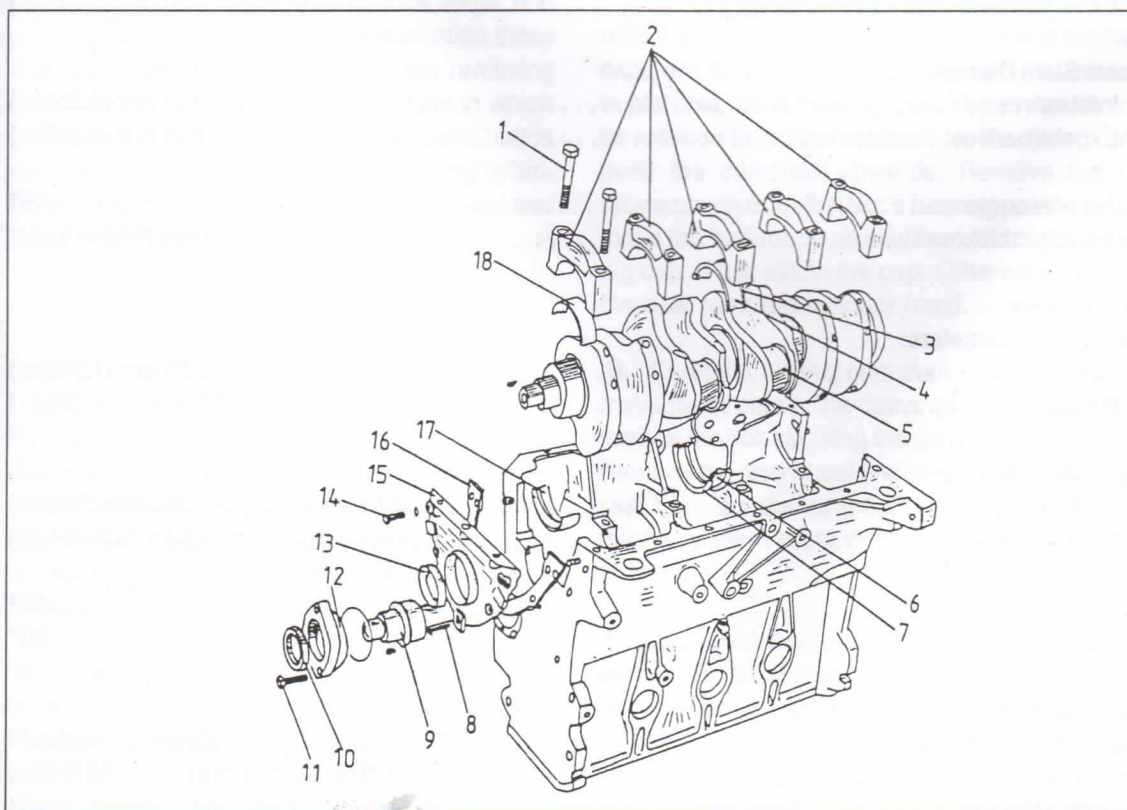
- Remove the crankshaft. The bearing caps are marked with numbers from 1 to 5 (No. 1 is at the crankshaft pulley end). Remove the half thrust washers from the centre crankshaft main bearing.

- Unscrew and remove the intermediate shaft timing gearwheel and then remove the mounting flange. Carefully pry off the flange and withdraw the shaft from the cylinder block.



**Fig. 1.10.**  
Marking connecting rods and bearing caps before removal. A centre punch is an ideal tool for this operation.

**NOTE:** The oil seal for the intermediate shaft may be marked with an arrow which must point in the rotating direction of the engine when the oil seal is refitted. Fig. 1.11 shows an exploded view of the crankcase and should be referred to during dismantling and the following assembly.



**Fig. 1.11.**  
Exploded view of the crankcase and crankshaft.

- 1 Main bearing cap bolt
- 2 Main bearing cap
- 3 Thrust washer in bearing cap
- 4 Upper bearing shell
- 5 Crankshaft
- 6 Lower bearing shell
- 7 Thrust washer in block
- 8 Bolt, 1.0 kgm
- 9 Intermediate shaft
- 10 Oil seal
- 11 Bolt, 2.5 kgm
- 12 Intermediate shaft flange
- 13 Oil seal, always replace
- 14 Bolt, 2.0 kgm
- 15 Front oil seal flange
- 16 Gasket
- 17 Lower bearing shell
- 18 Upper bearing shell



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## 1.3. Engine — Assembly

Refer to the sections commencing at 1.4. for details of the assembly procedures for individual parts and units. Follow the general instructions below at all times. In general proceed in reverse order to the dismantling procedure, but note the points given below:

- Take care that parts are only assembled in a clean condition.
- Keep tools, benches and hands free from dirt and swarf. Use only lint-free rags to wipe over the parts.
- Apply a film of clean engine oil to all parts that

slide or rotate. Do this **BEFORE** the parts are assembled so that the lubricant is actually on the bearing surfaces. It will **NOT** do to apply the oil to a completed assembly.

- Make sure that all parts have been properly inspected for wear and damage before fitting. Renew any parts that are not up to standard.
- Obtain all spares and replacement parts from an authorised dealer or distributor, quoting the vehicle serial number and the engine number. The manufacturers adopt a policy of continuous updating and improvement and only their official representatives are in a position to advise you of the latest component improvements and their application to your particular engine.

## 1.4. Engine Servicing and Overhaul

### 1.4.0. CYLINDER HEAD AND VALVES

#### 1.4.0.0. Technical Data

##### Valves

##### Valve Head Diameters:

|                       |                      |
|-----------------------|----------------------|
| Inlet valves: .....   | 40.00 mm (1.575 in.) |
| Exhaust valves: ..... | 33.00 mm (1.299 in.) |

##### Valve Length:

|                       |                      |
|-----------------------|----------------------|
| Inlet valves: .....   | 91.00 mm (3.615 in.) |
| Exhaust valves: ..... | 90.80 mm (3.607 in.) |

##### Valve Stem Diameters:

|                       |                     |
|-----------------------|---------------------|
| Inlet valves: .....   | 7.97 mm (0.314 in.) |
| Exhaust valves: ..... | 7.95 mm (0.313 in.) |

Valve seat angle: ..... 45°

Valve edge thickness: ..... 0.5 mm (0.02 in.) min.

##### Valve Seats

##### Valve Seat Diameters:

|                       |                      |
|-----------------------|----------------------|
| Inlet valves: .....   | 39.20 mm (1.543 in.) |
| Exhaust valves: ..... | 32.40 mm (1.276 in.) |

##### Valve Seat Widths:

|                       |                    |
|-----------------------|--------------------|
| Inlet valves: .....   | 2.0 mm (0.08 in.)  |
| Exhaust valves: ..... | 2.4 mm (0.094 in.) |

Valve seat angle: ..... 45°

Upper correction angle: ..... 30°

##### Valve Guides

Installation temperature: ..... Cylinder head cold

Inner diameter: ..... 8.013 - 8.035 mm (0.3154 - 0.3163 in.)

Running clearance of valve stems: ..... See under "Valves" in text



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### 1.4.0.1. Introduction

The cylinder head can be removed with the engine in position in the engine compartment. Due to the design of the valve gear, tappets and camshaft there are a number of special points arising which the reader is advised to study before attempting any work on the cylinder head. The following should be noted before any work is carried out on the cylinder head:

The overhead camshaft is supported in five bearings, the rear one providing axial location. There is no No. 4 camshaft bearing. In its place an oil return flow check in the oil gallery for the hydraulic tappets is fitted.

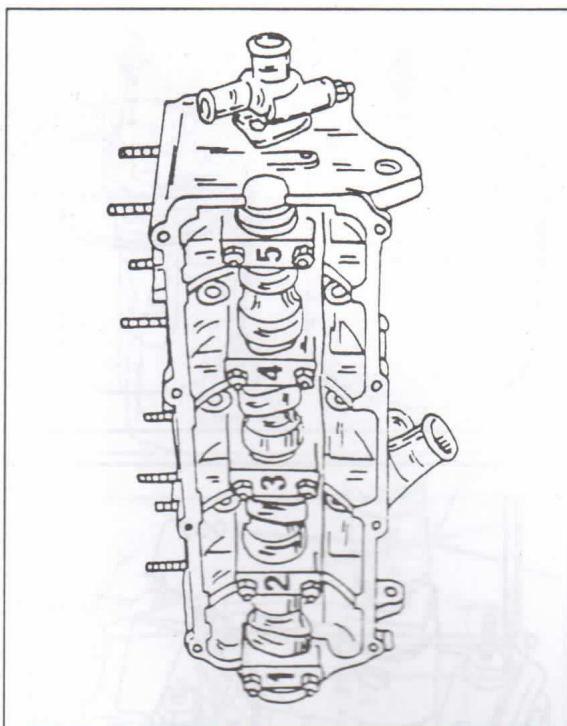
There is a special procedure for removing the camshaft for access to the valve springs and tappets and this must be followed to avoid distortion of the camshaft from the pressure of the valve springs. A number of special tools, or suitably made-up alternatives, will be required for servicing and the reader is advised not to undertake such work unless the proper equipment is available. The camshaft for a particular engine has a certain marking and only a camshaft with the same marking must be used if the part is replaced.

The valve retainers, springs and stem seals are rather inaccessible, being in pockets in the head. We shall be describing the removal and installation procedures, using the special tools and procedures recommended and will mention those that are essential for the work. When removing the valves, it is useful to note the order in which the parts will be taken out once the camshaft is removed: Valve cotter halves, top spring retainer, inner and outer valve springs, valve seal and bottom spring retainer.

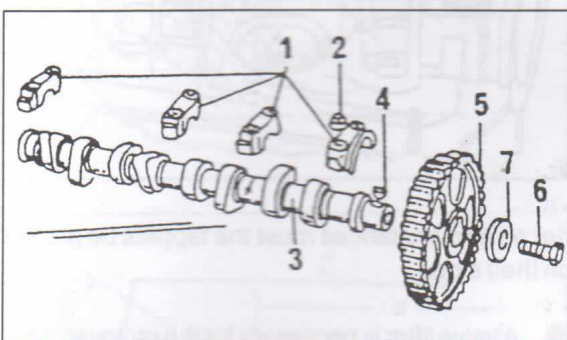
### 1.4.0.2. Servicing

Remove all auxiliary parts from the cylinder head, depending on the version. Make up a bracket which can be attached to the studs for the exhaust manifold and clamp the bracket into a vice. The dismantling of the cylinder head is carried out as follows:

- Refer to Fig. 1.12 and slowly slacken the nuts of bearing caps Nos. 1, and 3 and 5 in a diagonal manner. At this stage do not slacken the nuts of Nos. 2 and 4 bearing caps. Now unscrew the nuts of bearing caps No. 2 and 4 in a diagonal fashion



**Fig. 1.12.**  
The numbering of the camshaft bearing caps. Slacken the cap bolts in the order given in the text.



**Fig. 1.13.**  
The component parts of the camshaft. Note the missing No. 4 bearing cap.  
1 Camshaft bearing cap  
2 Bearing cap nut, 2.0 kgm  
3 Camshaft  
4 Woodruff key  
5 Camshaft timing gear  
6 Bolt, 8.0 kgm (58 ft.lb.)  
7 Plain washer

until the spring pressure is released and the two caps are fully free, i.e. the oil return flow check in place of No. 4 bearing cap. The pressure will be retained to the last moment, as the springs will push the camshaft upwards. Remove the oil return check from the No. 4 bearing position. Remove the half-round oil seal from the No. 1 bearing cap, if it is still in the cap. Otherwise remove the seal from the cylinder head.

- Carefully lift the camshaft out. Using soft-metal jaws, clamp the camshaft into a vice and remove the bolt securing the camshaft gearwheel. Remove the gearwheel and slide the camshaft oil seal from the end of the shaft. Fig. 1.13 shows the component parts of the camshaft, removed at this stage.

- Remove the tappets. Lay each of the tappets out in order (on a sheet of paper) so that they can be replaced in the same position. Mark the tappets with lines in accordance with their cylinder numbers, as shown in Fig. 1.14. Tappets must be stored with their contact area at the bottom. Un-



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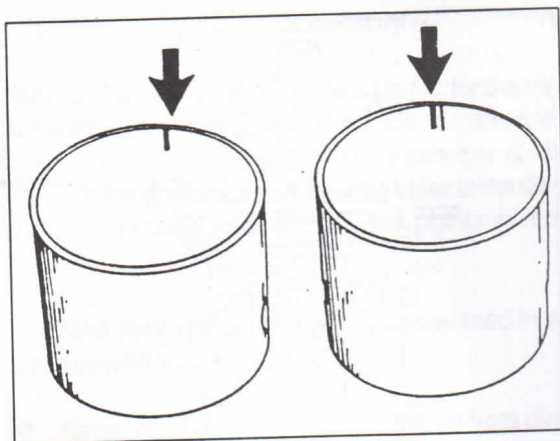


Fig. 1.14.  
Marking the tappets with notches in accordance with the cylinder numbers.

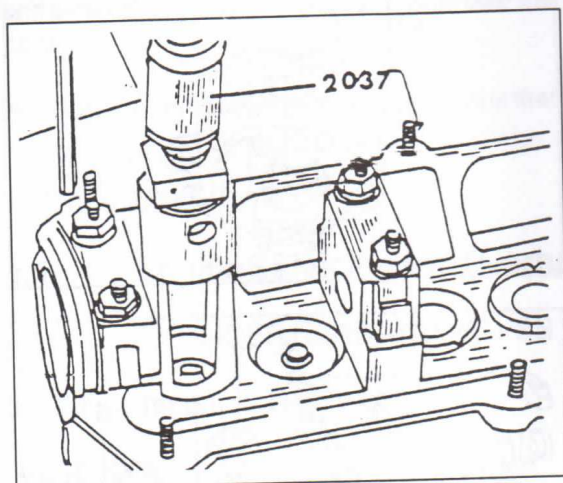


Fig. 1.15.  
Removal of the valve springs and valves with a valve lifter. Shown is the special tool, but a similar device can be used.

der no circumstances must the tappets be placed on their sides.

- A valve lifter is necessary for the removal of the valves and should be as shown in Fig. 1.15 or working with a similar principle. Press down the retainer to allow the collets to be extracted with a pair of thin-nosed pliers. An alternative method is to place a piece of tube over the valve spring retainer and to tap the tube with a short blow of a hammer. The valve cotter halves will be freed and collect in the inside of the tube. If this method is used, support the valve head from the other side. The valve lifter should, however, be available for the installation.

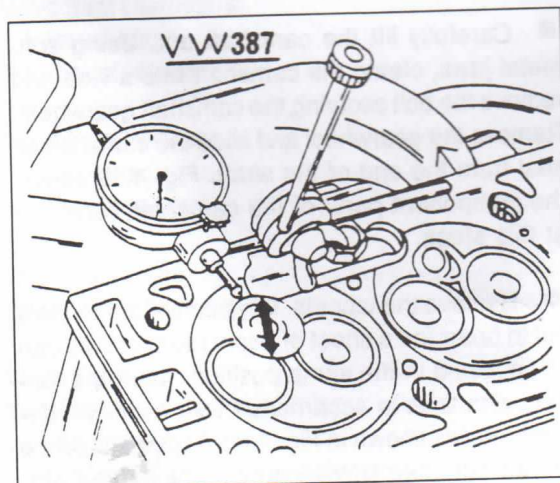


Fig. 1.16.  
Checking the valve stems for wear with the special tool. Rock the valve to and fro and read off the dial gauge.

- The lower valve spring seat can perhaps be removed with a pair of circlip pliers. Special tool 3047 is available for this purpose. The valve stem seal can also be extracted.

- The following points must be noted when the cylinder head is assembled as described in Section 1.4.0.3:

- The camshaft bearing caps must be fitted the correct way round. The tightening sequence of the bearing caps is important.

- The bearing running clearance and the camshaft end float must be checked before the cylinder head is assembled. In case of camshaft replacement make sure to fit the correct camshaft.

- The Woodruff key must have a tight fit in the groove of the camshaft.

- The half-round sealing insert must always be replaced.

- Check the hydraulic tappets before installation (see description later on).

- Note the fitting direction of the valve spring cups during installation of the valves.

The individual parts of the cylinder head can now be checked as follows, after they have been thoroughly cleaned.

**Valve Guides:** Valve guides and valve stems should first be inspected for visible wear. Clean the inside of the valve guides with a rag moistened in petrol, inserting the rag into the guides and move it to and fro to clean the inside bore. Valve stems are best cleaned by clamping them into an electric drill and using a wire brush to clean off the carbon deposits.

Valve guides can be checked for wear with the special tool VW387, as shown in Fig. 1.16, which is used in conjunction with a dial gauge. To use this tool with success, the following instructions should be observed:

- Attach the bracket to the side of the cylinder head as shown and lift the valve in question slightly from its guide until the dial gauge feeler can be applied against the valve head edge.

- Push the valve to one side and set the dial gauge to zero. Move the valve to the opposite side and read the indication of the dial gauge. The max. permissible reading is 1.0 mm (0.04 mm) for the inlet



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valves and 1.3 mm (0.05 in.) for the exhaust valves. If this value is exceeded, either the valves or the valve guides, or both must be replaced.

To replace the valve guides, press out the old guides from the cylinder head (from the combustion chamber side), using a suitable mandrel or carefully drive them out with a drift. Press in the new valve guides from the camshaft side of the cylinder head. The cylinder head must be cold and the guides must be coated with engine oil before they are pressed in.

**NOTE 1:** Before replacing the valve guides, measure the cylinder head height between the points shown in Fig. 1.17. If this dimension is less than 132.55 mm, replace the head.

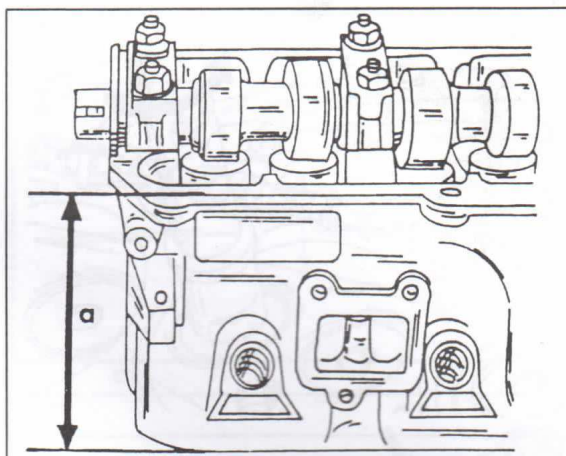
**NOTE 2:** If the correct VW mandrel is not used, measure the protruding end of the guides with a depth gauge before pressing them out. Refit to the same dimension when the new guides are driven in.

After all guides have been pressed in position, use an 8 mm reamer to open them up to the correct diameter, observing the running clearance for the valve stems. The VW special reamer 10-215 will automatically obtain the correct running clearance for the valve stems. **Valve seats must be re-faced after valve guides have been replaced.**

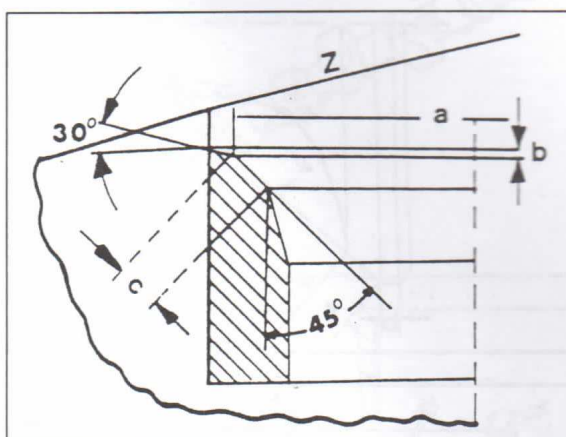
**Valve Seats:** If the camshaft bearings are worn, it is possible to fit an exchange cylinder head with camshaft bearing shells. In this case no further work is necessary on the cylinder head. This, of course, also applies to the replacement of the valve guides.

Valve seats can be re-machined to the dimensions given in Fig. 1.18 and Fig. 1.19 for the respective valve seat. When valve seats are re-cut, it is important to determine the maximum permissible re-cutting depth. If this is exceeded there is no guarantee that the tappets can work properly. Check the depth as follows:

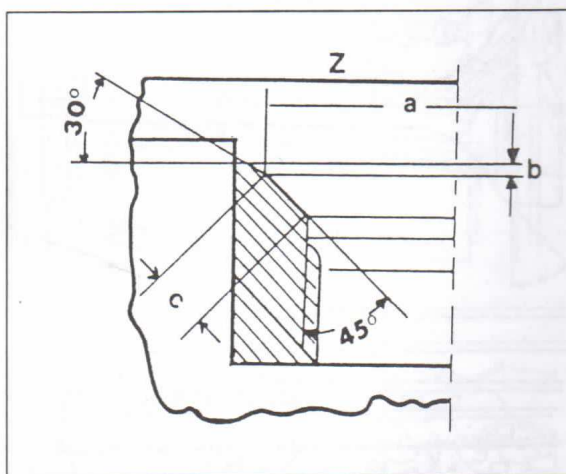
- Insert the valve into its guide and push it hard into the valve seat.
- Measure the dimension "a" in Fig. 1.20 between the tip of the valve stem and the cylinder head face. Use a depth gauge with millimetre graduation to obtain a precise measurement.
- Calculate the maximum permissible re-cutting depth from the measured dimension and



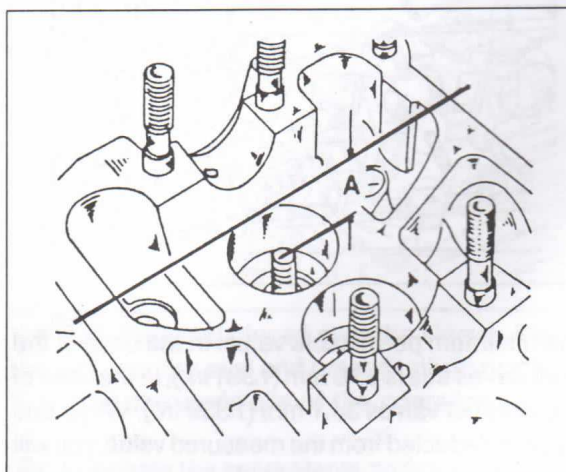
**Fig. 1.17.**  
Measure the cylinder head height between the points shown.



**Fig. 1.18.**  
The inlet valve re-finishing sizes.  
a = See Section 1.4.0.0.  
b = Max. permissible re-working depth  
c = 2.00 mm (0.0787 in.)  
Z = Cylinder head face



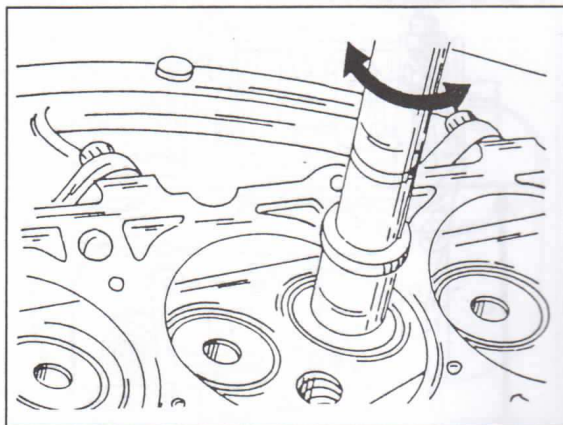
**Fig. 1.19.**  
The exhaust valve seat re-finishing sizes.  
a = See Section 1.4.0.0.  
b = Max. permissible re-working depth  
c = 2.40 mm (0.0945 in.)  
Z = Cylinder head face



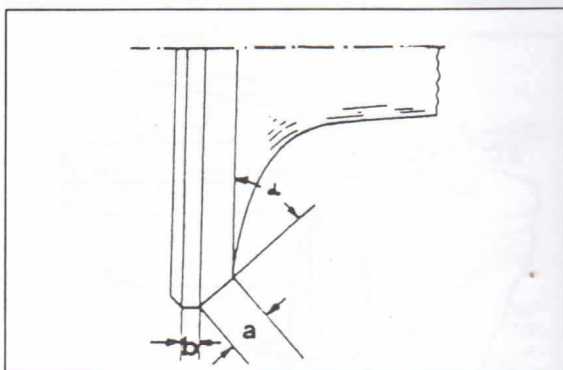
**Fig. 1.20.**  
Measuring the maximum permissible re-cutting dimension "a" between the end of the valve stem and the cylinder head face.



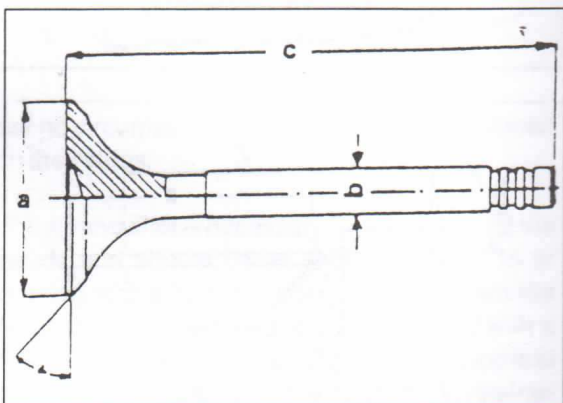
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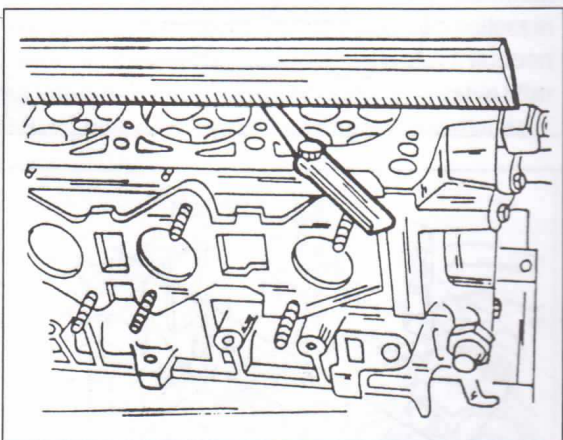
**Fig. 1.21.**  
Grinding-in of valves with a suction tool. Move the handle in the direction of the arrows and lift from time to time, rotate by 90° and continue grinding.



**Fig. 1.22.**  
A good valve must have the following dimensions:  
a = max. 3.5 mm  
b = min. 0.5 mm



**Fig. 1.23.**  
The principal valve dimensions. Refer to Section 1.4.0.0. for all dimensions.  
a = Valve head diameter  
b = Valve stem diameter  
c = Valve length  
d = Valve head thickness



**Fig. 1.24.**  
Checking a cylinder head surface for distortion, using a steel ruler and a feeler gauge.

the minimum permissible value. In the case of the inlet valves this is 33.8 mm (1.331 in.), in the case of the exhaust valves 34.1 mm (1.339 in.). When this value is deducted from the measured value, you will obtain the maximum amount of material that can be

removed in order to obtain a satisfactory valve seat, combined with the proper operation of the tappets. Figs. 1.18 and 1.19 show with "b" where this dimension is measured. The exhaust valve seat rings have also a reduced diameter. During re-facing, ensure that the radius of the reduced diameter is not damaged.

- When re-cutting valve seats, try to obtain a matt valve seat face. Use the cutter with feeling, to avoid grooving. Take away as little metal as absolutely necessary. The upper edge of the valve seat can be narrowed with a 30° cutter to obtain the correct valve seat width, given in the illustrations for the inlet and exhaust valves. Check the pattern of the valves and grind-in the valves in a conventional manner, should this be necessary. When grinding-in valves (lapping in), use a suction tool as shown in Fig. 1.21. Use fine lapping compound and work the seat until an uninterrupted ring is visible around the face of the valve. If the valve seats cannot be cleaned up, replace the cylinder head, as it is not possible to replace valve seat inserts.

After grinding-in valves, clean the cylinder head, and even more important the inside of the valve guide bores thoroughly. Any lapping paste left inside the cylinder head will accelerate the wear of the new parts.

**Valves:** Valves with bent or pitted stems should be replaced. Grinding or straightening of valve stems is not permissible. Inlet valves can be re-ground in a valve grinding machine. This is **not permissible** in the case of exhaust valves (special coating). These must be reconditioned by grinding in with lapping paste or replaced.

**NOTE:** When inlet valves are re-ground in a valve grinding machine, make sure that the edge "d" in Fig. 1.22 still has a width of 0.5 mm (0.02 in.) after re-grinding.

As already mentioned earlier on, take old exhaust valves to your dealer where they can be dealt with properly (sodium-filled).

**Cylinder Head:** Thorough clean the surfaces of cylinder head and cylinder block. The cylinder head surface must be checked for distortion. To do this, place a straight-edge over the gasket surface as shown in Fig. 1.24 and insert a feeler gauge between the steel ruler and the cylinder head face. Checks must be carried out in longitudinal, diagonal and transverse directions. If a feeler gauge of more than 0.10 mm (0.004 in.) in thickness can be inserted, try to have the cylinder head re-



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ground. Otherwise fit a new one.

**Camshaft:** The camshaft is marked so it can be identified for a particular engine. Fig. 1.26 shows where this marking has taken place. Normally a letter is engraved at position "A" and a number at position "B". Camshaft identifications sometimes change and we therefore recommend to take the old shaft to your parts supplier. By quoting the engine number you will be able to obtain the correct camshaft.

Place the camshaft with the two end journals into V-blocks or clamp the shaft between the points of a lathe, as shown in Fig. 1.27 and apply a dial gauge to the centre journal. Slowly rotate the camshaft and read off the dial gauge. If the indication is more than 0.01 mm, replace the shaft, as it is bent.

- Check all bearing journals for visible wear. If excessive wear can be noted, check with your VW Parts Supplier, as cylinder heads can be supplied with bearing shells for some engines, before you decide that a new cylinder head must be fitted.

To check the camshaft end float, place the shaft into the cylinder head without fitting the tappets in order to avoid the pressure of the valve springs onto the camshaft.

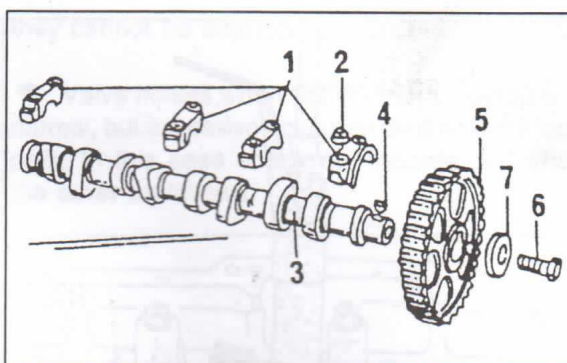
Arrange a dial gauge as shown in Fig. 1.28, with the stylus of the gauge resting against the end of the camshaft. Move the camshaft to and fro and read off the dial gauge. The dial gauge reading must not exceed 0.15 mm (0.006 in.). If this is the case, check the bearing cap end face and the camshaft. This is the position where the camshaft thrust is taken.

### 1.4.0.3. Cylinder Head Assembly

Re-assemble the cylinder head components in accordance with the notes below, following the dismantling procedure in the reverse sequence.

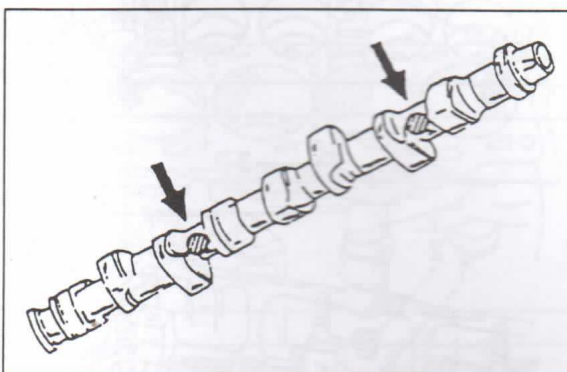
- With a pair of pliers as shown in Fig. 1.29 fit the bottom valve spring seat into the pocket for each valve. The illustration shows the special tool. If not available, use a pair of circlip pliers.

- Refit the bottom spring retainer over the guide and then fit new valve stem seals. A special tool (10-204) is available for this purpose. A plastic sleeve is pushed over the valve guide and

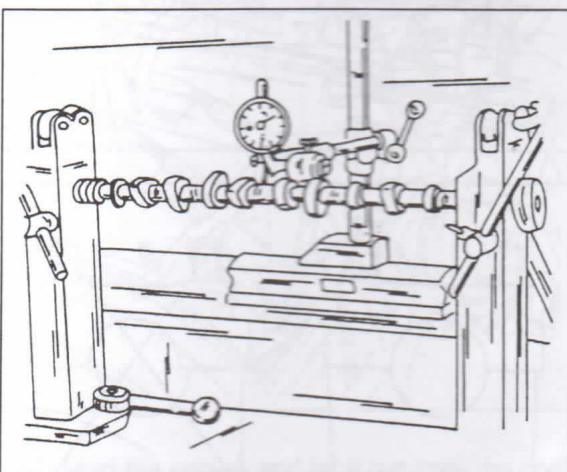


**Fig. 1.25.**  
The component parts of the camshaft. Note the missing No. 4 bearing cap.

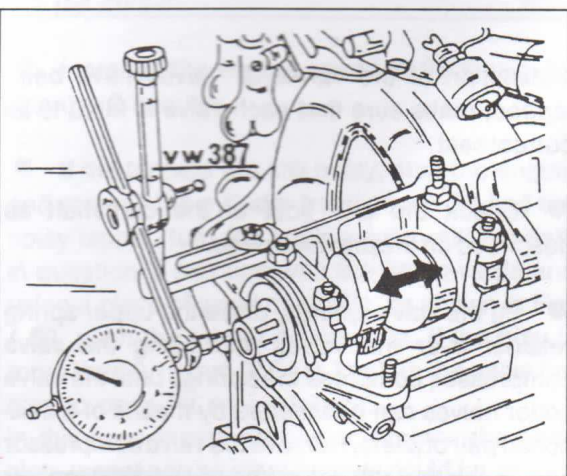
- 1 Camshaft bearing cap
- 2 Bearing cap nut, 2.0 kgm
- 3 Camshaft
- 4 Woodruff key
- 5 Camshaft timing gear
- 6 Bolt, 8.0 kgm (58 ft.lb.)
- 7 Plain washer



**Fig. 1.26.**  
The location of the identification markings on the camshaft (see text).



**Fig. 1.27.**  
Checking a camshaft for run-out.



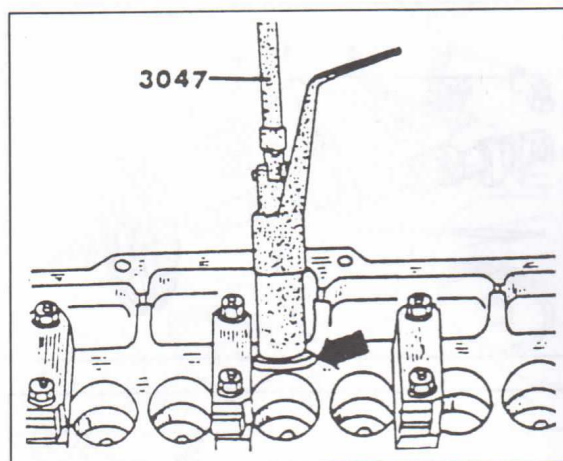
**Fig. 1.28.**  
To check the camshaft end float, attach a dial gauge to the end face of the cylinder head and apply the dial gauge plunger in accordance with the illustration.

the well oiled seal placed over the sleeve. Place the tool over the seal and press firmly in position. Fig. 1.30 shows details of the operation.

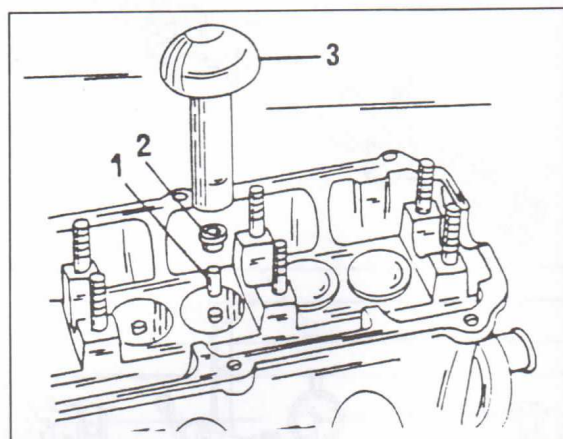
- Lubricate the valve stems and guides before



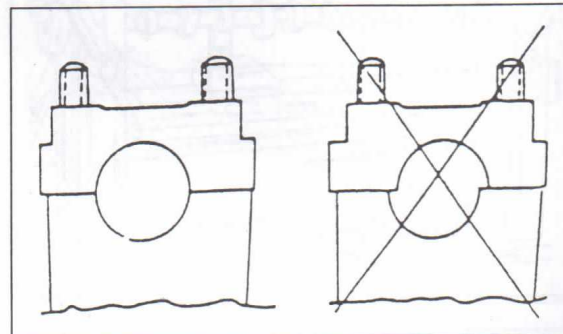
## 1 Four-cylinder Petrol Engine



**Fig. 1.29.**  
Removal or installation of  
lower spring seats.



**Fig. 1.30.**  
To refit the valve stem oil  
seals, fit the guide sleeve  
(1), followed by the seal (2)  
and then press down with  
the mandrel (3).



**Fig. 1.31.**  
The correct and wrong  
fitting of the camshaft  
bearing caps.

installation of the valves. If valves have been lapped, make sure that each valve is fitted to its correct seat.

- Check the end float of the camshaft as described on the previous page.

- Fit the valve springs, place the upper spring retainer over the valves and using the valve compressor, compress the springs until the valve cotter halves can be inserted by means of a thin-nosed pair of pliers. Remove the valve compressor and check that the cotters have engaged in their groove by tapping the ends of the valve stems lightly with a hammer. Make sure that the cotter halves match the valves if parts have been replaced.

- Insert the tappets into their bores (well oiled). If

the same tappets are used, insert them into their original bores.

- Refit the camshaft. Place the camshaft bearing shells in position (if used) and generously lubricate the camshaft journals and the bearing bores with engine oil. Place the camshaft in position. The two cams for the valves of the first cylinder must be facing upwards.

- Fit Nos. 3 and 5 camshaft bearing caps, referring to Fig. 1.12. The caps are slightly off-centre and must be fitted the correct way round. Fig. 1.31 shows the correct fitting of the caps.

- Tighten the nuts of the fitted bearing caps diagonally by a few turns to a final torque reading of 2.0 kgm (14.5 ft.lb.). Check that the bearing caps are flush against the cylinder head face.

- Fit the remaining bearing caps Nos. 2 and 4 and the oil return check and tighten the nuts in a diagonal manner. All nuts are tightened to 2.0 kgm (14 ft.lb.).

- Using a piece of tube of a suitable diameter, fit the camshaft oil seal over the shaft and into the bore. The spring inside the oil seal must be facing towards the cylinder head. Lubricate the oil seal lip and the running area on the camshaft with engine oil before fitting.

- Slide the camshaft timing gear over the camshaft (do not forget the Woodruff key) and fit the bolt with the washer. Hold the timing gear against rotation and tighten the bolt to 8.0 kgm (58 ft.lb.).

- Refit the remaining parts to the cylinder head in reverse order to the removal procedure.

The exploded view of the cylinder head should be used for reference during the assembly operations.

### 1.4.0.4. Fitting the Cylinder Head

- Thoroughly clean the cylinder block and cylinder head surfaces with special attention to the tapped holes for the head bolts. Place the cylinder head gasket over the engine block so that the word "Oben" or "Top" is seen — a new gasket must always be used. Two guide studs should be used during the installation (Fig. 1.32) and must be inserted into the bolt holes (8) and (10) in Fig. 1.9. Cut a slot for the application of a screwdriver into the top of the studs. Some engines have fitted dowel pins. In this case there is no need to fit the studs. Locate the gasket and the head in position. The



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valves can touch the pistons and for this reason the engine should be rotated until the piston of the first cylinder is at T.D.C. From this position turn the engine backwards by  $\frac{1}{4}$  of a turn. Only fit the cylinder head in this position.

- Fit the remaining 8 cylinder head bolts, remove the two guide studs with a screwdriver (if used) and fit the other two bolts.

- Cylinder heads are fitted with so-called polygon socket head bolts and a special spline bit is used to tighten the bolts. Your dealer may have these in stock and no attempt should be made to tighten the bolts with make-shift tools.

- The bolts must be tightened in the order shown in Fig. 1.9 to a torque reading of 4.0 kgm (29 ft.lb.) and then again to a torque of 6.0 kgm (43.5 ft.lb.). From this position by a further  $\frac{1}{2}$  of a turn (or twice  $\frac{1}{4}$  of a turn). These bolts **MUST NEVER** be re-tightened after the first 600 miles, as used to be the case with some earlier VW models.

- Fit the oil deflector plate over the cylinder head.

- Refit the timing belt and adjust the timing as described later on.

- Fit the half-moon shaped sealing insert to the rear end of the cylinder head and the half-round insert to the timing end. Coat both halves of the cylinder head cover gasket with grease and place them in position over the head.

- Fit the cylinder head cover. Place one reinforcement strip on each side of the cylinder head cover over the studs and fit and tighten the nuts to 1.0 kgm (7.2 ft.lb.).

- All other operations are carried out in reverse order to the removal procedure. Adjust the alternator drive belt tension.

### 1.4.0.5. Hydraulic Tappets

The following points must be observed at all times in order to prevent damage to the engine by the tappets, due to incorrect treatment:

- Always store hydraulic tappets in upright position, with the contact area at the bottom.

- Always replace tappets as complete units as

they cannot be adjusted or repaired.

- Valve noises when the engine is started are normal, but excessive noise can be due to the tappets. In this case check the tappets one after the other as follows:

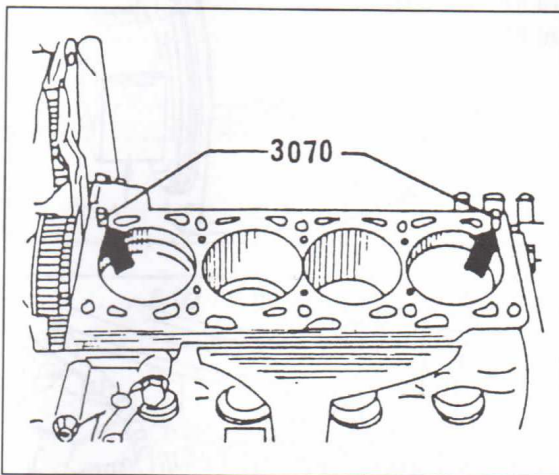


Fig. 1.32.  
Fit the cylinder head guide studs into the positions shown.



Fig. 1.33.  
Checking a hydraulic tappet.

- Start the engine and let it run until the cooling fan cuts-in.

- Increase the engine speed to 2500 rpm for approx. 2 minutes.

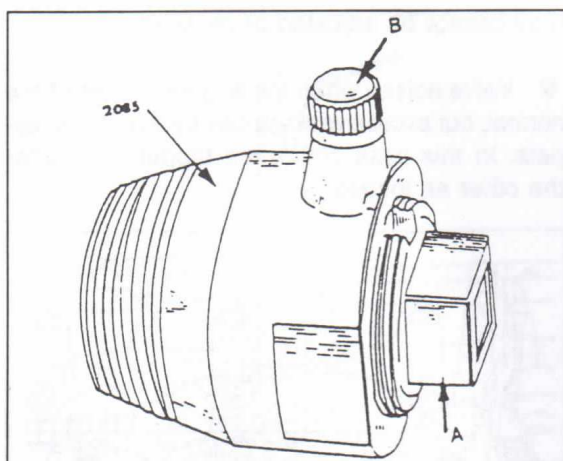
- If the tappets are still noisy, stop the engine and remove the cylinder head cover. To find the noisy tappet, turn the engine over until the cam in question is pointing with the tip upwards and using a piece of wood or plastic, as shown in Fig. 1.33, push the tappet downwards. If the play is more than 0.10 mm (0.04 in.) before the valve begins to open, fit a new tappet.

In this case it may be best to replace the complete tappet set, as other tappets could be equally in bad condition.

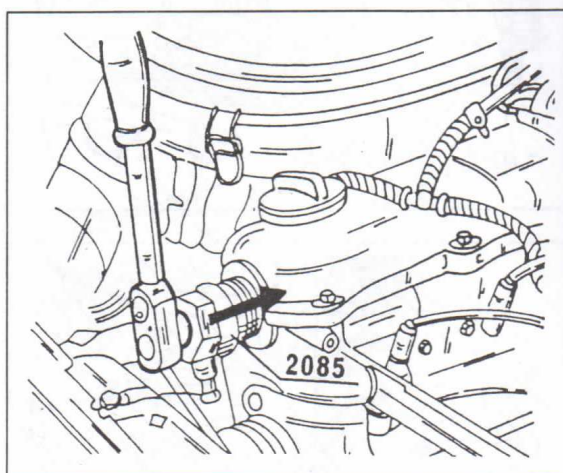
**NOTE:** If new tappets are fitted, do not start the engine for about 30 minutes after assembly, as this may cause the valves to strike the pistons.



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**Fig. 1.34.**  
Special tool for the removal of the camshaft oil seal. The same tool is also used for the front crankshaft oil seal.



**Fig. 1.35.**  
Special tool applied to the cylinder head to remove the camshaft oil seal. Push against the tool whilst tightening with the ratchet.

## 1.4.0.6. Replacing the Camshaft Oil Seal

The camshaft oil seal can be replaced with the engine fitted, if oil leaks are visible in this area. The oil seal is located behind the camshaft timing gear. A special tool (No. 2085) is used to extract the oil seal and should be obtained if possible. Otherwise use a small lever with a hook at the end to withdraw the oil seal. The operations are carried out as follows:

- Slacken the alternator mounting and tensioning device and remove the drive belt.
- Remove the upper timing belt cover. An Allen key is required for one of the screws.

## 1.4.1. PISTONS AND CONNECTING RODS

### 1.4.1.0. Technical Data

#### Piston Diameters:

|                   |                       |
|-------------------|-----------------------|
| Nominal Diameter: | 82.48 mm (3.2770 in.) |
| 1st oversize:     | 82.73 mm (3.2868 in.) |
| 2nd oversize:     | 82.98 mm (3.2968 in.) |

- Rotate the engine until the piston of the first cylinder is at T.D.C. Check on the flywheel marking.

- Slacken the timing belt tensioner (refer to Section 1.4.4.1) and remove the timing belt. Tie the belt in position to prevent it from slipping off the crankshaft pulley. The engine must not be rotated after the belt has been removed.

- Hold the camshaft timing gearwheel in suitable manner and unscrew the bolt. Remove the bolt and the washers.

- Remove the Woodruff key, using a pair of side cutters.

- Screw the bolt for the camshaft timing gear together with the washer into the end of the camshaft as far as it will go.

- Refer to Fig. 1.34 and unscrew the inner part (A) by 2 turns (approx. 3 mm) out of the outer part and in this position tighten the lock screw (B).

- Lubricate the tool head with engine oil and push it over the camshaft end and into the oil seal. Use a ratchet and screw the tool into the oil seal, at the same time exerting pressure against the seal, as shown in Fig. 1.35.

- Slacken the lock screw (B) and tighten the inner part (A) against the camshaft until the oil seal comes out of the bore.

- Clamp the tool into a vice and remove the oil seal with a pair of pliers.

- Coat the new oil seal on the sealing lip and the outer diameter with engine oil and place the seal over the camshaft and into the cylinder head bore. Use a piece of tube and carefully drive the seal in position, until the outer face is flush with the cylinder head face. Never drive the oil seal fully in, as it will cover the oil return bore.



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Position for checking piston diameter: .....10 mm (0.40 in.) from bottom edge of skirt, at 90° to piston pin axis

Max. allowable wear on piston diameter: .....0.04 mm (0.0016 in.) from the specified size

Clearance of piston in cylinder bore:

Standard: .....0.03 mm (0.0012 in.)

Maximum: .....0.07 mm (0.0028 in.)

Max. difference of piston weight in one engine: .....17 g (0.6 oz.)

Max. difference of connecting rod weight in one engine: .....15 g (0.53 oz.)

## Piston Rings

Number of rings: .....3

Side clearance — All rings:

Standard, all rings: .....0.02 - 0.05 mm (0.0001 - 0.002 in.)

Wear limit: .....0.15 mm (0.006 in.)

Ring Gaps:

Top and second ring: .....0.30 - 0.45 mm (0.012 - 0.018 in.)

Oil control ring: .....0.25 - 0.40 mm (0.01 - 0.016 in.)

Max. — Top and second: .....1.0 mm (0.04 in.)

## Connecting Rods

Bearing axial play:

Standard: .....0.05 - 0.31 mm (0.002 - 0.012 in.)

Max.: .....0.37 mm (0.015 in.)

Big end journals: .....See under "Crankshaft"

### 1.4.1.1. Servicing

The pistons and connecting rods are pushed out from the top of the block after removing the bearing caps and lower shells. Before carrying out these operations, note the instructions below regarding marking and identification:

- Mark each of the piston centres and connecting rods to the cylinder bore from which it is removed. This can be carried out by numbering the piston crowns with the numbers 1, 2, 3 and 4, as shown in Fig. 1.36 and with an arrow each, which should be facing towards the crankshaft pulley. Remember that the arrow marked into the piston crown cannot be seen due to the carbon deposits.

- Refer to Fig. 1.37 and note the arrows pointing to the cast lugs and their identification marks on the connecting rod and bearing cap. These lugs should face towards the crankshaft pulley.

- Before removing the connecting rod bearing caps, mark each of the con rods and its cap with a centre punch to ensure assembly in the same position (Fig. 1.38).

- Mark the bearing shells and the rod to which

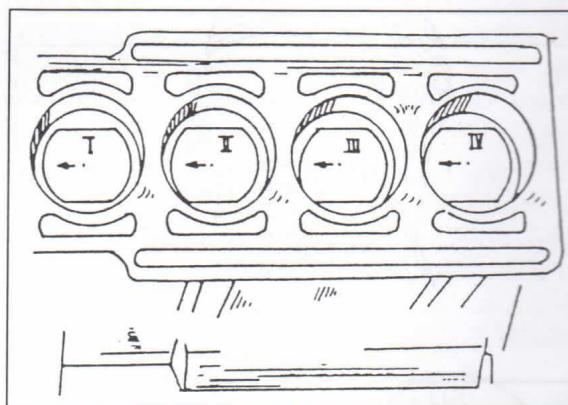


Fig. 1.36.  
Piston identification. The top of the pistons should be marked with their cylinder number and arrows.

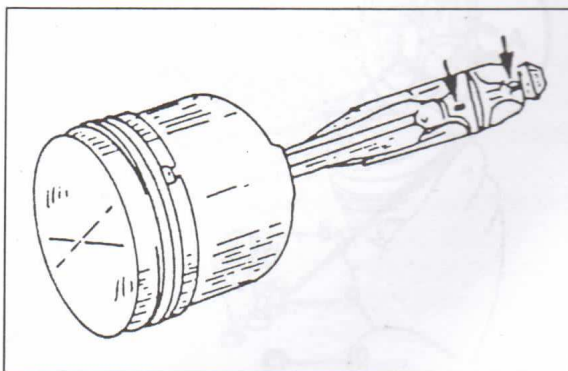


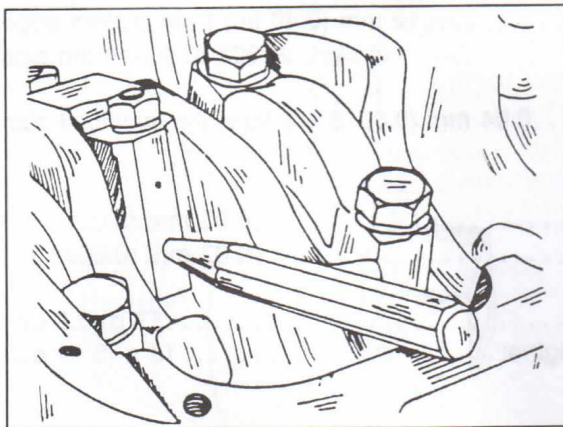
Fig. 1.37.  
The two casting lugs (arrows) on connecting rod and big end bearing cap — these must match when the bearing caps are refitted. Always use new connecting rod bolts and nuts.

they belong and mark the upper and the lower shells as soon as they have been removed.

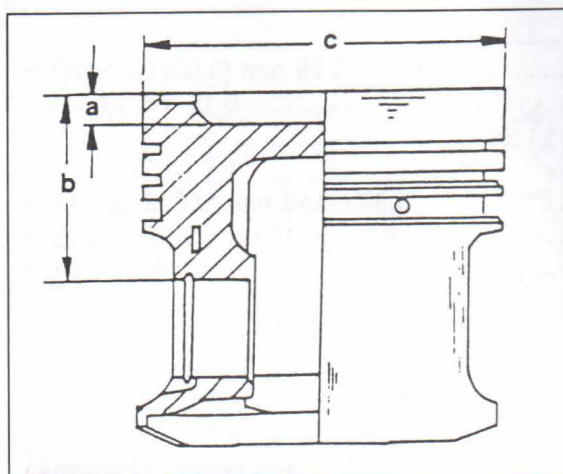


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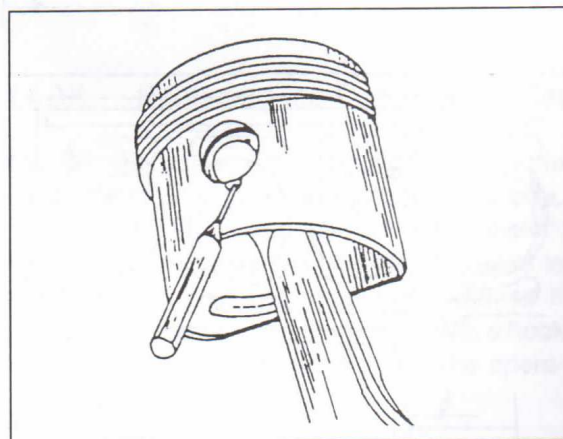
**Fig. 1.38.**  
Marking the connecting rod bearing cap and connecting rod with a centre punch, in this case shown for the first cylinder.



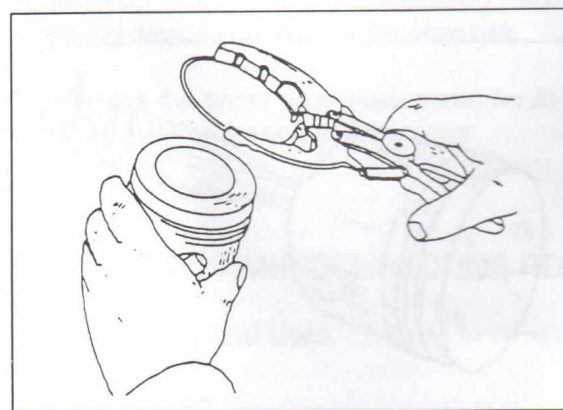
**Fig. 1.39.**  
Sectional view of a piston. The depth "a" is the important dimension and must be measured before new pistons are fitted. "c" indicates the piston diameter.



**Fig. 1.40.**  
Piston pin securing clips can be removed with a pointed drift, inserted into the notch of the piston pin bore.



**Fig. 1.41.**  
Removal and installation of piston rings.



**Fig. 1.42. (R.H. side)**  
Measuring the piston diameter.

● If pistons are replaced, make sure that they are of the correct diameter and for the correct engine.

Refer to Fig. 1.39 for further details. The piston diameters are given in Section 1.4.1.0.

● Remove the bearing caps and shells to take out the piston assemblies, making sure that there is no ridge of carbon in the bore that might prevent removal.

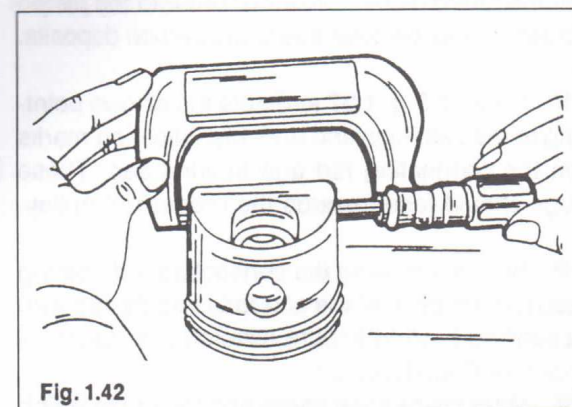
● Push out the piston pin after having removed the circlips, by inserting a pointed drift into the notches of the piston pin bore, as shown in Fig. 1.40. Use a suitable mandrel and press to extract the piston pin. If the pin has a tight seat, heat the piston in hot water (at least 60° C/140° F).

● Using a pair of piston ring pliers, as shown in Fig. 1.41, remove the piston rings carefully from the pistons (over the crown) and keep them matched if they are to be re-used. If no piston ring pliers are available, insert some metal strips under the piston ring to be removed, on opposite sides of the piston and lift the ring this way over the piston crown. Clean all parts thoroughly, avoiding abrasive or sharp tools that might scratch the pistons.

Carry out the inspections given below, all data being given in Section 1.4.1.0. Pistons are specific for the Transporter engine. When replacing a piston, measure the crown bowl depth "a" in Fig. 1.39 in the centre and re-check the same dimension on the new piston. Pistons must always be replaced in sets.

● Check the piston diameter 10 mm (0.4 in.) from the bottom edge of the piston skirt, as shown in Fig. 1.42, at right angles to the piston pin. The piston must be replaced if outside the limit given.

● Check the clearance of the piston rings in their grooves as shown in Fig. 1.43. The grooves must be thoroughly cleaned before this check is carried out. Piston ring grooves can be cleaned with a broken-off piston ring, which should be ground or filed flat at the broken end. Go around the circumference of the groove, being careful not to lift off any metal.





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- Check the ring gap by inserting the ring into the cylinder bore as shown in Fig. 1.44. Make sure that the ring is inserted squarely — use the crown of a piston to press the ring down.

Note that the gap is measured at the bottom end of the cylinder bore. Compare with the values given in Section 1.4.1.0.

- Check the piston pins and the bores of the connecting rods for wear. Connecting rods must be replaced in complete sets.

- Always replace the big end bearing cap nuts.

- If possible have the connecting rods checked for distortion, especially if the wear pattern on the old pistons is more pronounced on one side.

- Check the connecting rod bolts for wear. The bolts stretch with the tightening of the nuts. New bolts must be used if they appear to be over-stretched. *If in doubt replace.*

To install the piston pin into the piston and connecting rod, a proper mandrel must be used with a press, and the piston must be heated to at least 60° C (140° F). The piston can be inserted into hot water to heat it up. The disposition of the connecting rod must be:

- The arrow, marked in the piston crown must point to the crankshaft pulley side of the engine (Fig. 1.36).

- The cast bosses on the rod and cap (Fig. 1.37) must point towards the crankshaft pulley end of the engine.

- The cylinder No. marking on connecting rod and big end bearing cap (Fig. 1.38) must be opposite each other after the cap has been bolted to the connecting rod.

Push the piston pins into their bores with the use of a mandrel. Allow the assemblies to cool off and check that the pistons can move easily on their piston pins.

When installing the piston rings, note that the rings are marked on one side with "Top" or "Oben". This marking must be facing towards the piston crown when the rings have been fitted. Rings can easily break and we suggest to carry out this operation very slowly and with the greatest care. Fit the multi-part oil control rings carefully over the pistons.

Before fitting the pistons into the cylinder bores,

arrange the bottom ring gap so that it faces the front of the engine, with the other two rings arranged at 120° to each other and facing the rear.

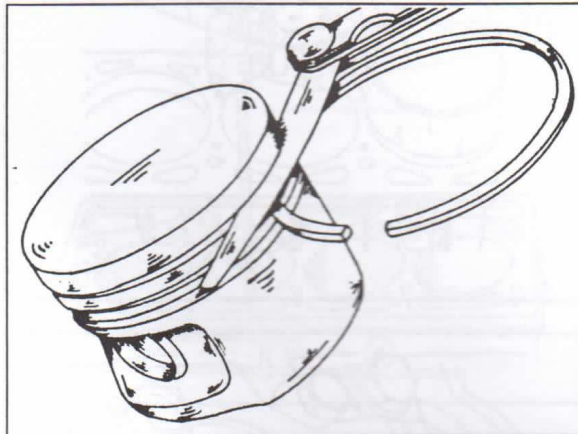


Fig. 1.43.  
Checking the side clearance of the piston rings by means of a feeler gauge.

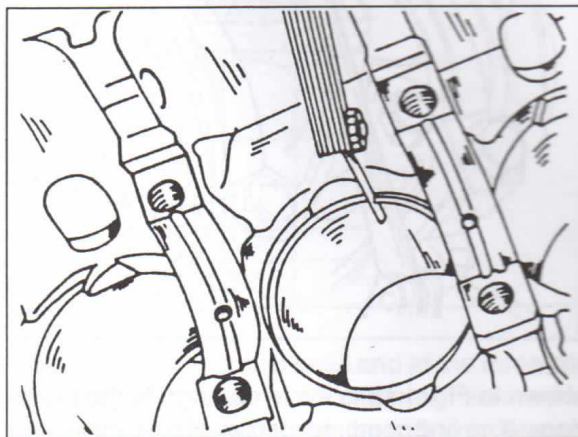


Fig. 1.44.  
Checking the piston ring gaps, rings at bottom of cylinder bore.

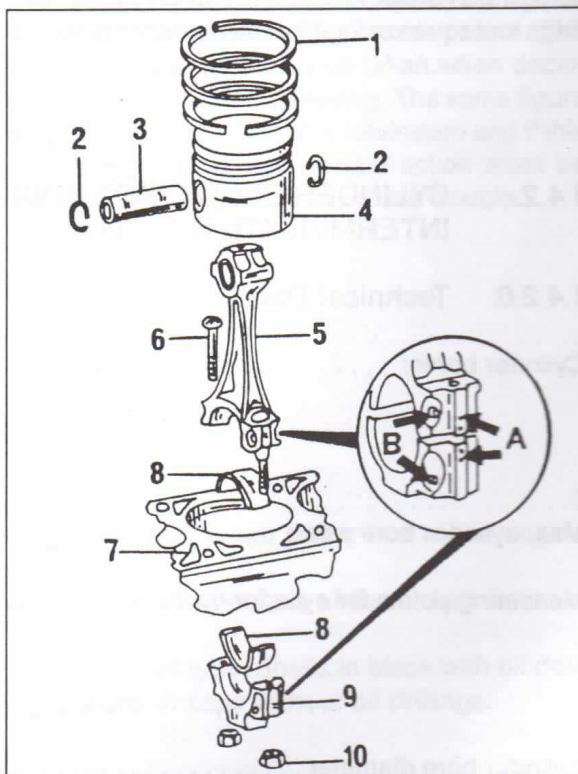
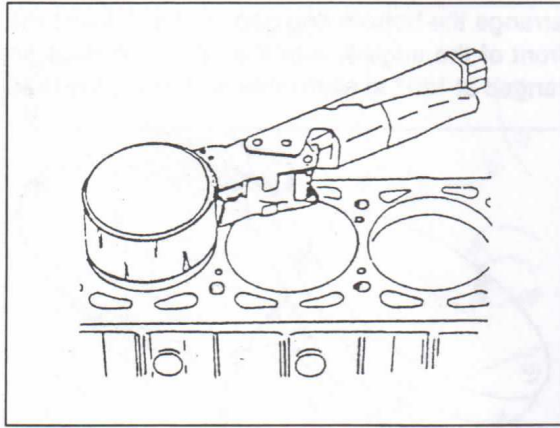


Fig. 1.45.  
Exploded view of piston and connecting rod. The letters refer to the location of the connecting rod and cap markings (A) and the cast lugs (B).  
1 Piston  
2 Piston pin clip  
3 Piston pin  
4 Piston  
5 Connecting rod  
6 Connecting rod bolt  
7 Cylinder block  
8 Big end bearing shells  
9 Big end bearing cap  
10 Bearing cap nut

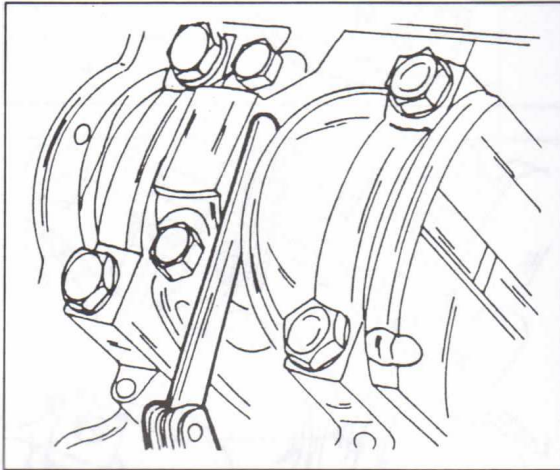
Oil the cylinder bores before inserting the pistons into the cylinders. Use a ring compressor, as



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**Fig. 1.46.**  
Pushing the piston rings into their grooves with the help of a proper piston ring compressor.



**Fig. 1.47.**  
Checking the connecting rod end float by means of a feeler gauge. Insert the feeler gauge between the con rod thrust face and the crankshaft.

shown in Fig. 1.46 to avoid damage to the piston rings. If no ring compressor is available, make up a strip of thin sheet metal, lay it around the piston rings and squeeze together the ends of the strip to

push the rings into their grooves. Install the pistons after checking that the piston pin circlips are in position on both sides, as it is very easy to forget one, after the first one has been fitted. The easiest method to install the pistons is to place the cylinder block on its side and turn the crankshaft until two crankpins are at the bottom. Fit these two pistons and connecting rods and then turn the crankshaft until the other two pins are at the bottom. Fit the remaining assemblies. Check once more that the cylinder markings on connecting rods and big end bearing caps are on the same side of the engine and that the connecting rods are fitted the correct way.

The connecting rod nuts must always be replaced. Oil the nut contact faces and tighten the two nuts in turn to 3.0 kgm (22 ft.lb.). From this position tighten the nuts a further 90°. Use the correct nuts for the engine in question.

After installation of the connecting rod bearings, check with a feeler gauge at the position shown in Fig. 1.47 to make sure that the connecting rod side play is less than 0.37 mm (0.016 in.). Temporarily fit the crankshaft pulley with the bolt, apply a socket to the bolt head and rotate the crankshaft assembly a few times. Any hard spots will be spotted immediately and can be rectified before the engine is further assembled. Do this after each assembly is fitted. After completed installation refit the oil sump to the bottom of the crankcase as described in Section 1.7.1. All other operations are carried out in reverse order to the removal procedure.

## 1.4.2. CYLINDER BLOCK (INCLUDING INTERMEDIATE SHAFT)

### 1.4.2.0. Technical Data

|                                            |                                                                                                                                                                                                 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cylinder bores: .....                      | Cylinder bores are 0.03 mm (0.0012 in.) larger in diameter than the piston belonging to any one cylinder bore. Full details are given in Section 1.4.1.0.                                       |
| Max. cylinder bore wear: .....             | 0.04 mm (0.0016 in.) from the specified size                                                                                                                                                    |
| Measuring points for cylinder bores: ..... | 10 mm (0.4 in.) from top edge of bore, 10 mm (0.4 in.) from lower edge of bore and in centre of bore. One measurement to be in axial direction and one in transverse direction (see Fig. 1.49). |
| Cylinder bore diameter .....               | 82.51 mm (3.2781 in.)                                                                                                                                                                           |
| 1st oversize: .....                        | 82.76 mm (3.2881 in.)                                                                                                                                                                           |
| 2nd oversize: .....                        | 83.01 mm (3.2980 in.)                                                                                                                                                                           |



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## 1.4.2.1. Servicing

Special attention should be given to the cylinder block at each major overhaul of the engine, irrespective of whether the bores are to be re-machined or not. Thoroughly clean all cavities and passages and remove all traces of foreign matter from the joint faces. If any machining or honing of the bores takes place, it is essential that all swarf is removed before assembly of the engine takes place.

To remove the intermediate shaft, remove the oil pump drive, remove the intermediate shaft timing gear and then take off the bearing flange and the seal at the front of the engine. This will allow the shaft to be removed from the engine block. Inspect the shaft journals and the timing wheel for wear and replace if worn or damaged. The intermediate shaft oil seal must always be replaced. The ring is marked with an arrow, which must be facing in the direction of rotation (the shaft rotates anti-clockwise). The flange bolts should be tightened with 2.5 kgm (18 ft.lb.). Insert the Woodruff key and carefully drive on the timing gearwheel. Tighten the bolt to 4.5 kgm (32 ft.lb.).

Measurement of the cylinder bores should be made in conjunction with the data given in Section 1.4.2.0. The original size group of the engine is given by the code number in the block near the alternator mounting. You will, of course, have to check that the engine has not previously been re-bored, if you do not know its history from new. If worn in excess of 0.04 mm (0.0016 in.) the bores will have to be honed or machined in accordance with the data given and the appropriate pistons fitted. Bores should be measured in both trans-

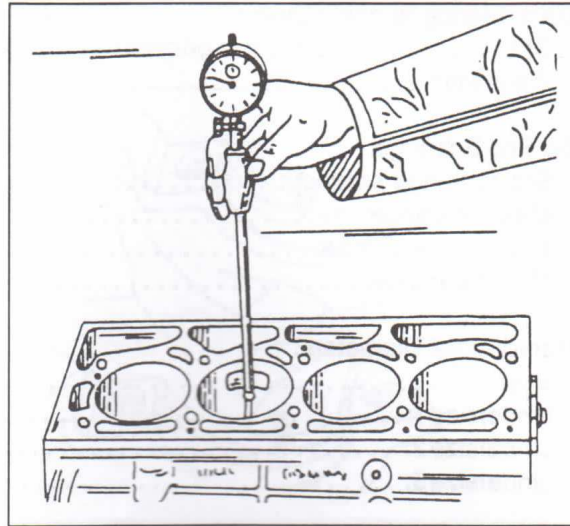


Fig. 1.48.  
Measuring a cylinder bore.

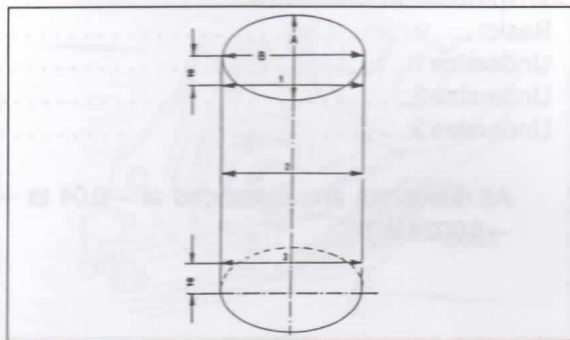


Fig. 1.49.  
Measuring the cylinder bores. The positions 1, 2 and 3 are the three positions down the bore and (A) and (B) are the transverse and longitudinal positions.

verse and longitudinal planes and at the three positions down the bore. An internal micrometer must be applied vertically to the cylinder bore, as shown in Fig. 1.48. Fig. 1.49 shows, by the figures 1, 2 and 3, the positions for measurement. The worst measurement must be taken when deciding on the size for re-machining. The same figure also shows the effect of poor lubrication and if this condition is found, appropriate action must be taken to find out the cause of the trouble.

## 1.4.3. CRANKSHAFT AND FLYWHEEL

### 1.4.3.0. Technical Data

Number of main bearings: .....5  
Markings (main bearing caps): ... 1 to 5, commencing at the crankshaft pulley end of the engine

Axial play taken at: ..... Bearing No. 3 (centre) by means of thrust half washers

Main/big end bearings: ..... Thin-wall shell type. Shells in block with oil drillings, shells in caps without oil drillings.

### Crankshaft End Clearance:

Std.: ..... 0.07 - 0.17 mm (0.0028 - 0.0067 in.)  
Wear limit: ..... 0.25 mm (0.10 in.)



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## Main Bearing Running Clearance:

|             |                                      |
|-------------|--------------------------------------|
| Std.:       | 0.03 - 0.08 mm (0.0012 - 0.0032 in.) |
| Wear limit: | 0.17 mm (0.0067 in.)                 |

## Big End Bearings:

|                         |                                      |
|-------------------------|--------------------------------------|
| Std. running clearance: | 0.02 - 0.076 mm (0.0008 - 0.003 in.) |
| Max. clearance:         | 0.12 mm (0.0047 in.)                 |
| Std. axial clearance:   | 0.05 - 0.31 mm (0.002 - 0.0122 in.)  |
| Max. clearance:         | 0.37 mm (0.015 in.)                  |

## Main Journal Diameters:\*

|              |                       |
|--------------|-----------------------|
| Basic:       | 54.00 mm (2.1260 in.) |
| Undersize 1: | 53.75 mm (2.1161 in.) |
| Undersize 2: | 53.50 mm (2.1063 in.) |
| Undersize 3: | 53.25 mm (2.0965 in.) |

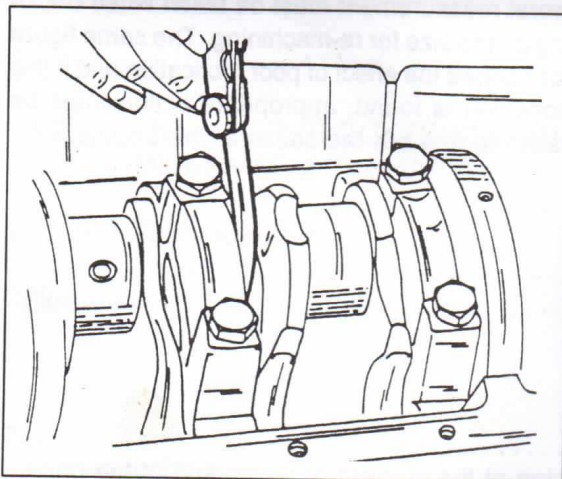
## Crankpin Journal Diameters:\*

|              |                       |
|--------------|-----------------------|
| Basic:       | 47.80 mm (1.8819 in.) |
| Undersize 1: | 47.75 mm (1.8799 in.) |
| Undersize 2: | 47.30 mm (1.8622 in.) |
| Undersize 3: | 47.05 mm (1.8523 in.) |

\* All diameters are toleranced at  $-0.04$  to  $-0.06$  mm ( $-0.0016$  to  $-0.0024$  in.).

### 1.4.3.1. Crankshaft — Removal and Installation

It will be more convenient to measure the crankshaft end float before the crankshaft is removed, so proceed as follows:



**Fig. 1.50.**  
Checking the crankshaft end float (axial play) at the centre bearing. Using a feeler gauge as shown, make sure that all clearance is taken up in each direction.

- Insert a feeler gauge at the centre bearing as shown in Fig. 1.50 and check that the end float is within the max. value given in Section 1.4.3.0.

- Make sure that all of the end float is taken up in each direction by applying a lever (preferably the wooden handle of a tool to avoid damage) and urging the crankshaft as far as it will go in each direction.

To remove the crankshaft, refer to Fig. 1.11 and remove the securing bolts of the front and rear oil seal flanges and carefully pry off the flanges from the cylinder block. The two oil seals must be removed from the flanges immediately, as they must be replaced. It is assumed that the flywheel has already been removed.

Remove the oil pump. Remove the bearing caps from the crankshaft, noting that they are marked from 1 to 5 from the front of the engine (No. 1 at the crankshaft pulley end; No. 5 at the flywheel end). Mark the shells and keep them matched with their caps. Remove the thrust half washers for the crankshaft end float from the centre bearing. It should be noted that all the bearing shells in the caps are without oil drillings.

Remove the crankshaft carefully and place to one side. Now look at the bearing shell halves remaining in the cylinder block. You will see that they have a lubrication groove and these halves must always go into the block. Also notice the nicks in the shells which must always align with the locators in the cylinder block and caps.

Install the crankshaft in the reverse sequence to removal, noting the points already mentioned. The crankshaft and all other parts must be absolutely clean before installation and the journals should be well lubricated. Tighten the bearing caps gradually,



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finally tightening to the specified torque. Refer to the next section for further information on the fitting of the front and rear oil seals and to Section 1.4.3.3. regarding the crankshaft main bearings.

**NOTE:** Check the running clearance of the main and connecting rod bearings before the crankshaft is refitted and re-check the end float after completed installation.

### 1.4.3.2. Crankshaft Oil Seals

Front and rear oil seals should always be replaced once the crankshaft oil seal flanges have been removed.

Both seals can be replaced with the engine fitted to the vehicle if necessary, but special tools are necessary, mainly for the front oil seal to carry out this operation successfully. In the case of the front seal, "V" belt, timing belt cover, timing belt guards and crankshaft pulley together with the timing gear wheel must be removed. To slacken the crankshaft timing gear bolt, engage 5th gear and apply the handbrake to lock up the engine and undo the bolt with a socket.

To remove the front oil seal use the special tool as used for the removal of the camshaft oil seal (refer to Section 1.4.0.6.) and the tool shown in Fig. 1.52. Screw the socket head bolt of the latter tool into the crankshaft front end as far as possible and then remove the oil seal in the same manner as described for the camshaft oil seal.

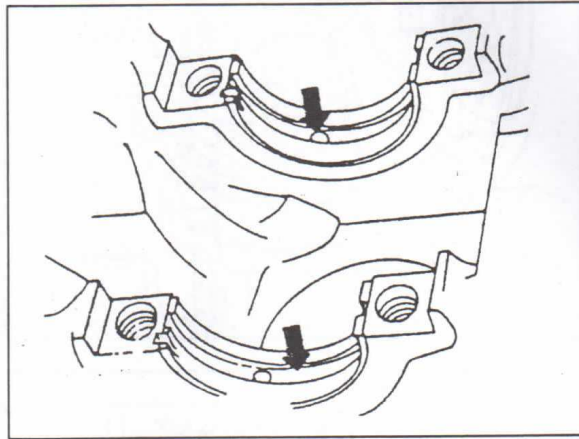
In the case of the rear oil seal, remove the transmission, the clutch and the flywheel or the drive plate in the case of automatic transmission, before extracting the oil seal. To remove the oil seal, pierce in a sharp-pointed screwdriver and lever the seal out, without damaging the crankshaft or, if available, use the tool shown in Fig. 1.53 to lever out the seal.

Some special precautions and tools are necessary to replace the oil seals and these are detailed below:

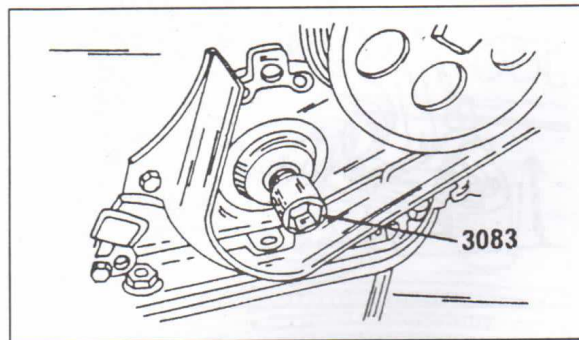
- For both the front and rear seals press out the old seal if the seal flange is removed from the engine. If the engine has been dismantled, fit the seal flanges with a new gasket and install the seals as follows:

- For the installation of the rear seal, carefully

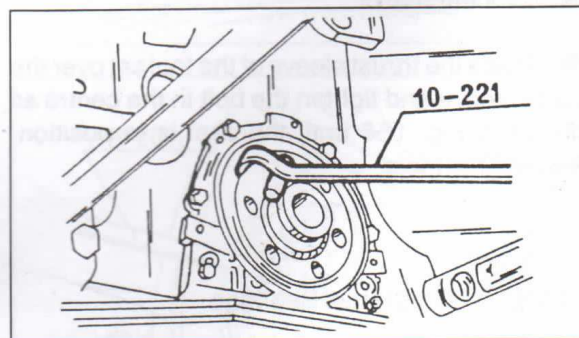
drive the seal in with a hammer and a drift, without damaging the seal lip.



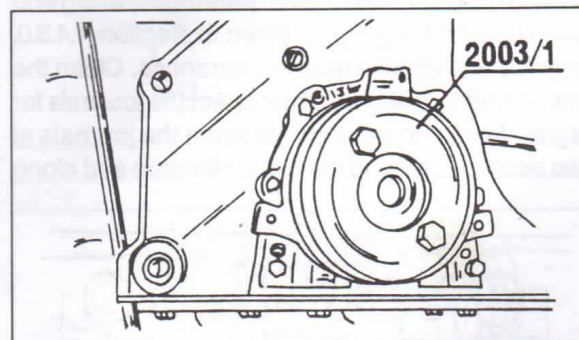
**Fig. 1.51.**  
View of the bearing shells in the crankcase. These are the ones with the oil grooves.



**Fig. 1.52.**  
Special tool to remove the front crankshaft oil seal. Tighten the bolt as far as it will go.



**Fig. 1.53.**  
Removal of the rear crankshaft oil seal with the special tool.



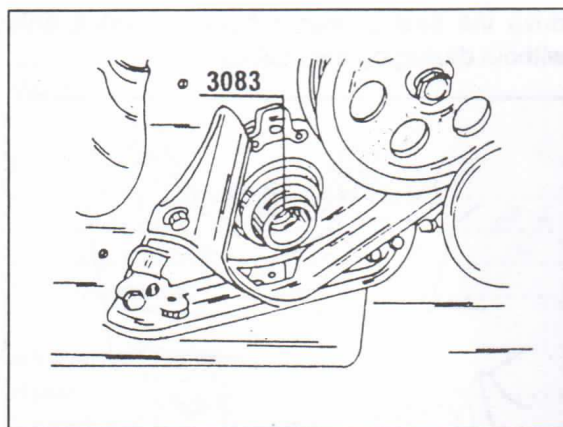
**Fig. 1.54.**  
Fitting the crankshaft oil seal at the flywheel end. See text for alternative method.

- Now press on the seal by using tool 2003/1 as shown in Fig. 1.54 or make up a round plate with two holes in it, which can be bolted to the end of the crankshaft flange. Great care should be taken if the seal is tapped in with a hammer. Oil leaks could develop if the ring is deformed.

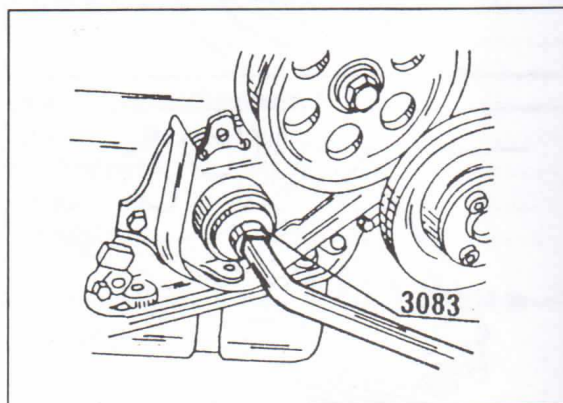
- A special tool is available to fit the front oil



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**Fig. 1.55.**  
Guide sleeve for the  
installation of the front oil  
seal.



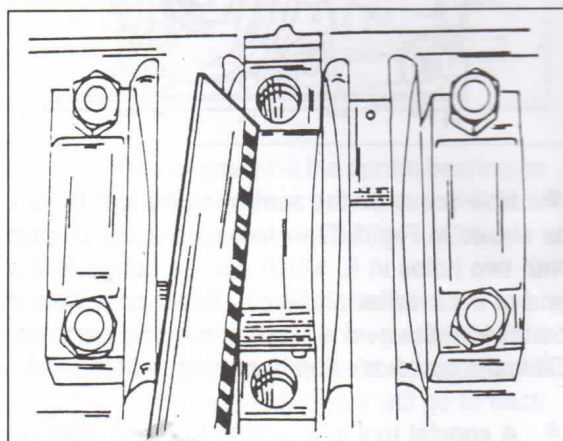
**Fig. 1.56.**  
Pulling the front crankshaft  
oil seal in position, using  
the special tools.

seal over the sleeve.

- Place the thrust sleeve of the tool set over the guide sleeve and tighten the bolt in the centre as shown in Fig. 1.56 until the seal is in position. Remove the tools.

## 1.4.3.3. Crankshaft Bearings

Data for the crankshaft main bearings and big end journals and bearings is given in Section 1.4.3.0. together with the allowable clearances. Clean the crankshaft thoroughly and inspect the journals for signs of wear or damage. Measure the journals at two positions around the circumference and along



**Fig. 1.57.**  
Measuring the width of the  
flattened "Plastigage" wire  
to determine the bearing  
running clearance. Check  
main bearings and big ends  
in the same manner.

its length. Out-of-round and/or a taper of more than 0.03 mm (0.0012 in.) will mean that the crankshaft will have to be re-ground.

Main bearing and crankpin bearing clearances can be assessed by the use of "Plastigage" as described below. Three types are available, with ranges of:

|           |       |                                         |
|-----------|-------|-----------------------------------------|
| PG1 Green | ..... | 0.025 - 0.075 mm (0.00098 - 0.0029 in.) |
| PR1 Red   | ..... | 0.050 - 0.150 mm (0.00196 - 0.0059 in.) |
| PB1 Blue  | ..... | 0.100 - 0.230 mm (0.0039 - 0.0090 in.)  |

To use the "Plastigage", first remove all dirt and grease from the journals and shells. Place a length of plastic wire along the complete length of the journal and fit the shell and bearing cap. Tighten the cap bolts to a tightening torque of 6.5 kgm (47 ft.lb.) in the case of the main bearing caps or to 3.0 kgm (22 ft.lb.) in the case of the big end bearing caps. Use the original connecting rod bolts and nuts for this check. Take care that the crankshaft cannot rotate once the bearing caps are fitted.

Now remove the bearing cap in question, refer to Fig. 1.57 and compare the width of the compressed "Plastigage" wire with the scale provided in the kit. If the clearance is excessive, the crankshaft bearing journals must be re-ground and undersize bearing shells fitted. Your dealer will advise you about availability of bearing shells.

## 1.4.3.4. Flywheel

The flywheel is of conventional construction and the clutch pressure plate is secured to the flywheel by six bolts. To remove the flywheel (after removal of clutch and clutch driven plate), counter-hold it in suitable manner. If the oil sump (pan) has been removed, insert a wooden block between the crankshaft and the side of the crankcase. Otherwise insert a strong screwdriver into the teeth of the flywheel. Fig. 1.58. shows how the special flywheel lock is inserted into the flywheel teeth to lock the flywheel. A similar tool can be used.

New flywheels are supplied without the ignition timing mark. The flywheel only has the "0" (top dead centre) marking and a new mark must be etched into the flywheel, as it will otherwise be impossible to adjust the ignition timing. Proceed as follows:

- Find the "0" mark and arrange it at the top of the flywheel.
- Place a ruler in line with the "0" mark towards the teeth and measure a distance of 14.5 mm



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towards the LEFT of the "0" mark line. At exactly this point mark a line with a file (see Fig. 1.59). This represents an ignition timing point of 6° before top dead centre.

- To mark the top dead centre mark into the outside of the flywheel, extend the "0" mark and mark a line into the material.

The needle roller bearing in the end of the crankshaft (only with a fitted manual transmission) can be removed with a suitable puller, which is applied in the manner shown in Fig. 1.60. The removal of the bearing must be carried out when the flywheel is fitted to the engine. Grease the new bearing and drive it into the crankshaft bore, using a suitable mandrel, until the dimension between the outer edge of the bearing and the outside of the crankshaft flange is 1.5 mm (Fig. 1.61). To obtain this exact dimension, place a washer of 1.5 mm in thickness over the bearing and then drive the bearing and washer into the crankshaft until the washer is flush with the crankshaft flange. The washer must, of course, be slightly smaller in diameter as it must be removed after the bearing has been fitted (otherwise the washer will jam).

### 1.4.3.5. Drive Plate (Automatic)

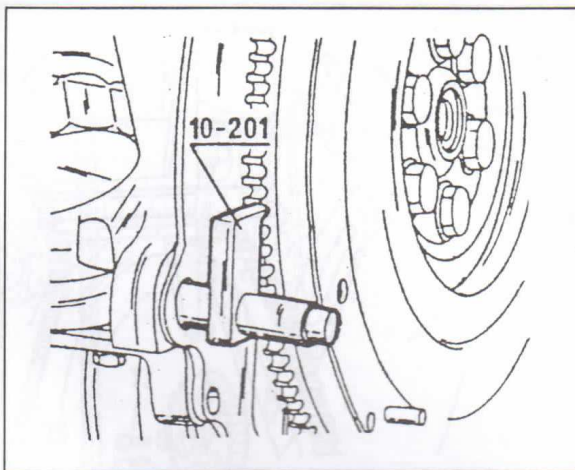
The drive plate is attached to the crankshaft flange by six bolts. A reinforcement washer is inserted between bolts and drive plate. This washer has a chamfer on its outer diameter which must always face towards the drive plate. Note that a distance washer may be inserted between crankshaft and drive plate. This washer determines the dimension of the drive plate towards the outside. Refit the plate and measure with a depth gauge between the drive plate surface and the cylinder block, as shown in Fig. 1.62. If this dimension is not within 30.5 to 32.1 mm, fit a distance washer.

Again only the top dead centre mark ("0") is marked into a new drive plate. To mark the ignition timing point, proceed in a similar manner as shown in Fig. 1.59 and measure the distance as described for the flywheel. Mark the timing point with a file.

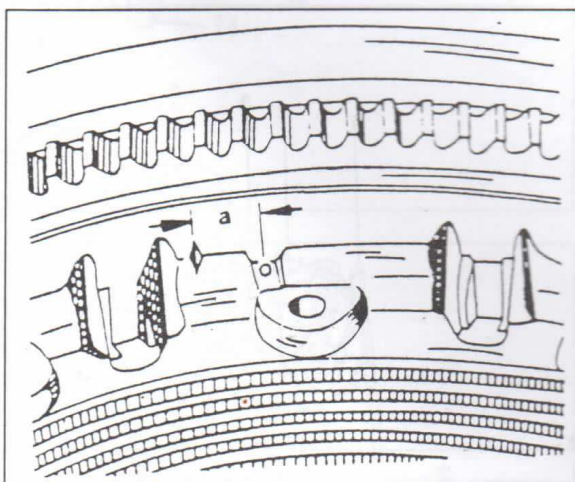
### 1.4.4. TIMING DRIVE/CAMSHAFT

#### 1.4.4.0. Introduction

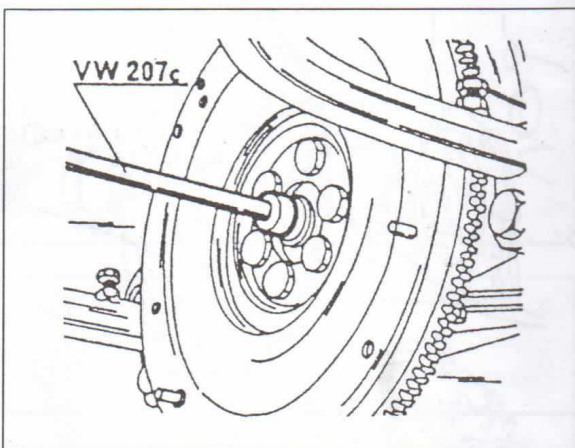
The drive to the overhead camshaft is provided



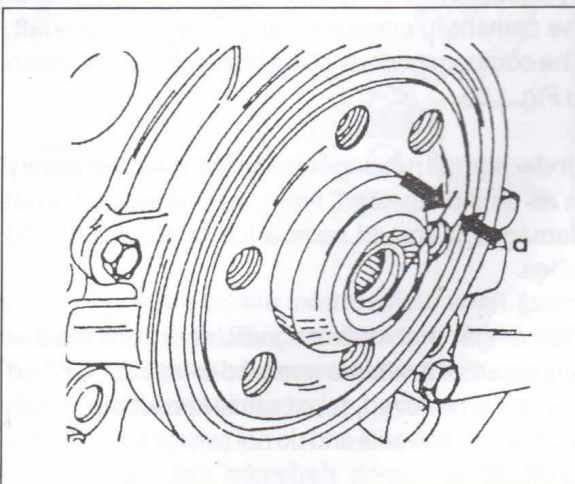
**Fig. 1.58.**  
A flywheel can be locked against rotation with a flywheel "brake".



**Fig. 1.59.**  
Marking the ignition timing point into a new flywheel. Measure dimension "a" as given in the text.



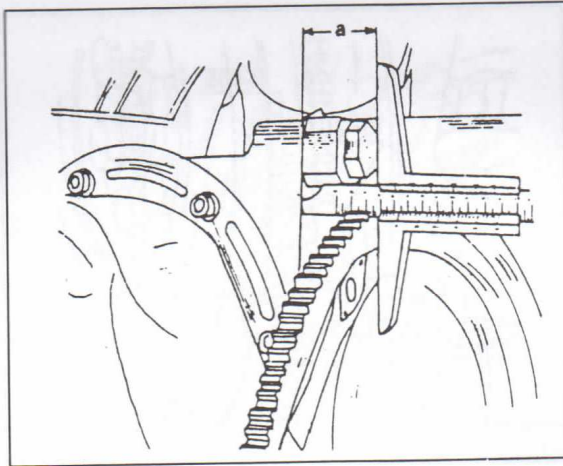
**Fig. 1.60.**  
Removal of the needle roller bearing in the crankshaft end, using the special tool.



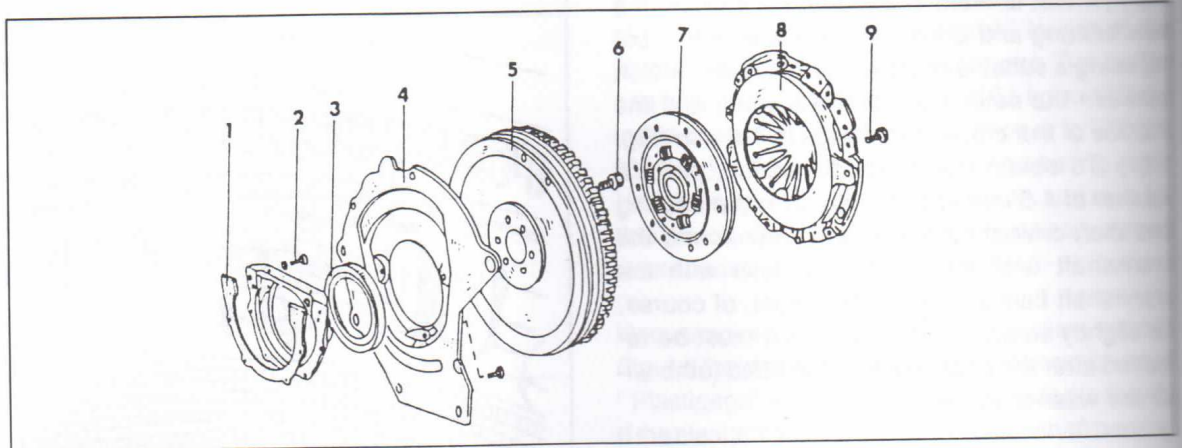
**Fig. 1.61.**  
Measure the fitting depth of the needle roller bearing "a" at the position shown.



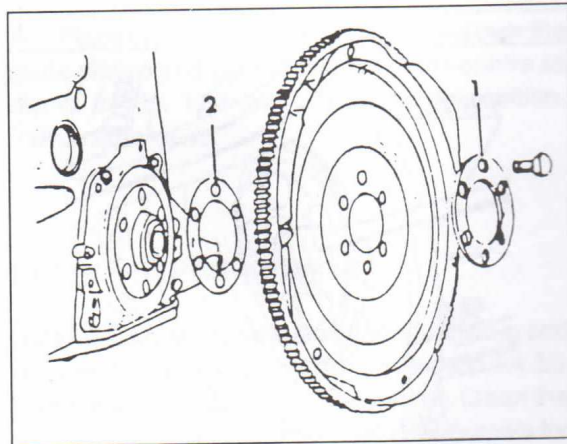
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**Fig. 1.62.**  
Measuring a drive plate  
before fitting.



**Fig. 1.63.**  
Exploded view of clutch,  
driven plate, flywheel and  
other parts at the rear end of  
the engine.  
1 Gasket, always replace  
2 Bolt, 1.0 kgm (7.2 ft. lb.)  
3 Rear oil seal  
4 Intermediate plate  
5 Flywheel  
6 Bolt, 10 kgm (72 ft. lb.)  
7 Driven plate  
8 Clutch pressure plate  
9 Bolt, 2.0 kgm (14.5 ft. lb.)



**Fig. 1.64.**  
The drive plate for the  
torque converter.  
1 Reinforcement washer  
2 Plain washer

by a toothed belt running on toothed sprockets at the camshaft, crankshaft and intermediate shaft. The component parts of the timing drive are shown in Fig. 1.65.

Under normal running conditions it is not necessary to re-tension the belt, provided that the belt is not damaged it should have a life of around 60,000 miles.

Remember that the timing will have to be reset at any time that the belt is removed or replaced. When the belt is removed, take care to keep it away from grease and solvents and do not twist or bend it into a small radius.

The tensioning of the timing belt is carried out by means of a special tensioner pulley (with an eccentric).

### 1.4.4.1. Removal and Installation of Timing Belt

To remove the timing belt, proceed as follows:

- Remove the upper timing belt cover.
- Slacken the alternator mounting bolts, push

the alternator towards the inside and remove the drive belt. If power-assisted steering is fitted remove the drive belt.

- Mark the position of the crankshaft pulley in relation to the crankshaft gear hub at the inside, engage 5th gear, apply the handbrake and remove the bolts securing the pulley halves. Remove the pulley halves.

- Unscrew the lower timing cover.

- Refer to Fig. 1.66 and slacken the nut by turning the spanner in direction "b" and move the tensioner towards the outside until the timing belt is slack. Remove the belt from the timing gears.

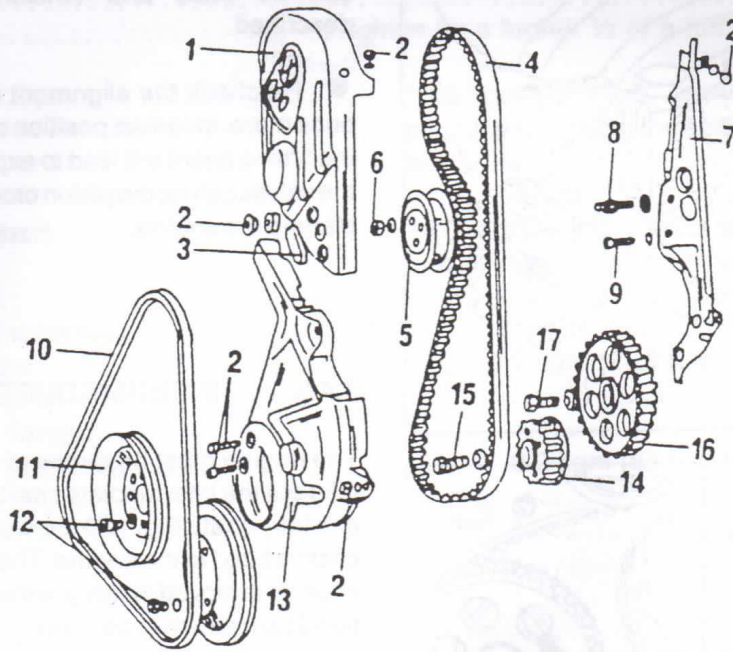
When installing the belt, the timing marks must be set as described in the next section. When this has been done, the tension must be adjusted.

- Apply a spanner to the hexagon of the tensioning roller and turn the roller in the direction shown by the arrow in Fig. 1.67. The belt is properly tensioned when it is just possible to twist the belt at the mid-position by 90° (C in Fig. 1.66).

- Tighten the tensioner roller nut to 4.5 kgm (32.5 ft. lb.).



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**Fig. 1.65.**  
The component parts of the timing drive.

- 1 Upper timing cover
- 2 Nut and washer, 1.0 kgm
- 3 Closing plug
- 4 Timing belt
- 5 Timing belt tensioner
- 6 Nut, 4.5 kgm (32.5 ft.lb.)
- 7 Inner cover
- 8 Special bolt, 3.0 kgm (22 ft.lb.)
- 9 Bolt, 3.0 kgm (22 ft.lb.)
- 10 Drive belt
- 11 Crankshaft pulley halves
- 12 Bolt, 2.0 kgm (14.5 ft.lb.)
- 13 Lower timing belt cover
- 14 Crankshaft timing gear
- 15 Timing gear bolt (note torque)
- 16 Intermediate shaft drive gear

- Turn the crankshaft by two complete revolutions and check that the tension has not changed.

- Refit the timing belt covers, the crankshaft pulley halves (note the markings) and the alternator drive belt. Tension the drive belt as described in Section "Cooling".

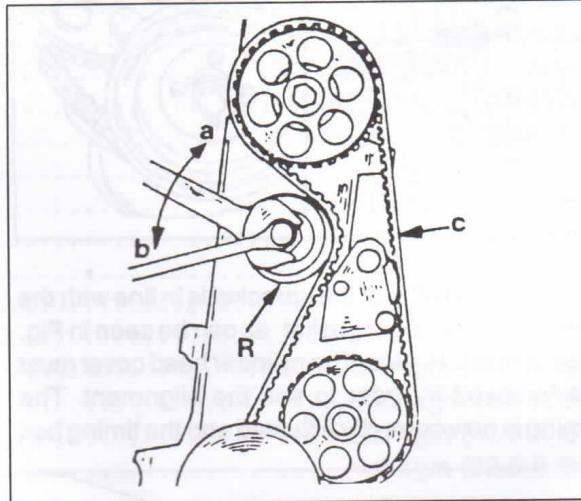
- If the crankshaft timing gear has been removed, fit the gear over the crankshaft end so that the lug in the gear engages with the cut-out in the crankshaft end, as shown in Fig. 1.68. Coat the bolt threads with engine oil and tighten the bolt to 20.0 kgm (145 ft.lb.). If a 12-point bolt is used, fit a new one. Tighten this type of bolt to 9.0 kgm (65 ft.lb.) and from this position a further 1/2 of a turn. The tightening can be carried out in two stages. The additional 1/2 of a turn is important.

## 1.4.4.2. Checking and Setting the Timing Drive

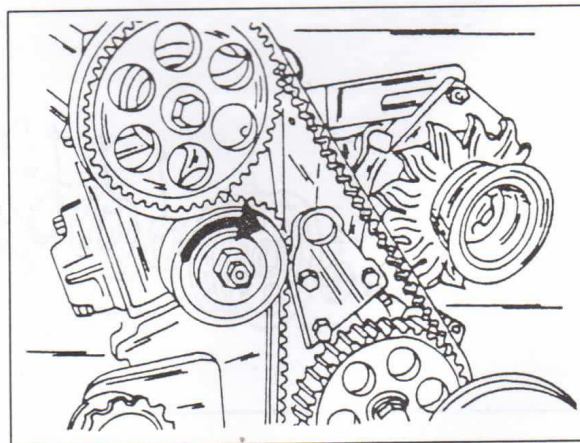
- Unscrew the spark plugs.

- Provisionally refit the crankshaft pulley halves to the crankshaft timing gear (without belt guard), taking care to align the marks made before removal.

- Turn the crankshaft by applying a spanner to the timing gear and the auxiliary shaft (intermediate shaft) until the piston of No. 1 cylinder is at T.D.C., i.e. the notch in the crankshaft pul-



**Fig. 1.66.**  
The timing belt and tensioner, shown here while adjusting the belt tensioner after installation.  
a. Direction to tighten belt  
b. Direction to slacken belt  
R. Tensioner pulley  
c. Centre of run, position for assessing the belt tension



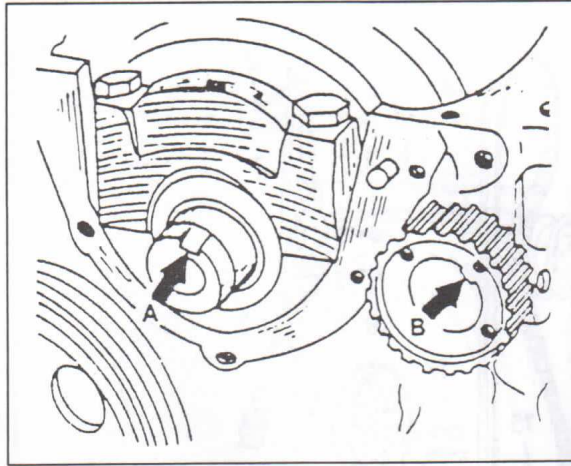
**Fig. 1.67.**  
Tensioning details for the timing belt.

ley and the mark on the intermediate shaft gear are opposite each other as shown in Fig. 1.69. The spark plugs can be removed to facilitate the rotation of the crankshaft.

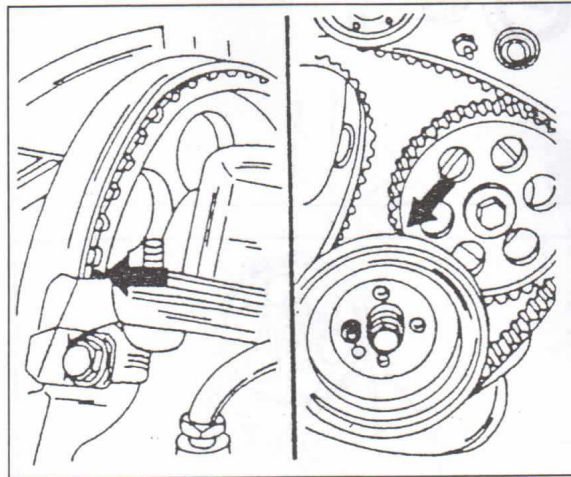
- Next turn the camshaft sprocket until the



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**Fig. 1.68.**  
The groove "A" in the crankshaft end and the lug "B" inside the crankshaft gear must engage during installation.



**Fig. 1.69.**  
Aligning the timing marks of the camshaft timing gear and the edge of the cylinder block on the L.H. side and the crankshaft pulley and the intermediate shaft pulley on the R.H. side. The points marked with the arrow must be aligned.

mark at the **BACK** of the sprocket is in line with the cylinder head cover gasket, as can be seen in Fig. 1.69 on the L.H. side. The cylinder head cover must be removed in order to see the alignment. The timing is now correctly adjusted and the timing belt

can be fitted and tensioned as previously described.

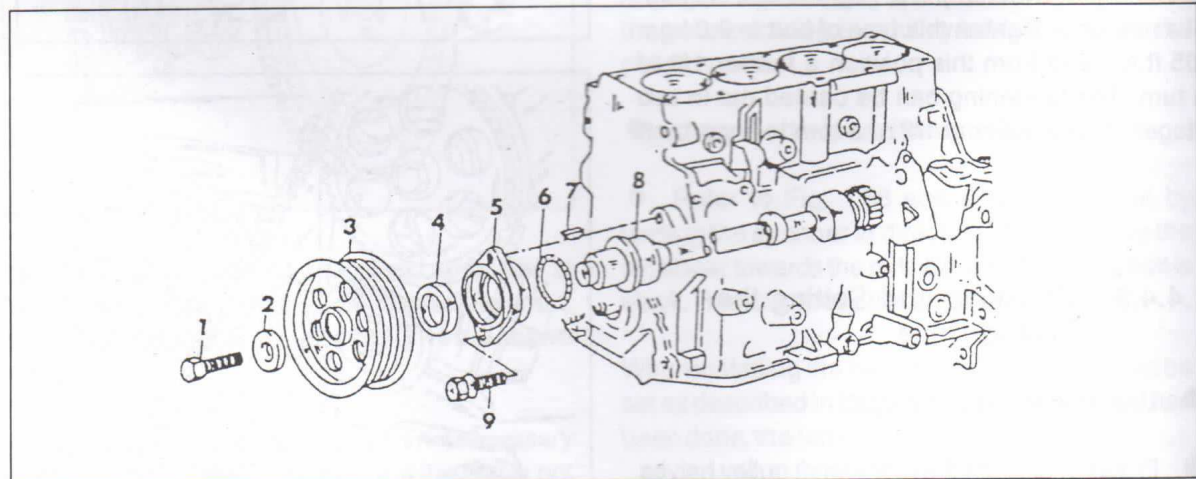
- Re-check the alignment of the timing gears once more. Incorrect position of one or the other of the timing gears will lead to expensive damage, as the valves can hit the piston crowns immediately on starting the engine.

## 1.4.5. INTERMEDIATE SHAFT

The engine must be removed from the vehicle to take out the intermediate shaft, also referred to as auxiliary shaft. Fig. 1.70 shows how and where the shaft is fitted to the engine. The ignition distributor must be removed to remove the shaft. The cylinder head can remain in position.

The oil seal flange has an oil return bore at the bottom and must be fitted accordingly. The flange determines the end float of the shaft and it may need replacement if the end float exceeds 0.25 mm (0.010 in.). An "O" sealing ring seals the shaft to the engine.

Replace the oil seal inside the seal flange, if the latter has been unbolted and removed. To fit the new oil seal, first fit the shaft and the flange and then knock the oil seal in position or pull it into the block bore and over the intermediate shaft as has been described for the crankshaft oil seal. Tighten the flange bolts to 2.5 kgm (18 ft. lb.).



**Fig. 1.70.**  
The component parts of the intermediate shaft.  
1 Bolt, 4.5 kgm (32.5 ft. lb.)  
2 Washer  
3 Drive gear  
4 Oil seal  
5 Oil seal flange  
6 "O" sealing ring  
7 Woodruff key  
8 Intermediate shaft  
9 Bolt, 2.5 kgm (18 ft. lb.)

## 1.5. Tightening Torque Values

Main bearing caps: ..... 6.5 kgm (47.0 ft. lb.)  
Cylinder Head Bolts:  
First stage: ..... 4.0 kgm (29 ft. lb.)



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|                                                         |                                                                                                             |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Second stage: .....                                     | 6.0 kgm (43.5 ft.lb.)                                                                                       |
| Third stage: .....                                      | Tighten by a further ½ of a turn (or 2 x ¼ of a turn)                                                       |
| Flywheel: .....                                         | 10.0 kgm (72 ft.lb.). Apply "D6" sealing compound before fitting the bolts — first clean off grease or oil. |
| Drive plate (converter): .....                          | 10.0 kgm (72 ft.lb.). Apply sealing compound before fitting bolts — first clean off grease or oil.          |
| Clutch: .....                                           | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Intermediate shaft sprocket: .....                      | 8.0 kgm (57.9 ft.lb.)                                                                                       |
| Connecting rod caps: .....                              | 3.0 kgm (21.0 ft.lb.), then by 90° further                                                                  |
| Water pump to engine: .....                             | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Intermediate shaft flange: .....                        | 2.5 kgm (18.0 ft.lb.)                                                                                       |
| Crankshaft timing gearwheel: .....                      | 9.0 kgm (65 ft.lb.), then a further 180°                                                                    |
| Pulley to sprocket: .....                               | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Oil pump to engine: .....                               | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Oil drain plug: .....                                   | 3.0 kgm (21.7 ft.lb.)                                                                                       |
| Oil sump to block:                                      |                                                                                                             |
| Short bolts: .....                                      | 1.0 kgm (7.2 ft.lb.)                                                                                        |
| Long bolts: .....                                       | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Oil filter bracket: .....                               | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Oil cooler to filter bracket: .....                     | 2.5 kgm (18 ft.lb.)                                                                                         |
| Parts of injection systems: .....                       | See exploded views                                                                                          |
| Exhaust manifold to cylinder head: .....                | 2.5 kgm (18.0 ft.lb.)                                                                                       |
| Exhaust manifold to exhaust pipe: .....                 | 4.0 kgm (29 ft.lb.)                                                                                         |
| Camshaft bearing caps: .....                            | 2.0 kgm (14.5 ft.lb.)                                                                                       |
| Camshaft sprocket: .....                                | 8.0 kgm (57.8 ft.lb.)                                                                                       |
| Belt tensioner nut: .....                               | 4.5 kgm (32.5 ft.lb.)                                                                                       |
| Cylinder head cover: .....                              | 0.8 kgm (5.8 ft.lb.)                                                                                        |
| Water adaptor and heater flange to cylinder head: ..... | 1.0 kgm (7.2 ft.lb.)                                                                                        |
| Oil pressure switch: .....                              | 1.0 kgm (7.2 ft.lb.)                                                                                        |
| Spark plugs: .....                                      | 3.0 kgm (21.7 ft.lb.)                                                                                       |
| Timing belt guard: .....                                | 0.9 kgm (6.5 ft.lb.)                                                                                        |
| Engine to transmission .....                            | 5.5 kgm (40.0 ft.lb.)                                                                                       |
| Drive shaft to flange: .....                            | 4.5 kgm (32.5 ft.lb.)                                                                                       |



## 1A FIVE-CYLINDER PETROL ENGINE

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### 1A.0. Main Features

|                        |                                                                                                                                    |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Type:                  | 5-cylinder, in-line, water cooled engine. Distributor drive from camshaft. Engine fitted transversely to the front of the vehicle. |
| Valve gear:            | Overhead camshaft, timing belt drive to camshaft. Camshaft operating directly onto inverted bucket-type tappets (hydraulic type).  |
| <b>Engine Details:</b> |                                                                                                                                    |
| Engine code:           | AAF                                                                                                                                |
| Max. power:            | 81 kW (111 BHP) at 4500 rpm                                                                                                        |
| Max. torque:           | 19.0 kgm (137 ft.lb.) at 2200 rpm                                                                                                  |
| Bore and stroke:       | 81.0 x 95.5 mm (3.2181 x 3.7942 in.)                                                                                               |
| Compression ratio:     | 8.5 : 1                                                                                                                            |
| <b>Valve Timing:</b>   |                                                                                                                                    |
| Inlet valve opens:     | 2.5° after top dead centre                                                                                                         |
| Inlet valve closes:    | 32.5° after bottom dead centre                                                                                                     |
| Exhaust valve opens:   | 32.5° before bottom dead centre                                                                                                    |
| Exhaust valve closes:  | 2.5° before top dead centre                                                                                                        |
| Fuel supply:           | "Digifant" fuel injection system                                                                                                   |



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|                        |                                                         |
|------------------------|---------------------------------------------------------|
| Firing order:          | 1—2—4—5—3                                               |
| Idle speed:            | 800 ± 25 rpm to Dec. 1992, 775 - 825 rpm from Jan. 1993 |
| CO Content:            |                                                         |
| To Dec. 1992:          | 0.7 ± 0.2 %                                             |
| From Jan. 1993:        | 0.3 - 1.2 %                                             |
| Ignition timing point: | See Section "Ignition System"                           |

**Note:** Idle speed and CO content not adjustable after Aug. 1992

### Oil Pressure:

|       |                           |
|-------|---------------------------|
| Min.: | 1.0 kg/sq.cm. (14.2 psi.) |
| Max.: | 7.0 kg/sq.cm. (99.6 psi.) |

### 1A.1. Engine — Removal and Installation

The engine is removed together with the transmission from below the vehicle. A strong mobile jack must be available. VW workshops use a special device to guide the engine. As this will obviously not be available to the average D.I.Y. man, we recommend that a helper holds the engine on the jack whilst it is lowered.

Before the engine is removed, it is necessary to tilt the radiator and the bonnet lock carrier towards the front. This operation will also be necessary for various maintenance and service operations and the following description will be referred to at various stages when required.

*Also note that the security code for a radio with anti-theft code must be to hand before the battery is disconnected.*

During the following description you will be referred to some of the illustrations shown for the 4-cylinder engine, if they are the same or similar.

- From underneath the vehicle unscrew the noise dampening panels. To do this, unscrew the screws and nuts shown in Fig. 1.1, unlock the locking lever, lower the panel assembly and take out of its mountings. Tighten the screws and nuts to 0.9 kgm (7 ft.lb.) during installation.

- To tilt the radiator towards the front, in the direction shown by the arrow in Fig. 1.2, remove the two screws (1) on the L.H. and R.H. side and then pivot the radiator and the lock plate towards the front. Lock the lock carrier plate in position.

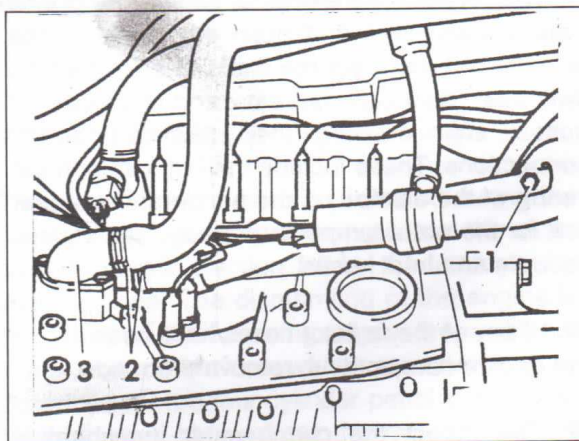
The removal of the engine can now proceed as follows:

- Disconnect the battery negative terminal.

The battery can be removed from the vehicle since this will avoid any possibility of damage or inadvertent short-circuiting.

- Place the heater operating lever into the "Warm" position and remove the cap from the expansion tank. The engine must be cold. Observe the necessary precautions if the engine is hot.

- Drain the cooling system. To do this, refer to Fig. 1A.1 open the drain plug (1) and disconnect the two coolant hoses (2) or unscrew the thermostat housing cover (3) at the position shown.



**Fig. 1A.**  
Draining the cooling system. The numbers are referred to in the text.

As anti-freeze is contained in the cooling system, check the condition of the solution before deciding whether to drain it or to collect it in a suitable container.

- Slacken the hose clamps on the upper radiator hose and withdraw the hose from the cylinder head. Also disconnect the remaining hoses between the radiator and the engine. Hoses are either secured by means of spring clamps or screw-type clamps. Spring clamps can be replaced with screw-type clamps during installation.

- Knock the pins out of the spreader clips on



## 1A Five-cylinder Petrol Engine

the L.H. and R.H. sides of the radiator and remove the spreader clips from the radiator mounting. Fig. 1.4 shows where the pins are located. Disconnect the electrical lead from the temperature switch on the radiator and the connector for the cooling fan motor. Completely remove the radiator. Remove the hoses from their connections to create enough room for the removal of the radiator assembly.

- Unscrew the drive shaft for the speedometer at the connection point on the transmission.

- Disconnect the cable connector plug from the rear of the alternator and from the side of the ignition distributor.

- Disconnect the fuel inlet and return pipes from their connections at the fuel distributor rail. The return line is the blue one. Also disconnect a vacuum feed line (black colour) at the distributor rail.

- Unhook the throttle operating cable from the throttle valve operating segment on the throttle valve body and detach it from the bracket. Do not remove the clip securing the cable to the bracket, but unscrew the bracket.

- Disconnect the electrical leads from the oil pressure switches and push the leads to one side. Also disconnect the leads of all remaining switches, connections, etc. and all vacuum hoses, after marking their terminals and/or connections. These include the H.T. cable in the centre of the distributor, the temperature sender unit for the water temperature gauge and various vacuum and inlet hoses.

- If any of the radiator hoses have been left on the engine connections, remove them now.

- Disconnect the clutch cable (mechanical clutch) or the clutch slave cylinder (hydraulic clutch) in accordance with the instructions in Section "Clutch" (Chapter 8). If the vehicle has mechanical clutch operation, remove the rubber plug from the hole in the transmission, shown by the arrow in Fig. 1.5, and secure the clutch release lever with a pin. The illustration shows the special pin used by VW workshops (top right), but an M8 x 22 mm bolt will do.

- Remove the gear actuating unit as described in Section 16.1 (Removal and Installation of a Diesel engine).

- Remove the drive shafts as described in

Chapter 10. Do not allow the drive shafts to hang down, but tie them up to keep them in horizontal position.

- Remove the front exhaust pipe together with the Lambda probe. The cable for the Lambda probe must be disconnected.

- Place mobile jack underneath the centre of the engine. A block of wood must be placed between oil sump and jack head. Operate the jack until the engine is slightly under tension.

- Remove all bolts between engine and transmission from below the vehicle.

- Release the steering pump belt tension and unscrew the pump from the engine. The hoses must be disconnected. Do not clamp up hoses, in order to avoid the loss of hydraulic fluid. Disconnect the pressure and return hoses at the power steering. Place the pump to one side where it is out of the way.

- Remove the cover from underneath the flywheel housing.

- Check that engine and transmission are securely supported on the jack and remove the transmission from the transmission mounting. The attachment is the same as for the diesel engine and can be seen in Fig. 16.3. The bolts shown by the arrows must be removed.

- Unscrew the central bolts for the engine and transmission mounting on the right and the left in the engine compartment.

- Remove all bolts connecting the engine to the transmission at the top.

- Withdraw the engine from the transmission, taking care all the time that the engine cannot drop off the jack. A second person must operate the jack slowly. Make sure that none of the connections have been left in position and take care that no damage is done when the engine is lowered from the engine compartment. Also make sure that the engine cannot rest on the clutch shaft (gearbox input shaft).

Install the engine and transmission in the reverse sequence to removal, noting the following points below:

- Check the clutch release bearing before installation of the engine. Slightly coat the contact face of the release bearing and the clutch



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shaft with grease. The guide sleeve for the release bearing must not be lubricated.

the complete system is free of tension.

- Fill the cooling system as described in Section 4. "Cooling".

- Fill the engine with engine oil. Also check the transmission oil level and correct if necessary.

- Adjust the throttle cable as described in the fuel section.

- If necessary adjust the ignition and idling speed (if possible, not after Aug. 1992) after the engine has been restarted.

- Check the headlamp adjustment or have it professionally checked.

### 1A.1.1. WITH AUTOMATIC TRANSMISSION

The removal and installation of the engine is carried out in a similar manner as described in Section 1A.1.0, but Section 1.1.1 for the four-cylinder engine should be consulted. Similar operations must be carried out if a five-cylinder engine is used together with an automatic transmission.

## 1A2. Engine — Dismantling

The basic information to be followed during the dismantling of the engine is in general the same as described in Section 1.2 for the four-cylinder petrol engine. The dismantling of the engine is described on the following pages, there will, however, be operations which are identical as described for the four-cylinder petrol engine and reference will be made to the relevant section and to certain illustrations.

### 1A.3. Cylinder Head

#### 1A.3.0. Technical Data

##### Valves

##### Valve Head Diameters:

Inlet valves: ..... 40.0 mm (1.5892 in.)

Exhaust valves: ..... 33.0 mm (1.2517 in.)

Valve Length — Inlet Valves: ..... 91.9 mm — 0.9 mm (3.6512 in. — 0.0358 in.)

— Exhaust valves: ..... 91.2 mm — 0.4 mm (3.6234 in. — 0.0159 in.)



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### Valve Stem Diameters:

|                             |                       |
|-----------------------------|-----------------------|
| Inlet valves: .....         | 7.97 mm (0.314 in.)   |
| Exhaust valves: .....       | 7.95 mm (0.313 in.)   |
| Valve seat angle: .....     | 45°                   |
| Valve edge thickness: ..... | 0.5 mm (0.02 in.) min |

### Valve Seats

#### Valve Seat Diameters:

|                       |                      |
|-----------------------|----------------------|
| Exhaust valves: ..... | 32.4 mm (1.2875 in.) |
| Inlet valves: .....   | 37.2 mm (1.4779 in.) |

#### Valve Seat Widths:

|                       |                     |
|-----------------------|---------------------|
| Inlet valves: .....   | 2.00 mm (0.080 in.) |
| Exhaust valves: ..... | 2.4 mm (0.095 in.)  |

Valve seat angle: ..... 45°

Upper correction angle: ..... 30°

### Valve Guides

Installation temperature: ..... Cylinder head cold

Inner diameter: ..... 8.013 - 8.035 mm (0.3154 - 0.3163 in.)

Running clearance of valve stems ..... See Fig. 1.16

### 1A.3.1. Introduction

The cylinder head can be removed with the engine in position in the engine compartment. Due to the design of the valve gear, tappets and camshaft there are a number of special points arising which the reader is advised to study before attempting any work on the cylinder head.

The overhead camshaft is supported in four bearings, the rear one providing axial location. There is a special procedure for removing the camshaft for access to the valve springs and tappets and this must be followed to avoid distortion of the camshaft from the pressure of the valve springs. A number of special tools, or suitably made-up alternatives, will be required for servicing and the reader is advised not to undertake such work unless the proper equipment is available.

Routine adjustment of the tappet clearance is not required, as any clearance will be taken up by the hydraulic tappets.

The valve retainers, springs and stem seals are rather inaccessible, being in pockets in the head. We shall be describing the removal and installation procedures, using the special tools and procedures recommended and will mention those that are essential for the work.

### 1A.3.2. Head Removal — Engine fitted

Only remove the cylinder head when the engine temperature is less than 40° C. Fig. 1A.2 shows an exploded view of the the cylinder head. The removal of the individual parts takes place in their numbered order. The following description is a guide line for the removal.

- Tilt the front end of the vehicle forward, as described on page 11 and disconnect the battery earth cable.

- Drain the cooling system and disconnect the coolant hoses from the cylinder head.

- Disconnect the electrical cables from all parts on the cylinder head. Also disconnect the pipes belonging to the fuel injection system between cylinder head and body. Protect the pipe ends against entry of foreign matter.

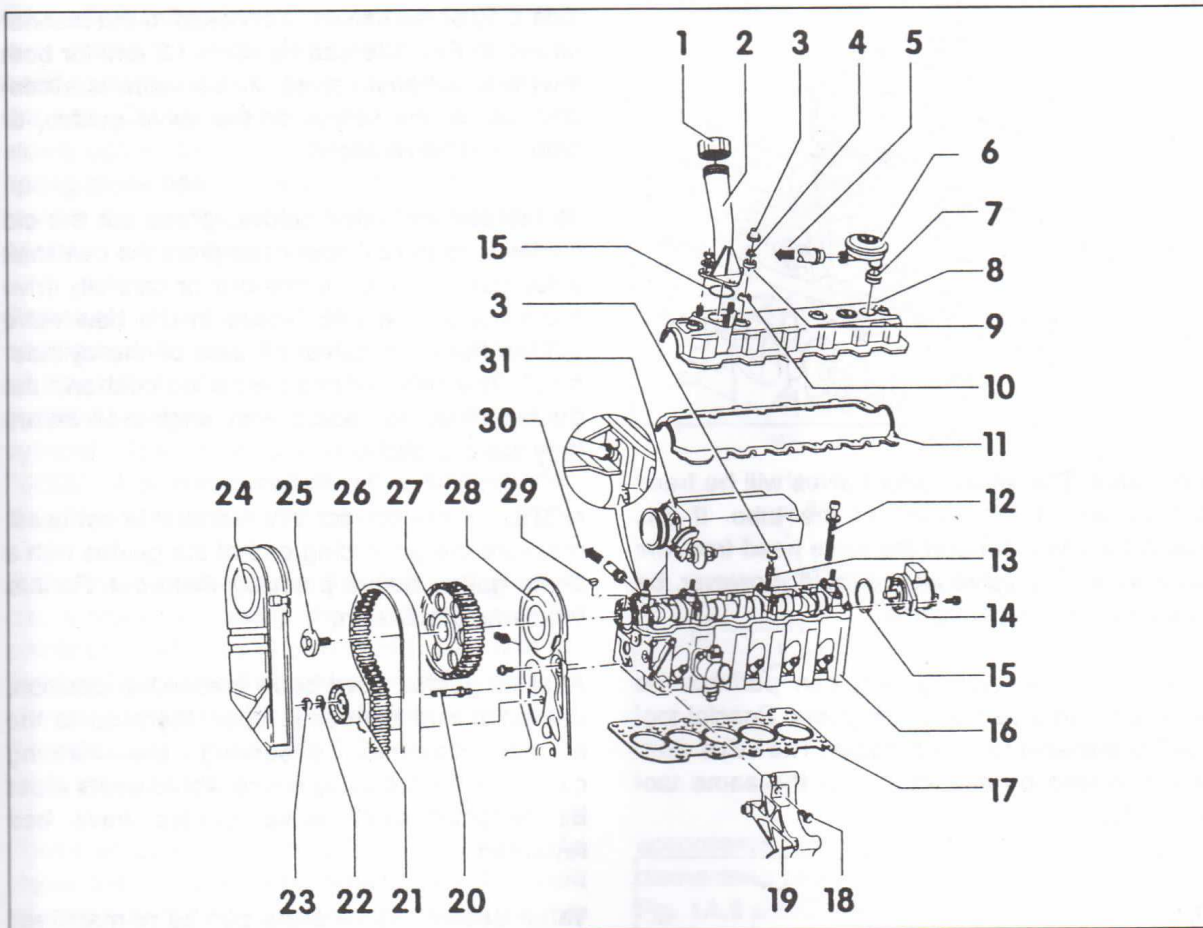
- Remove the exhaust manifold and the front exhaust pipe.

- Unscrew the oil filler pipe and the cylinder head cover. Carefully remove the gaskets as they can be re-used, if still in good condition.

- Remove the timing belt as described later on under the relevant heading. Also remove the camshaft timing gearwheel from the end of the



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**Fig. 1A.2**  
Details for the removal and installation of the cylinder head.

- 1 Oil filler cap
- 2 Oil filler pipe
- 3 Cap
- 4 Nut, 1.0 kgm
- 5 To intake hose
- 6 Crankshaft breather pressure control valve
- 7 Oil seal
- 8 Cylinder head cover
- 9 Dished washer
- 10 Upper sealing washer
- 11 Cylinder head cover gasket
- 12 Cylinder head bolt
- 13 Stud, 1.5 kgm
- 14 Ignition distributor
- 15 "O" sealing ring
- 16 Cylinder head
- 17 Cylinder head gasket
- 18 Screw, 2.0 kgm
- 19 Bracket
- 20 Stud, 2.0 kgm
- 21 Tensioning pulley
- 22 Washer
- 23 Nut, 1.5 kgm
- 24 Upper belt guard
- 25 Camshaft sprocket bolt
- 26 Toothed belt
- 27 Camshaft sprocket
- 28 Rear belt guard
- 29 Woodruff key
- 30 Hose connection
- 31 Inlet manifold

camshaft. The timing wheel must be prevented from rotating when the bolt is slackened.

● Using a socket head wrench slacken the cylinder head bolts in reverse order to the one shown in Fig. 1A.3. Slacken the bolts in several stages. The cylinder head and the gasket can now be removed.

### 1A.3.3. Cylinder Head — Dismantling

Remove all auxiliary parts from the cylinder head and put them away safely where they cannot suffer damage during the work on the cylinder head. Make up a bracket which can be attached to the studs for the exhaust manifold and clamp the bracket into a vice.

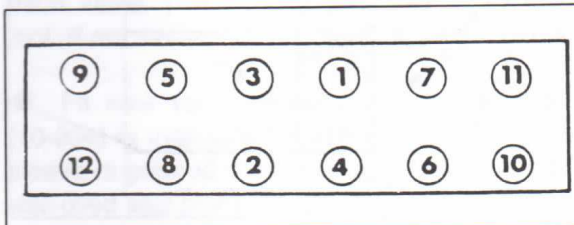
Remove the camshaft as described in Section 1A.5. Remove the half-round sealing insert from the bearing cap, if it is still in the cap. Otherwise remove the seal from the cylinder head.

Carefully lift the camshaft out. Using soft-metal jaws, clamp the camshaft into a vice and remove the bolt securing the camshaft gearwheel. Re-

move the gearwheel and slide the camshaft oil seal from the end of the shaft.

Remove the tappets. Lay each of the tappets out in order (on a sheet of paper) so that they can be replaced in the same position. Mark the tappets by marking them as shown in Fig. 1.14.

A valve lifter is necessary for the removal of the valves and should be as shown in Fig. 1A.4 or working with a similar principle. Press down the retainer to allow the collets to be extracted with a pair of thin-nosed pliers. An alternative method is to place a piece of tube over the valve spring retainer and to tap the tube with a short blow of

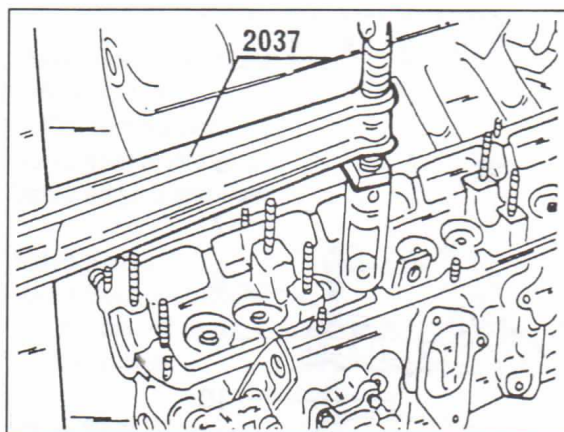


**Fig. 1A.3**  
Tightening sequence for the cylinder head bolts. Slacken the bolts in reverse order.

**Attention:** The head of the camshaft gear bolt (25) can either be marked with "8.8" or "10.9". Different tightening torques apply to the two types of bolts.



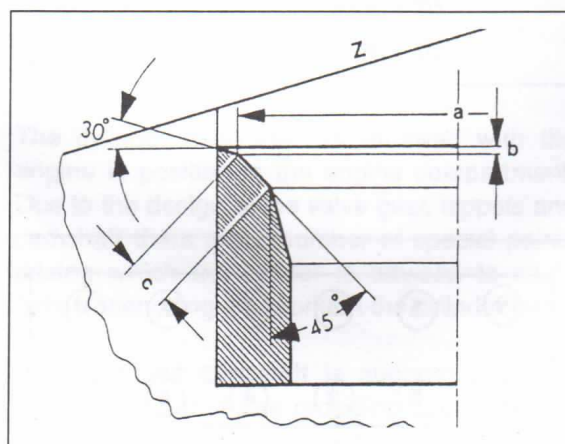
## 1A Five-cylinder Petrol Engine



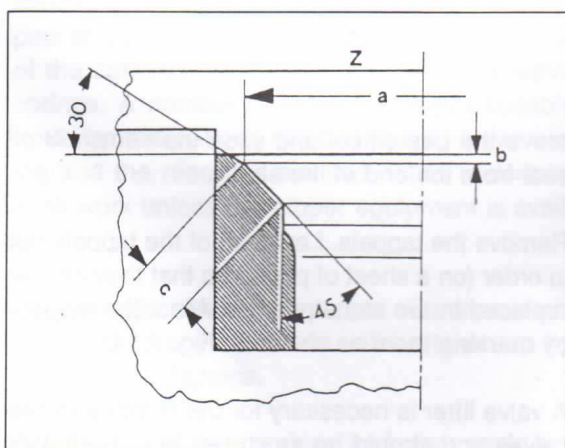
**Fig. 1A.4**  
Removal of valve springs,  
using the valve lifter from  
VW.

a hammer. The valve cotter halves will be freed and collect in the inside of the tube. If this method is used, support the valve head from the other side. The valve lifter should, however, be available for the installation.

The lower valve spring seat can perhaps be removed with a pair of circlip pliers. Special tool 3047 is available for this purpose. The valve stem seal can also be extracted with the same tool (Fig 1.29).



**Fig. 1A.5.**  
The inlet valve re-finishing  
sizes.  
a = See Section 1A.4.0.0.  
b = Max. permissible re-  
working depth  
c = 2.00 mm (0.0787 in.)  
Z = Cylinder head face



**Fig. 1A.6.**  
The exhaust valve seat re-  
finishing sizes.  
a = See Section 1A.4.0.0.  
b = Max. permissible re-  
working depth  
c = 2.40 mm (0.0945 in.)  
Z = Cylinder head face

**Valve Guides:** Valve guides and valve stems should first be inspected for visible wear. The operations are the same as described on pages 18 and 19 for the petrol engines, but note that the

side play of the valves, if checked in the manner shown in Fig. 1.16 can be up to 1.3 mm for both inlet and exhaust valves. If this value is exceeded, either the valves or the valve guides, or both must be replaced.

To replace the valve guides, press out the old guides from the cylinder head (from the camshaft side), using a suitable mandrel or carefully drive them out with a drift. Press in the new valve guides from the camshaft side of the cylinder head. The cylinder head must be cold and the guides must be coated with engine oil before they are pressed in.

**NOTE:** If the correct VW mandrel is not used, measure the protruding end of the guides with a depth gauge before pressing them out. Refit to the same dimension.

After all guides have been pressed in position, use an 8 mm reamer to open them up to the correct diameter, observing the running clearance for the valve stems. **Valve seats must be re-faced after valve guides have been replaced.**

**Valve Seats:** Valve seats can be re-machined to the dimensions given in Figs. 1A.5 and 1A.6. When valve seats are re-cut, determine the maximum permissible re-cutting depth. On pages 19 and 20 you will find a detailed description to renovate the valve seats. The dimensions given at the bottom of page 20 are also valid for the five-cylinder engine. If this is exceeded there is no guarantee that the tappets can work properly.

Shorter valves are available as replacement parts and can be fitted if the valve seats cannot be reworked to the min. dimensions given.

**Valves:** Valves are treated in the same manner as the valves of a four-cylinder petrol engine and page 23 should be consulted. Grinding or straightening of valve stems is not permissible. Inlet valves can be re-ground in a valve grinding machine. This is **not permissible** in the case of exhaust valves (special coating). These must be reconditioned by grinding in with lapping paste or replaced. Make sure that the minimum valve head thickness "d" in Fig. 1.23 is retained at all times (0.5 mm).

**Valve Springs:** Springs should be compared with new springs and rejected if weak or cracked. Lay each spring on a surface plate and check that the ends of the springs are square. Slide the



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originally fitted spring and a new spring together over a long bolt (with large washers under bolt head and nut) and screw a nut onto the end of the bolt. Clamp the bolt head into a vice and slowly tighten the nut. If the coils of the original spring close before the coils of the new spring, replace the springs as a set, as the other springs will have similar defects.

**Camshaft:** If a camshaft is to be replaced, always quote the engine number to obtain the correct camshaft. The camshaft is marked with a number between the cams for the 2nd and 3rd cylinder. The identification for this engine is "023E". A similar camshaft with a different identification number will change the valve timing.

Place the camshaft with the two end journals into V-blocks or clamp the shaft between the points of a lathe, as shown in Fig. 1.27 and apply a dial gauge to the centre journal. Slowly rotate the camshaft and read off the dial gauge. If the indication is more than 0.01 mm, replace the shaft, as it is bent.

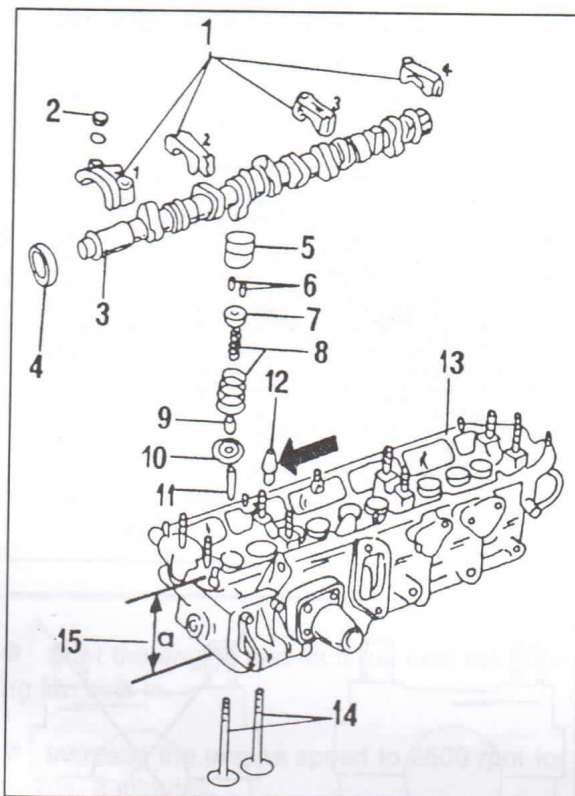
Check all bearing journals for visible wear. To check the camshaft end float, place the shaft into the cylinder head without fitting the tappets in order to avoid the pressure of the valve springs onto the camshaft.

Arrange a dial gauge as shown in Fig. 1.28, with the stylus of the gauge resting against the end of the camshaft. Bolt down the camshaft with the two end bearing caps. Move the camshaft to and fro and read off the dial gauge. The dial gauge reading must not exceed 0.15 mm (0.006 in.). If this is the case, check the bearing cap end face and the camshaft. These are the positions where the camshaft thrust is taken.

**Cylinder Head:** Thoroughly clean the surfaces of cylinder head and cylinder block. The cylinder head surface must be checked for distortion. To do this, place a straight-edge over the gasket surface as shown in Fig. 1.24 and insert a feeler gauge between the steel ruler and the cylinder head face. Checks must be carried out in longitudinal, diagonal and transverse directions. If a feeler gauge of more than 0.10 mm (0.004 in.) in thickness can be inserted, replace the cylinder head or discuss the problem with your dealer.

### 1A.3.4. Cylinder Head Assembly

Re-assemble the cylinder head components in



**Fig. 1A.7**  
Exploded view of the cylinder head. Note where the height of the cylinder head is measured (a).  
1 Camshaft bearing caps  
2 Bearing cap nuts, 2.0 kgm  
3 Camshaft  
4 Camshaft oil seal  
5 Hydraulic tappet  
6 Valve cotter halves  
7 Upper valve spring retainer  
8 Valve springs  
9 Valve stem oil seal  
10 Lower valve spring retainer  
11 Valve guide  
12 Repair valve guide with shoulder  
13 Cylinder head  
14 Valves  
15 Cylinder head height = 132.6 mm (a)

accordance with the notes below, following the dismantling procedure in the reverse sequence. Fig. 1A.8 shows an exploded view of the cylinder head.

- With a pair of pliers as shown in Fig. 1.29 fit the bottom valve spring seat into the recess for each valve. The illustration shows the special tool. If not available, use a pair of circlip pliers.

- Fit new valve stem seals. A special tool (10-204) is available for this purpose. A plastic sleeve is pushed over the valve guide and the well oiled seal placed over the sleeve. The installation of the seals is carried out as described on Page 21 and as shown in Fig. 1.30 for the four-cylinder petrol engine.

- Lubricate the valve stems and guides before installation of the valves. If valves have been lapped, make sure that each valve is fitted to its correct seat.

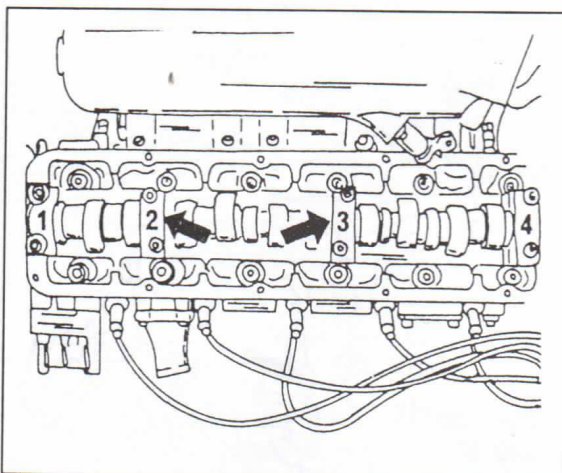
- Check the end float of the camshaft as described on the left.

- Fit the inner and outer valve springs, place the upper spring retainer over the valves and using the valve compressor, compress the springs until the valve cotter halves can be inserted by means of a thin-nosed pair of pliers. Remove the valve compressor and check that the cotters have engaged in their groove by tap-

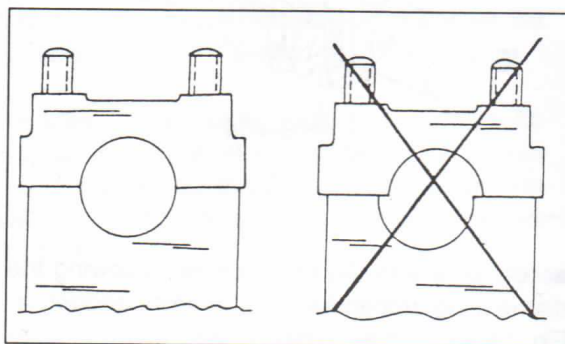


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ping the ends of the valve stems lightly with a hammer.



**Fig. 1A.8**  
Camshaft bearing caps are marked with their number. Make sure they are fitted the correct way round.

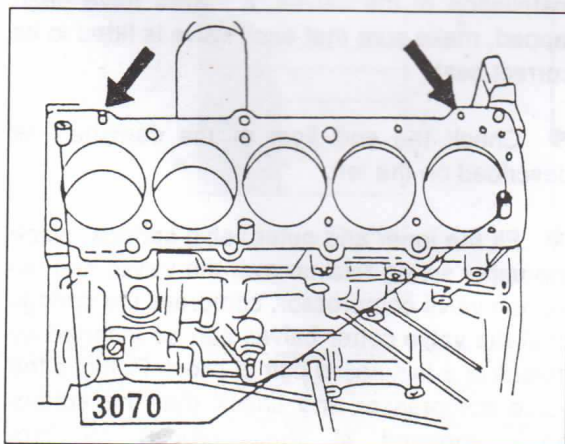


**Fig. 1A.9**  
Correct and incorrect fitting of camshaft bearing caps.

- Insert the tappets into their bores (well oiled). If the same tappets are used, insert them into their original bores.

- Refit the camshaft. Generously lubricate the camshaft journals and the bearing bores with engine oil. Place the camshaft in position. The two cams for the valves of the first cylinder must be facing upwards. Install the camshaft as follows:

- Fit Nos. 2 and 4 camshaft bearing caps, referring to Fig. 1A.8. The caps are slightly off-centre and must be fitted the correct way round. Fig. 1A.9 shows the correct fitting of the caps.



**Fig. 1A.10**  
Two guide studs (3070) are screwed into the cylinder block to guide the head. The arrows show the guide pins for the cylinder head gasket.

- Tighten the nuts of the fitted bearing caps diagonally by a few turns to a final torque reading of 2.0 kgm (14.5 ft.lb.). Check that the bearing caps are flush against the cylinder head face.

- Fit the remaining bearing caps Nos. 1 and 3 in the same manner. Refer to Fig. 1A.9 to make sure that the offset is as shown.

- Using a piece of tube of a suitable diameter, fit the camshaft oil seal over the shaft and into the bore. The spring inside the oil seal must be facing towards the cylinder head. Lubricate the oil seal lip and the running area on the camshaft with engine oil. The camshaft oil seal can also be fitted as described later on under "Camshaft and Camshaft Oil Seal".

- Slide the camshaft timing gear over the camshaft (do not forget the Woodruff key) and fit the bolt with the washer. Check the stamping in the outside of the bolt head. If it is marked with "8.8", tighten the bolt to 8.5 kgm (62 ft.lb.), if the marking is "10.9", tighten the bolt with 10.0 kgm (72 ft.lb.). Hold the timing gear against rotation when the bolt is tightened.

- Refit the inlet and exhaust manifolds to the cylinder head (new gaskets). Refit the remaining parts to the cylinder head in reverse order to the removal procedure. Refit the ignition distributor as described in the relevant section.

The exploded view of the cylinder head should be used for reference during the assembly operations. Mainly the tightening torques given in the exploded view should be followed. Read Section 1A.4.0.5. when new tappets are used.

### 1A.3.5. Fitting the Cylinder Head

Thoroughly clean the cylinder block and cylinder head surfaces. The following points must be noted before installation:

- When ordering the cylinder head gasket the engine type and number must be quoted.

- Special guide studs are available for the fitting of the cylinder head. These are fitted to the positions shown in Fig. 1A.10 on the side of the exhaust manifold. The arrows show where centering pins for the cylinder head gasket are located. Alternatively studs can be prepared to screw in position.



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Fit the cylinder head as follows:

- Thoroughly clean the cylinder head and cylinder block faces. Special attention should be paid to the threaded stud holes in the block. Place the cylinder head gasket over the engine block, the correct way round.

- Place the cylinder head over the block, engaging it with the two guide studs.

- Insert the cylinder head bolts and tighten them finger-tight. The cylinder head bolts must always be replaced. Remove the two studs and screw the cylinder head bolts in their place.

- Refer to Figs. 1A.3 and tighten all bolts in the order shown to a torque reading of 4.0 kgm (29 ft.lb.).

- Tighten all cylinder head bolts in the order shown to a torque reading of 6.0 kgm (45 ft.lb.) A special spline bit is used to tighten the bolts, together with a torque wrench. Your VW dealer or other suppliers may have these in stock and no attempt should be made to tighten the bolts with make shift tools.

- Insert the spline bit into each bolt, in the order shown in the two illustrations, make a note of the position of the torque wrench. Tighten each bolt by exactly one quarter of a turn and then once more by a further quarter of a turn.

*Once the cylinder head bolts have been tightened in the manner described above, there is no further need to re-tighten the cylinder head bolts after the engine has reached its operating temperature.*

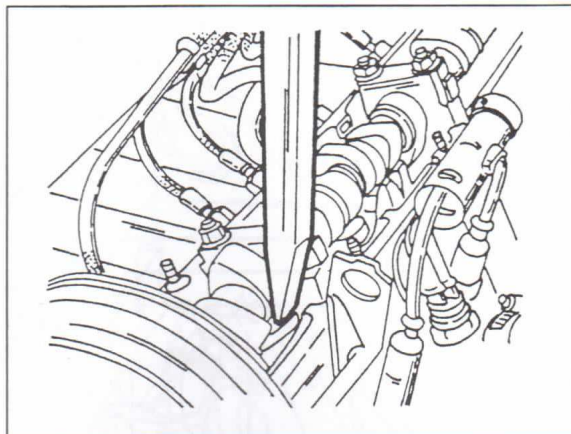
All other operations are carried out in reverse order to the removal procedure. The installation of the timing parts and the adjustment of the timing is described under a separate heading. Replace the cylinder head cover gasket.

### 1A.3.6. Hydraulic Tappets

The following points must be observed at all times in order to prevent damage to the engine by the tappets, due to incorrect treatment:

- Always store hydraulic tappets in upright position, with the contact area at the bottom.
- Always replace tappets as complete units as they cannot be adjusted or repaired.

- Valve noises when the engine is started are normal, but excessive noise can be due to the tappets. In this case check the tappets one after the other as follows:



**Fig. 1A.11**  
Checking a hydraulic tappet.

- Start the engine and let it run until the cooling fan cuts-in.

- Increase the engine speed to 2500 rpm for approx. 2 minutes.

- If the tappets are still noisy, stop the engine and remove the cylinder head cover. To find the noisy tappet, turn the engine until the cam in question is pointing with the tip upwards and using a piece of wood or plastic, as shown in Fig. 1A.11, push the tappet downwards. If the play is more than 0.10 mm (0.04 in.) before the valve begins to open, fit a new tappet. In this case it may be best to replace the complete tappet set, as other tappets could be in an equally bad condition.

**NOTE:** If new tappets are fitted, do not start the engine for about 30 minutes after assembly, as this may cause the valves to strike the pistons.

### 1A.4. CAMSHAFT AND TIMING DRIVE

The component parts of this engine are shown in Fig. 1A.12. The drive to the overhead camshaft is provided by a toothed belt running on toothed sprockets. The water pump is also driven by the timing belt. A major modification has, however, taken place around October 1991. On engines produced before the given date, the tension of the belt is adjusted by moving the water pump housing in elongated holes. A tensioner pulley for the timing belt has been fitted after the given date. The fitting and tensioning of the timing belt is therefore different on earlier and later engines. Both versions are covered.

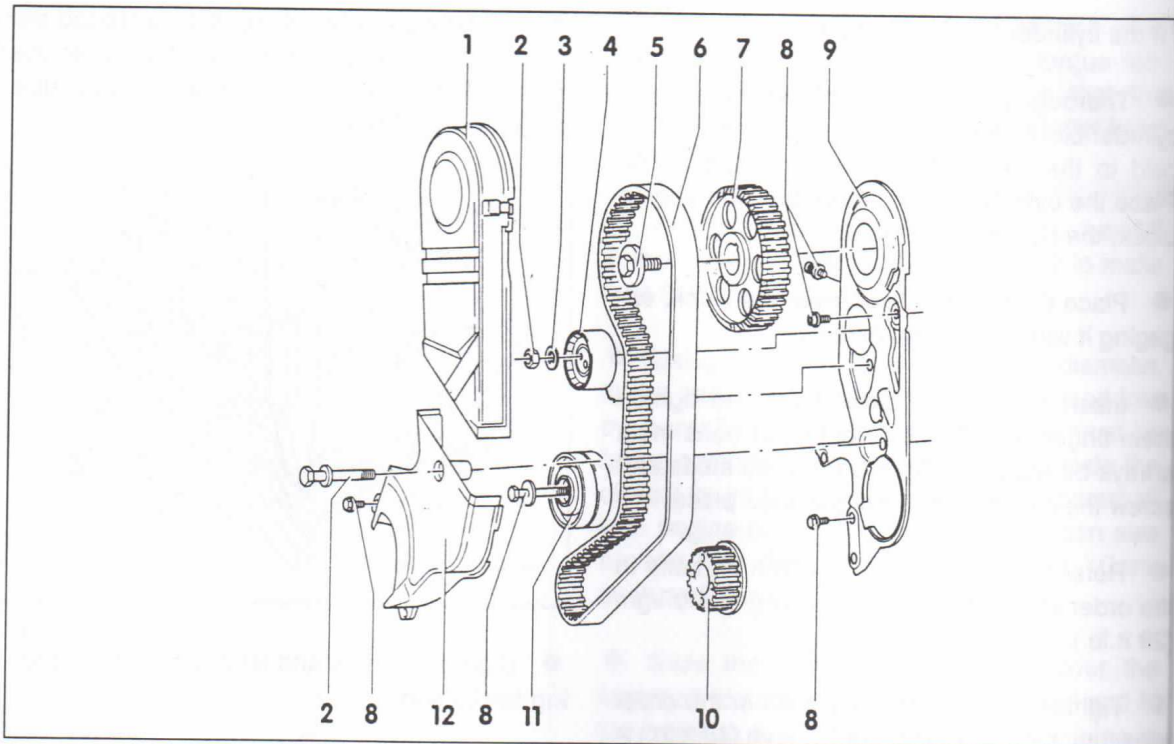


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**Fig. 1A.12**

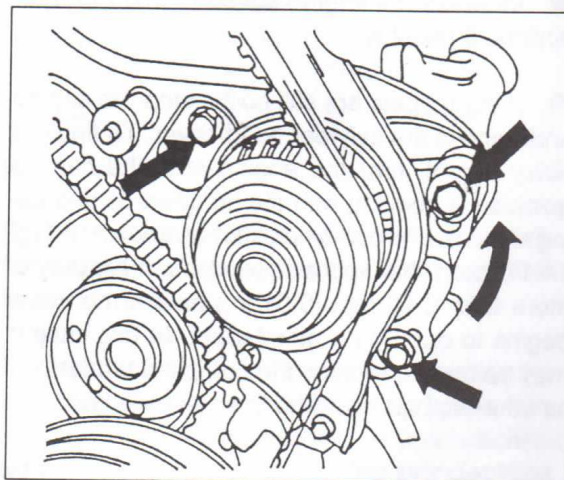
The component parts of the timing gear.

- 1 Upper belt guard
- 2 Nut, 2.0 kgm
- 3 Washer
- 4 Tensioning pulley
- 5 Camshaft sprocket bolt (note tightening torque)
- 6 Timing belt
- 7 Camshaft sprocket
- 8 Screw, 1.0 kgm
- 9 Rear timing belt guard
- 10 Crankshaft sprocket
- 11 Guide pulley
- 12 Lower timing belt guard



**Fig. 1A.13**

The arrows show the securing bolts for the water pump. Turn the pump in the direction of the arrow when tensioning the belt on early engines.



Under normal running conditions it is not necessary to re-tension the belt, provided that the belt is not damaged it should have a life of around 60,000 miles.

Remember that the timing will have to be reset at any time that the belt is removed or replaced. When the belt is removed, take care to keep it away from grease and solvents and do not twist or bend it into a small radius.

### 1A.4.4.1. Removal and Installation of Timing Belt

To remove the timing belt, proceed as follows:

- Remove the ribbed V-belt or the V belt, the vibration damper and the upper and lower timing

belt guards. Immediately mark the running direction of the timing belt with a felt pen on the outside of the belt.

- Slacken the timing belt. Either slacken the three bolts securing the water pump (shown in Fig. 1A.13 by the arrows) and turn the water pump in clockwise direction until the belt is slack enough to be removed, or slacken the nut (2) in Fig. 1A.12 and push the belt away from the tensioning roller until it can be taken off.

When installing the belt, the timing marks must be set and the belt tension adjusted. The operations are not the same on earlier and later engines. You will also have to differentiate between a fitted engine and an engine which has been repaired or overhauled. The crankshaft must not be at top dead centre when the belt is placed in position.

- Fit the toothed belt over the crankshaft sprocket, the guide pulley and the coolant pump (water pump).

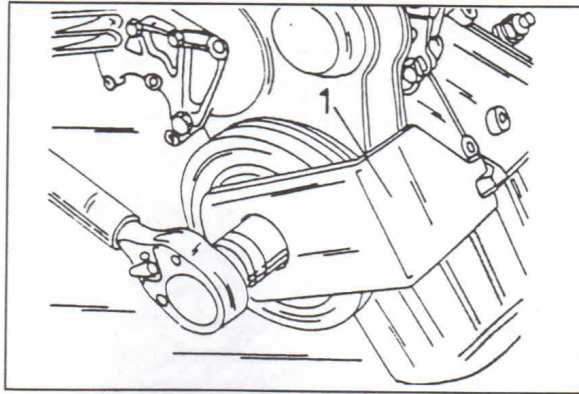
- Fit the lower timing belt guard. Provisionally tighten the water pump (belt fairly tight) or if a tensioning pulley is used, tighten the pulley nut to 2.0 kgm (14.5 ft.lb.).

- Fit the vibration damper to the crankshaft belt sprocket and tighten the four M8 bolts to 2.0 kgm (14.5 ft.lb.). The centre bolt inside the vibration damper must now be tightened. Normally a restraint lever is used to stop the crank-



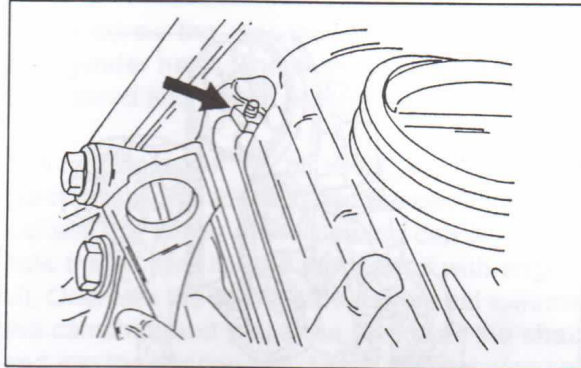
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shaft from rotating. This lever has the shape shown in Fig. 1A.14. Insert the lever into the vibration damper and allow the lever to rest against the cylinder block, as shown. If the engine is fitted, you can engage a gear and apply the handbrake. Coat the threads and the underside of the bolt with locking compound (AMV 188 001 02) and screw the bolt into the end of the crankshaft. Tighten the bolt to 46 kgm (330 ft.lb.).



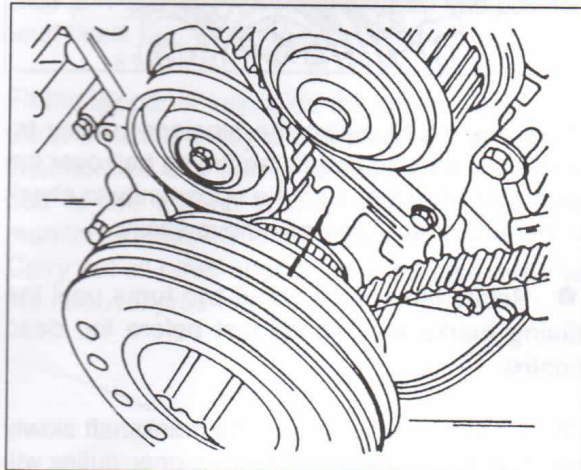
**Fig. 1A.14**  
Holding the crankshaft against rotation when tightening the large bolt for the vibration damper/timing gear. The restraining lever (1) is used in a VW workshop and is engaged as shown.

- Rotate the camshaft to align the top dead centre marking for cylinder No. 1. The marking on the camshaft sprocket must be aligned with the mark on the rear timing belt guard and can be seen near the position shown in Fig. 1A.15.



**Fig. 1A.15**  
The camshaft timing mark must be aligned with the mark on the rear timing belt guard.

- Rotate the crankshaft until the notch in the vibration damper is in line with the mark on the lower timing belt guard (Fig. 1A.16). If the engine is fitted, it may be difficult to see the alignment marks. If this is the case, rotate the engine until the "O" mark on the flywheel or the driven plate is opposite the pointer on the flywheel (converter) housing. This alignment is shown in Fig. 1A.17.



**Fig. 1A.16**  
Aligning the timing mark on the vibration damper with the mark on the lower timing belt guard.

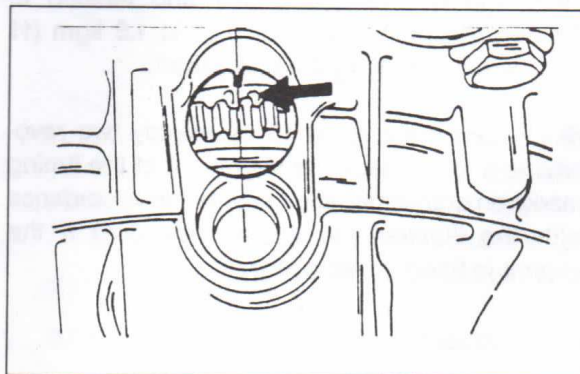
The timing belt must now be tensioned in accordance with the version:

### **Without Tensioning Pulley**

- If the engine is removed, slacken the water pump securing bolts in Fig. 1A.13 and rotate the water pump in the direction of the arrow. The tension is correct, when the belt can be twisted between thumb and forefinger by 90° on its run between the camshaft timing gear and water pump drive gear. The check is shown in Fig. 1A.18. Tighten the securing bolts to 2.0 kgm (14.5 ft.lb.).

**Note:** If the engine is fairly old, it may be a good precaution to remove the water pump from the engine to replace the "O" sealing ring between pump and cylinder block.

- If the engine is fitted, rotate the crankshaft until the piston of No. 1 cylinder is at top dead centre (check on the flywheel/converter housing opening, Fig. 1A.17) and then tension the belt as has been described with the engine removed.



**Fig. 1A.17**  
Aligning the TDC mark on the flywheel (marked OT) or the driven plate (marked "O"). This will set the piston of No. 1 cylinder to TDC.

- Rotate the engine by two complete revolutions and re-check the belt tension as described and shown in Fig. 1A.18. Once more check the timing marks on camshaft and crankshaft to make sure everything is O.K.

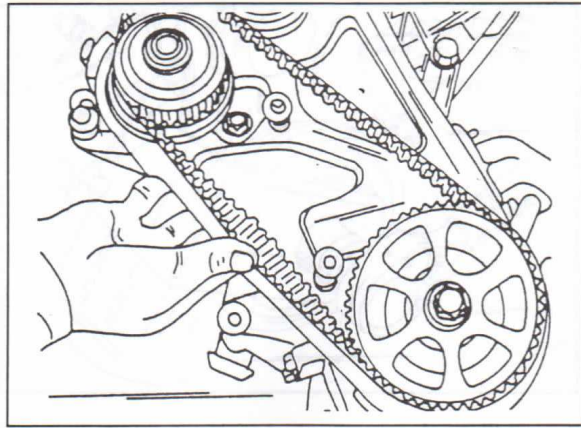
### **With Tensioning Pulley**

- Align the timing marks as described above, either with the engine fitted or removed.

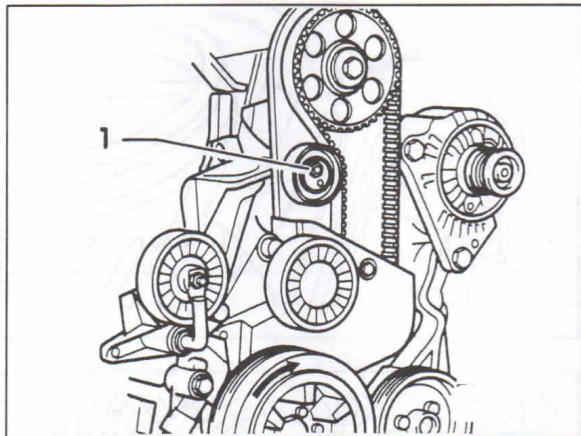
- Slacken the tensioner pulley securing nut



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**Fig. 1A.18**  
Checking the timing belt tension.



**Fig. 1A.19**  
Tighten the securing nut (1) when the pulley is pressing against the timing belt.

(1) in Fig. 1A.19, move the tensioner pulley towards the outside and fit the timing belt over the camshaft sprocket. Take the opportunity to check if the tensioner pulley can move easily.

- Rotate the engine about two turns until the timing marks are aligned just before top dead centre.

- From this position turn the crankshaft slowly into the T.D.C. position. The tensioner pulley will push against the timing belt and tension it. Tighten the pulley securing nut to 1.5 kgm (11 ft.lb.) without moving the crankshaft.

- Rotate the crankshaft by exactly two revolutions and re-check the alignment of the timing marks on crankshaft and camshaft in accordance with the illustrations, again depending if the engine is fitted or removed.

### 1A.5. Camshaft

#### 1A.5.0. Camshaft — Removal and Installation

The camshaft can be removed with the cylinder head fitted. Prepare the vehicle to have access

to the engine compartment. First remove the upper timing belt cover and the cylinder head cover.

- Slacken the camshaft sprocket bolt (hold the camshaft against rotation) and remove the bolt. Immediately check the marking on the bolt head for reference for the tightening torque (see Page 55).

- Rotate the engine until the piston of No. 1 cylinder is at top dead centre position. Check on the inside of the camshaft sprocket (see Fig. 1A.15, page 49).

- Remove the timing belt as described in the last section.

- Using a suitable puller, withdraw the camshaft sprocket from the shaft end. Remove the Woodruff key with a pair of sidecutters.

- Remove the ignition distributor.

- Slacken and then remove the No. 1 and No. 3 bearing caps (Fig. 1A.8).

- Gradually and evenly slacken the nuts securing bearing caps Nos. 2 and 4 (not more than 1/2 a turn at a time) until the spring pressure is released and the two caps are fully free. The pressure will be retained to the last moment as the springs will push the camshaft upwards.

- Either remove the tappets or leave them in the cylinder head.

The installation is a reversal of the removal procedure, but the tightening sequence of the bearing caps is important:

- If the tappets have been removed, check them as described on page 47. Then insert each tappet (well oiled) into its original bore (if the same tappets are used), in accordance with the markings.

- Generously lubricate the camshaft bearing journals and the bearing bores with engine oil. Place the camshaft in position. The two camshaft lobes for the valves of the first cylinder must be facing upwards. Fit the bearing caps Nos. 2 and 4. The caps are slightly off-centre and must be fitted the correct way round. Fig. 1A.9 (page 45) shows the correct and incorrect installation of the bearing caps and should be referred to.

- Tighten the nuts of the fitted bearing caps diagonally by a few turns until the caps are down



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on the cylinder head and then to a final torque of 2.0 kgm (14.5 ft.lb.).

- Fit the remaining bearing caps and tighten the nuts in a diagonal manner to 2.0 kgm (14.5 ft.lb.).

- Fit the camshaft oil seal as described in Section 1A.5.1.

### 1A.5.1. Replacing the Camshaft Oil Seal

The oil seal at the camshaft sprocket end can be replaced with the engine fitted. VW Workshops use a special tool to remove the oil seal, but it is also possible to remove the bearing cap to remove and install the seal. The oil seal is located behind the timing wheel. If the special oil seal puller VW 2085 can be obtained, remove the oil seal in the manner described in Section 1.4.0.6 on page 24. Also see Figs. 1.34 and 1.35. Otherwise proceed as follows to remove the seal:

- Remove the upper timing belt cover. Also unscrew the cylinder head cover.

- Rotate the engine until the piston of the first cylinder is at top dead centre. This is indicated when both valves of this cylinder are closed. Turn the engine by applying a socket or ring spanner to the crankshaft pulley centre bolt.

- Slacken the timing belt as described in Section 1A.4 for the respective engine type (with or without tensioning pulley) and lift off the timing belt. Tie the belt in position to prevent it from slipping off the other timing wheels.

- Counterhold the camshaft timing wheel to slacken and remove the camshaft timing gear bolt. Immediately check the head marking of the bolt to tighten the bolt with the correct torque during installation (see page 55). Using a pair of side cutters remove the Woodruff key.

- Unscrew the rear toothed belt guard from the cylinder head. The bearing cap can now be unscrewed and the oil seal replaced.

The installation of the oil seals is a reversal of the removal procedure. Clean the camshaft journal and the inside of the bearing cap and lubricate the oil seal lip and the journal with engine oil. Orientate the spring side of the seal towards the camshaft and place the seal over the shaft and into the bearing cap. Use a suitable piece of tube and carefully knock the oil seal into position until flush.

Fit the Woodruff key, slide the timing wheel over the shaft and the key and fit the bolt and washer. Counterhold the timing wheel and tighten the bolt to the correct torque, depending on the marking stamped into the bolt head.

Carry out all other operations in reverse order to the removal procedure.

## 1A.6. Pistons and Connecting Rods

### 1A.6.0. Technical Data

#### Piston Diameters:

Nominal Diameter: ..... 80.985 mm

1st oversize: ..... 81.235 mm

2nd oversize: ..... 81.485 mm

Position for checking piston diameter: ..... 10 mm (0.40 in.) from bottom edge of skirt, at 90° to piston pin axis

Max. allowable wear on piston diameter: ..... 0.04 mm (0.0016 in.) from the specified size

#### Clearance of piston in cylinder bore:

Standard: ..... 0.03 mm (0.0012 in.)

Maximum: ..... 0.08 mm (0.0031 in.)

#### Piston Rings

Number of rings: ..... 3

Markings of piston rings: ..... "Top" marking towards piston crown



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Side clearance — All rings: ..... 0.02 - 0.05 mm (0.0008 - 0.002 in.)  
Wear limit: ..... 0.15 mm (0.006 in.)

### Ring Gaps:

Top and second ring: ..... 0.20 - 0.40 mm (0.008 - 0.016 in.)  
Oil control ring: ..... 0.25 - 0.50 mm (0.01 - 0.02 in.)  
Max. ring gaps: ..... 1.0 mm (0.04 in.)

**Note:** The connecting rod caps of the five-cylinder engine are secured with bolts; the caps of the four-cylinder engine are fixed with bolts and nuts. The tightening torque is the same.

### Connecting Rods

#### Bearing axial play:

Standard: ..... 0.05 - 0.31 mm (0.002 - 0.012 in.)  
Max.: ..... 0.37 mm (0.015 in.)

Big end journals: ..... See under "Crankshaft"

### 1A.6.1. Servicing

The piston and connecting rod is shown in Fig. 1A.20. The construction is similar as for the four-cylinder engine. The engine must be removed from the vehicle to remove the piston and connecting rods. Remove the assemblies in the order described from page 25 on.

- 8 Piston and connecting rod
- 9 Dowel pin
- 10 Oil jet
- 11 Screw, 1.0 mm
- 12 Connecting rod

cribed for the four-cylinder petrol engine.

- Fit the connecting rods in accordance with Fig. 1A.20, i.e. the cast lugs (B) and the cylinder identifications (A) must be towards the crankshaft pulley side of the engine. Dowel pins are inserted into the bottom of the connecting rod face which must engage into the bearing caps. Make sure these dowel pins are in the connecting rods and have a tight fit. They must not be in the big end bearing caps.

- All arrows must point towards the front of the engine.

- When installing the piston rings, note that the rings are marked on one side with "Top" or "Open". This marking must be facing towards the piston crown when the rings have been fitted. The rings are made of a special alloy which can easily break and we suggest to carry out the operation very slowly and with the

- Fit the piston into the cylinder. Push the piston up against the cylinder wall. Tighten the pulley (ft.lb.) without moving the piston.

- Rotate the crankshaft through two full revolutions and re-check the alignment marks on crankshaft and camshaft. Compare with the illustrations, again depending on whether the engine is fitted or removed.

### 1A.5. Camshaft

#### 1A.5.0. Camshaft — Removal and Installation

The camshaft can be removed with the cylinder head fitted. Prepare the vehicle to have access

to the pistons into the cylinder. Push the pistons down from ring gap so that it is possible to remove the engine, with the other two pistons facing each other and facing

bolts must always be tightened in turn to 3.0 kgm. When tightening the bolts a

the big end bearing caps and tighten them to 1/2 of a turn.

connecting rod bearing caps at the position



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shown in Fig. 1.47 to make sure that the connecting rod side play is less than 0.37 mm (0.015 in.). Temporarily fit the crankshaft pulley with the bolt, apply a socket to the bolt head and rotate the crankshaft assembly a few times. Any hard spots will be spotted immediately and can be rectified before the engine is further assembled.

*Do this after each assembly.*

● After completed installation refit the oil sump to the bottom of the crankcase as described in Section "Engine Lubrication". All other operations are carried out in reverse order to the removal procedure.

### 1A.7. Crankshaft and Flywheel

#### 1A.7.0. Technical Data

Number of main bearings: ..... 6  
Markings (main bearing caps): ..... 1 to 6, commencing at the crankshaft pulley end of the engine

Axial play taken at: ..... By means of thrust half washers, at one of the bearings  
Main/big end bearings: ..... Thin-wall shell type. Shells in block with oil drillings, shells in caps without oil drillings.

#### Crankshaft End Clearance:

Std.: ..... 0.07 - 0.18 mm (0.0028 - 0.0069 in.)  
Wear limit: ..... 0.25 mm (0.10 in.)

#### Main Bearing Running Clearance:

Std.: ..... 0.016 - 0.075 mm (0.001 - 0.003 in.)  
Wear limit: ..... 0.16 mm (0.006 in.)

#### Big End Bearings:

Std. running clearance: ..... 0.01 - 0.06 mm (0.0004 - 0.002 in.)  
Max. clearance: ..... 0.12 mm (0.005 in.)  
Std. axial clearance: ..... 0.05 - 0.31 mm (0.002 - 0.0122 in.)  
Max. clearance: ..... 0.37 mm (0.015 in.)

#### Main Journal Diameters:\*

Basic: ..... 58.00 mm (2.304 in.)  
Undersize 1: ..... 57.75 mm (2.294 in.)  
Undersize 2: ..... 57.50 mm (2.284 in.)  
Undersize 3: ..... 57.25 mm (2.275 in.)

#### Crankpin Journal Diameters:\*

Basic: ..... 47.80 mm (1.8819 in.)  
Undersize 1: ..... 47.75 mm (1.8799 in.)  
Undersize 2: ..... 47.30 mm (1.8622 in.)  
Undersize 3: ..... 47.05 mm (1.8523 in.)

\* All diameters are toleranced between  $-0.022$  to  $-0.042$  mm

#### 1A.7.1. Crankshaft — Removal and Installation

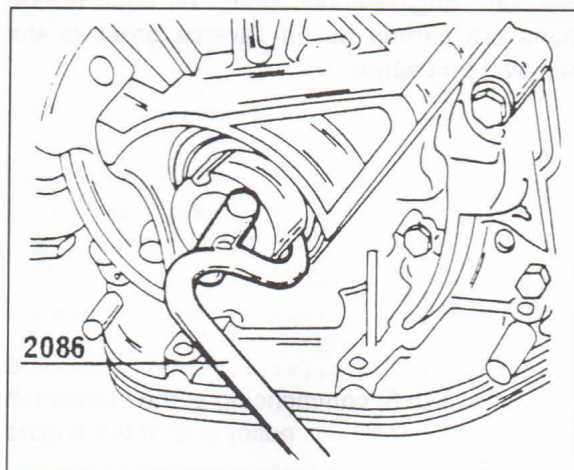
The crankshaft of the five cylinder petrol engine is practically the same as the crankshaft of the five-cylinder diesel engine. The component parts are shown in Fig. 16.32.

The crankshaft end float of the shaft must be measured before removal in the manner described on page 30. The end float for the five-cylinder engine is given above. There is a difference in the end float limit, as this is restricted to 0.25 mm (0.01 in.) on the five-cylinder petrol engine. New half thrust washers must be used to



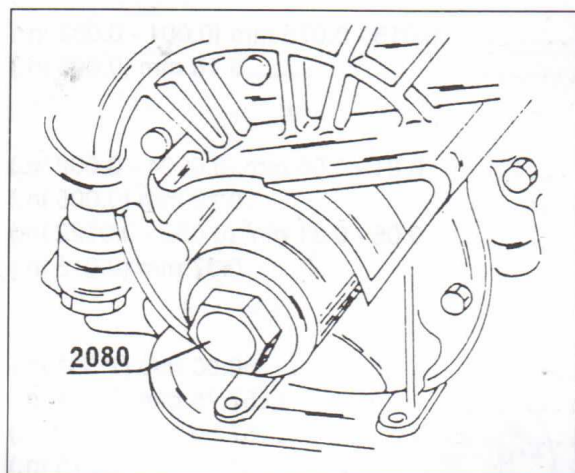
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correct the end float. Thrust washers are different for the cylinder block location and the bearing cap location.



**Fig. 1A.21.**  
Removal of the front crankshaft oil seal with the special extractor lever. See text for alternative.

The oil pump must be removed from the front of the engine when the crankshaft is removed. The bearing caps are marked with numbers 1 to 6, commencing at the pulley end. The bearing shells have an oil drilling when fitted in the cylinder block and no oil drilling when fitted on the bearing caps.



**Fig. 1A.22.**  
Installation of the front oil seal with the special fitting tool. See text for alternative.

A driver for the oil pump is fitted onto the end of the crankshaft, but should only be removed if the crankshaft is replaced or the driver damaged. A new driver must be heated to 200° C and driven over the crankshaft end.

### 1A.7.2. Crankshaft Oil Seals

The front and rear oil seals of the crankshaft must be replaced any time the crankshaft, the oil sealing flange or the oil pump have been removed. The replacement of the rear oil seal is carried out in the same manner as described on pages 31 to 32, using the same special tools or

respective alternatives. The operations to replace the front oil seal is different on a five-cylinder engine, mainly due to the arrangement of the oil pump. Proceed as described in the following text:

- Remove the drive belts, the timing belt covers, the vibration damper with the crankshaft timing gear and the steering pump together with the drive belt. To slacken the bolt in the centre of the vibration damper, engage a gear, apply the handbrake and use a socket.

- To remove the oil seal, use a similar tool as shown in Fig. 1A.21. Otherwise screw a self-tapping screw into the metal case and lever the seal out with a screwdriver. If the engine is removed, unscrew the oil pump from the front of the engine and remove the gasket. The oil seal can then be removed as described, but the work is facilitated.

The installation of the oil seal is carried out as follows:

- If the engine is removed, smear the seal lip and the outside of the oil seal with grease and carefully drive the seal into the oil pump. Refit the oil pump as described under "Engine Lubrication" and carry out all other assembly operations in reverse order to the removal procedure.

- To fit the oil seal to an engine in situ, use the special tool shown in Fig. 1A.22. This is a piece of tube which presses against the outer diameter of the oil seal. A bolt in the end of the tube is screwed into the end of the crankshaft. By tightening the bolt, the oil seal is pulled into the flange. If this tool is not available, use a piece of tube of suitable diameter and place a large washer over the end. Screw a long bolt into the crankshaft end and tighten the bolt until the seal is in position. Alternatively try to drive the oil seal carefully in position with a drift and a hammer, but be careful not to damage it.

### 1A.7.3. Crankshaft — Checking and Bearings

The operations are the same as described for the four-cylinder petrol engine. This includes the checking of the bearing running clearance, but note the values given in Section 1A.7.0. Main bearing and crankpin journals can be re-ground to the sizes given so that oversize bearing shells can be used.



## 1A Five-cylinder Petrol Engine

### 1A.7.4. Crankshaft — Installation

The installation is a reversal of the removal procedure. Use the exploded view of the engine in question. The flywheel bolts must always be replaced. The bolts are tightened to 6.0 kgm (43 ft.lb.) and from this position tightened by a further 90°, without torque wrench. The main bearing cap bolts are tightened to 6.5 kgm (47 ft.lb.).

### 1A.8. Cylinder block

The cylinder block is treated in the same manner as described for the four-cylinder petrol engine and the relevant pages should be referred to for all information.

### 1A.9. Flywheel

Only the TDC mark is marked into a new flywheel. If the flywheel is replaced, you must mark the ignition timing notch into the flywheel. Refer to Section 1.4.3.4 on Page 32 and mark the flywheel as described. The same dimension (14.5 mm) is applicable. If you cannot carry out the marking yourself, have it done in a workshop, as you will need the ignition timing mark.

### 1A.10 Drive Plate (Automatic)

The drive plate is attached to the crankshaft flange by six bolts. A reinforcement washer is inserted between bolts and drive plate. This washer has a chamfer on its outer diameter which must always face towards the drive plate. Note that a distance washer may be inserted between crankshaft and drive plate. This washer determines the dimension of the drive plate towards the rear. Refit the plate and measure with a depth gauge between the drive plate surface and the cylinder block, as shown in Fig. 1.62. If this dimension is not within 10.7 to 12.3 mm, fit a distance washer.

Again only the top dead centre mark ("0") is marked into a new drive plate. To mark the ignition timing point, proceed in a similar manner as shown in Fig. 1.59 and measure the distance as described for the flywheel. Mark the timing point with a file.

When fitting a new driven plate note the arrangement of the TDC sensor. This can either be located at top of the transmission housing or at the side of the transmission housing.

The driven plate bolts are tightened to 6.0 kgm (43 ft.lb.) and from this position by a further 1/4 of a turn.

### 1A.11. Tightening Torque Values

|                                              |                                                               |
|----------------------------------------------|---------------------------------------------------------------|
| Main bearing caps: .....                     | 6.5 kgm (47.0 ft.lb.)                                         |
| Cylinder Head Bolts:                         |                                                               |
| First stage: .....                           | 4.0 kgm (29 ft.lb.)                                           |
| Second stage: .....                          | 6.0 kgm (43.5 ft.lb.)                                         |
| Third stage: .....                           | Tighten by a further 1/4 of a turn                            |
| Fourth stage: .....                          | Tighten by a further 1/4 of a turn                            |
| Flywheel and driven plate (automatic): ..... | 6.0 kgm (43.5 ft.lb.) plus a further 1/4 of a turn            |
| Clutch: .....                                | 2.0 kgm (14.5 ft.lb.)                                         |
| Connecting rod caps: .....                   | 3.0 kgm (21.0 ft.lb.), then by 90° further                    |
| Water pump to engine: .....                  | 2.0 kgm (14.5 ft.lb.)                                         |
| Vibration damper bolt: .....                 | 46.0 kgm (331 ft.lb.)                                         |
| Pulley to damper: .....                      | 2.0 kgm (14.5 ft.lb.)                                         |
| Oil pump to engine: .....                    | 2.0 kgm (14.5 ft.lb.)/M8 bolts, 1.0 kgm (7 ft.lb.)/M6 bolts   |
| Oil drain plug: .....                        | 5.0 kgm (36.0 ft.lb.)                                         |
| Oil sump to block: .....                     | 1.0 kgm (7.2 ft.lb.)/M6 bolts, 2.0 kgm (14.5 ft.lb.)/M8 bolts |
| Oil filter bracket: .....                    | 2.0 kgm (14.5 ft.lb.)                                         |
| Oil cooler to filter bracket: .....          | 2.5 kgm (18 ft.lb.)                                           |
| Exhaust manifold to cylinder head: .....     | 2.5 kgm (18.0 ft.lb.)                                         |
| Exhaust manifold to exhaust pipe: .....      | 4.0 kgm (29 ft.lb.)                                           |
| Camshaft bearing caps: .....                 | 2.0 kgm (14.5 ft.lb.)                                         |
| Camshaft sprocket: .....                     | 8.5 kgm (61 ft.lb.) or 10.0 kgm (72 ft.lb.) — See text        |
| Belt tensioner nut: .....                    | 1.5 kgm (10 ft.lb.)                                           |
| Cylinder head cover: .....                   | 1.0 kgm (7.2 ft.lb.)                                          |



## 2 IGNITION SYSTEM

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| Distributor:<br>Removal and Installation .....  | 57 | Ignition Transformer ..... | 59 |
|                                                 |    | Spark Plugs .....          | 60 |

### 2.0. Technical Data

#### Ignition Timing:

Checking value: ..... 4 - 8° before T.D.C., at 2000 - 2500 rpm.  
Temperature sender unit plug disconnected.

Adjusting value: ..... 6 ± 1° before T.D.C. at 2000 - 2500 rpm  
Temperature sender unit plug disconnected

#### Ignition Spark Check — Temperature sender unit connected:

Advance angle: ..... 20 ± 3° of obtained ignition timing point (4-cyl. only)

#### Firing order:

Four-cylinder engine: ..... 1 — 3 — 4 — 2

Five-cylinder engine: ..... 1—2—4—5—3

Timing mark: ..... Flywheel

### 2.1. PRECAUTIONS DURING WORK ON THE IGNITION SYSTEM

The following points should be noted before any work is carried out on the ignition system. The fully-electronically operating ignition system is linked to the Digifant fuel injection system, both on the four-cylinder and the five-cylinder engine. The following precautions apply:

- Never disconnect the spark plug cables with the engine running and do not touch or remove the cables at cranking speeds. The high tension is very high.

- Disconnect any lead or cable from the ignition system only when the engine is switched off. The same applies when testing instruments

are connected. In this case, make sure that the ignition is switched off.

- Never connect a test lamp to terminal "1" of the ignition coil ("—" terminal) or test instruments or a stroboscopic timing light to terminal "15" of the coil.

- If the centre high tension cable is removed from the distributor connect it with a jumper lead to earth (ground). Do not turn the engine over if this precaution is not taken.

- Do not use a starting aid for the engine unless you know that it is suitable for the elec-



## 2 Ignition System

tronic ignition system fitted.

- The ignition coil is specifically designed for the type of ignition system fitted and an ordinary coil must, under no circumstances, be fitted.
- Disconnect the battery when carrying out electric welding jobs (this must be observed in any case because of the alternator).
- Do not spray the engine with water or any other solvents when the ignition is on or the engine is running.
- Disconnect the unit controlling the ignition when towing the vehicle.

### 2.2. Ignition Distributor

#### 2.2.0. REMOVAL AND INSTALLATION

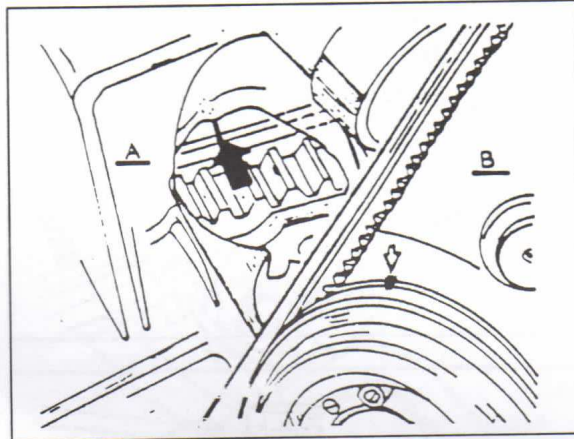
- Disconnect the battery.
- Disconnect the plug for the Hall sender unit from the side of the distributor by pulling it upwards. The spring clip must be depressed to free the plug.
- Remove the distributor cap and place it to one side or withdraw the high tension cables from the cap. Mark the cables in a suitable manner with the cylinder number. This is best carried out by attaching a piece of sticky tape and writing the respective cylinder number on it. Remember also to mark the terminal connections on the distributor cap in a similar manner.
- Unscrew the distributor clamp nut and withdraw the unit. Remove the sealing ring from the distributor (if fitted).

**NOTE:** If the distributor is to be removed without rotating the engine, it is better if the engine is set to T.D.C. position. With the engine at T.D.C. mark a line into the edge of the distributor housing in line with the tip of the distributor rotor.

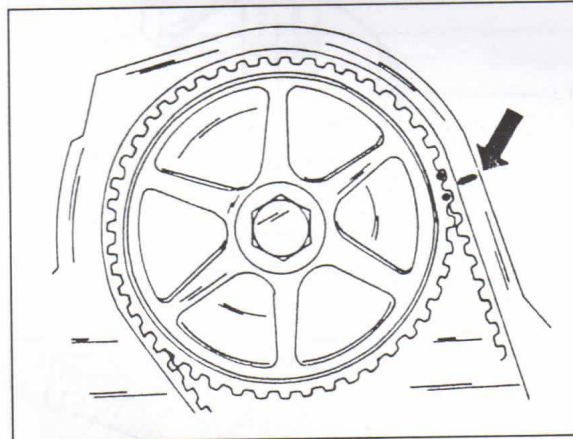
Install the ignition distributor as follows:

- Rotate the crankshaft until the piston of No. 1 cylinder is at T.D.C. position, i.e. both valves of this cylinder must be closed (if the cylinder head cover is removed) or rotate the engine until the "O" mark in the flywheel is in line with the adjusting mark on the clutch housing (view "A" in Fig. 2.1). If the engine is removed rotate the crankshaft until the notch in the crankshaft pul-

ley is in line with the arrow mark in the timing belt cover (view "B", Fig. 2.1). The timing mark on the camshaft sprocket must be aligned as has been described during the installation of the timing belt, i.e. the timing mark in the camshaft timing gear must be opposite the mark in the cover for the belt drive, as shown in Fig. 2.2 for a four-cylinder engine. Refer to the relevant section for the five-cylinder engine.



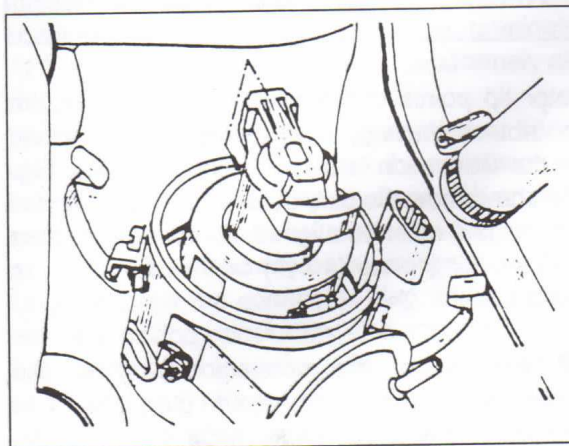
**Fig. 2.1.** View of the "O" mark on the flywheel after removal of the plug in the flywheel housing (engine fitted — A) and the notch in the crankshaft pulley and the T.D.C. mark on the timing belt cover (engine removed — B).



**Fig. 2.2.** Aligning the timing marks on camshaft timing gear and timing belt cover (four-cylinder). Fig. 1A.15 shows the alignment on the five-cylinder engine.

- Turn the distributor shaft until the rotor tip and the mark in the distributor housing edge are aligned (see Fig. 2.3).

Refer to Fig. 2.4 and turn the oil pump drive shaft tongue so that it is parallel with the crank-



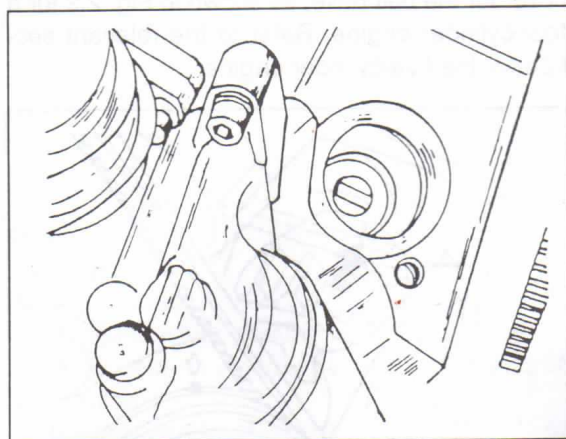
**Fig. 2.3.** Turn the distributor rotor until the rotor tip is in line with the mark in the edge of the distributor housing.



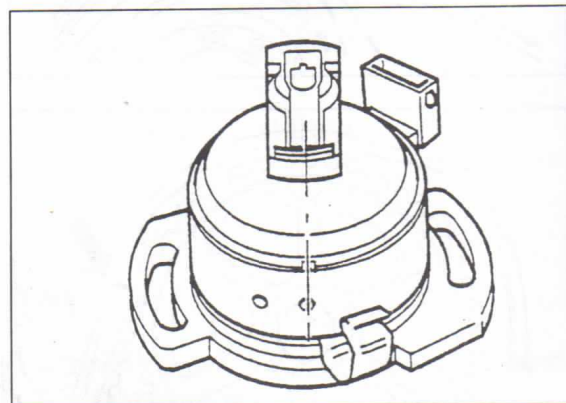
## 2 Ignition System

shaft axis. If necessary use a pair of pliers and turn the drive tongue (remove it and re-insert it).

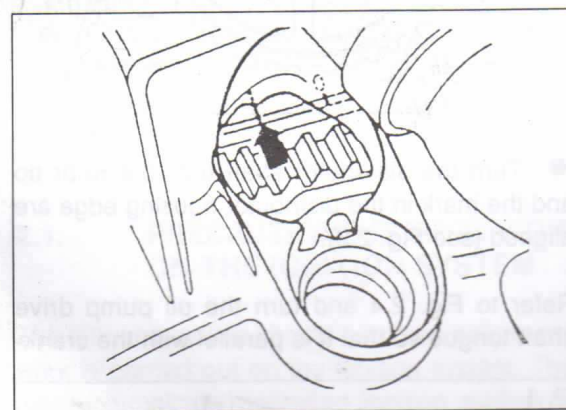
- Insert the distributor into the engine cylinder block (4-cyl.) or the cylinder head (5-cyl.) without disturbing the position of the distributor shaft. When the distributor is in position, check that the



**Fig. 2.4.**  
Align the oil pump drive tongue before inserting the distributor (4-cyl.).



**Fig. 2.5.**  
The rotor of the distributor of a five-cylinder engine must be aligned as shown, i.e. the rotor tip must face the notch in the distributor housing.



**Fig. 2.6.**  
The ignition timing mark in the flywheel must appear in advance of the "0" mark (T.D.C.) when the flash of the timing light is directed against the opening in the flywheel housing.

rotor tip points to the mark in the edge of the distributor housing, as shown in Fig. 2.3. Shown in the illustration is a four-cylinder engine. Fig. 2.5 shows how the distributor rotor of a five-cylinder engine must be aligned. Temporarily tighten the retaining plate (4 cyl.) or the two securing bolts (5-cyl.).

- Re-connect the connector plug to the distributor. Connect the spark plug cables in accordance with the marks made.

- Check, and if necessary, adjust the ignition timing as described in Section 2.3.

### 2.2.1. DISTRIBUTOR — SERVICING

We suggest that your dealer should be asked to overhaul the distributor, as he has test instruments to check the centrifugal and vacuum advance curves and all other aspects of the ignition and fuel injection system to ensure the correct operation of the distributor and the ignition system.

### 2.3. Timing the Ignition

It is essential that the ignition timing is finally adjusted with a stroboscopic timing light with the engine running at the speed indicated in Section 2.0. Never attempt the adjustment of the ignition unless a tachometer (revolution counter) is available. The ignition timing point is engraved in the flywheel. A pointer in the opening of the flywheel housing serves as reference point. Fig. 2.6 shows where this mark can be seen. A second mark in the flywheel (or driven plate) will either be marked with "OT" (TDC) or "0", indicating the top dead centre position of the No. 1 piston. Proceed as follows:

- The engine oil temperature must be at 30 to 70° C (85 to 165° F) before the ignition timing can be adjusted. Check the idling speed of the engine and adjust if necessary. Remember that the latest 5-cyl. engine cannot be adjusted.

- Check with Section 2.0 for the value of the ignition timing point, noting that a checking value and an adjusting value is given.

- Connect a stroboscopic timing light in accordance with the instructions of the manufacturer and start the engine and run at idle speed. Aim the flash of the timing light at the opening in the transmission casing and check that the timing mark on the flywheel is in line with the pointer of the transmission housing (see Fig. 2.6).

- When the cooling fan has cut-in, withdraw the plug, shown in Figs. 2.7 or 2.8 from the temperature switch for the engine coolant. This is the blue-colour 2-pin connector plug.

- Accelerate the engine to 2000 - 2500 rpm and again aim the flash of the timing light at the



## 2 Ignition System

opening in the transmission housing. If the indication is between 4 and 8°, there is no need for further attention. If the timing point is outside the given limits, adjust the timing point to the setting value of  $6 \pm 1^\circ$  before top dead centre.

- If necessary, slacken the distributor clamp or the two distributor securing screws (5-cyl.) and turn the distributor until the two timing marks are in line. Tighten the distributor and re-check the timing.

Re-connect the plug in Figs. 2.7 or 2.8 and check the ignition timing advance as follows. The operations are different for the two engines.

### Four-cylinder Engine

- Accelerate the engine three times to more than 2500 rpm and re-check the ignition timing point. The timing point advance can now be checked as follows:

- Start the engine and let it run at idle speed. As soon as the cooling fan has cut-in, withdraw the plug shown in Fig. 2.7.

- Run the engine at exactly 2200 rpm (check at the revolution counter) and check the timing point in the opening of the flywheel housing. Make a note of the reading.

- Allow the engine to drop back into the idling speed and re-connect the plug.

- Again accelerate the engine to 2200 rpm and re-check the timing point. The timing point must now be  $20 \pm 3^\circ$  more advanced as has been the case with the plug disconnected. If the same value is obtained with the plug connected and disconnected, there could be a fault in the coolant temperature sender unit or the plug. Check as necessary. A faulty Digifant control unit could also be the reason.

- Disconnect the timing light and re-connect the spark plug cable.

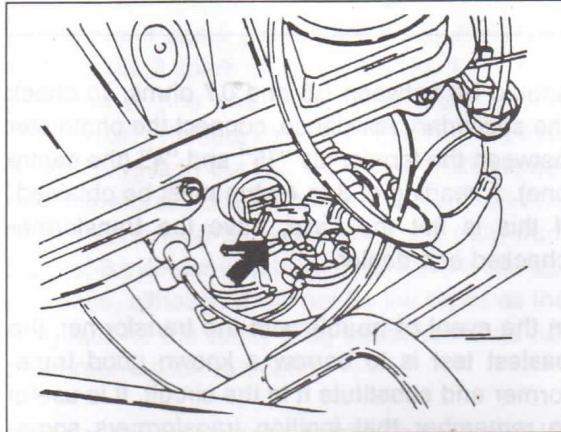
### Five-cylinder Engine

- Start the engine and run it at idle speed. Now increase the engine speed to slightly more than 2200 rpm until the ignition timing point is indicated (within the adjusting valve). Direct the flash of the stroboscopic timing light against the flywheel/converter housing window as before.

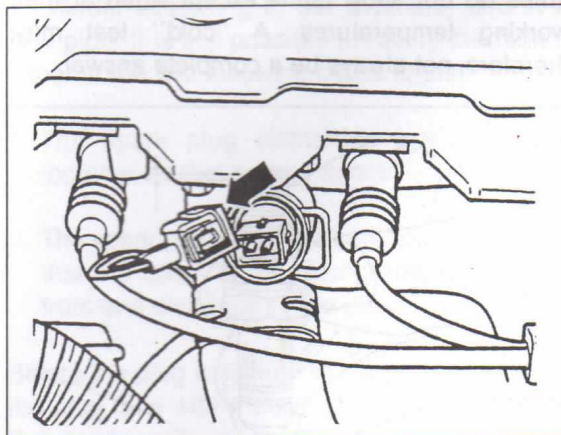
- Increase the engine speed further and

check that the ignition timing point advances to 26 - 36° before TDC. If this is not the case, have the ignition system checked at a dealer.

**Note:** If you are not familiar with checking the ignition timing point, we strongly recommend you to take the vehicle to a dealer. Special checking instruments are used to check all aspects of the ignition system, assuring you of proper operation.



**Fig. 2.7.**  
The arrow shows the plug for the coolant temperature sender unit on the 4-cyl. engine which must be withdrawn to check the ignition timing point.



**Fig. 2.8.**  
The arrow shows the plug for the coolant temperature sender unit on the 5-cyl. engine which must be withdrawn to check the ignition timing point.

### 2.4. Ignition Transformer

The ignition transformer takes the place of the ignition coil, associated with the more conventional ignition systems. As in the case, terminals "1" and "15" are used on the transformer, as shown in Fig. 2.9.

The transformer cannot be dismantled or serviced, but your dealer can check the resistance of the primary and secondary windings with special equipment. You will be able to check the resistance if an ohmmeter is available. In this case withdraw the connector plug and HT lead from the ignition transformer and, referring to Fig. 2.9, connect the instrument between the terminals "1" and "15" (ignition switched on). This will measure the primary resistance which



## 2 Ignition System

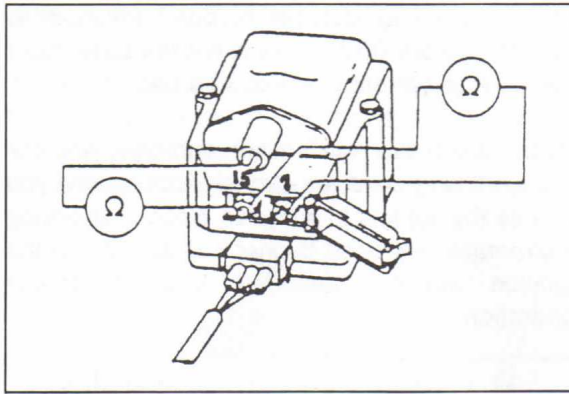


Fig. 2.9.  
View of the ignition transformer, with the location of terminals "1" and "15", used to check the resistance.

should be between 0.5 and 0.7 ohms. To check the secondary resistance, connect the ohmmeter between the terminals "15" and "4" (the centre one). A reading of 3 to 4 ohm must be obtained. If this is not the case, have the transformer checked at a dealer.

In the event of trouble with the transformer, the easiest test is to borrow a known good transformer and substitute it in the circuit. It is useful to remember that ignition transformers sometimes do not show faults except when at their working temperatures. A "cold" test may, therefore, not always be a complete answer.

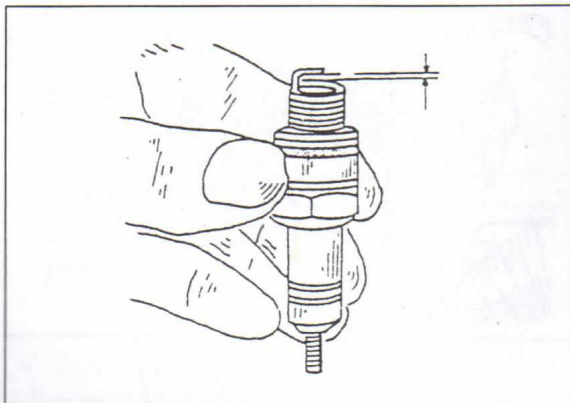


Fig. 2.10.  
Electrode gaps of spark plugs are checked between the arrows.

### 2.5. Spark Plugs

If spark plugs are removed, make sure that the surrounding area is clean to prevent foreign matter from falling into the plug holes as soon as the plugs are unscrewed. Suitably mark the plug leads to facilitate their re-connection. Clean the plug face with a wire brush and check the electrodes for wear or burns.

Use a feeler gauge to check the electrode gap (Fig. 2.10) and close the gap if necessary, by tapping the outside electrode with the handle of a screwdriver. To open up a plug gap, insert the blade of a small screwdriver and bend up the

side electrode. Never bend the centre electrode in order to correct plug gaps as this will damage the insulator.

Standard plug types:

Fitted plugs:

Four-cylinder: Bosch W8DTC, Beru 14-8 DTU, Champion N9 BYC

Five-cylinder: Bosch W8DTC, Beru 14-8 DTU, Champion N 7 BYC

Plug electrode gap: 0.7 - 0.9 mm (0.027 - 0.035 in.)

Tightening torque: . . 2.0 - 2.5 kgm (15 - 18 ft.lb.)

Inspect the condition of the insulator tip and the electrodes. Following there are a few examples to interpret the condition of plugs removed from the engine:

**Normal Plug Face:** The colour of the of the insulator should appear greyish- brown or tan-coloured. The electrodes should be black or sooted. These are signs of a plug which has been used under normal conditions with alternative short and long driving periods. White or yellow deposits mean that the car has been used for long periods at high speeds and can be ignored.

**Worn Plug Appearance:** Insulator tip and electrodes are burnt away. All plugs which show this condition must be replaced. Always replace the whole set and make sure to fit the correct plug.

**Oiled-up Appearance:** Normally this condition is recognised by wet oil deposits which have been left by excessive ingress of oil into the combustion chamber (worn piston rings or pistons, inlet valves or valve guides, worn bearings, etc.). Hotter plugs are normally able to overcome the fault, but in serious cases an overhaul of the engine is necessary.

**Burnt or Overheated Appearance:** Burnt or overheated plugs can normally be recognised by their electrodes being coloured white or being burnt, or by the presence of blisters on the insulator or the electrodes. Electrodes may also be burnt off. Faults can be traced to the cooling system or improper ignition timing.

To single out a faulty plug in the engine, proceed as follows:

- Remove the plug from the engine and push the plug cable connector over the plug.
- Place the plug on the cylinder head cover, ensuring that it cannot fall off when the starter



## 2 Ignition System

motor is operated. An insulated pair of pliers can be used to hold the plug.

- Have a second person turn the starter switch and observe if there is a spark between the two electrodes. If a spark is visible, this is by no means an indication that the plug is in perfect condition, as it is possible that the spark cannot be produced under the compression of the engine. This can only be tested with a spark plug tester.

- If no spark is visible after several attempts, examine the plug. If the engine has been running with one of the plugs out of action this will be indicated by the fact that the spark plug will be saturated with petrol or oil and this is your confirmation that this particular cylinder has not been firing. This could be so for various reasons, with the extreme case that the piston rings are allowing oil to pass from the cylinder into the combustion chamber. There are, however, a few points which might be cured on the spot. The first remedy is, of course, to substitute the suspect plug with one known to be working to ensure that the plug is at fault. To do this, proceed as follows (let us assume that the No. 3 cylinder is the faulty one):

- Unscrew one of the remaining plugs and check the appearance of the plug face. This will be dry and will most probably have a light brown colour. Screw this plug into the cylinder where the first plug has been removed and fit the faulty plug to the remaining cylinder. Re-connect the high-tension leads to the spark plugs and re-start the engine.

- Check the firing of the engine by pulling off the H.T. leads, using insulated pliers, between the ignition distributor and the plugs. If the suspected plug is faulty the engine should still run on three cylinders with the difference that the

cylinder that was originally misfiring is now operating and that the good cylinder, where the suspected plug is fitted, is now out of action.

### Example:

As already mentioned, it was assumed that the No. 3 cylinder (and thereby the spark plug) was faulty. Remove either Nos. 1, 2 or 4 spark plugs from the engine which should operate normally. For our example let us remove No. 1 spark plug.

Fit the No. 1 spark plug into the No. 3 cylinder and the No. 3 spark plug into the No. 1 cylinder. After the engine has been re-started it should now run on cylinders Nos. 2, 3 and 4 as the suspected plug is in the No. 1 cylinder this cylinder will, therefore, not be able to fire. This can be further confirmed by unscrewing the plug from the No. 3 cylinder which will now have a wet appearance, although it will not be the same as the plug face of the faulty plug because it has not been running for very long.

Remove the faulty plug (which is now in the No. 1 cylinder according to our example) and fit a new plug. It is still possible to rectify the fault if either of the two following cases apply:

1. The spark plug electrodes are too close together so that no gap exists.
2. The spark plug electrodes are too far apart so that the spark is not strong enough to jump from one electrode to the other.

Before the plug is refitted to the engine, wipe off the plug face with a clean cloth and make sure that no deposits are bridging the gap between the two electrodes. If the plug appears wet, blow in the inside of the plug. The plug insulator (the white centre part) must be wiped clean to prevent leakage of current between the end terminal and the plug body.



### 3 LUBRICATION SYSTEM — PETROL ENGINES

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| Removal and Installation | 62        | <b>Oil Cooler</b>                | <b>67</b> |
| Overhauling an Oil Pump  | 64        | <b>Oil Level</b>                 | <b>67</b> |
| <b>Oil Sump</b>          | <b>66</b> |                                  |           |

#### 3.0. Technical Data

##### System Pressure:

|          |                          |
|----------|--------------------------|
| Minimum: | 1.0 kg/sq.cm. (14.2 psi) |
| Maximum: | 7.0 kgm (99.6 psi)       |

System capacities: ..... See Section 0.3

##### Oil Pump:

###### Type:

|                |                                                              |
|----------------|--------------------------------------------------------------|
| 4-cyl. engine: | Gear-type oil pump in crankcase, driven from auxiliary shaft |
| 5-cyl. engine: | Gear-type oil pump, driven directly from front of crankshaft |

##### Pump Checking Data (four-cylinder):

|                               |                     |
|-------------------------------|---------------------|
| Clearance between gearwheels: | 0.05 mm (0.002 in.) |
| Max. clearance:               | 0.20 mm (0.008 in.) |
| End float of pump gears:      | 0.15 mm (0.006 in.) |

#### 3.1. Oil Pump

The engine is lubricated by means of a pressure-fed system. The oil pump of a four-cylinder engine is driven off the intermediate (auxiliary) shaft. The drive gear for the oil pump is also used for the distributor drive. The engine is fitted with an oil cooler, located between the oil filter bracket and the filter itself.

A different oil pump arrangement is used on the five-cylinder engine. The pump is located at the lower front face of the engine and is driven directly by the crankshaft. The pump is removed as a complete unit (also with the engine fitted)

and can be dismantled after unscrewing the pump cover. Two ring gears are operating inside the pump and produce the oil pressure. Fig. 3.1 shows an exploded view of the oil pump and its associated parts.

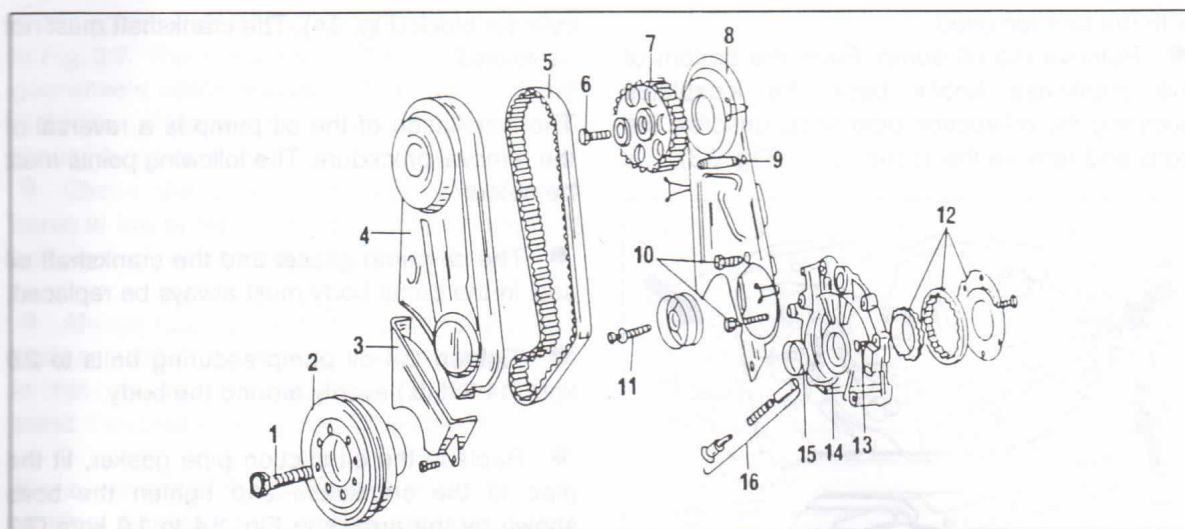
The removal and installation is not the same for the four- and five-cylinder engine.

#### 3.1.1 REMOVAL AND INSTALLATION

Refer to Figs. 3.1 or 3.2



### 3 Lubrication System — Petrol Engines



**Fig. 3.1.**  
The component parts of the oil pump of a five-cylinder engine and the parts to be removed to gain access to the pump.

- 1 Bolt, 46 kgm
- 2 Vibration damper
- 3 Lower timing belt cover
- 4 Upper timing belt cover
- 5 Timing belt
- 6 Bolt, 8.5 kgm or 10.0 kgm
- 7 Camshaft timing gear
- 8 Rear timing belt guard
- 9 Stud, 1.0 kgm
- 10 Bolts, 2.0 kgm
- 11 Bolts, 1.0 kgm
- 12 Oil pump gearwheels
- 13 Bolt, 1.0 kgm
- 14 Oil pump body
- 15 Oil seal
- 16 Oil pressure relief valve

#### Four-cylinder Engine

- Remove the oil sump.

● Unscrew the pump securing bolts at the bottom of the crankcase. Withdraw the pump towards the bottom until the pump shaft is disengaged from the drive gear. The ignition distributor must also be removed, as it cannot be in position during the installation of the pump.

The installation of the oil pump is a reversal of the removal procedure. First install the oil pump drive gear. Use a new "O" sealing ring.

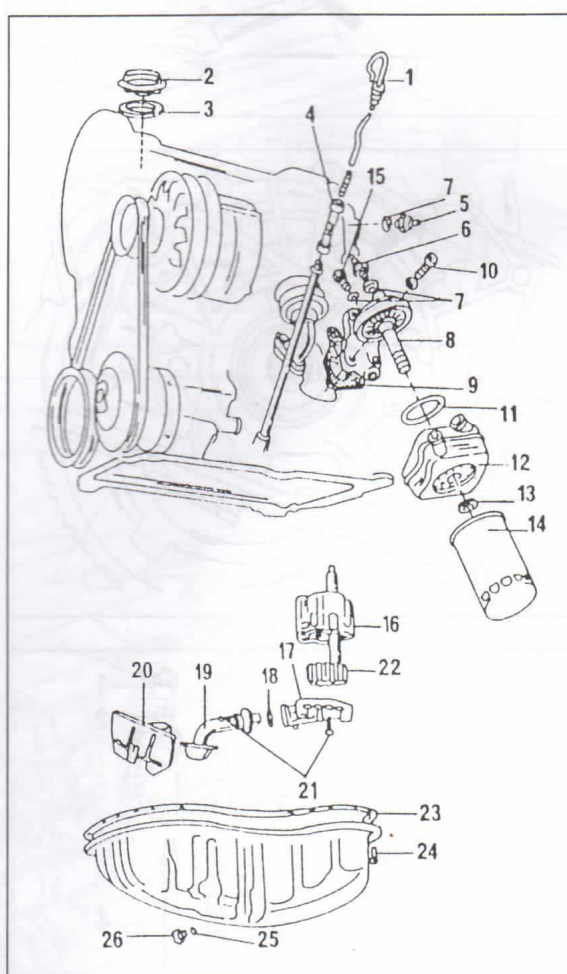
Insert the pump drive shaft from below the engine and into the splines of the oil pump drive gear and push the pump against the crankcase. The pump is fitted without a gasket. Tighten the securing bolts to 2.0 kgm (14.5 ft.lb.). Refit the distributor and adjust the ignition timing.

Refit the oil sump and fill the engine with the correct quantity of the recommended oil. Make sure that the oil drain plug is securely tightened.

#### Five-cylinder Engine

We would like to point out that the crankshaft must be prevented from rotating when the bolt in the centre of the vibration damper is slackened and tightened to the very high torque.

● Remove the steering pump together with the drive belt, slacken the alternator belt tensioner adjuster and remove the drive belt and unscrew the upper timing belt cover from the front of the engine. The different arrangement of the drive belts before and after September 1991 are covered in the "Cooling" section. Either V-belts or a ribbed V-belt are fitted.



**Fig. 3.2.**  
Main component parts of the lubrication system of a four-cylinder. The oil cooler (12) is between oil filter and oil filter bracket.

- 1 Oil dipstick
- 2 Oil filler cap
- 3 Sealing ring
- 4 Dipstick guide tube
- 5 0.3 bar oil pressure switch
- 6 1.8 bar oil pressure switch
- 7 "O" sealing ring
- 8 Filter bracket
- 9 Gasket
- 10 Bolt, 2.5 kgm
- 11 "O" sealing ring
- 12 Oil cooler
- 13 Nut, 2.5 kgm
- 14 Oil filter
- 15 Plug or thermoswitch
- 16 Oil pump body
- 17 Pump cover
- 18 "O" sealing ring
- 19 Oil suction pipe
- 20 Oil baffle panel
- 21 Bolts, 1.0 kgm
- 22 Pump gearwheels
- 23 Oil sump gasket
- 24 Oil sump screw, 2.0 kgm
- 25 Sealing washer
- 26 Oil drain plug, 3.0 kgm

● Slacken the bolt on the centre of the vibration damper. VW workshops use the restraining lever shown in Fig. 1A.14. If not available, engage a low gear, apply the handbrake and slacken the bolt with a socket. Fully remove the bolt and, using two tyre levers, applied at opposite points, lever off the damper.

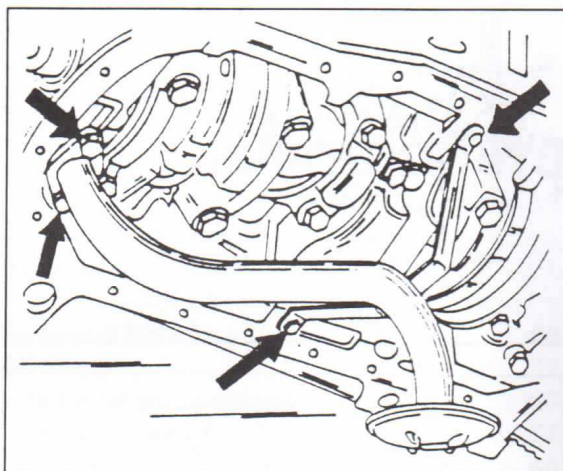
● Remove the oil dipstick. The timing drive is now removed as described in the relevant section. The engine must not be rotated thereafter



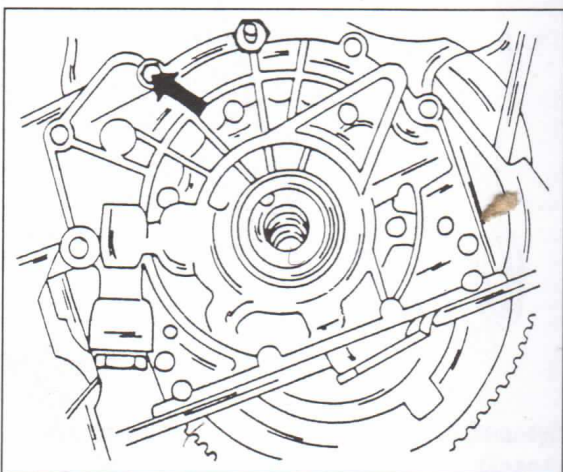
### 3 Lubrication System — Petrol Engines

with the belt removed.

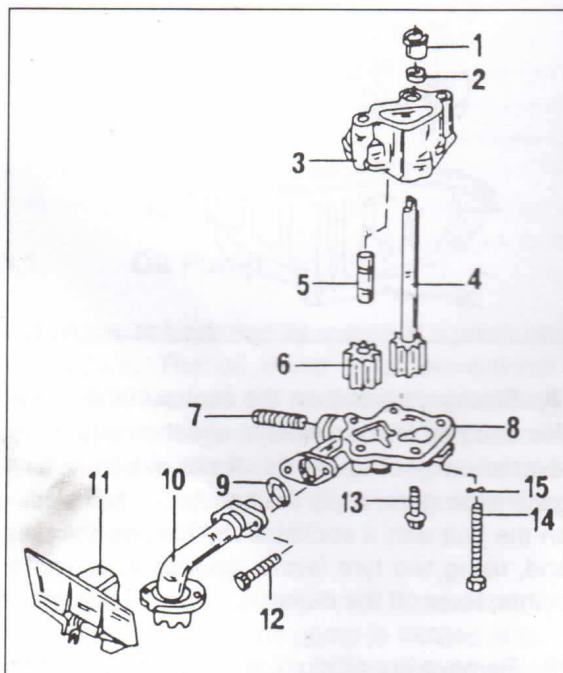
- Remove the oil sump. From the bottom of the crankcase knock back the lockplates securing the oil suction pipe bolts, unscrew the bolts and remove the suction pipe (Fig. 3.3).



**Fig. 3.3.**  
The arrows show the securing screws for the oil suction pipe at the bottom of the crankcase (5-cyl.).



**Fig. 3.4.**  
The arrows show where the oil pump bolts are situated (5-cyl.).



**Fig. 3.5.**  
Exploded view of the oil pump (4-cyl.).

- 1 Driver for distributor
- 2 Driver for oil pump
- 3 Oil pump body
- 4 Gearwheel with shaft
- 5 Relief valve plunger
- 6 Driven gearwheel
- 7 Spring
- 8 Pump cover
- 9 "O" sealing ring
- 10 Oil suction tube
- 11 Oil baffle plate
- 12 Bolt
- 13 Bolt, M6 thread
- 14 Bolt, M8 thread
- 15 Spring washer

- Unscrew the oil pump from the front of the

cylinder block (Fig. 3.4). The crankshaft must **not** be rotated.

The installation of the oil pump is a reversal of the removal procedure. The following points must be noted:

- The oil pump gasket and the crankshaft oil seal in the pump body must always be replaced.

- Tighten the oil pump securing bolts to 2.0 kgm (14.5 ft.lb.) evenly around the body.

- Replace the oil suction pipe gasket, fit the pipe to the crankcase and tighten the bolts shown by the arrows in Fig. 3.4 to 1.0 kgm (7.2 ft.lb.). New lockplates must be used and knocked over the bolt heads to secure the bolts in position.

- Refit the timing belt as described for the five-cylinder engine. All timing marks should be in line as the crankshaft has not been rotated. Refit the oil sump and fill the engine with engine oil.

#### 3.1.1. Servicing the Oil Pump

##### *Four-cylinder Engine*

Dismantle the pump by referring to Fig. 3.5. Remove the two shorter screws from the suction elbow and withdraw the elbow together with the oil strainer. Remove the drive shaft and gear and the driven gear. Using a screwdriver, remove the baffle plate (11) from the pump elbow and lift out the strainer.

Thoroughly clean all parts and dry with a lint-free cloth or with compressed air. Inspect the pump body and components for wear or damage. In view of the importance of the pump to the engine, we recommend that a worn pump should either be completely reconditioned or replaced with a new unit. If reconditioning is called for, carry out the following operations:

- Insert both gearwheels and using a feeler gauge, measure the clearance between the flanks of two of the gear teeth, as shown in Fig. 3.6. This clearance should be between 0.05 - 0.20 mm (0.002 - 0.008 in.). Replace the gearwheels as a set if necessary.

- Place a steel ruler on top of the pump housing, across the gearwheels and measure the clearance between the ruler and the surface



### 3 Lubrication System — Petrol Engines

of the gearwheels with a feeler gauge as shown in Fig. 3.7. This will measure the end float of the gearwheels which should not exceed 0.15 mm (0.006 in.). Also check the pump housing cover for any signs of wear.

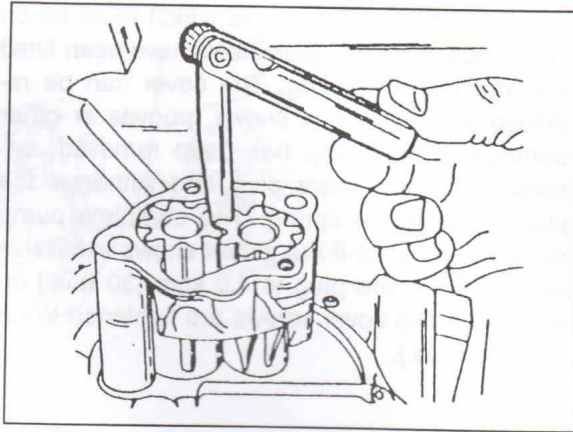
- Check the pump shaft and the bearing bores in the pump housing for wear or signs of seizure and replace the parts as necessary.

- Always replace the pump gears as a pair, if signs of wear or damage to the teeth are visible. In most cases the tooth flanks show polished areas if excessive wear has taken place.

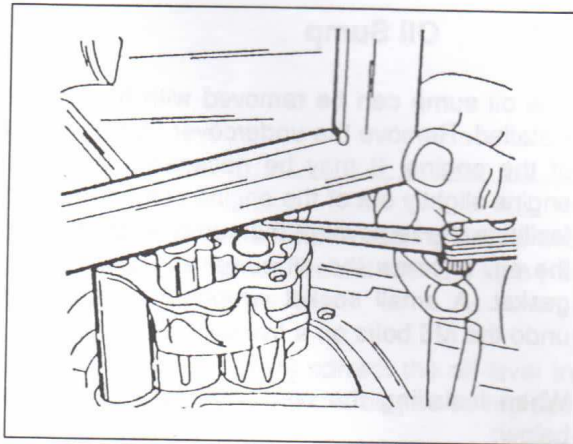
The assembly of the pump is a reversal of the removal procedure. Lubricate the gears and bearings liberally before assembly to provide lubrication for the initial start-up of the pump. The faces of pump body and pump cover must be free of foreign matter. Check that the pump can be turned freely without binding.

#### Five-cylinder Engine

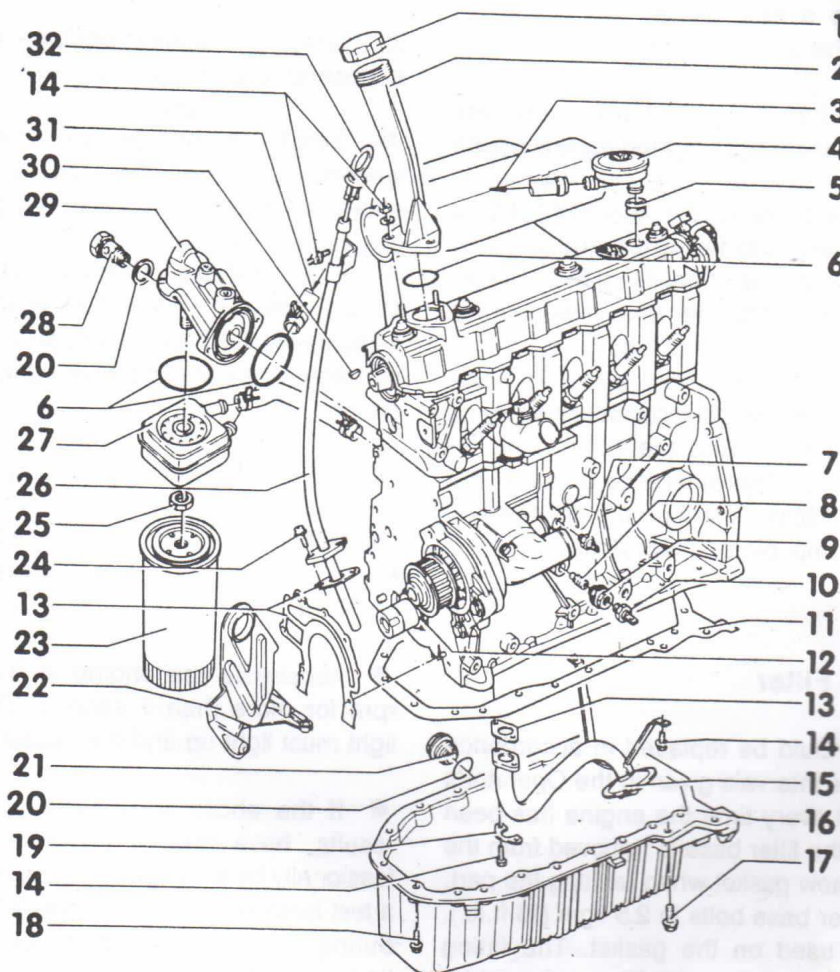
The pump gearwheels can be removed after unscrewing the rear cover (12) in Fig. 3.1. If the gearwheels show wear, replace them as a set.



**Fig. 3.6.**  
Checking the clearance between the pump gearwheels with a feeler gauge.



**Fig. 3.7.**  
Checking the end clearance of the oil pump gears by means of a steel square and a feeler gauge.



**Fig. 3.8.**  
Component parts of the lubrication system (5-cyl.).

- 1 Oil filler cap
- 2 Oil filler pipe
- 3 To intake hose
- 4 Pressure control valve for crankcase breather
- 5 Oil seal (replace)
- 6 "O" sealing ring (replace)
- 7 0.3 bar oil pressure switch (brown)
- 8 Oil pressure holding valve
- 9 Adapter, 5.0 kgm
- 10 1.8 bar oil pressure switch (white)
- 11 Oil sump gasket
- 12 Oil pump driving dog
- 13 Gasket
- 14 Screw, 1.0 kgm
- 15 Suction pipe
- 16 Oil sump
- 17 Bolt, 2.0 kgm
- 18 Screw, 1.0 kgm
- 19 Tab washer
- 20 Oil seal (replace)
- 21 Oil drain plug, 5.0 kgm
- 22 Oil collecting tray
- 23 Oil filter
- 24 Screw, 2.0 kgm
- 25 Nut, 2.5 kgm
- 26 Guide tube for dipstick
- 27 Oil cooler
- 28 Banjo bolt, 7.0 kgm
- 29 Oil filter holder
- 30 Woodruff key
- 31 From coolant pipe
- 32 Oil dipstick



### 3 Lubrication System — Petrol Engines

The gearwheels have marks which must be on the outside after the gearwheels have been fitted into the pump housing. The cover can be replaced separately if it shows grooves or other damage. If the pump has been removed, unscrew the relief valve plug and withdraw the piston and return spring. The complete pump must be replaced if the piston shows excessive wear. Tighten the plug to 4.0 kgm (30 ft.lb.) on assembly. The cover screws are tightened to 1.0 kgm (7.2 ft.lb.).

#### 3.2. Oil Sump

The oil sump can be removed with the engine installed. Remove the undercover from the front of the engine. It may be necessary to lift the engine slightly out of the engine compartment to facilitate the removal of the sump. After draining the oil, unscrew the oil sump and take off the gasket. A small socket wrench is required to undo the M6 bolts on a five-cylinder engine.

When installing the oil sump, note the points below:

- Always use a new gasket. No grease or sealers should be applied to gaskets or facings.
- Take care that the gasket and sump are properly positioned before tightening any bolts.
- Tighten the bolts to 2.0 kgm (14.5 ft.lb.), working diagonally and taking several steps to reach the final torque reading. On a five-cylinder engine fit the M8 bolts with hex. head on the transmission side.
- Fill the engine with the correct quantity of the recommended oil. Run the engine and re-check the oil level. The difference between the "Min." and the "Max." mark on the dipstick is 1 litre (approx. 2 Imp. pints, 2 U.S. pints).

#### 3.3. Oil Filter

The oil filter should be replaced in accordance with the service intervals given in the Operator's Handbook and every time the engine has been overhauled. If the filter base is removed from the engine, use a new gasket when refitting the part. Tighten the filter base bolts to 2.5 kgm (18 ft.lb.). No grease is used on the gasket. The fitting instructions are printed on the filter and must be

followed during installation. Always use a new sealing ring for the filter. Lubricate the sealing ring with engine oil before installation.

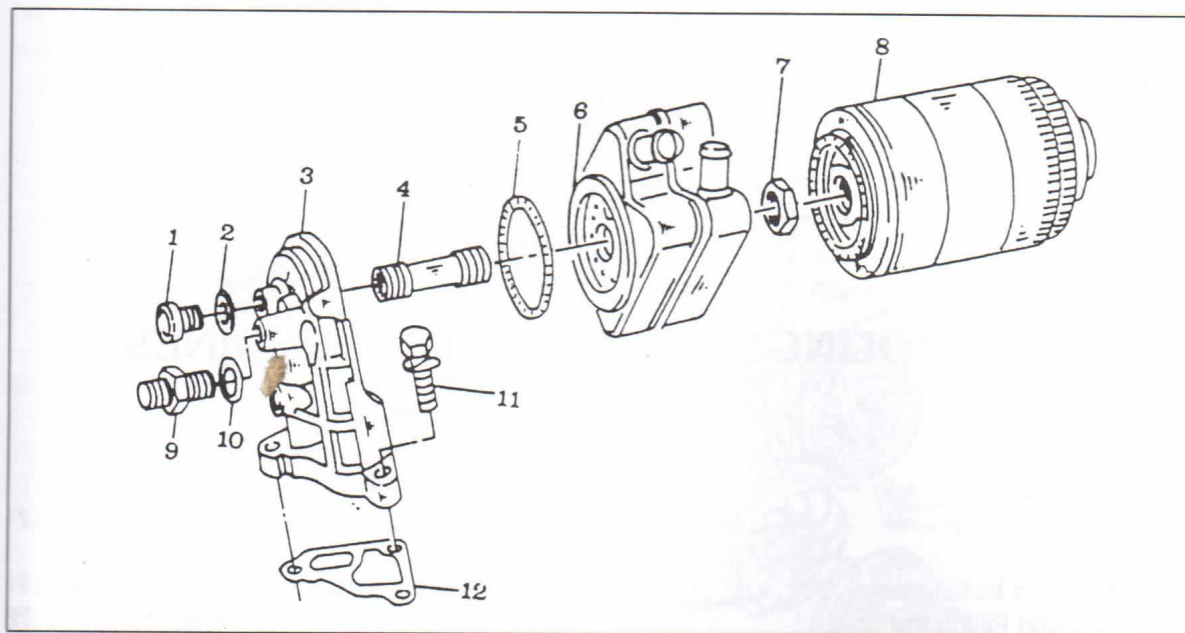
#### 3.4. Checking the Oil Pressure

The oil pressure of the engine lubrication system can be checked by means of a suitable pressure gauge, which should have provision for the connection of the oil pressure switch. To check the oil pressure, remove the oil pressure switch from the engine and connect to the pressure gauge. These engines are fitted with a second oil pressure switch with a warning buzzer, the so-called 1.8 bar oil pressure switch. If the oil pressure drops below 1.8 bar (26 psi.) and the engine speed is kept above 2150 rpm for more than 1 second, the contacts of the 1.8 bar switch open. The oil pressure warning light comes on and the buzzer sounds. The 0.3 bar oil pressure indicates when the oil pressure drops below 0.3 bar (approx. 4.5 psi.) and lights up the oil pressure warning light. The checking of the oil pressure should be carried out by a VW Dealer, but the oil pressure switches can be checked for functioning as follows:

- Check the engine oil level and correct if necessary.
- Switch on the ignition. The oil pressure warning light must come on. Start the engine and check that the warning light goes out.
- Pull the cable off the 0.3 bar oil pressure switch (see Fig. 3.2 or 3.8 for location — the switch with the brown lead) and hold the cable end against earth. The warning light must come on.
- Re-connect the plug to the switch.
- Pull the connector off the 1.8 bar switch (see Fig. 3.2 or 3.8 for location — the switch with the white lead).
- Accelerate the engine to more than 2500 rpm for more than 1 second. The oil warning light must light up and the buzzer should sound.
- If the above tests show not the required results, have the oil pressure checked professionally by a VW Dealer. A special gauge and a test lamp are required to check the oil pressure during idle speed and under acceleration.



### 3 Lubrication System — Petrol Engines



**Fig. 3.9.**  
View of the oil cooler  
(4-cyl. engine shown).  
Some parts are only fitted  
to the Diesel engine.

- 1 Plug
- 2 Sealing washer
- 3 Oil filter bracket
- 4 Connector
- 5 Seal ring
- 6 Oil cooler
- 7 Hexagonal nut
- 8 Oil filter
- 9 Plug
- 10 Sealing washer
- 11 Bolt
- 12 Gasket

#### 3.5. Oil Cooler

An oil cooler is fitted between the oil filter bracket and the oil filter, as shown in Fig. 3.9 for the four-cylinder engine. The attachment of the oil cooler on the five-cylinder engine can be seen in Fig. 3.8. You will notice that the oil filter bracket is different. The fitting of the bracket is fixed by dowel pins. Also in the bracket is a non-return valve for the hydraulic tappets.

The oil cooler can be removed after removal of the oil filter and disconnecting the hoses and the hose connected to the filter bracket in the case of the five-cylinder engine. Oil will drop out of the filter/oil cooler connection and a suitable container must be in position to avoid contamination. A nut at the bottom of the oil cooler secures the assembly in position.

The oil cooler is sealed with a sealing ring to the oil filter bracket. Tighten the nut with 2.5 kgm (18 ft.lb.) when refitting the filter.

Check and, if necessary correct the oil level in the sump before starting the engine to replace the drained oil.

#### 3.6. Oil Level

Check the oil level in regular intervals, especially when venturing on longer journeys. Make sure that the vehicle is standing on a level surface when the oil is checked. The difference between the "Min" and "Max" mark on the dipstick is approx 1 litre. It is therefore possible to judge without difficulties the amount of oil that may be missing. Never overfill the engine — Possible damage to the catalytic converter.



## 4 COOLING SYSTEM — PETROL ENGINES

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### 4.0. Technical Data

|                             |                                                                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| System type: .....          | Pressurised, with impeller type water pump, thermostat and separate expansion tank. Electrically operated cooling fan or two fans with thermo switch in radiator. |
| Water pump drive:           |                                                                                                                                                                   |
| 4-cylinder:.....            | From "V" belt, driven by crankshaft pulley                                                                                                                        |
| 5-cylinder: .....           | Driven by timing belt                                                                                                                                             |
| System capacity: .....      | See Section 0.3.                                                                                                                                                  |
| Thermostat:                 |                                                                                                                                                                   |
| Opens at: .....             | 87° C                                                                                                                                                             |
| Fully open at: .....        | 102° C                                                                                                                                                            |
| Anti-freeze capacity: ..... | See Section 4.5                                                                                                                                                   |

### 4.1. Radiator

#### 4.1.0. REMOVAL AND INSTALLATION

The radiator together with the electrically operated fans and the radiator hoses are shown in Fig. 4.1. There are no differences between the two petrol engines. To remove the radiator proceed as follows:

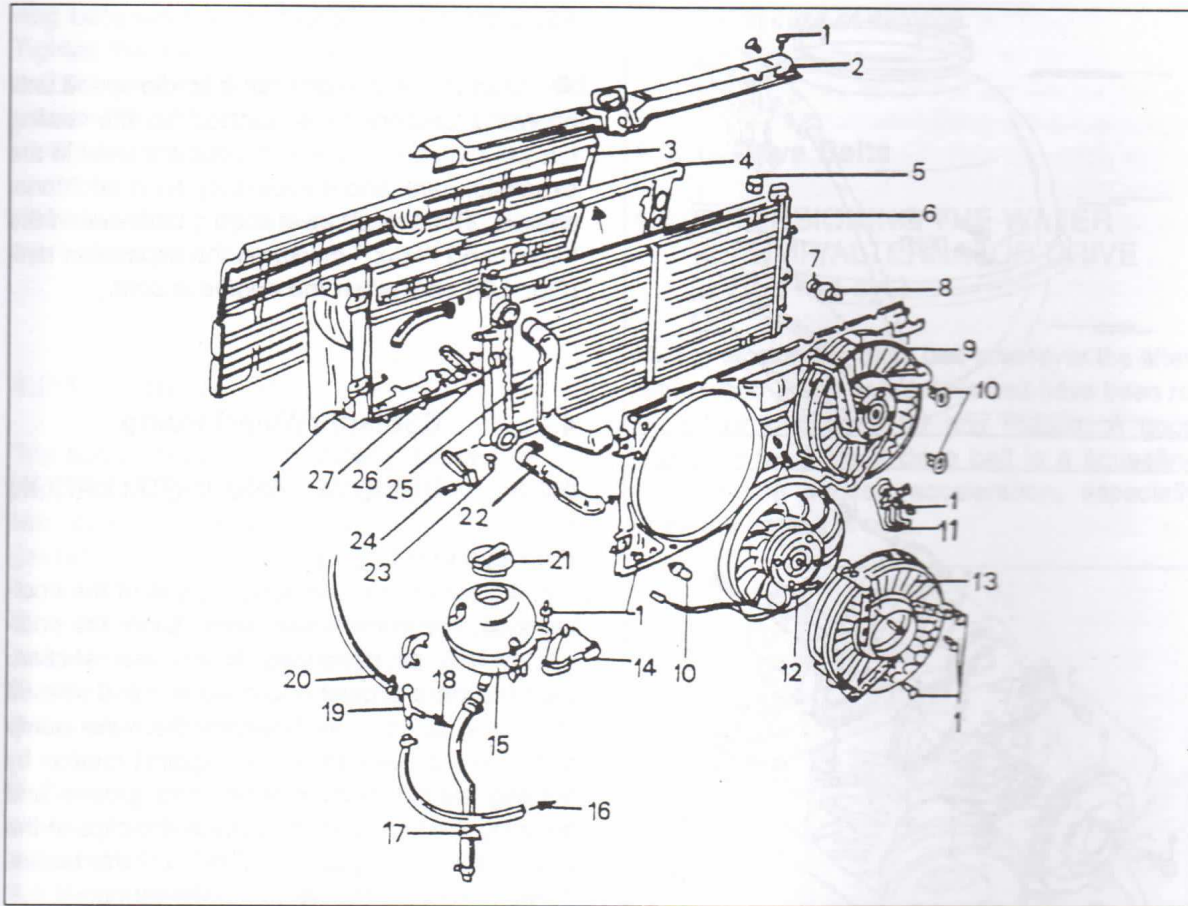
- Disconnect the battery.
- Tilt the radiator and the front panel of the vehicle towards the front as described on page

11. Also remove the undercover (refer to Figs. 1.1 and 1.2).

- Drain the cooling system as described in the next section. Remove the expansion tank cap to speed-up the draining operation.
- Disconnect the plug from the temperature switch at the bottom of the radiator and from the cooling fan motor leads.
- Slacken the clamps of the upper and lower radiator hoses. Withdraw the hoses from the connections and push them to one side without



## 4 Cooling System



**Fig. 4.1.**  
View of the radiator and associated parts.

- 1 Screw, 1.0 kgm
- 2 Bonnet lock carrier
- 3 Radiator grille
- 4 Air guide panel
- 5 Rubber bearing
- 6 Radiator
- 7 Sealing washer
- 8 Thermo switch, 2.5 kgm
- 9 Radiator cowl/fan
- 10 Cable clamp
- 11 Adjuster
- 12 Electric fan
- 13 Retaining ring
- 14 Covering
- 15 Expansion tank
- 16 To cylinder head
- 17 To coolant pipe
- 18 To heat exchanger
- 19 "T"-piece
- 20 Overflow hose
- 21 Expansion tank cap
- 22 Lower radiator hose
- 23 Rubber washer
- 24 Retaining pin
- 25 Upper radiator hose
- 26 Expansion clip
- 27 Retainer

kinking them. Also remove the hose between radiator and expansion tank. Hoses can either be secured by spring clamps or screw clamps. Screw clamps can be used during installation.

- Remove the pins from the expansion clips at the positions shown in Fig. 4.2 on the L.H. and R.H. side of the radiator and remove the clips from the radiator.

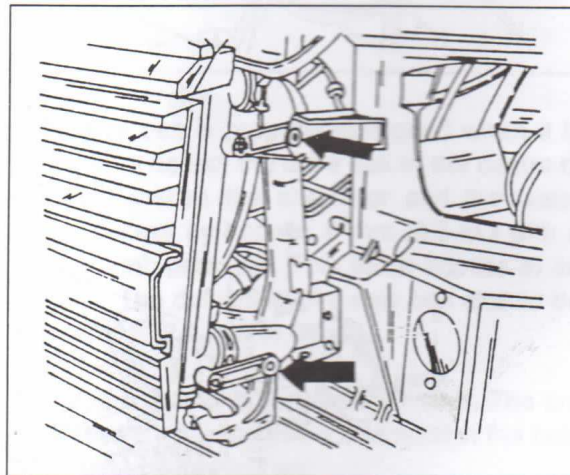
- Lift the radiator out of the vehicle, taking care not to damage the radiator core during removal.

- If necessary unscrew the fan cowling from the radiator or the fan motor(s) from the cowl.

The installation is a reversal of the removal procedure. The next section describes the draining and refilling of the cooling system and the various instructions must be noted.

### 4.1.1. DRAINING AND FILLING THE COOLING SYSTEM

- Set the heater control lever in the dashboard to the "Hot" position and remove the expansion tank filler cap. Careful when the engine is hot.



**Fig. 4.2.**  
The two arrows point to the retaining pins for the expansion clips.

- Drain the coolant by either removing the lower water hose, unscrewing the water pump flange or unscrewing the drain plug. Fig. 1.3 shows the draining points.

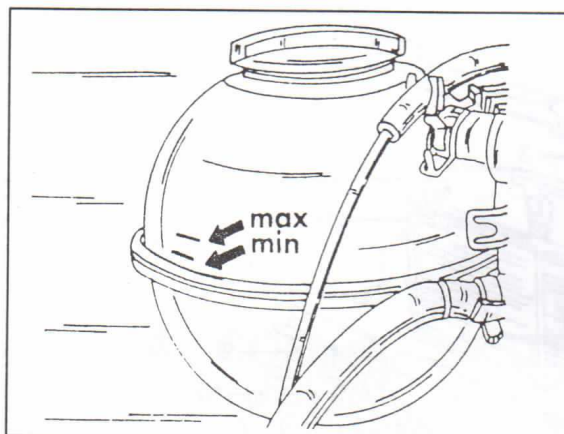
**NOTE:** If the anti-freeze mixture is to be re-used, place a container underneath the drain points to collect as much as possible.

To ensure that the cooling system is filled without any air pockets, follow the instructions given below:

- Check that the heater control lever is still in the "Hot" position and re-connect the lower



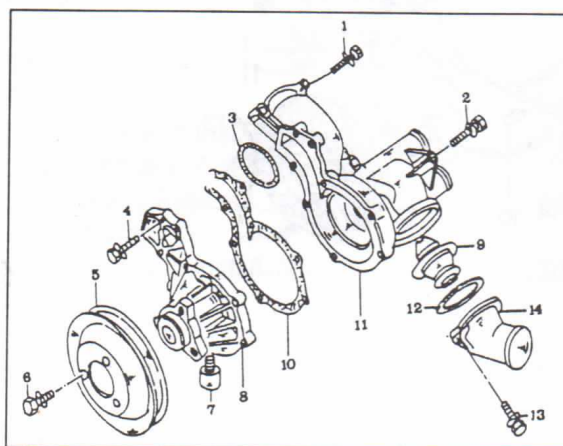
## 4 Cooling System



**Fig. 4.3.**  
View of the coolant expansion tank.

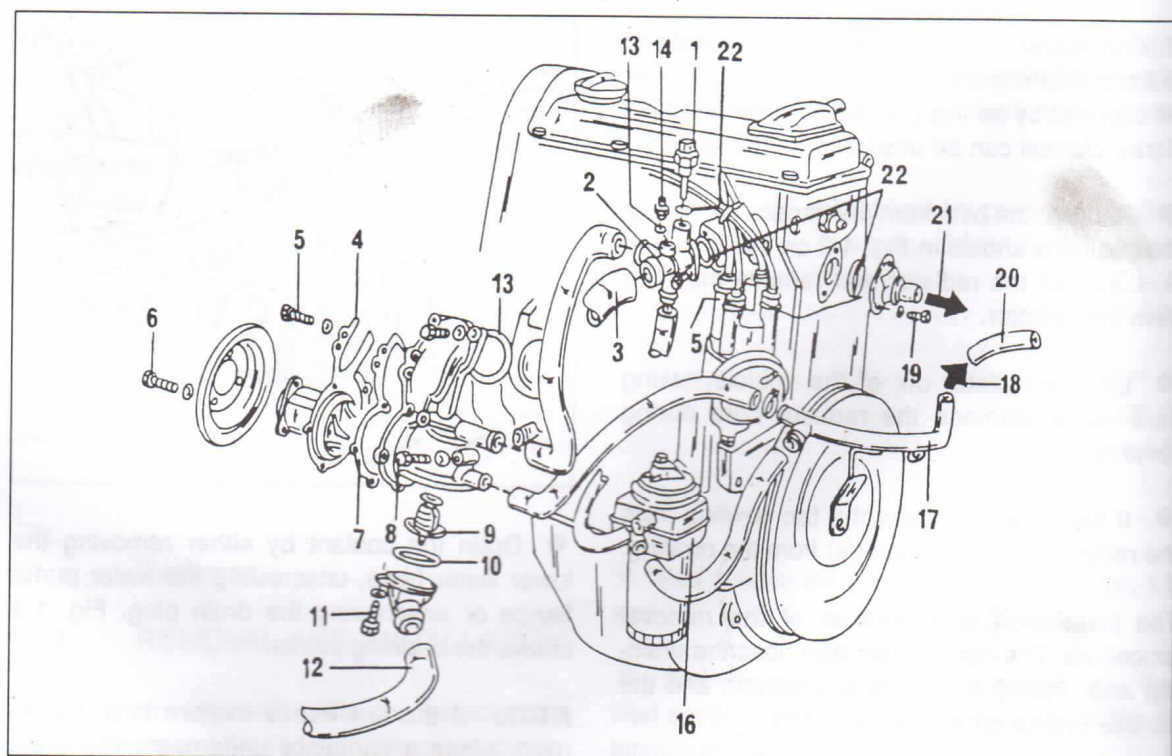
**Fig. 4.4.**  
The component parts of the water pump.

- 1 Bolt, M8 x 30
- 2 Bolt, M8 x 50
- 3 Sealing ring
- 4 Bolt, M6 x 22
- 5 Water pump pulley
- 6 Bolt, M8 x 12
- 7 Plug
- 8 Water pump
- 9 Thermostat
- 10 Pump cover gasket
- 11 Water pump housing
- 12 Sealing washer
- 13 Bolt, M6 x 22
- 14 Thermostat housing



**Fig. 4.5.**  
The component parts of the cooling system on the cylinder block (four-cylinder).

- 1 Thermo switch
- 2 Connector
- 3 Upper coolant hose
- 4 Water pump
- 5 Bolt, 1.0 kgm
- 6 Bolt, 2.0 kgm
- 7 Water pump gasket
- 8 Bolt, 2.0 kgm
- 9 Thermostat
- 10 "O" sealing ring
- 11 Bolt, 1.0 kgm
- 12 Lower coolant hose
- 13 Sealing rings
- 14 Temperature sender unit
- 15 Bolt, 1.0 kgm
- 16 Oil cooler
- 17 Coolant pipe
- 18 To expansion tank
- 19 Bolts, 1.0 kgm
- 20 From heat exchanger
- 21 To heat exchanger
- 22 "O" sealing ring



hose to the radiator or refit the water pump flange. In the latter case always replace the "O" sealing ring. Close the drain plug if it has been unscrewed.

- Fill the expansion tank to the upper edge with anti-freeze solution (see Fig. 4.3 and Section

4.5) and fit the filler cap.

- Start the engine and run it at idle speed until operating temperature is reached, i.e. the cooling fan will switch on. Check the coolant level in the expansion tank and if necessary fill in additional coolant. The coolant level should be between the "Min." and "Max." marks on the expansion tank (Fig. 4.3), *only when the engine is cold.*

### 4.2. Coolant (Water) Pump

#### 4.2.0. REMOVAL AND INSTALLATION

##### *Four-cylinder Engine*

Fig. 4.5 shows the component parts of the cooling system and the water pump. Drain the cooling system as described in the last section. Remove the alternator and drive belt and take off the timing belt guards. Unscrew the water pump pulley. The pulley can be held against rotation by placing an old drive belt into the groove and pressing the belt together. Loosen the clips at the rear of the water pump and pull off the hoses. Three hoses are connected to the pump.

Take off the mounting bolts and remove the complete pump. If the engine is still in the vehicle, the pump will have to be turned slightly before removal. Fig. 4.5 shows details of the pump.

The installation of the water pump is a reversal of the removal procedure. Always use a new "O"



## 4 Cooling System

ring between the pump and the engine faces. Tighten the pump bolts and the drive pulley bolts to 2.0 kgm (14.5 ft.lb.). Refit the alternator and tension the drive belt as described in Section 4.3 for the four-cylinder engine.

Refill the cooling system as described in Section 4.1.1.

### 4.2.1. SERVICING

The pump cannot be completely dismantled. To check the condition of the pump, separate the two pump housing halves and remove the gasket.

Turn the pump shaft with the impeller by hand and check for roughness or play in the bearing. If any of these defects are noticeable, replace the pump as a complete unit.

If the lower water pump flange has been removed (the thermostat is located there), always replace the "O" sealing ring on installation. Fig. 4.4 shows the dismantled water pump.

### Five-cylinder Engine

- Drain the cooling system as described in Section 4.1.1. Collect the anti-freeze if still in good condition.

- Remove the alternator and the steering pump drive belt(s). Remove the steering pump and tie it with a piece of wire somewhere in the engine compartment without disconnecting the hoses.

- Remove the timing belt as described on page 48 and the subsequent page until the water pump is free and can be fully unscrewed from the cylinder block. Fig. 1A.13 on page 48 shows where the securing bolts are located.

The installation of the water pump is a reversal of the removal procedure. Fit the pump bolts finger-tight only, as they must be tightened during the tensioning of the timing belt. Fit and adjust the belts or the belt as described in Section 4.3.1. Before the engine is finally closed off, recheck the setting once more to make sure that crankshaft or camshaft have not been rotated whilst the pump has been out of the engine. Follow the installation and tensioning details step by step to avoid mistake and consequent engine damage.

The water pump cannot be repaired and must be

replaced in case of damage.

### 4.3. Drive Belts

#### 4.3.0. TENSIONING THE WATER PUMP/ALTERNATOR DRIVE BELT (4-cyl.)

Always tension the drive belt whenever the alternator, water pump or the drive belt have been removed or slackened for any reason. A good indication for a slack drive belt is a squeeling noise during sudden acceleration, especially when the engine is cold.

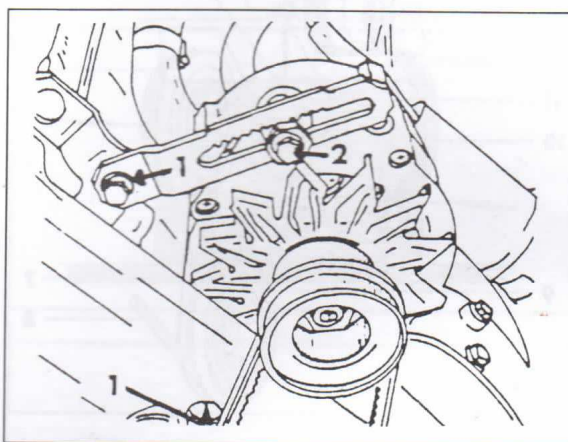


Fig. 4.6.  
Adjusting details for the drive belt with tensioning device. Slacken the bolts (1) and (2) and turn the tensioning nut (2) to obtain the tension.

The drive belt is properly tensioned when it is possible to deflect the drive belt in the centre of its run between the alternator and the water pump pulleys by approx. 5 mm (0.5 in.) with a good thumb pressure. This value applies to an old belt. The deflection of a new belt should be restricted to 2.0 mm (0.08 in.).

The belt is tensioned on the alternator. The engine uses a tensioning device to tension the belt. Adjust the belt as follows:

- Refer to Fig. 4.6 and slacken the mounting bolts (1) and the lock bolt for the tensioning nut (2) by at least one turn. The alternator should drop down under its own weight after the bolts have been slackened.

- Tension the belt by tightening the tensioning nut to 0.8 kgm (6 ft.lb.) if a new belt is tensioned or to 0.4 kgm (3 ft.lb.) if the old belt is re-tensioned.

- Tighten the lock bolt for the tensioning nut to 3.5 kgm (25 ft.lb.), the alternator mounting bolt to 3.5 kgm (25 ft.lb.) and the bolt on the adjusting strut to 2.0 kgm (14.5 ft.lb.).



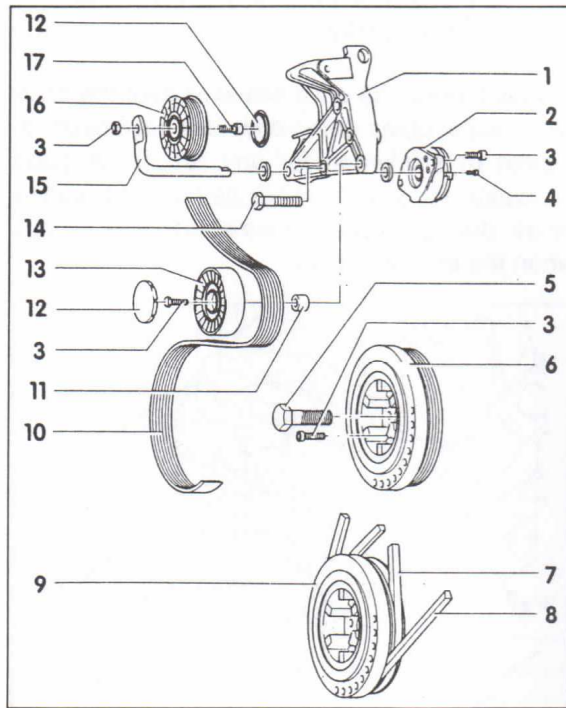
## 4 Cooling System

### 4.3.1. DRIVE BELT(S) — 5-cyl.

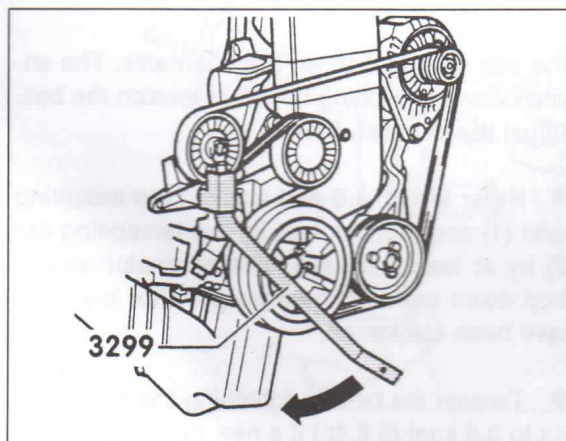
Fig. 4.7 shows the drive belt on engines with a single ribbed V-belt and the two drive belts, one for the alternator and the other for the steering pump. The single ribbed V-belt is fitted to the engine from Oct. 1991 onwards.

**Fig. 4.7.**  
The arrangement of the belt drive of a 5-cyl. engine.

- 1 Mounting bracket for tensioning device
- 2 Tensioning element
- 3 Nut, 2.0 kgm
- 4 Bolt, 1.0 kgm
- 5 Bolt, 46.0 kgm
- 6 Vibration damper for ribbed V-belt (after Oct. 1991)
- 7 V-belt for power steering pump (to Sept. 1991)
- 8 V-belt for alternator (to Sept. 1991)
- 9 Vibration damper to Sept. 1991
- 10 Ribbed V-belt
- 11 Spacer sleeve
- 12 Protective cap
- 13 Guide pulley
- 14 Bolt, 4.0 kgm
- 15 Tensioning lever
- 16 Tensioning pulley
- 17 Pulley bolt



The V-belt for the alternator is tensioned in the manner described for the four cylinder engine. A tensioning device is used. A new belt should deflect by approx. 2.0 mm (0.08 in.), a used belt can deflect up to 5.0 mm (0.2 in.). All tightening torques quoted on the previous page also apply to the five-cylinder engine.



**Fig. 4.8.**  
Layout of the ribbed V-belt on a vehicle without A/C system. The lever is pushed in the direction of the arrow to move the pulley away from the belt.

A special tensioning lever is required to move the tensioning pulley if a single ribbed V-belt is fitted. The application of the lever is shown in Fig. 4.8. After the pulley has been removed towards the inside it will be possible to lift off the belt in order to replace it.

When the new belt is fitted, make sure it is seated correctly in the centre of the belt pulleys. After releasing the tensioner pulley against the belt there is no further need for any adjustments.

The tensioning device itself can be removed as follows, but it should be noted that the engine must be detached from the mountings, lowered and pushed forward in order to reach the tensioning device. The exhaust pipe can touch the steering box, i.e. observe this area when lowering the engine. Also make sure that none of the connecting lines and hoses are over-stretched when the engine is pushed forward:

- Tilt the radiator forward as described on Page 11.

- Remove the air cleaner housing

- Unscrew the clamp securing the power steering lines from the bracket for the tensioning device and the engine mount.

- Remove the noise dampening panel from underneath the engine (refer to Page 11).

- Remove the ribbed V-belt as described above.

- Disconnect the R.H. drive shaft at the input flange on the inside of the shaft. Keep the shaft in a horizontal position.

- Attach the engine with ropes or chains to a hoist or hand crane and lift it out of the engine compartment until you feel that the mountings are under tension.

- Detach the transmission mounting from the subframe. Also slacken the central bolt for the L.H. engine/transmission mount in the engine compartment by 1 turn and completely remove the central bolt for the R.H. engine mounting. Make sure that the engine is well supported on the lifting tackle.

- Lower the engine and push it forward as far as possible. Wedge a piece of wood between the rear of the engine and the bulkhead to prevent it from returning to its previous position.

- Unscrew guide pulley and the tensioner pulley and then unscrew the tensioning device together with the engine mount. The tensioning element can now be removed from the engine. Mounting details for the tensioning device together with the tightening torques can be taken



## 4 Cooling System

from Fig. 4.7. Note the following tightening torques to re-attach the engine:

Central bolt, engine mount . . . 6.5 kgm (47 ft.lb.)  
Drive shaft . . . . . 5.5 kgm (40 ft.lb.)  
Transmission mount to  
subframe . . . . . 4.5 kgm (32.5 ft.lb.)

### 4.4. Thermostat

The location of the thermostat of a four-cylinder engine can be seen in Fig. 4.5. The thermostat is inside a housing, underneath a cover and can be taken out of its opening after disconnecting the hose and unscrewing the cover. The coolant must, of course, be drained at least below the level of the thermostat.

The thermostat cannot be repaired or adjusted and must be replaced if faulty. A thermostat can be tested by immersing it in a container of cool water and gradually raising the temperature to check that it opens properly.

Suspend the thermostat on a piece of wire so that it does not touch the sides or the bottom of the container. A thermometer must also be suspended in the same manner. Fig. 4.9 shows the arrangement. The opening temperature of the thermostat is marked on the unit and this can be used as a guide during the test. Standard thermostats must be fully open at a temperature of 105° C.

Protection to —25° C:

3.5 litres anti-freeze, 5.5 litres water

Protection to —35° C:

4.5 litres anti-freeze, 4.5 litres water

To check the strength of the anti-freeze, special hydrometers are used. It often happens that water has been drained during the summer months and one never knows how much anti-freeze is missing to protect the engine and cooling system. Such a hydrometer is used as shown in Fig. 4.10, in accordance with the instructions of the manufacturer. From the results

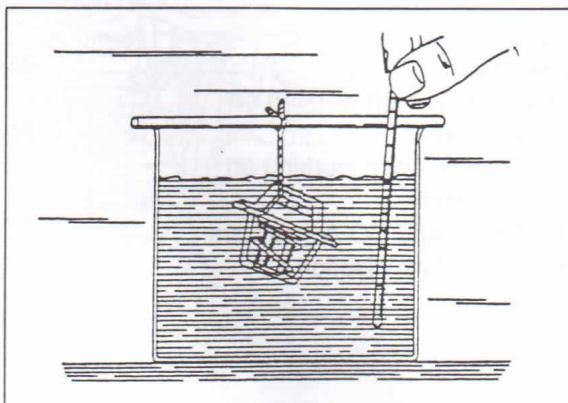


Fig. 4.9.  
Testing a thermostat.

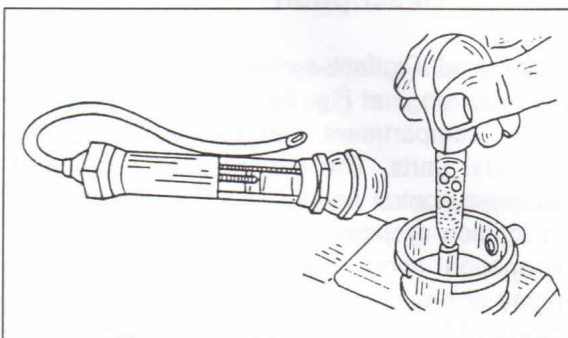


Fig. 4.10.  
Checking the anti-freeze.

### 4.5. Anti-freeze Solution

The cooling system is filled with an anti-freeze solution and this mixture should be left in the system throughout the year. If a fresh mixture is prepared, use the following table in accordance with the temperatures to be expected. We advise you only to use the anti-freeze marketed by VW Dealers, as this solution has been specially formulated for use with your engine. The quantities apply to both engines:

obtained and the table below, it will then be possible to correct the strength of the anti-freeze without draining the complete cooling system.

Maximum protection will be obtained if half anti-freeze and half water is used in the cooling system (for extreme temperatures below freezing point, i.e. below —35° C).

The anti-freeze used by VW is marketed under the name "G11".



## 5 FUEL INJECTION SYSTEM — FOUR-CYLINDER

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### 5.0. Description

A so-called Digifant system is used with the 4-cylinder engine. Fig. 5.1 shows a view of the engine compartment with the location of the individual parts. The system uses a common electronic control unit for the fuel injection and the ignition systems. The unit receives various information about the load condition of the engine at any given moment and regulates the amount of fuel to be injected, the duration of the injection phase and the best ignition timing point.

The Digifant control unit for the injection and fuel system is fitted with a fault memory. If a fault occurs in the sensors and components being monitored, these are stored in the fault memory together with an indication of the type of fault. The self diagnosis can only be evaluated in a VW workshop, using special equipment. After the fault has been rectified, the memory will be cleared to store further possible faults in the future.

Work on the fuel injection system should be kept to a minimum. The following pages describe some of the operations which can be carried out, provided that the precautionary measures given in Section 5.1 are observed at all times. Also note the rules on cleanliness in the next section.

The idle speed and the CO content of the fuel

mixture can be checked and/or adjusted, if this is required during the life of your vehicle.

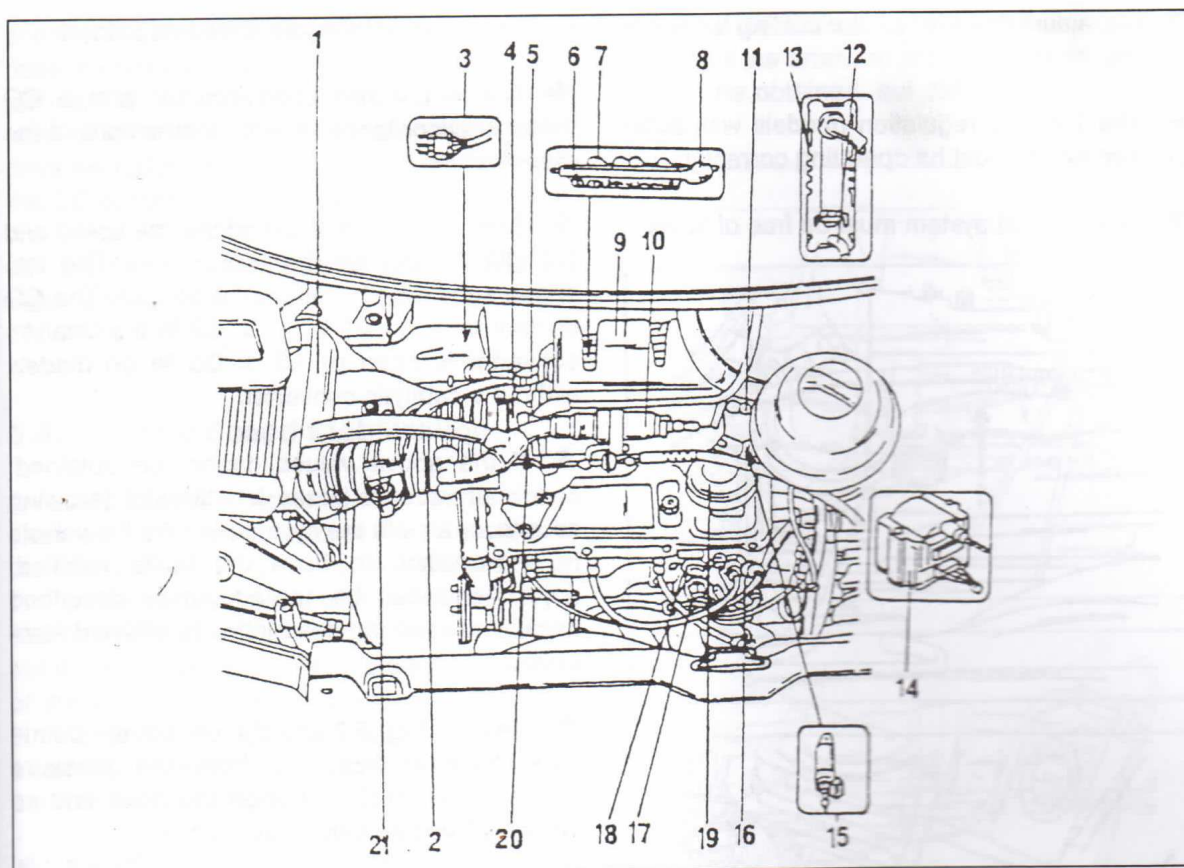
### 5.1. Cleanliness when working on the System

If fuel pipes are disconnected from the system, note the following points:

- Before unscrewing union nuts, clean the surrounding areas thoroughly to prevent entry of dirt.
- Store removed parts on a clean surface and immediately cover with clean paper or plastic sheets. Never use fluffy rags to clean parts.
- Removed parts which are not immediately refitted should be kept in a closed box until installation.
- Remove new parts from their packing if installed immediately.
- Never use compressed air to clean parts of the engine compartment, if connections of the injection system are open. Also avoid moving the vehicle from its place of repair, if at all possible.



## 5 Fuel Injection System — Four-cylinder



**Fig. 5.1.** Layout of the "Digifant" system component parts in the engine compartment. Items marked with "\*" are monitored by the self diagnosis system. The lock carrier plate must be folded down (remove two screws) to access the items shown.

- 1 Air cleaner
- 2 Intake hose
- 3 Connector for Lambda probe and Lambda probe heating
- 4 Throttle valve housing
- 5 Throttle valve potentiometer\*
- 6 Injectors
- 7 Fuel distributor
- 8 Fuel pressure regulator
- 9 Intake manifold
- 10 Idle speed stabilisation valve
- 11 Sealing cap for CO measuring pipe
- 12 Vacuum pipe
- 13 Digifant control unit
- 14 Ignition transformer
- 15 Cold start valve
- 16 Ignition distributor
- 17 Thermo switch for fan run-on with coolant temperature gauge sender unit
- 18 Coolant temperature sender unit\*
- 19 Pressure regulating valve for crankcase breather
- 20 Idle adjusting screw
- 21 CO potentiometer\*

### 5.2. Precautions when working on the System

As the system is connected electronically with the ignition system, there are certain precautions which must be taken when work is to be carried out on the engine to prevent personal injury or damage to component parts:

- The ignition must be switched off when electrical connections of the ignition or fuel system are disconnected or connected.
- When the engine is to be cranked with the starter motor, withdraw the centre lead (H.T. lead) out of the coil or disconnect the main connector plug from the side of the distributor.
- Starting aids of more than 16.5 volts must not be used to start the engine. Never crank the engine more than 1 minute at a time.
- The battery cables must be disconnected when welding work is carried out on the vehicle.
- Switch off the ignition before the engine is washed down.
- If the vehicle is to be towed due to faults in

the ignition system or injection system, disconnect the large connector plug from the electronic control unit.

- Before fitting suppressors for a radio, check with your dealer about suitability.

### 5.3. Idle Speed and CO Content Adjustment

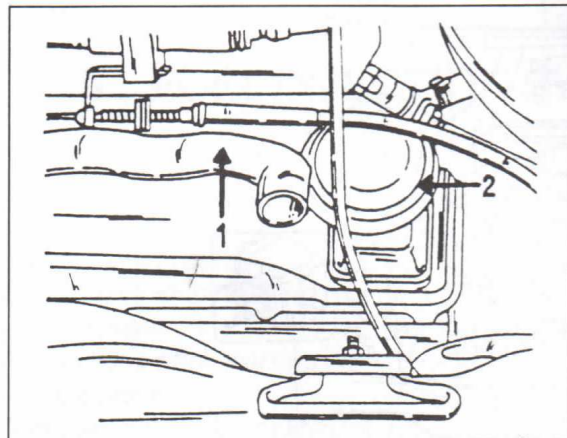
Special instruments are normally used for these adjustments. The following description can therefore only be considered as an emergency measure, but with a little knowledge there should be no problem to carry them out sufficiently. The following points must be observed before idle speed and CO content can be checked:

- Run the engine until it has reached its operating temperature.
- Ensure that the ignition timing is properly adjusted before the idle speed and CO content is checked or corrected.
- If fuel pipes have been disconnected, accelerate the engine several times to 3000 rpm and then allow it to idle for at least 2 minutes.

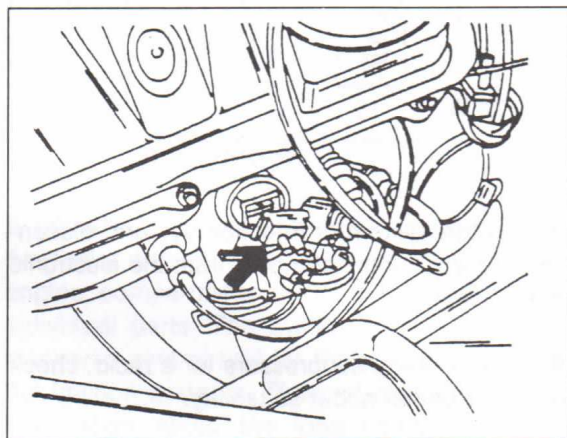


## 5 Fuel Injection System — Four-cylinder

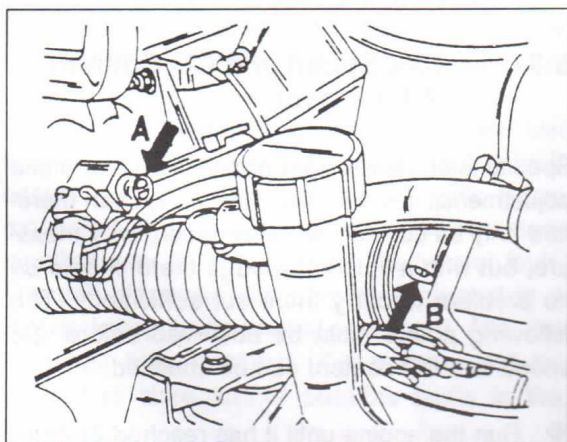
- Make sure that the radiator cooling fan is not running.
- The Lambda regulation (models with catalytic converter) must be operating correctly.
- The exhaust system must be free of leaks.



**Fig. 5.2.**  
Disconnect the hose (1) from the pressure regulator (2) and arrange the open hose end so that only fresh air can be sucked in.



**Fig. 5.3.**  
The arrow shows the connector plug for the coolant temperature sender unit which must be disconnected during adjustment of idle speed and CO content (also during the ignition timing point adjustment).



**Fig. 5.4.**  
The position of the CO adjusting screw (A) and idle speed adjusting screw (B).

- All electrical consumers must be switched off.
- The idle speed stabilising control valve must buzz or vibrate when the ignition is switched on. If this is not the case, check the idle speed stabilisation as described in Section 5.4.

Check and adjust the idle speed as follows:

- Connect a revolution counter and a CO meter in accordance with the instructions of the manufacturer.
- Start the engine and read the idle speed and the CO content on the instruments. The idle speed should be within  $800 \pm 50$  rpm. The CO content must be within  $0.7 \pm 0.2$  % if a catalytic converter is fitted or  $1.0 \pm 0.5$  % on models without a catalytic converter.
- If the above values cannot be obtained, check all vacuum hoses for damage (allowing secondary air into the system) or take the vehicle to a workshop to have the faults rectified. Adjustments can be carried out as described below, provided the description is followed step-by-step.
- Refer to Fig. 5.2 and disconnect the crankcase breather hose (1) from the pressure regulating valve (2). Arrange the hose end so that only fresh air can be sucked in.
- With the throttle valve closed, start the engine and run at idle speed until the coolant fan cuts-in. As soon as this is the case, withdraw the plug shown in Fig. 5.3 off the temperature sender, accelerate the engine three times to more than 3000 rpm and allow it to return to idling.
- To correct the settings by turning the adjusting screws shown in Fig. 5.4 alternately until both values are within the limits. A sealing cap is fitted over the bore (A) which must be removed before any adjustment can be carried out. Turn the two screws little by little and re-check the settings frequently.
- Re-connect the temperature sender and again accelerate the engine three times to 3000 rpm. Re-check the idle speed and CO content adjustments in accordance with the data above.
- Place a new sealing cap over the bore for the CO adjusting screw (A) in Fig. 5.4.
- If the CO content cannot be obtained on a model with catalytic converter it is possible that a fault is present in the Lambda regulation. The Lambda sonde is monitored by the self diagnosis system and the help of a VW workshop is required.
- After the idle speed has been adjusted re-



## 5 Fuel Injection System — Four-cylinder

connect the breather hose. If the CO content rises afterwards, this does not mean that the adjustment is incorrect, but is due to enrichment from oil dilution in the crankcase. A long, fast drive will reduce the amount of fuel in the oil and the CO content will return to the normal level.

- Disconnect the revolution counter and CO tester and re-make all connections.

### 5.4. Idle Speed Stabilisation

An ammeter with a high indication range and an ohmmeter are required to check the operation of the idle speed control valve. Always switch off the ignition before disconnecting electrical leads. The following operations should only be carried out if some experience with the electrical system of the vehicle has been gained. Both the functioning and the regulation of the idle speed stabilisation system can be checked. First check the function as follows:

- Switch on the ignition and check that the idle speed control valve (1) in Fig. 5.5 is buzzing or vibrating. If this is not the case, pull the connector off the control valve (1) and check the valve for continuity by connecting an ohmmeter as shown. A resistance of 2.0 - 10.0 ohm should be shown. Replace the valve if this is not the case.

- The ammeter (with a high indicating range) is required to check the regulation. The engine must be at operating temperature, the idle speed must be correctly adjusted and the air intake system must be free of leaks (gas-tight). The measurement is carried out with the engine running.

- Withdraw the plug from the end of the valve and connect the ammeter in the manner shown in Fig. 5.6. The illustration shows the extension cable used by VW workshops.

- Start the engine and allow it run at idle speed.

- After approx. 1 minute increase the engine speed three times to 3000 rpm and check the ammeter reading. The indication should be within  $420 \pm 20$  megaamps, when the engine has returned to idle speed. Some fluctuation is permissible.

- Locate the temperature sender unit (Fig.

5.3) and disconnect plug from the sender unit. Re-check the ammeter reading. The same value should be obtained, but the reading should be steady.

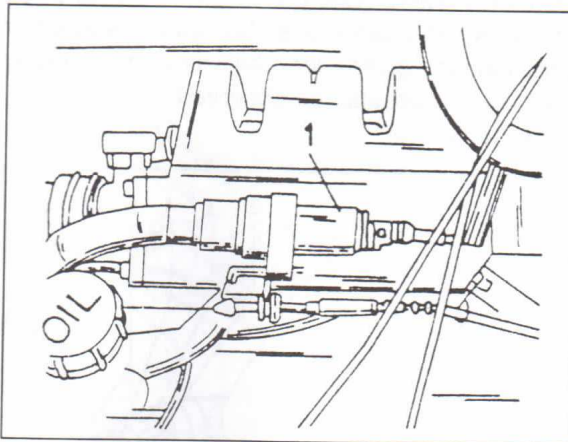


Fig. 5.5.  
The position of the idle speed stabilising valve (1) near the throttle cable connection.

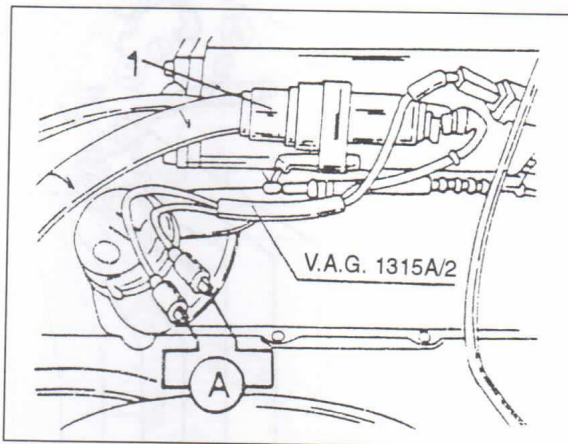


Fig. 5.6.  
Checking the regulation of the idle speed stabilisation. Connect an ammeter (A) as shown. The extension cables are VW items, which facilitate the check.

A fault in the electronic control unit can have developed if the above values cannot be obtained and a VW workshop must be consulted. The following faults can also be responsible if the amp readings cannot be obtained. These can be rectified as necessary:

- The engine is cold.
- One or more electrical consumers are switched on.
- The wheels are at full lock, thereby creating additional engine load due to the power-assisted steering.
- Idle speed not properly adjusted.
- Ignition timing point out of adjustment.

If you have experience with electrical systems, check all electrical leads, cables, etc. for continuity before the stabilising valve is replaced. Otherwise have the work entrusted to your dealer.



## 5 Fuel Injection System — Four-cylinder

### 5.5. Checking parts of the System

Figs. 5.1 and the illustrations on the following pages show some of the parts fitted to the Digifant system. Note the following points when studying the illustrations. The safety and other precautions given for the systems already described must also be observed.

Refer to Fig. 5.1:

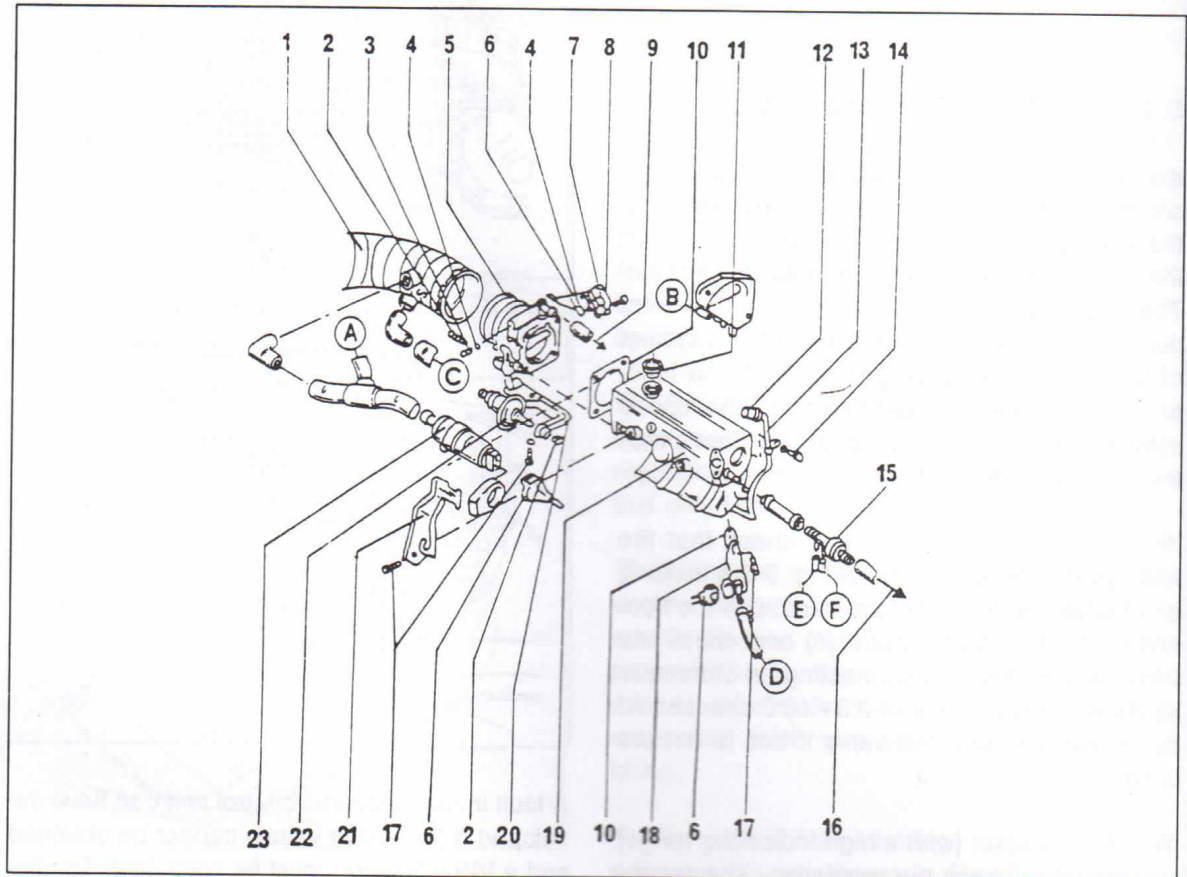
direction of travel.

- The coolant temperature sender unit transmits the temperature of the coolant to the Digifant unit.

- The CO content potentiometer (21) is fitted with the CO adjusting screw and the intake air temperature sender.

**Fig. 5.7.**  
Location of fuel injection system parts near the inlet manifold. The letters refer to the respective connections, shown in the other illustrations, e.i. "A" is connected to "A" in Figs. 5.8 or 5.10.

- 1 Air intake hose
- 2 Screw, 2.0 kgm
- 3 Idle adjusting screw
- 4 "O" sealing ring
- 5 Throttle valve housing
- 6 Connector plug
- 7 Throttle valve potentiometer
- 8 Locking plate
- 9 To activated charcoal filter system solenoid
- 10 Gasket, always replace
- 11 Seal
- 12 Sealing cap
- 13 CO measuring pipe
- 14 Screw, 1.5 kgm
- 15 Non-return valve
- 16 To brake servo unit
- 17 Screw, 1.0 kgm
- 18 Cold start valve
- 19 Intake manifold
- 20 Bracket for vacuum unit
- 21 Support bracket for throttle cable
- 22 Vacuum unit
- 23 Idle speed stabilisation valve



- The air cleaner (1) is fitted with a control flap for the pre-heating of the intake air.

- The connector plug for the Lambda probe is located on the R.H. side of the engine mounting, seen in direction of travel.

- The sealing cap (11) is pushed over the measuring pipe for the CO content.

- The vacuum pipe (12) is connected to the non-return valve on the inlet manifold and operates in conjunction with the intake manifold pressure sensor in the Digifant control unit.

- The Digifant control unit (13) is fitted on the L.H. side of the engine compartment, seen in direction of travel.

- The ignition transformer (14) is fitted on the L.H. side of the engine compartment, seen in

The following notes refer to Fig. 5.7:

- Connection (A) is connected to connection (A) in Fig. 5.10.

- Connection (B) is connected to connection (B) in Fig. 5.10.

- The connections (C), (D) and (E) are connected to the corresponding connections in Fig. 5.8.

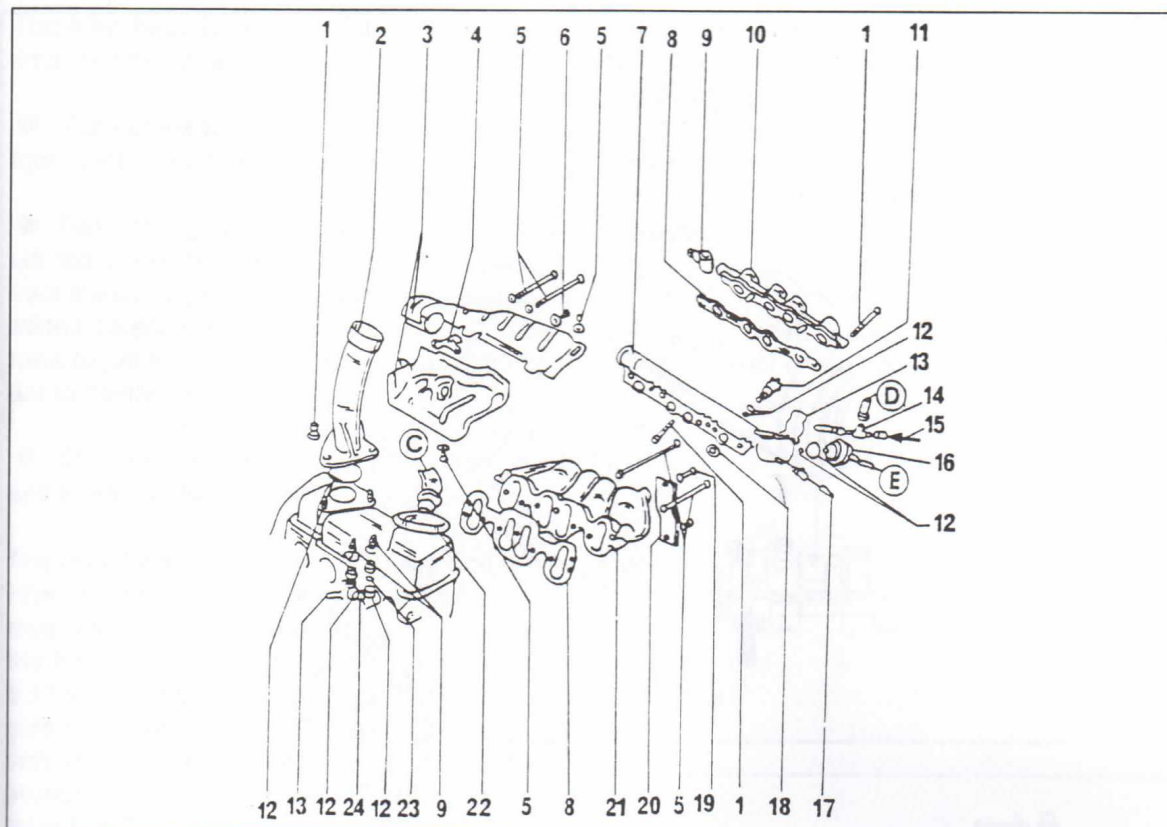
- Connection (F) is connected to connection (F) in Fig. 5.9.

- If removed, make sure to re-connect the air intake hose (1) properly to prevent entry of secondary air.

- The throttle valve potentiometer (7) has a 3-pin connector to connect it to the Digifant



## 5 Fuel Injection System — Four-cylinder



**Fig. 5.8.**  
Component parts of the fuel injection system. Refer to Fig. 5.7 for significance of letters.

- 1 Screw, 1.0 kgm
- 2 Oil filler pipe
- 3 Warm air baffle
- 4 Bracket for (3)
- 5 Screws, 2.5 kgm
- 6 Nut, 4.0 kgm
- 7 Fuel distributor
- 8 Seal, always replace
- 9 Connector plug
- 10 Fuel distributor, upper section
- 11 Fuel injectors
- 12 "O" sealing ring
- 13 Retaining clip
- 14 T-piece
- 15 Fuel supply line, black colour
- 16 Fuel pressure regulator
- 17 Fuel return line, blue colour
- 18 Seal
- 19 Bolt, 4.0 kgm
- 20 Support bracket between inlet and exhaust manifold
- 21 Inlet manifold
- 22 Pressure regulator valve for crankcase breather
- 23 Coolant temperature sender
- 24 Thermoswitch for fan run-on

system. On vehicles with automatic transmission there is an additional 4-pin connector to make the connection to the automatic transmission control box.

- The seal (11) must always be replaced, if removed.
- The sealing cap (12) must have a tight fit.
- The non-return valve (15) must be fitted the correct way round.
- The vacuum unit (22) is only fitted to models with manual transmission.

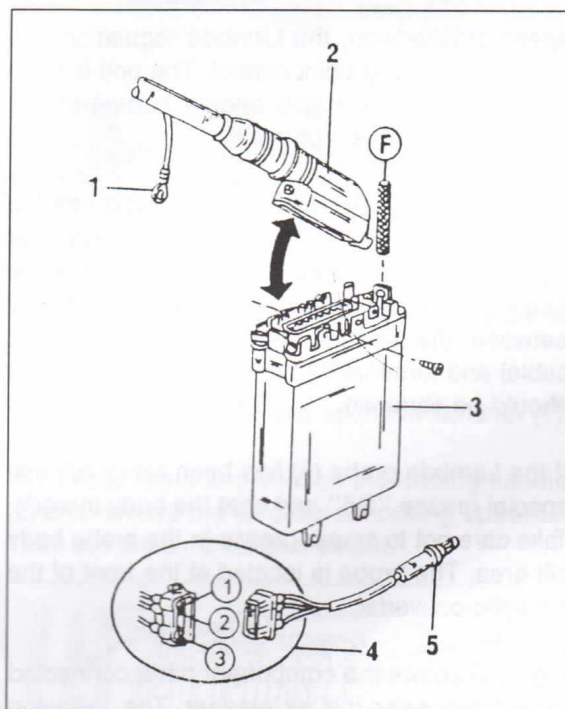
Refer to Fig. 5.8 for the following notes:

- Connections (C), (D) and (E) are connected to the corresponding connections, identified with the same letters, in Fig. 5.8.

- The fuel distributor (7) can only be removed together with the injectors.

- The seal (8) must be replaced, if it has been removed. The same applies to the "O" sealing ring (12) and the seal (18).

- Fuel hoses (15) and (17) are colour-coded as specified in the legend of Fig. 5.8. They must not be interchanged.



**Fig. 5.9.**  
View of the Digifant control unit. Connection (F) is connected with connection "F" in Fig. 5.7.

- 1 Earth connection, connected to body
- 2 Connector plug
- 3 Digifant control unit
- 4 Connector plug
- 5 Lambda probe

- The support bracket (20) is fitted between the inlet and the exhaust manifolds.

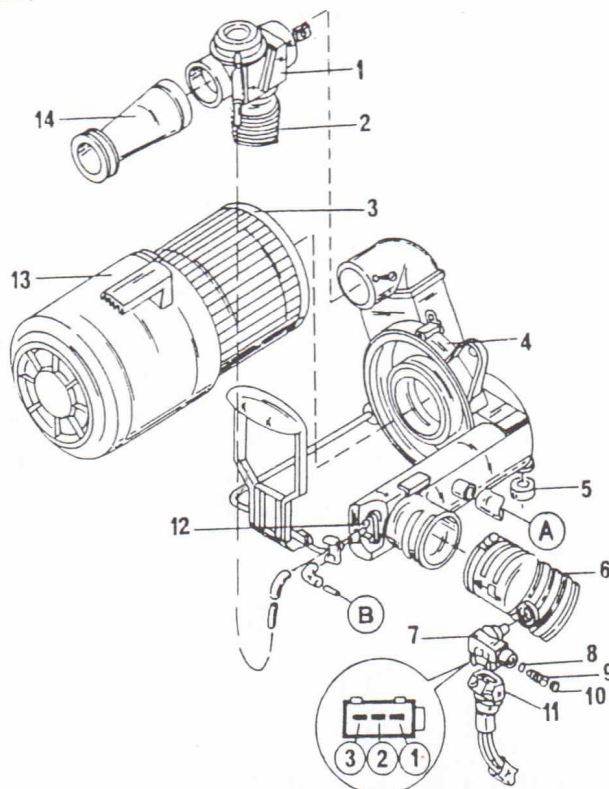
Fig. 5.9 shows the electronic control unit. The connector (2) must only be disconnected or connected when the ignition is switched off. To detach the plug, disengage the spring on the Digifant control unit and remove in the direction of the arrow. The electronic control unit controls the fuel injection, the ignition system, the idle



## 5 Fuel Injection System — Four-cylinder

**Fig. 5.10.**  
The component parts of the fuel injection system near the air cleaner.

- 1 Air intake
- 2 Connecting hose to warm-air baffle on exhaust manifold
- 3 Air cleaner element
- 4 Air cleaner housing
- 5 Rubber washer
- 6 Air intake hose
- 7 CO potentiometer
- 8 "O" sealing ring
- 9 CO adjusting screw
- 10 Plug for CO adjusting screw
- 11 Connector
- 12 Temperature regulator
- 13 Air cleaner housing
- 14 Air guide



speed stabilisation, the Lambda regulation and the ignition timing point control. The unit is fitted on the L.H. side of the engine compartment, seen in the direction of travel.

The Lambda probe connector plug (4) is fitted to the R.H. engine mounting, seen in direction of travel. The voltage supply for the Lambda probe heating can be checked with a voltmeter between the contact terminal "1" (red/black cable) and terminal "2" (brown). Battery voltage should be obtained.

If the Lambda probe (5) has been removed, use special grease "G5" and coat the body threads. Take care not to smear grease in the probe body slit area. The probe is located at the front of the catalytic converter.

Fig. 5.10 shows the component parts connected to or fitted near the air cleaner. The following should be noted:

- Connections (A) and (B) are connected to the respective connections (A) and (B) in Fig. 5.7.
- The air intake (1) is fitted with a control flap for the pre-heating of the intake air.
- The hose (2) is connected to the exhaust manifold in Fig. 5.8. Note the fitted position of the air intake hose (6). Make sure to obtain an air-

tight connection when fitting the intake hose.

- The CO potentiometer is fitted with the intake air temperature sender.
- The plug (10) must be removed if the CO adjustment is to be adjusted.
- The temperature regulator (12) must be fitted correctly. The hose connection made of brass or with a notch, must be facing towards the top.
- If the air guide (14) is removed, remember its fitted position to ensure installation as originally fitted.

### 5.6. Fuel Injectors

It is not too difficult to replace one of the fuel injectors:

- Disconnect the battery.
- Disconnect the injector plug off the fuel distributor.
- Pull the fuel supply hose and the fuel return hose off the fuel distributor. Note the different colours of the hoses.
- Unscrew the fuel distributor securing screws.



## 5 Fuel Injection System — Four-cylinder

The Allen-head bolts must be removed with a small 5 mm socket.

- Pull out the fuel distributor together with the fuel injectors from the front left.

- Refer to Fig. 5.11 and remove the screw (1). Lift the upper section of the fuel distributor (2) from the lower part (3). A screwdriver must be inserted carefully at the points shown by the arrows to prise the two sections apart. Take care not to damage the fuel distributor.

- Clamp the M6 Allen-head screw into a vice and force out the injector(s).

The installation of the injectors is carried out in reverse order. Damaged seals and/or gaskets must always be renewed. Place the gasket on the fuel distributor upper section. Refer to Fig. 5.12 and coat the two oil seals (arrows) with engine oil. Then press the fuel distributor upper section together with the injectors into the lower section of the fuel distributor. Tighten the screw (1) in Fig. 5.11 to 1.0 kgm (7.2 ft.lb.).

Locate the fuel distributor onto the inlet manifold and tighten the screws to 1.0 kgm (7.2 ft.lb.). Take care not to interchange the fuel supply and return lines.

### 5.7. Air Cleaner

The air cleaner has a load- and temperature-sensitive induction air heating device and is fitted with a vacuum unit on the air inlet. Irregular running of the engine can be caused by poorly pre-heated induction air. It may, therefore, be of advantage to check the operation of the pre-heating device as follows:

- Pull the vacuum hose off the temperature regulator (refer to Fig. 5.10) and remove the air cleaner housing and the air cleaner element (see below).

- Disconnect the hose from the arm-air baffle (warm air opening).

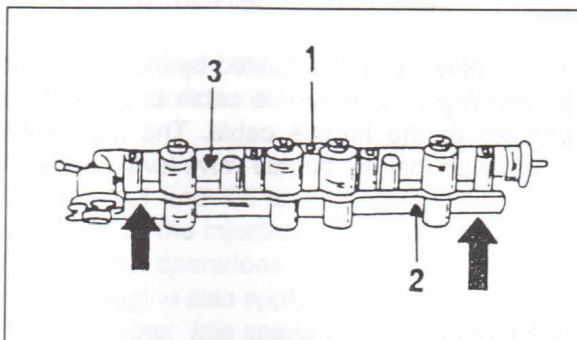
- Check the position of the regulating flap inside the air intake by either inserting the forefinger or using a small mirror. The flap must close off the warm-air opening.

- Start the engine and run at idle speed. Push the vacuum hose onto the connecting pipe on

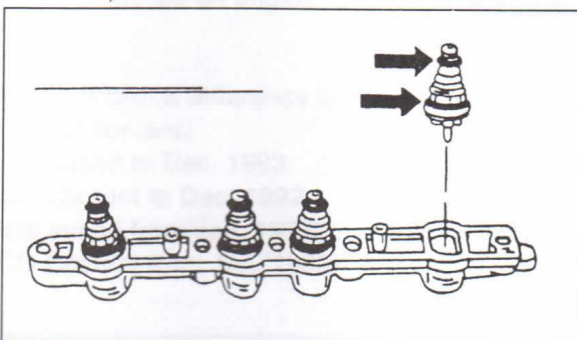
the temperature regulator and check the regulator in accordance with the following temperatures after waiting approx. 20 seconds:

below 20° C ..... cold air opening closed  
above 30° C ..... warm air opening closed  
between 20 and 30° C ..... cold and warm air openings open

- If the above check fails, either the temperature regulator or the vacuum unit are faulty.



**Fig. 5.11.**  
Dismantling the fuel distributor to take out the injectors.

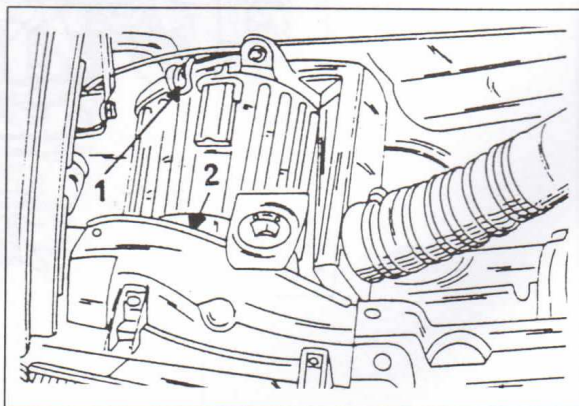


**Fig. 5.12.**  
Coat the areas shown by the arrows with engine oil before fitting the injectors into the fuel distributor.

To remove the air cleaner element proceed as follows:

- Refer to Fig. 5.13 and open the fastener (1).

- Press down and unhook the locking handle (2) and remove the air cleaner housing upwards. Take out the air cleaner element.



**Fig. 5.13.**  
Details for the removal and installation of the air cleaner element. The numbers are referred to in the text.

- Thoroughly clean the air cleaner housing and fit the new air cleaner element.



## 5 Fuel Injection System — Four-cylinder

- Install the air cleaner housing. The plastic tab, located on the other end of the filter element, must fit in the opening of the holder.

- Secure the fastener (1) and pull up the locking handle until it engages.

### 5.8. Throttle Cable Adjustment

#### 5.8.1. MANUAL TRANSMISSION

The throttle cable is adjusted by moving the retaining clip on the throttle cable bracket in the grooves of the throttle cable. The adjustment must be so that the throttle valve lever can reach

the end of its travel (full throttle). The max. play allowed in the throttle cable is 1.0 mm (0.04 in.) before the throttle lever starts to move.

#### 5.8.2. AUTOMATIC TRANSMISSION

The adjustment is more complicated, as the throttle cable is acting on the transmission. The throttle valve linkage must be adjusted so that the valves are in the coasting position when the operating lever on the transmission is resting against its stop. This adjustment, however, is not recommended, and should be left to a VW workshop.



## 6 FUEL INJECTION SYSTEM — FIVE-CYLINDER

The Digifant injection/ignition system, as used together with the four-cylinder engine, is also fitted to the five-cylinder engine. Fig. 6.1 shows a view of the engine compartment with the location of the individual parts. The system uses a common electronic control unit for the fuel injection and the ignition systems. The unit receives various information about the load condition of the engine at any given moment and regulates the amount of fuel to be injected, the duration of the injection phase and the best ignition timing point.

The Digifant control unit for the injection and fuel systems is fitted with a fault memory. If faults occur in the sensors and components being monitored, these are stored in the fault memory together with an indication of the type of fault. The self diagnosis can only be evaluated in a VW workshop, using special equipment. After

the fault has been rectified, the memory will be cleared to store further possible faults in the future.

Sections 5.1 and 5.2 should be studied before any work on the injection system is carried out. Most of the operations described for the four-cylinder engine also apply to the five-cylinder engine, but note: *Idle speed and CO content cannot be adjusted on engines produced after Jan. 1993.*

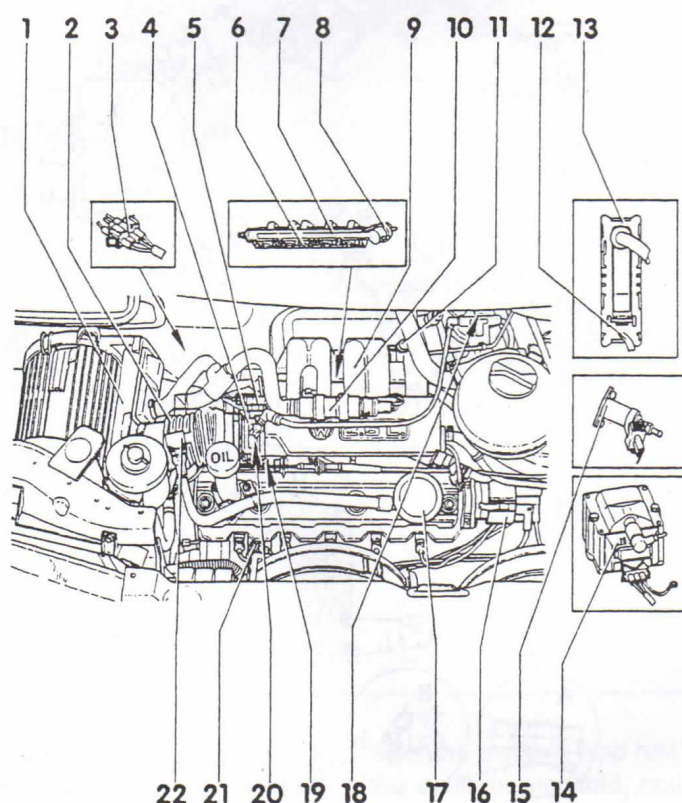
There is also a difference in the idle speed and the CO content:

Idle speed to Dec. 1992: .....  $800 \pm 25$  rpm

CO Content to Dec. 1992: .....  $0.7 \pm 0.2$  %

Idle speed from Jan. 1993: .... 775 to 825 rpm

CO Content from Jan. 1993: .... 0.3 to 1.2 %



**Fig. 6.1.**  
Layout of the "Digifant" system component parts in the engine compartment.

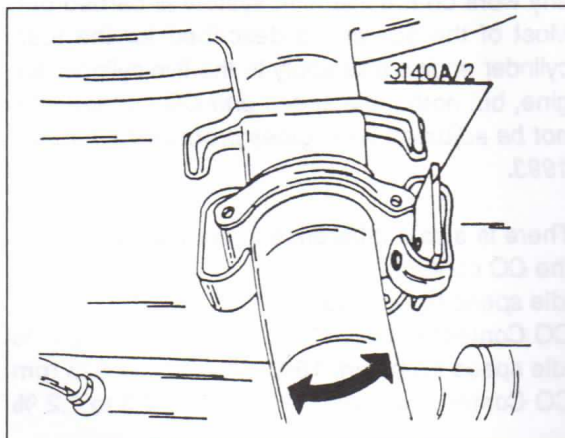
- 1 Air cleaner
- 2 Intake hose
- 3 3-pin connector for Lambda probe and Lambda probe heater
- 4 Throttle valve body
- 5 Throttle valve potentiometer
- 6 Injectors
- 7 Fuel distributor
- 8 Fuel pressure regulator
- 9 Intake manifold
- 10 Idle speed stabilisation valve
- 11 CO measuring pipe
- 12 Vacuum pipe
- 13 Digifant control unit
- 14 Ignition transformer
- 15 Cold start valve
- 16 Ignition distributor
- 17 Pressure control valve for crankcase breather
- 18 Solenoid valve for activated charcoal filter system
- 19 Idle speed (from Aug. 1992)
- 20 Idle speed adjusting screw
- 21 Coolant temperature sender
- 22 Intake air temperature sender



## 7 EXHAUST SYSTEM

### 7.1. Disconnecting the Exhaust Pipe (4-cyl. Diesel Engine)

The illustration below shows the exhaust system fitted to the VW Transporter with 4-cyl. diesel



**Fig. 7.1.**  
View of the connection between the exhaust pipe and the exhaust manifold connection. The sealing ring must always be replaced.

engine. A special tool may be required to disconnect the exhaust down pipe from the exhaust manifold on some models whereas other models have a bolt connection between exhaust manifold and exhaust pipe. Provided that the special tool can be obtained, separate the connections as follows after the exhaust system is completely cold:

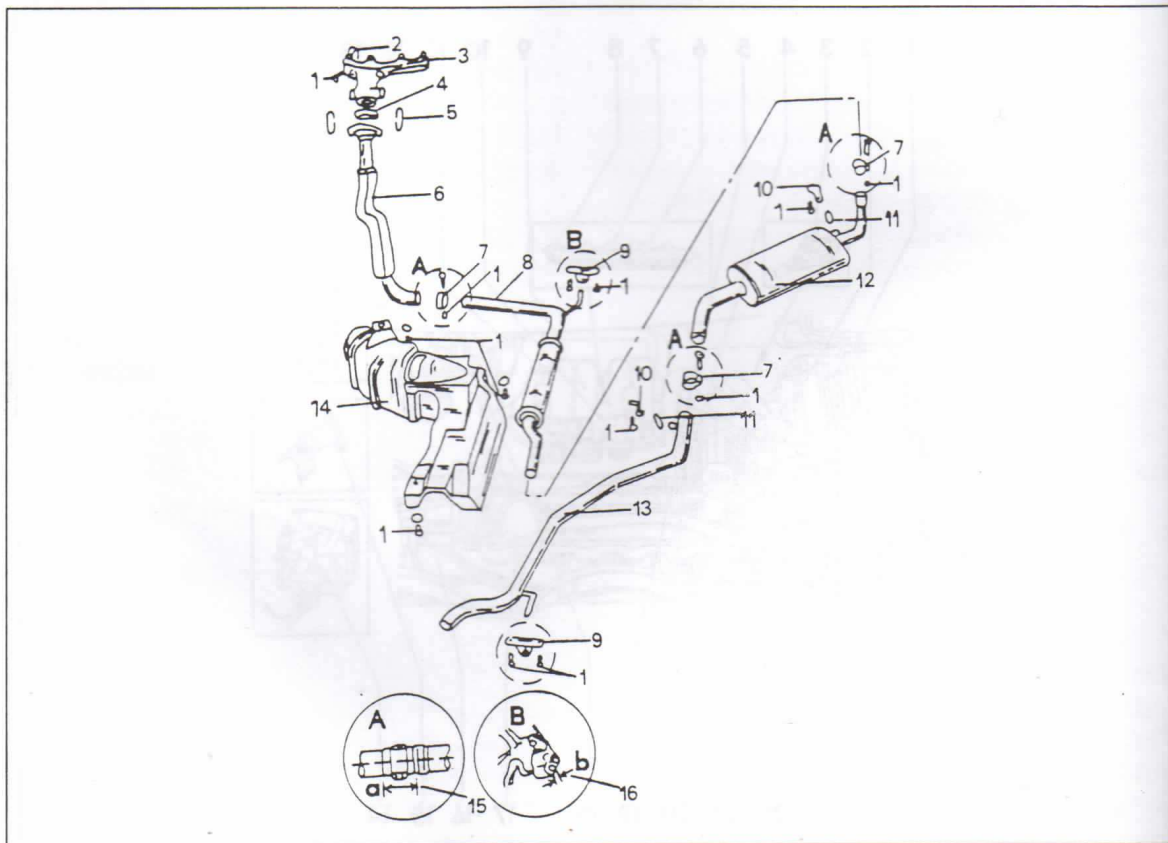
- Expand the spring clips by pushing the exhaust pipe to one side, until the small wedges shown in Fig. 7.1 can be fully inserted.

- Push the exhaust pipe to the side where the clip is to be removed. The clip must rest against the wedge. The clip can be removed to free the exhaust pipe. The other clip will be free to be removed.

The installation of the pipe is a reversal of the

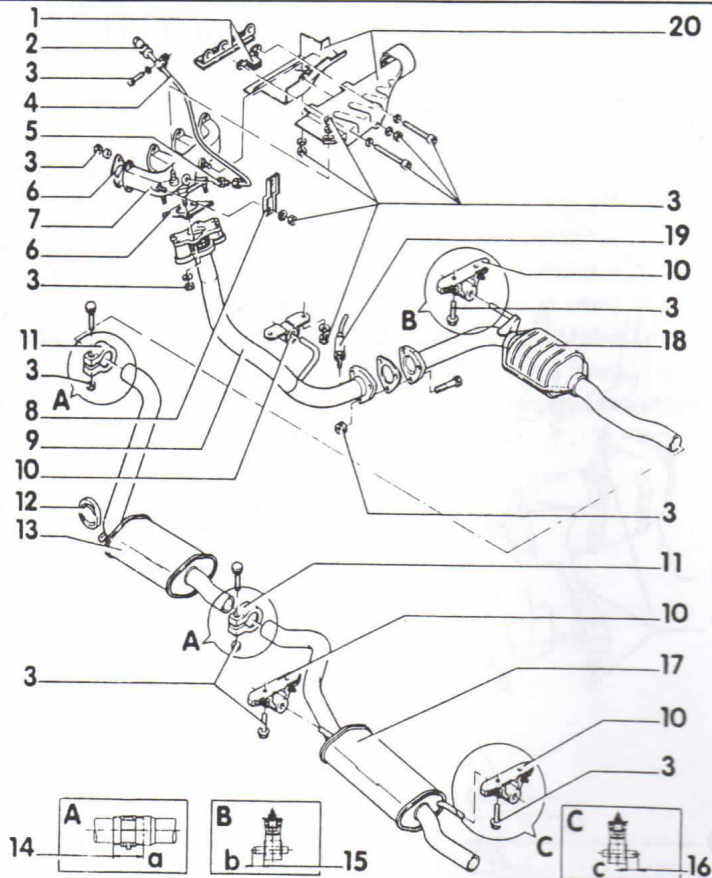
**Fig. 7.2.**  
Exploded view of the exhaust system, as fitted to the four-cylinder diesel-engined model.

- 1 Bolts  
M6 = 0.5 kgm  
M8 = 2.3 kgm  
M10 = 4.0 kgm
- 2 Gasket, always replace
- 3 Exhaust manifold
- 4 Sealing ring, use screwdriver to lift off, replace if necessary
- 5 Retaining clip
- 6 Front exhaust pipe
- 7 Connecting sleeve
- 8 Front silencer
- 9 Exhaust mounting bracket
- 10 Mounting bracket
- 11 Rubber suspension ring
- 12 Intermediate pipe
- 13 End pipe
- 14 Heat shield
- 15 Dimension "a" = 50 mm
- 16 Dimension "b" = 30 mm



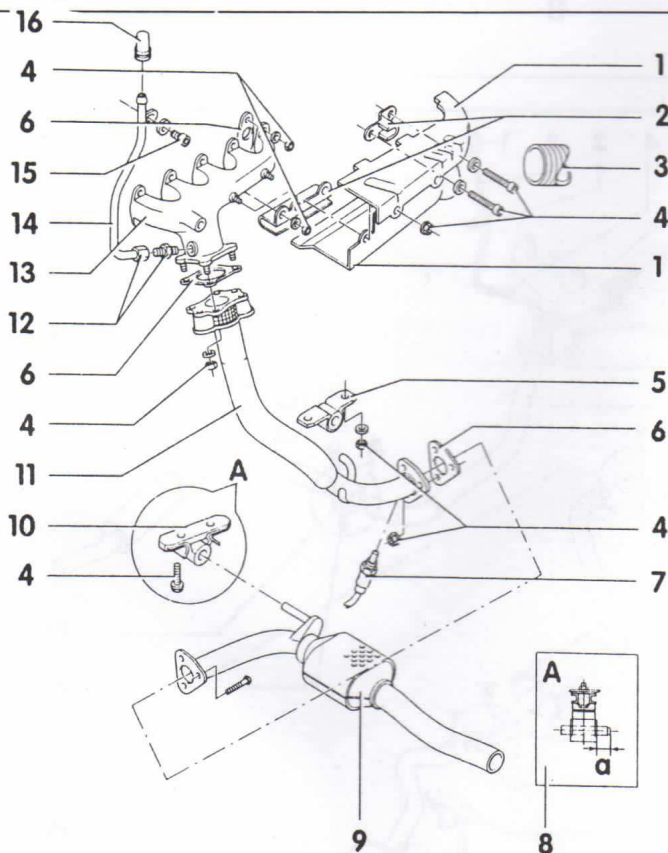


## 7 Exhaust System



**Fig. 7.3.**  
Exploded view of the exhaust system as fitted to models with 4-cyl. petrol engine with catalytic converter.

- 1 Bracket for deflector plate
- 2 Cap for (4)
- 3 Nuts, M6, M8 or M10, see Fig. 7.2
- 4 CO measuring pipe
- 5 Connector, 3.0 kgm
- 6 Gasket
- 7 Exhaust manifold
- 8 Support
- 9 Front exhaust pipe
- 10 Mounting
- 11 Clamp
- 12 Suspension rings
- 13 Centre silencer
- 14 Dimension "a" = 50 mm
- 15 Dimension "b" = 20 mm
- 16 Dimension "c" = 30 mm
- 17 Rear silencer
- 18 Catalytic converter
- 19 Lambda probe, 5.0 kgm
- 20 Heat deflector plate



**Fig. 7.4.**  
Exploded view of the front section of the exhaust system as fitted to models with 5-cyl. petrol engine. The rear section is similar as shown in Fig. 7.3.

- 1 Hot air shield
- 2 Mounting bracket
- 3 Hose
- 4 Nut, bolts, M6, M8 or M10, see (1), Fig. 7.2
- 5 Hanger, from Sept. 1991
- 6 Gasket
- 7 Lambda probe
- 8 Dimension "a" = 20 mm
- 9 Catalytic converter
- 10 Hanger
- 11 Front exhaust pipe
- 12 Connection, 3.0 kgm
- 13 Exhaust manifold
- 14 CO measuring pipe
- 15 Bolt, 1.5 kgm
- 16 Closing cap for (14)

removal procedure. The sealing ring between the exhaust pipe and the exhaust manifold must always be replaced, irrespective to its condition.

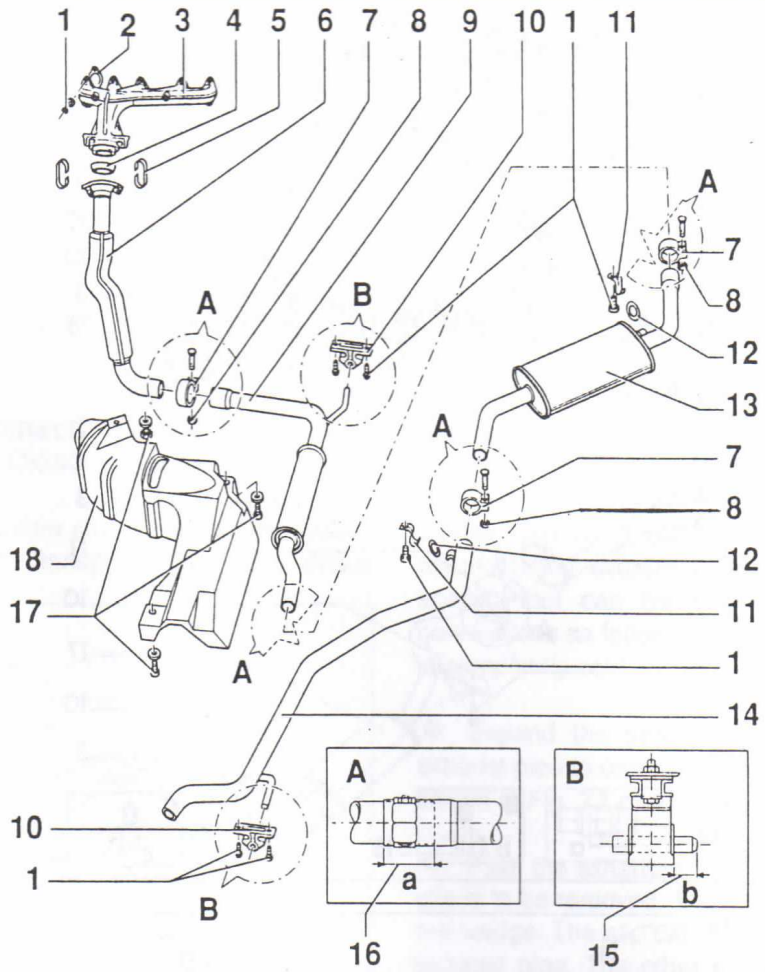
After the exhaust pipe has been re-connected to the exhaust manifold, make sure that the clips are securely fastened into their recesses. Start



## 7 Exhaust System

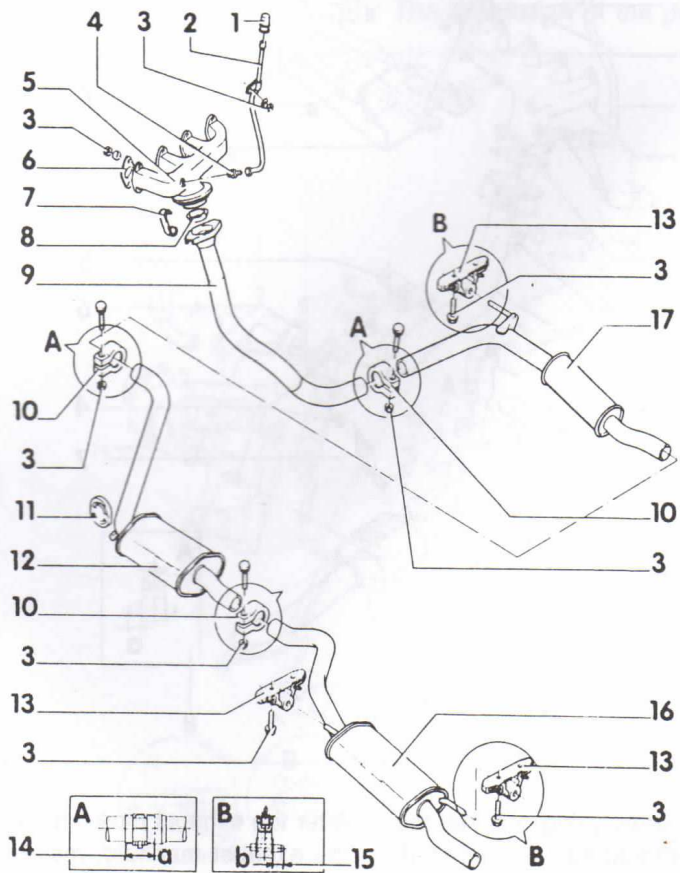
**Fig. 7.5.**  
Exploded view of the  
exhaust system as fitted to  
the 5-cyl. diesel engine.

- 1 Nut, 2.5 kgm
- 2 Gasket
- 3 Exhaust manifold
- 4 Suspension ring
- 5 Clamping spring
- 6 Front exhaust pipe
- 7 Clamp
- 8 Nut, 4.0 kgm
- 9 Front silencer
- 10 Mounting
- 11 Retainer
- 12 Retaining ring
- 13 Centre silencer
- 14 End pipe
- 15 Dimension "b" = 10 mm
- 16 Dimension "a" = 50 mm
- 17 Screws, 1.0 kgm
- 18 Heat shield



**Fig. 7.6.**  
Exploded view of the  
exhaust system as fitted to  
the 4-cyl. petrol models  
without catalytic converter.

- 1 Closing cap for (2)
- 2 CO measuring pipe
- 3 Bolts, Nut, M6, M8, M10,  
(see 1, Fig. 7.2)
- 4 Connector, 3.0 kgm
- 5 Exhaust manifold
- 6 Gasket
- 7 Spring clamp
- 8 Sealing ring
- 9 Front exhaust pipe
- 10 Clamp
- 11 Suspension rings
- 12 Centre silencer
- 13 Mounting
- 14 Dimension "a" = 50 mm
- 15 Dimension "b" = 30 mm
- 16 Rear silencer
- 17 Front silencer





## 7 Exhaust System

the engine and check the pipe/manifold connection for gas leaks.

### 7.2. Systems of remaining Engines

Figs. 7.3 to 7.6 show the exhaust system of the various engines. From the illustrations you will see which exhaust systems have a spring clamp connection to the exhaust manifold. If this is the case, follow the instructions in Section 7.1. The same special tool is used.

All self-locking nuts, seals and gaskets must be replaced if the connection has been separated. Note the dimensions specified in the illustrations. These are obtained by moving the exhaust clamp into the correct position.

Note that the suspension rings for the various suspension points are not the same at all positions. Always make sure to use the correct rings. A screwdriver is used to lever the rings off the attachment lugs. Make sure that the rings are not under excessive tension when they are refitted to the pipe/converter mounting lugs.



## 8 CLUTCH

### Index

|                                |    |                                   |    |
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### 8.1. Description

A single dry plate clutch with diaphragm spring is fitted to all models equipped with a manual transmission.

It should be noted that the pressure plate and the diaphragm spring unit cannot be dismantled or serviced. In the event of wear or damage the complete unit must be replaced.

The clutch mechanism is shown in Fig. 8.1. The needle roller bearing in the crankshaft should be noted. This item will need inspection and possible replacement whenever the clutch is removed for servicing. The clutch diameter is 215 mm or 228 mm, depending on the engine (see note on right).

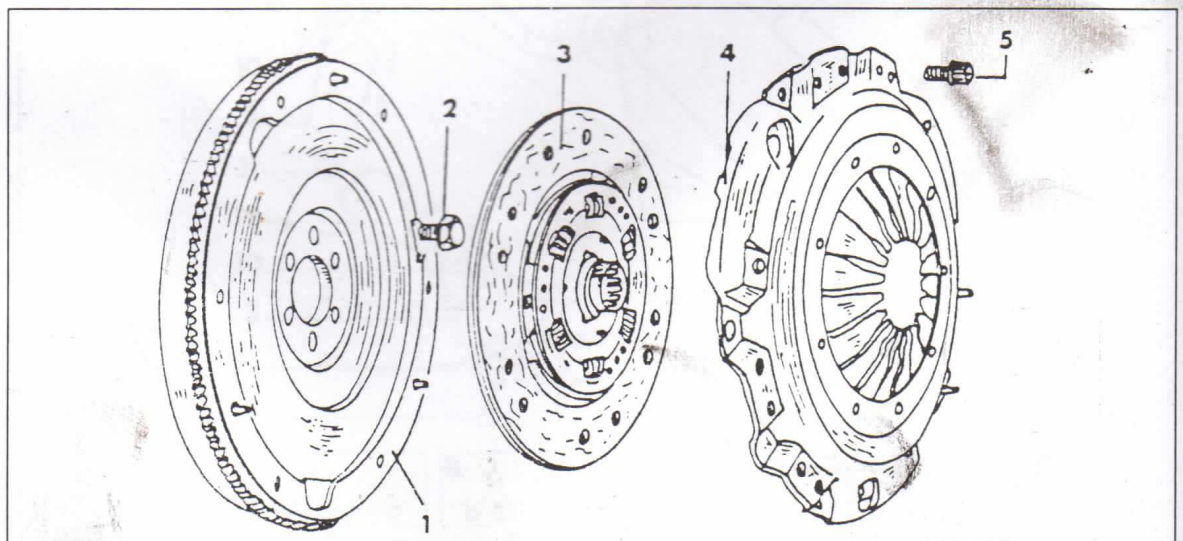
Models with four-cylinder engine are mechanically operated by means of a clutch cable. Models with five-cylinder engine have a hydraulic system with master cylinder and slave cylinder.

### 8.2. Clutch

#### 8.2.0. REMOVAL AND INSTALLATION

The engine or the transmission must be removed to gain access to the clutch cover. Before commencing removal, mark the pressure plate in relation to the flywheel so that it can be refitted in the same position to avoid unbalance.

**Attention: Note the difference in the clutch diameter when a new clutch is purchased.**



**Fig. 8.1.**  
The component parts of the clutch assembly.  
1 Flywheel  
2 Flywheel bolt, 10.0 kgm (72 ft.lb.)  
3 Clutch driven plate  
4 Clutch pressure plate  
5 Bolt, 2.0 kgm



## 8 The Clutch

Unscrew the six pressure plate bolts a little at a time, working in a diagonal pattern. Carry on with the loosening of each bolt until the spring pressure is relieved. Take care with this operation since careless removal can result in distortion of the clutch cover.

Lift off the pressure plate assembly and the driven plate. Note that the long centre boss of the driven plate is facing you as the cover is removed.

Inspect the clutch components as outlined in the following section and do not install the clutch until all components have been serviced as necessary. Read the following text before a new clutch is ordered.

Install the clutch in the reverse sequence to removal, noting the following points:

- If the old clutch is to be refitted, align the marks in clutch pressure plate and flywheel, made during removal.
- The clutch driven plate must be centralised with a spare gearbox mainshaft. If this is not available, a mandrel should be hired from a tool hire company. The larger diameter of the mandrel should be a slide fit in the bore of the driven plate splines and the end of the mandrel should fit into the spigot bearing bore in the end of the crankshaft.
- Offer the driven plate and the mandrel up to the flywheel and place the cover assembly into position. Insert all bolts with just two or three threads engaged. Tighten down the securing screws a little at a time, working in a diagonal pattern until all are tight to 2.0 kgm (14.5 ft.lb.). Fig. 8.2 shows the centering mandrel and the flywheel brake (lock) in position.

- Refit the engine or transmission to the vehicle as described in the relevant section.

### 8.2.1. SERVICING AND CHECKING

The cover assembly — pressure plate and diaphragm spring — must not be dismantled. Replace, if necessary with a complete assembly from your dealer or distributor.

Inspect the driven plate and the linings, replacing the complete plate, if the linings are worn

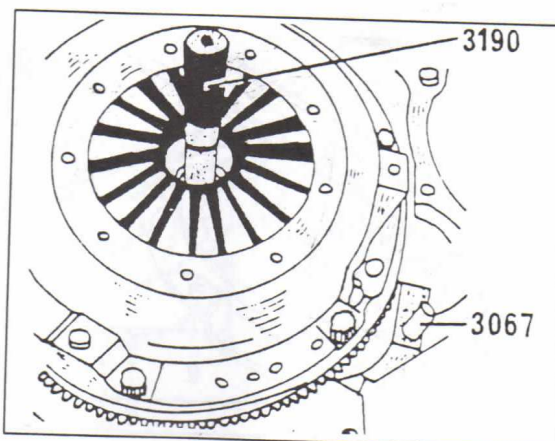


Fig. 8.2.  
Using the special VW tools to lock the flywheel and to centre the clutch driven plate.

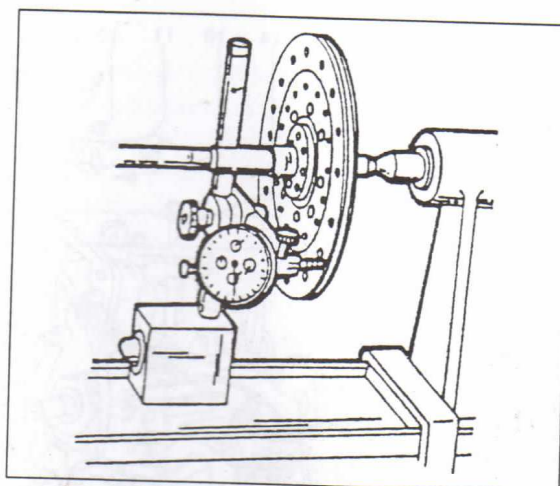


Fig. 8.3.  
To check the driven plate for run-out, clamp it between the centres of a lathe and check with a dial gauge.

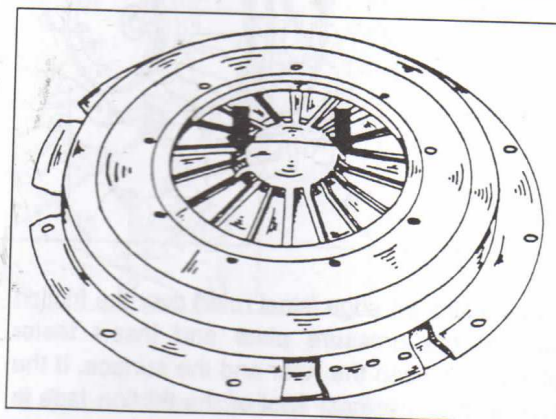


Fig. 8.4.  
Wear on a clutch unit can be found at the positions shown by the arrows. The release fingers of the diaphragm spring should be at the same height.

down close to the rivets. A driven plate with the linings contaminated with grease or oil cannot be cleaned successfully and should also be replaced. All rivets should be tight and the torsion springs should be sound and unbroken. Check the condition of the driven plate splines. Clamp the driven plate between the centres of a lathe and apply a dial gauge to the outside of the plate as shown in Fig. 8.3, at a diameter of approx. 175.0 mm (6.4 in.). The max. run-out of the driven plate should be no more than 0.4 mm (0.016 in.).

Check the rivet fastening of the clutch pressure plate and replace the plate, if loose rivets can be detected.



## 8 The Clutch

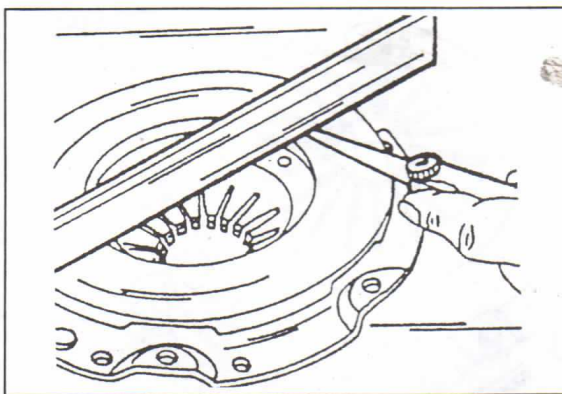


Fig. 8.5.  
Checking the clutch  
pressure plate.

bearing (9) and withdraw the bearing.

- To remove the clutch release lever (8), use a screwdriver and pry it off the ball-headed stud (2).

- Coat all contact areas of the release bearing and the release lever with graphited grease, fit the bearing and position and secure with new retaining clips. Refit the transmission as described in the relevant section.

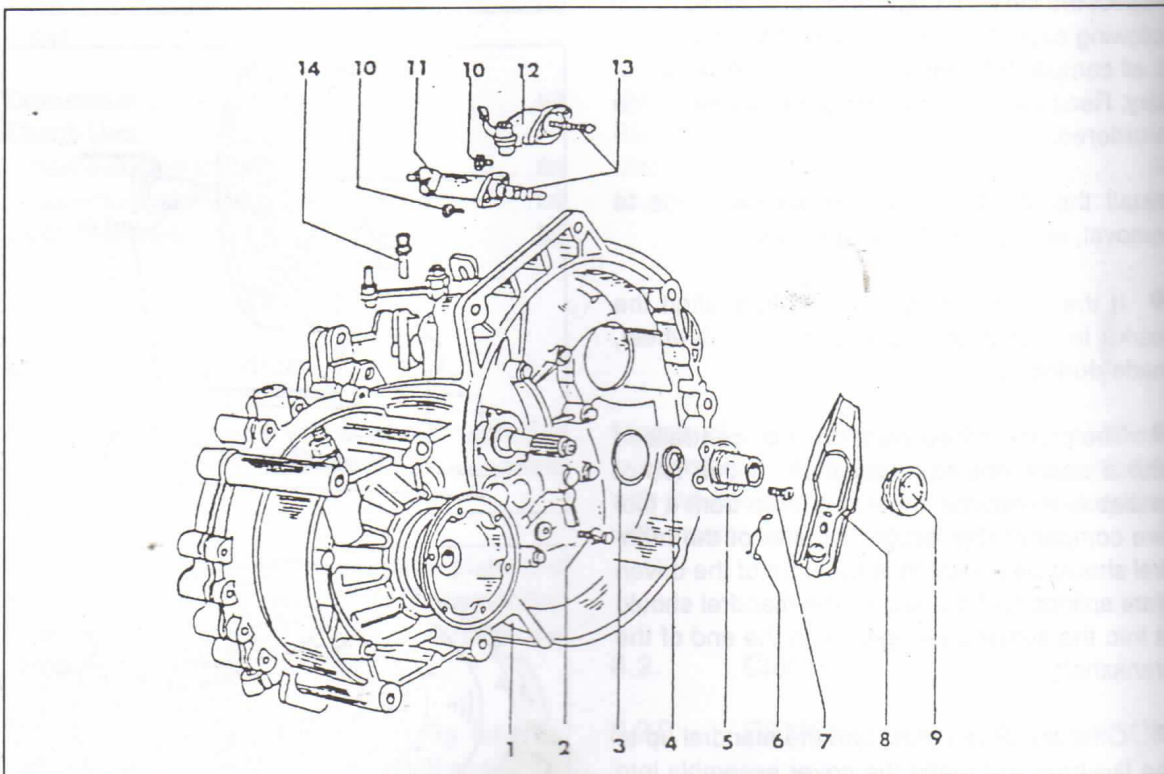


Fig. 8.6.  
The component parts of  
the clutch release me-  
chanism for models with  
mechanical and hydraulic  
clutch operation.

- 1 Transmission
- 2 Ball stud
- 3 "O" sealing ring
- 4 Oil seal, clutch shaft
- 5 Guide sleeve
- 6 Retaining clips
- 7 Bolt, 1.5 kgm
- 8 Clutch release lever
- 9 Release bearing
- 10 Bolt, 2.5 kgm
- 11 Clutch slave cylinder
- 12 Mechanical clutch release
- 13 Push rod
- 14 Fitting pin

Place a straight edge (steel ruler) over the friction face of the pressure plate and insert feeler gauges between the ruler and the surface. If the gap at the innermost spot of the friction face is no more than 0.3 mm (0.012 in.), the plate can be re-used. Fig. 8.5. shows this check.

### 8.3. Clutch Release

The clutch release bearing is fitted with a ball bearing. Fig. 8.6 shows the transmission case with the release mechanism inside the transmission. The bearing must not be cleaned in grease-dissolving liquids, if it is to be refitted. Replace the clutch release bearing as follows:

- Remove the transmission.
- Remove the retaining clips for the release

### 8.4. Hydraulic Clutch System

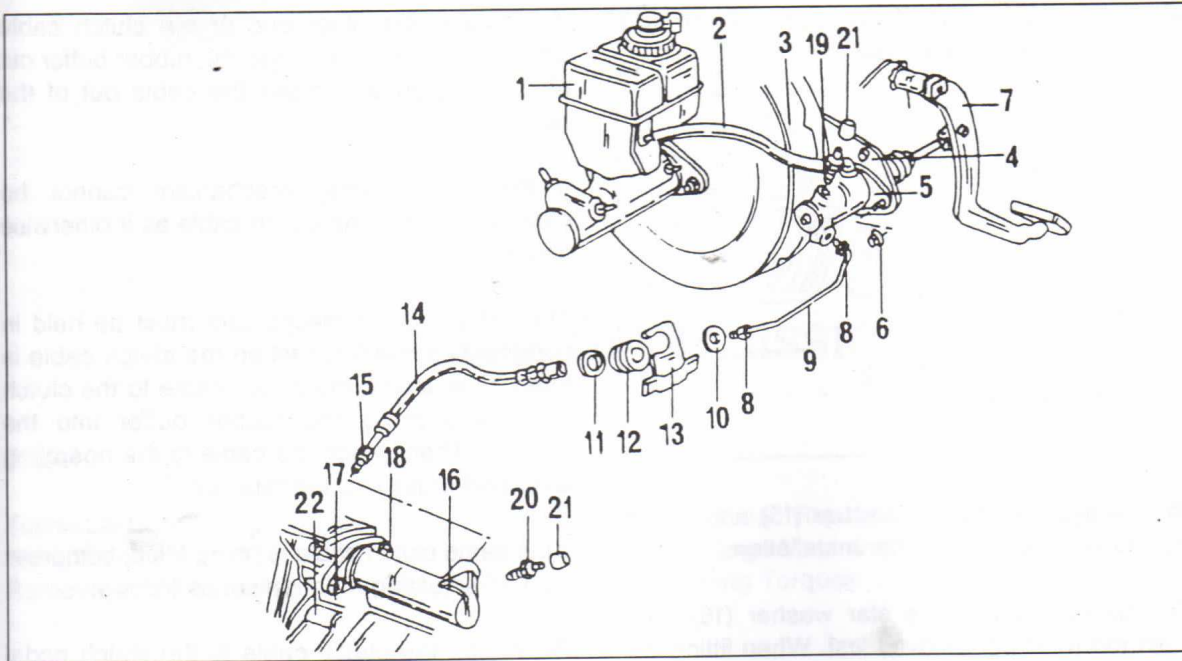
On this system, the clutch is released by means of a clutch master cylinder and slave or operating cylinder. The master cylinder is fitted to the pedal bracket, held by two bolts and is connected via the push rod by means of a clevis pin. Fig. 8.7 shows an exploded view of the parts belonging to the hydraulic system.

The following points must be noted during removal and installation of the hydraulic cylinders:

- Before removal of the clutch master cylinder remove the large reservoir for the windscreen washer.
- Before removal of the clutch slave cylinder

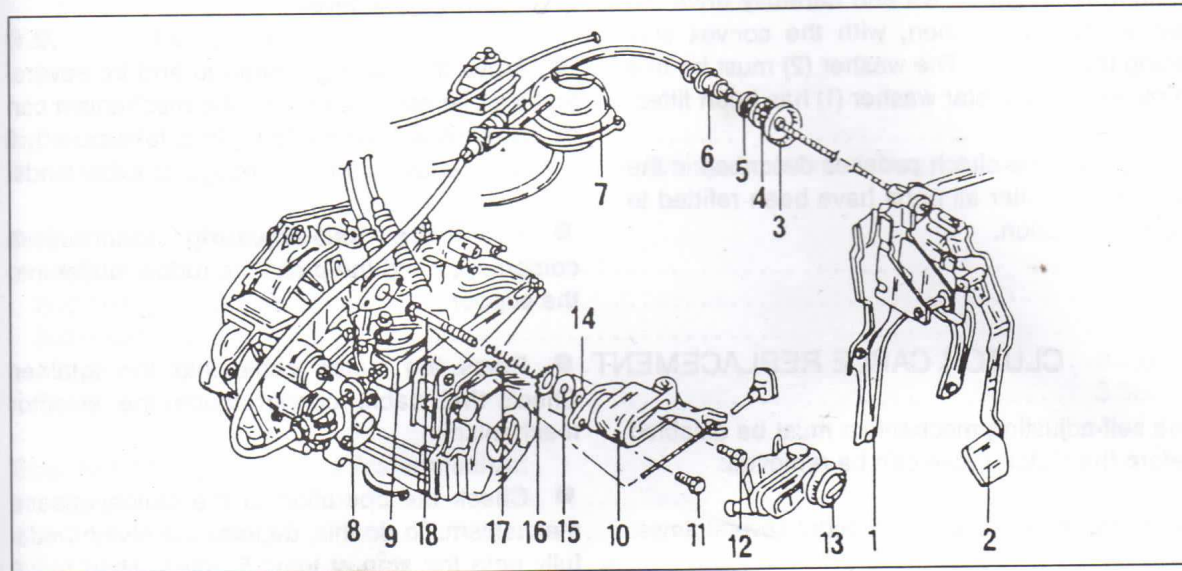


## 8 The Clutch



**Fig. 8.7.**  
The component parts of the hydraulic system.

- 1 Fluid reservoir
- 2 Fluid hose
- 3 Brake servo unit
- 4 Mounting for cylinder
- 5 Master cylinder
- 6 Nut, 0.7 kgm
- 7 Clutch pedal
- 8 Union nut, 1.5 kgm
- 9 Pressure pipe
- 10 Washer
- 11 Washer
- 12 Bush
- 13 Spring plate
- 14 Pressure hose
- 15 Union nut, 1.5 kgm (11 ft.lb.)
- 16 Slave cylinder
- 17 Bolt, 2.5 kgm (18 ft.lb.)
- 18 Bolt, 2.5 kgm (18 ft.lb.)
- 19 Bleeder screw
- 20 Bleeder screw
- 21 Rubber dust cap
- 22 Transmission



**Fig. 8.8.**  
The component parts of the mechanical clutch release mechanism.

- 1 Mounting bracket
- 2 Clutch pedal
- 3 Sleeve
- 4 Clamping washer
- 5 Sealing ring
- 6 Clutch cable
- 7 Cable retainer
- 8 Rubber stop
- 9 Support on transmission
- 10 Housing with operating lever
- 11 Bolt, 2.5 kgm (18 ft.lb.)
- 12 Bolt, 2.5 kgm (18 ft.lb.)
- 13 Sealing boot
- 14 Lock washer
- 15 Washer
- 16 Star washer
- 17 Spring
- 18 Push rod

remove the bracket from the side of the transmission. There is no need to disconnect the gearchange cables.

### 8.4.0. BLEEDING THE HYDRAULIC SYSTEM

The bleeding of the hydraulic clutch system is carried out in the same manner as described for the brake system in the relevant section, with the difference that the bleeding hose must be used on the master cylinder and the slave cylinder. The system must be bled of air if hydraulic connections have been slackened or air has entered the system through a leaking pipe or low brake fluid level. The pedal must show a firm pressure when depressed.

### 8.5. Mechanical Clutch Operation

Fig. 8.8 shows the parts belonging to the mechanical clutch operation with self-adjusting mechanism and all necessary operations can be carried out by referring to the drawing.

The replacement of the clutch operating cable is described in the next section, but note the following points when other parts of the system require replacement:

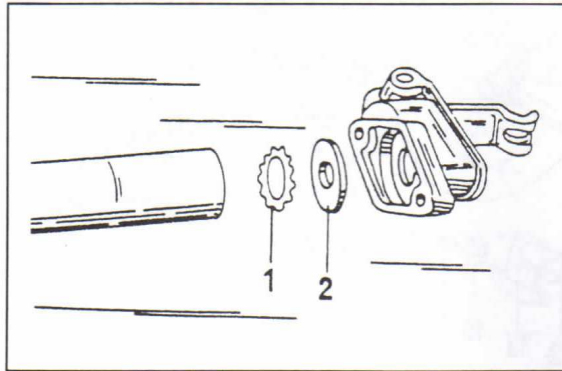
- Before removal of the housing with the clutch operating lever (10) disconnect the clutch cable.
- Before removal of the bolt (11) engage the reverse gear.

**Warning: Never allow brake fluid to come into contact with paint work or the skin.**



## 8 The Clutch

- Fit the lock washer (14) approx. 8 mm (0.3 in.) from the end of the push rod.



**Fig. 8.9.**  
Fitting details for the star washer on models with mechanical clutch release. Drive the star washer (1) into position, using a hollow drift over the washer (2).

- Always replace the washer (15) and check that it can move freely after installation.
- Always replace the star washer (16). The push rod must be removed first. When fitting the washer, refer to Fig. 8.9 and carefully drive the star washer in position, with the convex side facing the housing. The washer (2) must be free to move after the star washer (1) has been fitted.
- Operate the clutch pedal as described in the next section after all parts have been refitted to the transmission.

### 8.5.0. CLUTCH CABLE REPLACEMENT

The self-adjusting mechanism must be disabled before the clutch cable can be removed:

- Fully depress the clutch pedal several times.
- Press the operating lever against the normal direction of operation as far as the stop. This compresses the self-adjusting mechanism.
- Keep the mechanism compressed and at the same time detach the clutch cable from the operating lever.

- Detach the other end of the clutch cable from the clutch pedal, press the rubber buffer out of the support and press the cable out of the retainer.

If the self-adjusting mechanism cannot be compressed, cut the clutch cable as it otherwise cannot be removed

The self-adjusting mechanism must be held in compressed condition when the clutch cable is fitted. First attach the clutch cable to the clutch pedal and press the rubber buffer into the support. Then attach the cable to the operating lever and press into the retainer.

If the same clutch cable is being fitted, compress the self-adjusting mechanism as follows:

- Attach the clutch cable to the clutch pedal and the operating lever.
- Move the cable grommet to and fro several times as far as the stop until the mechanism can be compressed. When doing this, take care that the cable ends cannot disengage at either ends.
- Hold the self-adjusting mechanism compressed and the press the rubber buffer into the support.

- Press the clutch cable into the retainer. Check that cable cannot touch the selector mechanism.

- Check the operation of the clutch release mechanism. To do this, depress the clutch pedal fully onto the stop at least 5 times. Then move the release lever by approx. 10 mm against the operating direction and check that it can move freely.

Under no circumstances open the automatic adjustment housing. It contains a number of balls which cannot be installed by hand.



## 9 MANUAL TRANSMISSION

### Index

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### 9.0. Technical Data

|                     |                                                       |
|---------------------|-------------------------------------------------------|
| Type code: .....    | 02A                                                   |
| Construction: ..... | Four- or five-speed transmission, depending on market |

#### Gear Ratios — Four-speed Transmission:

|                     |           |
|---------------------|-----------|
| 1st gear: .....     | 3.778 : 1 |
| 2nd gear: .....     | 1.950 : 1 |
| 3rd gear: .....     | 1.190 : 1 |
| 4th gear: .....     | 0.820 : 1 |
| Reverse gear: ..... | 3.380 : 1 |

#### Gear Ratios — Five-speed Transmission:

|                     |           |
|---------------------|-----------|
| 1st gear: .....     | 3.778 : 1 |
| 2nd gear: .....     | 2.105 : 1 |
| 3rd gear: .....     | 1.345 : 1 |
| 4th gear: .....     | 0.971 : 1 |
| 5th gear: .....     | 0.795 : 1 |
| Reverse gear: ..... | 3.800 : 1 |

#### Final Drive Ratio:

|                                  |           |
|----------------------------------|-----------|
| Four-speed: .....                | 3.944 : 1 |
| Five-speed, petrol engine: ..... | 3.684 : 1 |
| Five-speed, diesel engine: ..... | 3.450 : 1 |

#### Transmission Lubricant:

|                   |                                                                       |
|-------------------|-----------------------------------------------------------------------|
| Capacity: .....   | 2.0 litres (3.8 Imp. pints)                                           |
| Oil grade: .....  | SAE 80 or SAE 90 transmission oil<br>or G50 SAE 75 W90, synthetic oil |
| Oil change: ..... | No oil change necessary, filled for life                              |

### 9.1. Introduction

A new four- or five-speed transmission, type 02A,

is fitted to the new Transporter range. The transmission and final drive are contained within one housing and thus dismantling and servicing



## 9 Manual Transmission

procedures on one can only be carried out with some disturbance of the other. The overhaul and setting of the final drive needs several special tools and cannot be recommended. The gearbox for the various models since their introduction are identified by a code letter, which is stamped into the transmission case at the position shown in Fig. 9.1. Arrow (2) in the same illustration shows where the transmission type (02A) can be found. Looking at the side of the transmission you will see the transmission number.

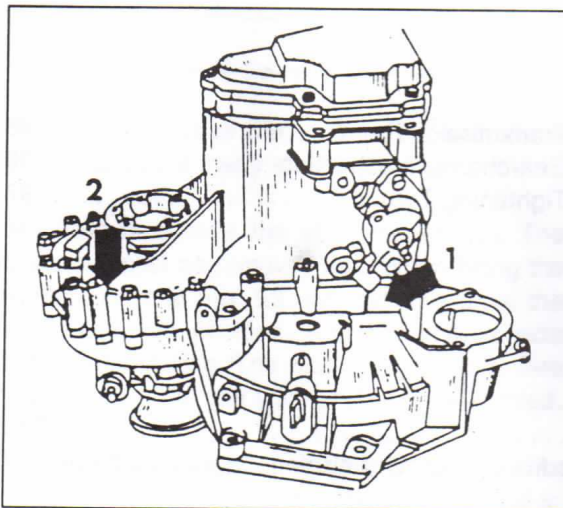


Fig. 9.1.  
The location of the transmission code (1) and the transmission type (2).

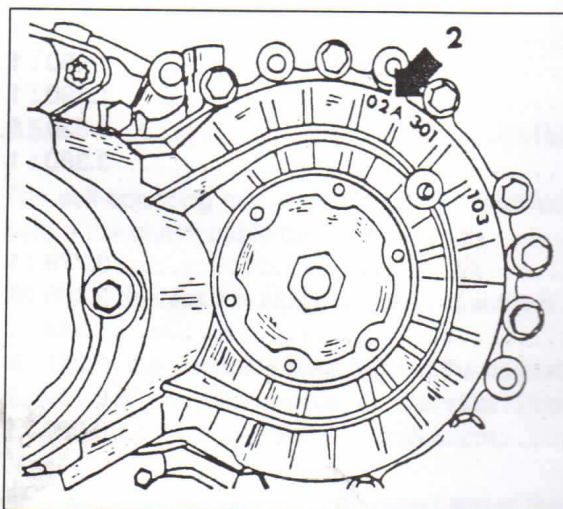


Fig. 9.2.  
The transmission number (2).

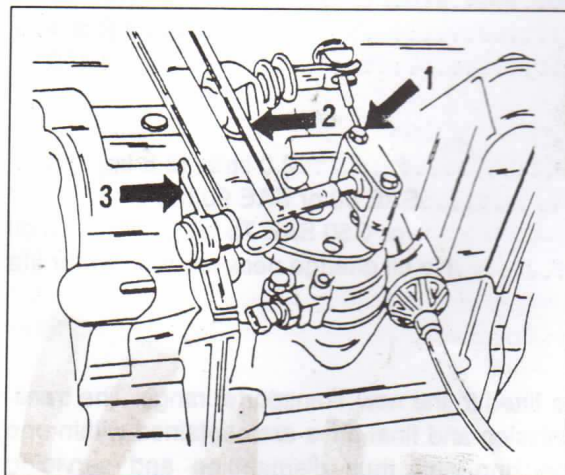


Fig. 9.3.  
Details for the removal of the gear actuation unit (see text).

### 9.2. Removal and Installation

The following instructions apply to the four- and five-speed transmission.

The transmission will come out only from below the vehicle, therefore, access will be required together with a substantial jack, preferably one of the trolley type. Whichever method of raising and support for the vehicle is used, be sure that it is safe to work below the car before commencing any operations.

- Disconnect the earth (ground) cable from the battery terminal, to avoid short-circuiting the system.
- Remove the vehicle undercover and tilt the front end of the vehicle forward as described on page 11.
- Place a jack underneath the transmission. It is even better if the engine can be lifted out of the mounting, using a suitable hoist and ropes.
- Disconnect the electrical leads from the transmission.
- Disconnect the gearchange cables from the side of the transmission and unscrew the bracket from the transmission case. To remove the clutch slave cylinder on models with hydraulic clutch operation, remove the selector cable together with the bracket from the transmission.
- On models with mechanical clutch operation remove the clutch cable from the operating lever and the support; on models with hydraulic operation, remove the clutch slave cylinder and place it to one side. There is no need to disconnect the hydraulic hose or pipe.
- If a five-cylinder engine is fitted, remove the gear actuation unit as follows from the transmission (Fig. 9.3):
  - Unscrew the clevis (1).
  - Lever up the gearchange lever at the front from the gear control lever (2).
  - Unscrew the bearing block together with the selector rod (3).
- Disconnect the speedometer cable from the transmission.
- Remove the bolts between engine and transmission at the top.



## 9 Manual Transmission

- Refer to Fig. 9.4 and remove the four bolts shown with the arrows to free the bracket for the transmission mounting.

- Remove the nut of the front mounting bracket.

- If necessary remove the intake hose to the air cleaner.

- Place ropes around the engine and lift the engine on a hoist out of the mountings as far as it will go. Take care not to touch other parts of the engine compartment under tension.

- Place a jack underneath the transmission (insert a block of wood between jack head and transmission) and operate the jack until the remaining mountings are under tension.

- Remove the centre bolts from the transmission mountings on the L.H. and R.H. side of the transmission. Also disconnect and remove the starter motor.

- Remove the L.H. and R.H. drive shaft from the transmission drive flanges, using the correct splined inserts to unscrew the bolts. Use a piece of wire and tie the shafts to the chassis where they cannot disturb the removal of the transmission.

- Remove the cover from underneath the flywheel housing and the bolts between transmission and engine at the lower part.

- Check once more that all connections, leads, cables, etc. between engine and transmission and between transmission and body have been removed or disconnected. Different models will have different cables or similar fitted and only by checking can you make certain that everything is free.

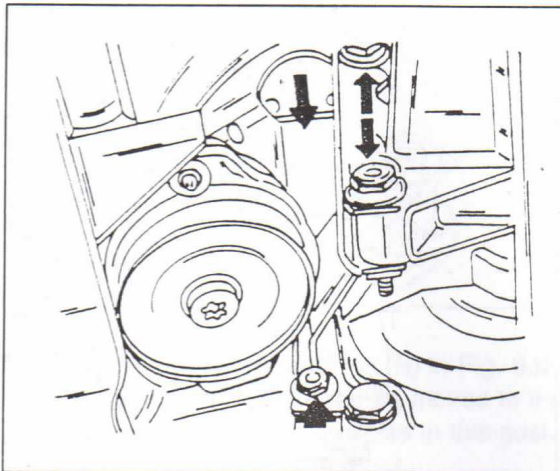
- Using, if necessary, a tyre lever, lever the transmission away from the engine, taking care at all times that the transmission cannot drop off the jack. A helper should hold the transmission on the jack during the complete lifting and removal operation. Lower the transmission to the ground after it is free of the dowel pins in the cylinder block.

The installation of the transmission is a reversal of the removal procedure, noting the following points:

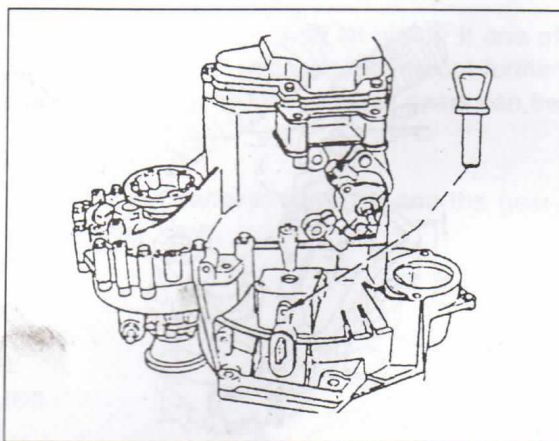
- Coat the serrations of the clutch shaft with

graphited grease.

- Make sure that the engine intermediate plate is located properly on its dowel pins.



**Fig. 9.4.**  
The arrows show the attachment of the transmission mounting on a 2.4 litre diesel model.



**Fig. 9.5.**  
Insert a pin or bolt of the dimensions given to arrest the clutch operating lever.

- Push the clutch release lever towards the transmission and insert a pin or bolt M8 x 22 mm long into the hole shown by the arrow in Fig. 9.5. This will hold the release lever in the released position. The hole is at present closed off with a plug which must be removed first. After installation remove the bolt and refit the plug. Do not forget.

- When connecting the transmission to the engine take care not to dislodge the intermediate plate. The transmission must engage over the dowel pins in the cylinder block.

- Tighten the bolts between engine and transmission to 6.0 kgm (43.5 ft.lb.).

- Refit all engine and transmission mountings free of stress or tension and tighten the bolts and nuts to the torque values given at the end of the transmission section.

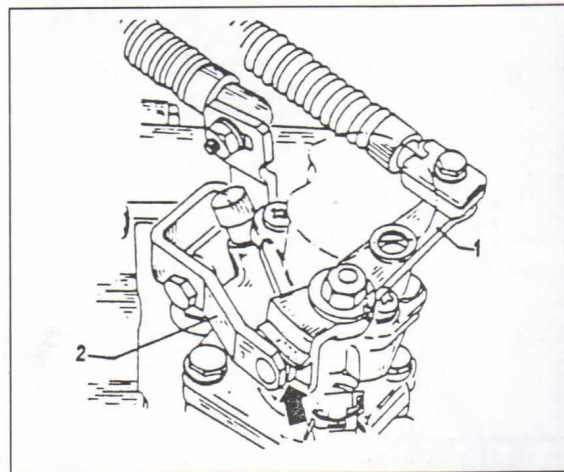
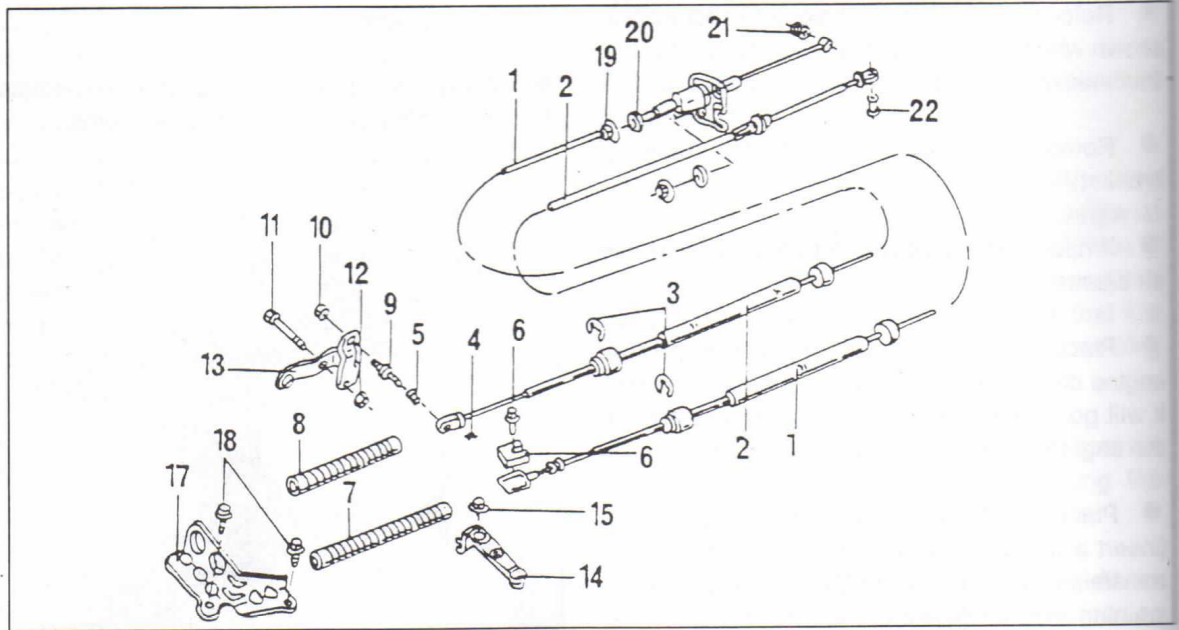
- On vehicles with mechanical clutch operation depress the clutch pedal at least 5 times to



## 9 Manual Transmission

**Fig. 9.6.**  
Exploded view of the  
gearchange mechanism.

- 1 Gearchange cable
- 2 Gate selector cable
- 3 Circlip
- 4 Retaining clip
- 5 Rubber bush
- 6 Cable end block, gear-  
change cable
- 7 Boot, gearchange cable
- 8 Boot, gate selection cable
- 9 Pin
- 10 Nut, 1.5 kgm (11 ft.lb.)
- 11 Fitted bolt
- 12 Nut, 1.0 kgm (7.2 ft.lb.)
- 13 Relay lever
- 14 Gearchange lever
- 15 Nut, 2.5 kgm (18 ft.lb.)
- 16 Shouldered bolt, 2.5 kgm
- 17 Bracket
- 18 Bolts, 1.5 kgm (11 ft.lb.)
- 19 Nut, 1.5 kgm (11 ft.lb.)
- 20 Rubber washer
- 21 Rubber bush
- 22 Rubber bush



**Fig. 9.7.**  
Arrange the gearchange  
lever (1) and the relay lever  
(2) as shown when con-  
necting the gearchange  
mechanism.

the pedal stop. Then move the operating lever against its normal operationg direction by approx. 10 mm (0.4 in.). The lever must move freely. The check will assure that the clutch mechanism works properly and the automatic adjusting device is functioning.

- On models with hydraulic clutch control, bleed the clutch system as described in Section 8.4.0, if the connection between clutch fluid hose and pipe has been separated.
- Check the gearchange mechanism after installation. All gears must engage easily.

### 9.3. Transmission Repairs

Special tools and equipment is required to overhaul the transmission and the final drive and we do not recommend to dismantle the trans-  
mission. If the transmission appears to be faulty,

try to obtain an exchange unit, making sure to fit the correct transmission.

### 9.4. Gearchange Mechanism

The cable gearchange mechanism can be dis-  
mantled and assembled by referring to Fig. 9.6.

It should be noted that special gauges are  
required to adjust the gearchange mechanism  
correctly. Otherwise the adjustment can only be  
carried out by trial and error.

The following points must be noted during  
removal and installation of the gearchange  
mechanism:

- The gate selector cable (2) must be fitted before the gearchange cable (1).
- Always replace the circlip (3) if it has been removed. Take care not to damage the rubber boot.
- Replace the rubber bush (5) between the gate selection cable and the relay lever with a suitable drift under a press.
- Pull the rubber boot for the gearchange cable (7) carefully over the cable end. Grease with graphited grease.
- Pull the rubber boot for the gate selection cable (8) carefully over the cable end.
- Slacken the nut (10) only to adjust the gearchange.



## 9 Manual Transmission

- Insert the fitted bolt (11) with graphited grease.

- The nut (12) is self-locking and must always be replaced.

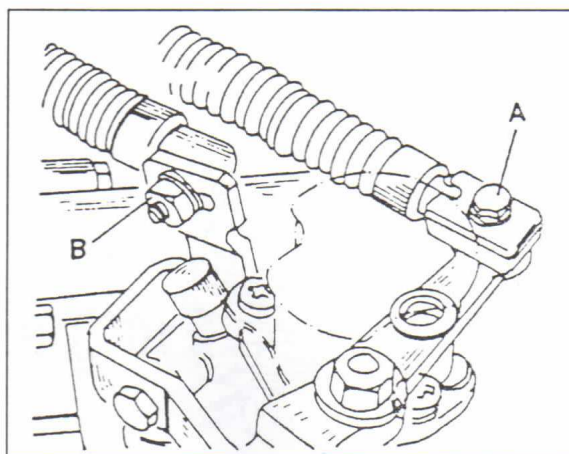
- The relay lever (13) must be removed from the transmission before the clutch release mechanism can be removed. When fitting the lever (13) and (14) refer to Fig. 9.7.

- The shouldered bolt (16) connects the gear-change cable to the gearchange lever.

- Replace the rubber bushes (21) and (22) under a press, using a suitable drift.

The gearchange mechanism must be adjusted after the gearchange or gate selector cable have been replaced. As already mentioned, an adjustment gauge is required for this operation. As this is most probably not available, you will still be able to adjust the cables by trial and error, but it will take, of course, longer. Proceed as follows:

- Change the transmission into neutral, remove the gearchange lever knob and remove the gearchange lever surround.



**Fig. 9.8.**  
Details of the gearchange cable adjustment. Bolts (A) and nut (B) are referred to in the text.

- Slacken the bolt (A) and nut (B) in Fig. 9.8, until the gearchange cable can be moved in its elongated hole. Connect the cables in this position and re-tighten the bolt and nut.

- Try the transmission in all gears. If one of the gears is difficult to engage, carry out further adjustments, little by little, until all gears can be engaged properly.

- Refit the gearlever surround and the gear-change lever knob.

### 9.5. Transmission — Tightening Torques

Engine to transmission:

|                                                            |                                 |
|------------------------------------------------------------|---------------------------------|
| 8 mm thread: .....                                         | 2.0 kgm (14.5 ft.lb.)           |
| 10 mm thread: .....                                        | 6.0 kgm (43.2 ft.lb.)           |
| 12 mm thread: .....                                        | 8.0 kgm (58.0 ft.lb.)           |
| Engine mounting bracket to mounting (petrol engine): ..... | 65.0 kgm (47.0 ft.lb.)          |
| Engine carrier, R.H. side of engine (petrol): .....        | 5.0 kgm + 90° (36 ft.lb. + 90°) |
| Engine mounting, rear on cylinder block (petrol): .....    | 4.5 kgm (32.5 ft.lb.)           |
| Mounting, rear on transmission (petrol): .....             | 2.0 kgm (14.5 ft.lb.)           |
| Transmission mounting bracket (M10 x 60 mm bolts): .....   | 6.5 kgm (47.0 ft.lb.)           |
| Transmission mounting bracket (M10 x 28 mm bolts): .....   | 4.5 kgm (32.5 ft.lb.)           |
| Drive shaft flanges: .....                                 | 5.5 kgm (40 ft.lb.)             |
| Starter motor to transmission: .....                       | 6.0 kgm (43.2 ft.lb.)           |
| Cable bracket to transmission: .....                       | 1.5 kgm (11 ft.lb.)             |
| Gearchange cable to gearchange lever: .....                | 2.5 kgm (18 ft.lb.)             |
| Slave cylinder to transmission: .....                      | 2.5 kgm (18 ft.lb.)             |
| Oil drain plug: .....                                      | 3.0 kgm (22 ft.lb.)             |



## 10 DRIVE SHAFTS

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### 10.0. Introduction

The drive shafts are the same on both sides and have the same length. The front suspension of

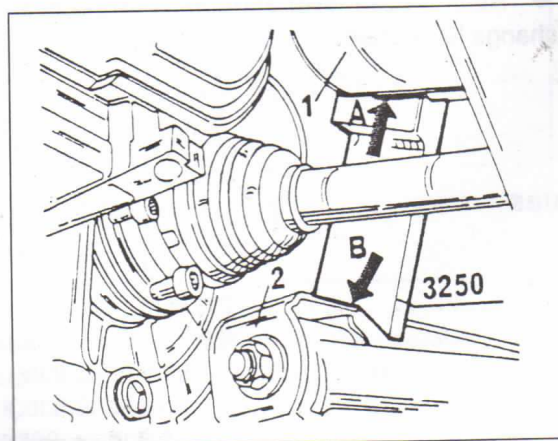


Fig. 10.1.  
Support strut fitted to one side of the front suspension. Refer to text.

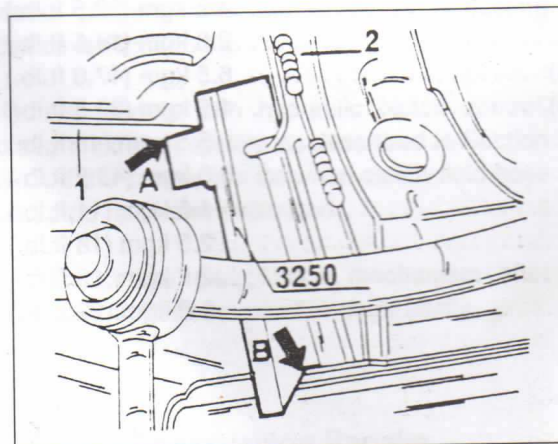


Fig. 10.2.  
Support strut fitted to the other side of the front suspension. Refer to text.

the new Transporter is fitted with torsion bars. These bars are under tension and the upper wishbone is pushed down by the tension of these bars. To release the tension in the bars,

VW have developed support struts which are inserted between the upper wishbone and the subframe as described below. The shape of the struts is shown in Figs. 10.1 and 10.2 and similar "spacers" must be inserted, not only to remove a drive shaft, but any time when the front of the vehicle is lifted to carry out work on the front suspension. The alternative method is to release the tension of the torsion bars as described in section "Front Suspension" or the suspension must be settled by driving it backwards and forwards or by loading it down (a helper can sit in the seat). A description of the use of the support struts follows in the next section.

### 10.1. Removal and Installation

- Refer to the illustrations and insert the struts so that the seating surface (arrow A) is underneath the upper wishbone (1) and the "V"-shaped cut-out (arrow B) on the subframe (2). If the vehicle is not completely empty, either remove the items from inside or lift the front of the vehicle body (very carefully) until the struts can be inserted.

The drive shafts can now be removed. Note that some of the operations are referred to, but not described. Detailed descriptions of these operations can be found in the "Front Suspension" section.

- Remove the wheel embellisher.

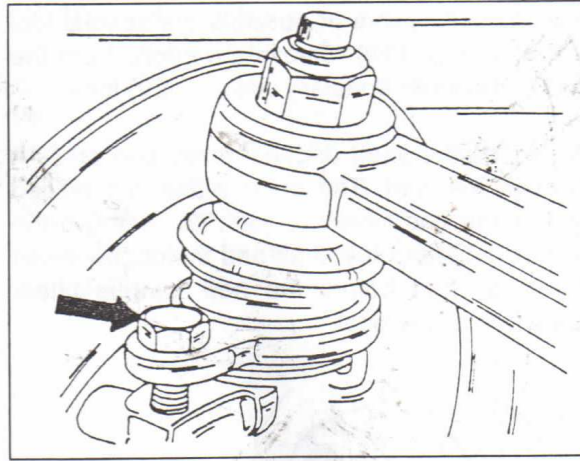


## 10 Drive Shafts

- Loosen the axle bolt (note that a bolt is fitted instead of the familiar nut) with the wheel on the ground (this nut will be very tight, tightening torque of 20.0 kgm/145 ft.lb.).

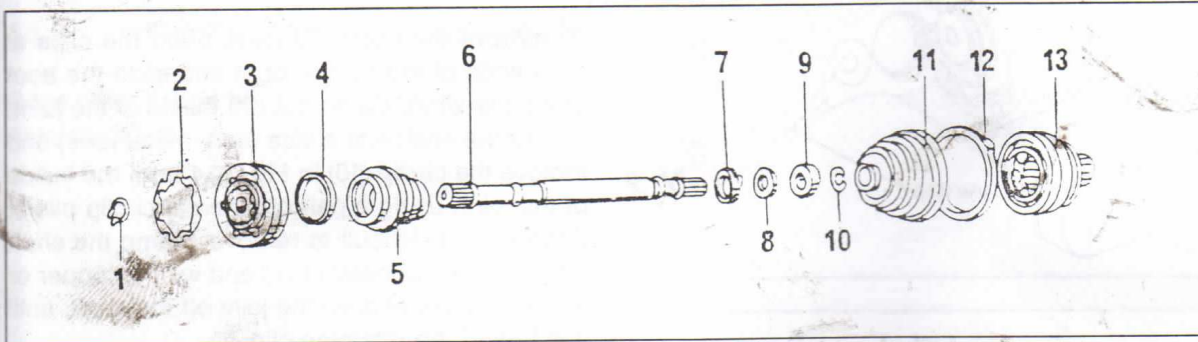
- Jack up the front of the car and support on stands — there is no need to remove the wheel for this operation, but more working space will be created when the wheel is removed. Select a spot where the vehicle can remain for the duration of the repair, as it cannot be moved when the drive shaft is out of the steering knuckle.

- Separate the suspension ball joint from the



**Fig. 10.3.**

The bolts shown by the arrows secure the suspension ball joint to the steering knuckle. The nut at the bottom secures the suspension arm to the ball joint.



**Fig. 10.4.**

Exploded view of a drive shaft.

- 1 Circlip
- 2 Gasket
- 3 Inner C.V. joint
- 4 Boot clip
- 5 Rubber boot
- 6 Drive shaft
- 7 Boot clip
- 8 Dished washer
- 9 Thrust ring
- 10 Circlip (must always be replaced)
- 11 Rubber boot
- 12 Boot clip
- 13 Outer C.V. joint

wheel bearing housing (steering knuckle). To do this, undo the two bolts shown in Fig. 10.3 and lever the lower suspension arm (wishbone) towards the bottom. The suspension arm can also be separated from the ball joint (nut at bottom), but a puller will be required to separate the connection.

- Loosen the bolts securing the inner ends of the shafts to the transmission drive flange. A splined insert, similar to an Allen key, but with 12 points, must be used for this operation.

- Completely compress the shock absorber until the drive shaft can be disengaged from the steering knuckle (wheel bearing housing). The vehicle must not be moved after a drive shaft has been removed, as the wheel bearing will be damaged.

*Never heat up the wheel bearing housing in order to facilitate the removal of a drive shaft, as the wheel bearings will be destroyed. When a new drive shaft is ordered, quote the model and year of manufacturer and also the side where the shaft is to be fitted to, as experience has shown that alterations to drive shafts are sometimes made to new vehicles.*

The installation of the drive shaft is a reversal of the removal procedure. Thoroughly clean the serration at the end of the drive shaft and the in-

side of the wheel hub before inserting the shaft. Insert the drive shaft into the steering knuckle and tighten the drive shaft bolt to 20.0 kgm (144 ft.lb.) when the vehicle is resting with its wheels on the ground. Tighten the bolts at the inner end to 5.5 kgm (40 ft.lb.). A lock plate is used for a set of two bolts (3 in all).

### 10.2. Drive Shafts — Servicing

#### 10.2.0. INNER CV JOINT

Fig. 10.4 shows an exploded view of a drive shaft and the following description refers to this illustration. The inner CV joint cannot be repaired and must be replaced if worn or damaged. Different size C.V. joints are used within the VW vehicle range. Remember this when ordering a new joint at some time in the life of your vehicle. It is always best to quote the chassis number and engine when a new C.V. joint is purchased. Proceed as follows to replace a joint:

- Remove the rubber boot clip (4) and the inner clip. A wire cutter must be used to cut the clips. A pair of special pliers is normally used to tension the new clips (see later on). Push the rubber boot along the shaft, away from the joint.

- Clamp the drive shaft into a vice and with a

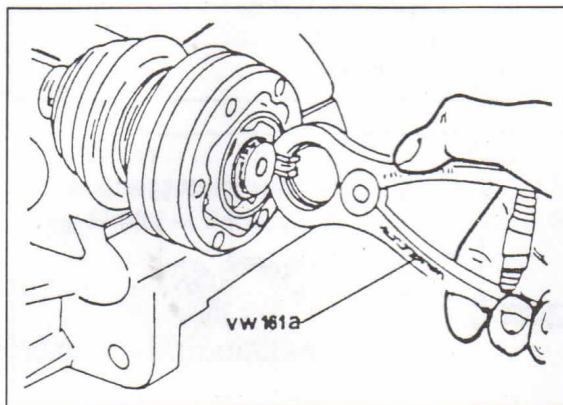


## 10 Drive Shafts

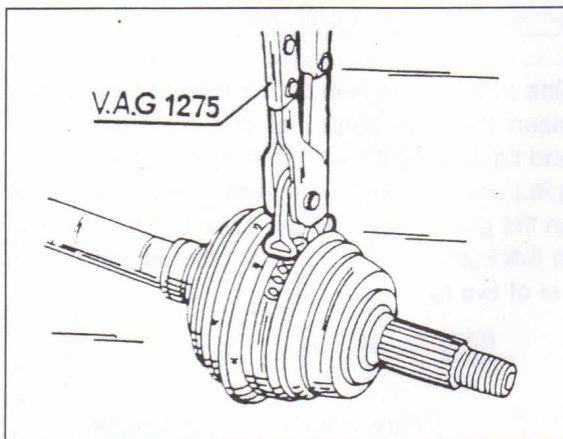
pair of circlip pliers (if possible the special tool shown in Fig. 10.5) remove the circlip from the end of the inner constant velocity (CV) joint.

- Place the shaft under a press and press it through the joint. The press plates are placed underneath the inner C.V. joint (3). Remove the rubber boot from the shaft and thoroughly clean the axle shaft before the new joint is fitted. Always fit a new boot.

**Fig. 10.5.**  
Removing the inner joint circlip from the drive shaft. Take the inner joint from the drive shaft only if it is to be replaced.



**Fig. 10.6.**  
Fitting a C.V. joint rubber boot to the joint. The special pair of pliers is used by VW workshops to tension the clip.



The installation of a new C.V. joint is carried out as follows:

- Support the shaft from below and press the joint in position. This is easy if the joint on the other end has been removed. If the joint is in position, it will be far better to clamp the drive shaft into a vice and knock the joint over the shaft, using a plastic mallet, until the groove for the circlip is free. Fit a new circlip to the shaft groove. If necessary use a pair of pliers to press the circlip in position.

- Fill the joint with 120 grams of G.6.3 grease. The grease must be obtained from your VW Dealer. Fill half of the grease into each side of the joint. If only the rubber boot is replaced, without cleaning the joint, you will have to judge how much grease must be replaced. The joint should, however, not be overfilled. Fit the rubber boot to the joint.

- Fit a new boot clip to the joint. VW workshops use a pair of special tensioning pliers to tighten the joint. The pliers have the shape shown in Fig. 10.6 and grip each end of the clip, at the same time engaging the ends when the clip is tensioned.

### 10.2.1. OUTER CV JOINT

The outer C.V. joint must be replaced as a complete unit in case of damage, as it cannot be overhauled.

To remove the outer CV joint, undo the clips at both ends of the rubber boot and slide the boot along the shaft. Clean out the inside of the joint. Clamp the shaft into a vice (soft-metal jaws) and remove the circlip (10) in Fig. 10.4 from the inside of the joint, using a pair of external circlip pliers. If the joint is difficult to remove, clamp the shaft into a vice (soft-metal jaws) and with a copper or aluminium mallet drive the joint off the shaft, until it is free of the retaining clip.

Remove the thrust ring (9) and the dished washer (8) from the shaft, noting which way the concave side of the washer is facing (against the thrust ring "9"). It is best to mark the relationship between washer and thrust ring to avoid mistakes.

Check the condition of the CV joint as described for the inner joint and if necessary renew the complete assembly. Note the differences during the assembly of the outer joint:

- Slide the rubber boot (11) over the shaft, all the way down.

- Fit the dished washer (8) and the thrust ring (9) over the shaft with the curved side of the washer facing towards the thrust ring, i.e. fit the parts together as marked during removal.

- Fit a new snap ring (10) into the groove of the shaft. Use a pair of pliers to press the ring well into the groove.

- Slide the C.V. joint over the shaft end and clamp the shaft into a vice. Use copper or aluminium mallet and drive the joint over the shaft until the snap rings springs in position into the groove inside the joint. Grip the joint and try to pull it to and fro. It should be held by the circlip.

- To assemble, pack approx. 80 grams of the



## 10 Drive Shafts

120 grams of the required amount of grease (as mentioned above) through the internal splines of the ball hub into the joint housing. The remaining 40 grams are smeared to the inner side of the joint.

- Fit the rubber boot over the joint and secure with a new clamp (clip). Again the special pliers shown in Fig. 10.6 are best to tension the clamp properly. Press the rubber boots together to push out enclosed air before the clamp band is tightened.

**NOTE:** If the rubber boot has been damaged for some time and dirt has entered the joint, call at your VW dealer, as he may be able to dismantle the outer joint to clean it out of old grease and re-assemble it to the shaft, ready for re-installation of the shaft. Provided that no wear has taken place on the joint balls, cages and races, there may be no need to replace the complete joint.

### 10.2. Tightening Torque Values

|                                 |                       |
|---------------------------------|-----------------------|
| Drive shaft flange bolts: ..... | 5.5 kgm (40 ft.lb.)   |
| Axle shaft bolts: .....         | 20.0 kgm (144 ft.lb.) |



## 11 POWER-ASSISTED STEERING

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### 11.0. Technical Data

Type and column: ..... Rack and pinion steering with fixed ratio. Safety column and intermediate shaft. Power-assistance fitted as standard.

Steering Ratio:

|                        |          |
|------------------------|----------|
| Short wheelbase: ..... | 24.0 : 1 |
| Long wheelbase: .....  | 19.3 : 1 |

### Front Wheel Geometry:

**NOTE:** Transporter models are graded in vehicle groups, depending on wheel base and other criteria. There are also differences in the settings on an empty, half-laden vehicle and a fully laden vehicle. The specific data for each vehicle group is listed in Section 11.5. All specifications with vehicle at curb weight, including spare wheel and full fuel tank. Bottom both front and rear axles once. Correct tyre pressures, if necessary.

### 11.1. Steering Gear

#### 11.1.0. REMOVAL AND INSTALLATION

The power-assisted steering is fitted with a cylinder, the piston of which is secured with one end to the steering. Depending which way the steering is turned, the piston receives fluid pressure on one side or the other, thereby reducing the effort necessary to turn the steering wheel. The fluid used in the steering system is identical to fluid used in automatic transmissions.

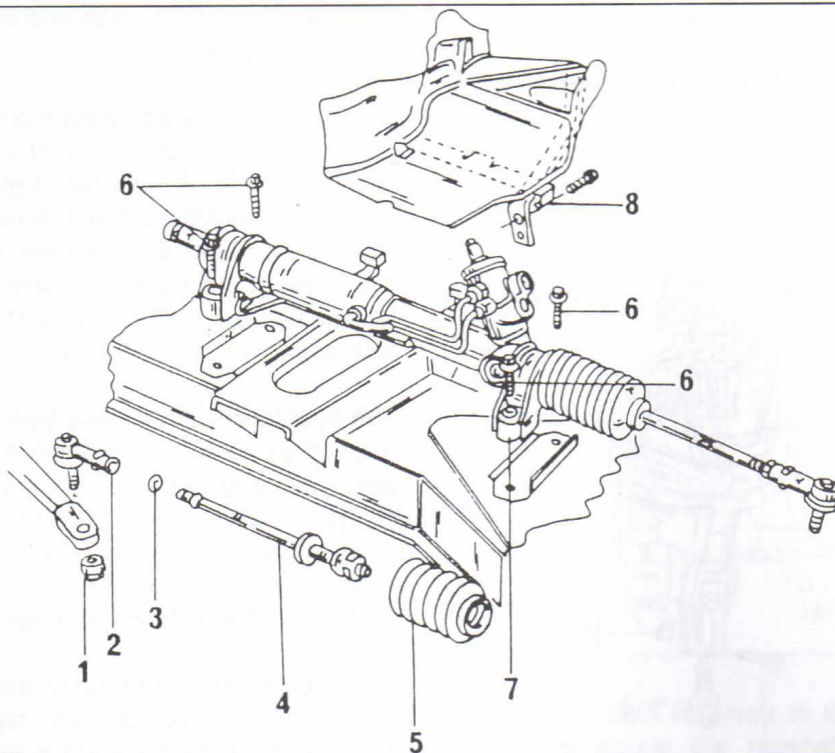
A vane pump is used to suck the fluid out of a fluid reservoir and delivers it to a sliding valve.

Before removal of the steering refer to Section 11.3, as certain rules must be observed when work on the hydraulic system is carried out. Proceed as follows to remove the complete steering, referring to Fig. 11.2:

- Remove the noise dampening panels from underneath the vehicle. Refer to page 11 and Fig. 1.1.



## 11 Power-assisted Steering



**Fig. 11.1.**  
Details for the removal and installation of the power-assisted steering.

- 1 Self-locking nut, 4.0 kgm
- 2 Track rod ball joint
- 3 Locknut, 5.5 kgm (40 ft.lb.)
- 4 Track rod
- 5 Steering rubber gaiter
- 6 Mounting bolt, 3.3 kgm
- 7 Steering gear
- 8 Heat shield (if fitted)

- Disconnect the front exhaust pipe from the exhaust manifold and completely remove the pipe from the system.

- Some vehicles have a heat shield above the steering. Remove the shield, if fitted. The shield has been omitted during later production.

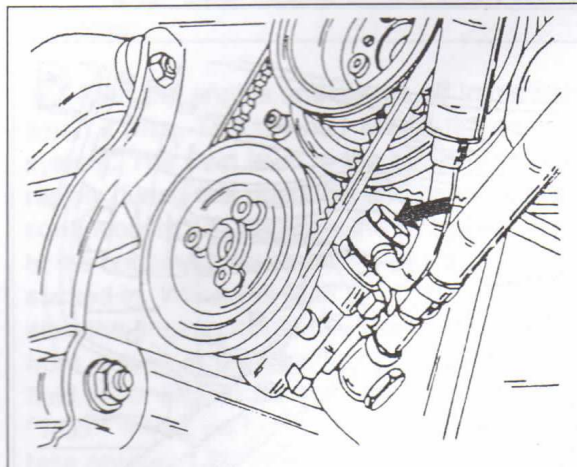
- Slacken the wheels, jack up the front end of the vehicle and place chassis stands under the sides of the body. Remove both wheels.

- If a four-cylinder engine is fitted, unscrew the banjo bolt shown in Fig. 11.2 and disconnect the fluid hose. Collect any fluid running out of the connection. If a five-cylinder engine is fitted, disconnect the fluid the pressure and return pipes from the steering.

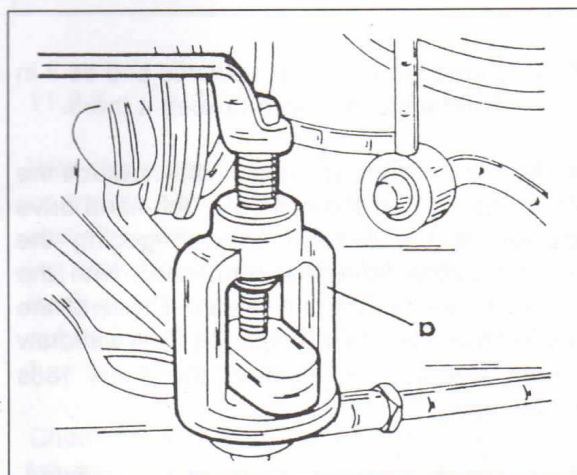
- If a four-cylinder engine is fitted disconnect the hoses from the steering box and seal the hose ends with a small plastic bag, secured with sticky tape. Also close off the connection holes in the steering box in suitable manner.

- Remove the self-locking nuts from the track rod ball joints on both sides of the vehicle and use a suitable puller, as shown in Fig. 11.3 to separate the track rod ball joints from the steering levers.

- From below the vehicle remove the mounting clamps for the stabiliser bar on each side of the vehicle.



**Fig. 11.2.**  
The banjo bolt (1) connects the hydraulic hose with the steering pump in the case of a vehicle with 4-cylinder engine.



**Fig. 11.3.**  
Apply the ball joint extractor (a) as shown and tighten the extractor bolt until the joint shank is free of the steering lever. Hit the bolt end with a hammer to free a tight ball joint.

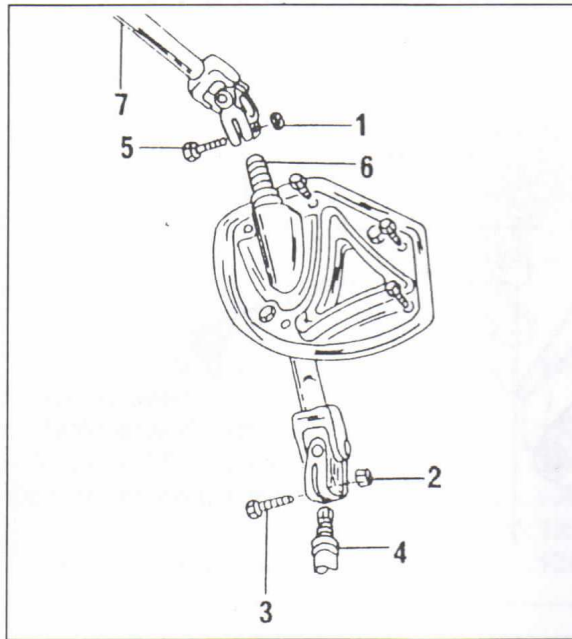
- Slacken the clamp bolt and the self-locking nut at the connection between the lower steering shaft universal joint and the steering pinion. Fig. 11.4 shows the connections between the steer-



## 11 Power-assisted Steering

ing shafts and the two universal joints.

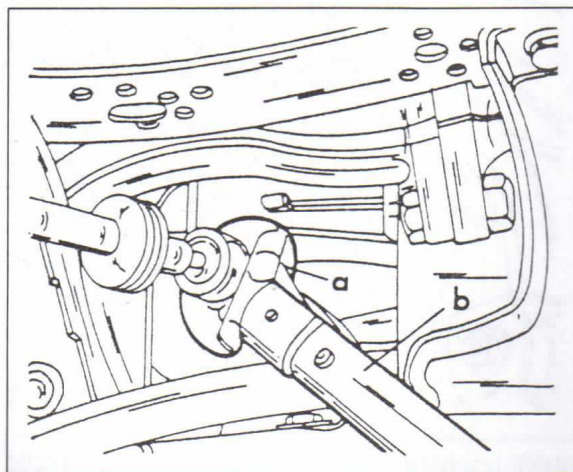
- Remove the bolts securing the steering box to the underside of the vehicle.



**Fig. 11.4.**

The attachment of the steering shaft to the steering pinion.

- 1 Self-locking nut
- 2 Self-locking nut
- 3 Clamp bolt
- 4 Steering pinion
- 5 Clamp bolt
- 6 Lower steering shaft
- 7 Centre steering shaft



**Fig. 11.5.**

Tightening a track rod ball joint to the steering rack. The special spanner "a" and the torque wrench "b" is used.

- Push the stabiliser bar upwards and tie it in position with a piece of wire to keep it there.
- Move the power steering slightly towards the left (to the right in the case of a left-hand drive vehicle), at the same time disengaging the steering pinion from the connection with the universal joint. Swing the left-hand side of the steering box towards the rear and then withdraw it from the vehicle, guiding the track rods accordingly.
- If a new power steering is to be fitted, remove the track rods as described in the next section.

The installation of the steering box is a reversal of the removal procedure. If the track rods have

been removed, fit them in position as described in the next section.

The steering mounting bolts are tightened evenly across to a tightening torque of 3.3 kgm (24 ft.lb.). Clean the ball joint shanks of grease or oil and insert them into the steering levers. Fit new self-locking nuts and tighten them to 4.0 kgm (30 ft.lb.). After the toe-in adjustment of the front wheels has been checked, tighten the track rod locknuts to 5.5 kgm (40 ft.lb.).

The hydraulic system must be filled and bled of trapped air as described later on. Check all fluid connections for leaks (see later section).

### 11.2. Track Rods — Replacement

The steering should be removed to replace one of the track rods or both. The steering rack can be damaged if the track rod is replaced with the steering fitted, if the correct special tools are not used. The steering rack can be clamped into a vice. Use soft-metal jaws, but take care not to overtighten the vice jaws to prevent damage to the steering rack. You will need special grease from your VW dealer to refit the new track rod.

- Remove the steering rubber gaiter from the steering housing and slide it towards the outside, away from the ball joint connection. Remove all visible grease.
- Extend the steering rack towards the side where the track rod is to be replaced and clamp this end of the steering rack into the vice, noting the comment above.
- Use a large open-ended spanner and unscrew the track rod ball joint from the steering rack end. The thread inside the steering rack will have thread locking compound, which must be cleaned out carefully in order to clean the threads.
- Coat the threads of the new track rod with "D6" locking compound and screw it into the end of the steering rack. Use the large spanner and tighten the ball joint to 7.0 kgm (50 ft.lb.). It will obviously be difficult to obtain this torque without the use of a torque spanner, which cannot be applied to an open-ended spanner. You must therefore estimate the torque setting. VW workshops use a special wrench to which a torque wrench can be applied as shown in Fig. 11.5.



## 11 Power-assisted Steering

- Generously grease both sides of the steering rack. Use the grease available under VW Parts No. AOF 063 000 04. Refit the rubber gaiter, making sure it cannot come off.

- Refit the steering box and check and/or adjust the front wheel toe-in as described later on. Tighten the two track rod joint locknuts to 5.5 kgm (40 ft.lb.).

### 11.3. Operations on the Hydraulic System

Before any operations are carried out on the hydraulic system, including the removal of the steering box, read the following to prevent entry of dirt or other matter:

- Before disconnecting any of the fluid lines or hoses, clean the unit nuts, banjo bolts, etc. and the surrounding area of the connection.

- Place removed parts onto a clean working place and immediately cover with a sheet of paper, plastic or rag. Rags must be free of fluff.

- If the repair is not carried out immediately, try to close off open connections. Even a piece of chewing gum pushed carefully into an opening is better than an open connection.

- Only fit clean parts. Parts stored in a tool box should not be refitted. New parts must be taken out of their packing just before installation.

- Never use compressed air to clean any part of the engine or other parts when connections of the steering system are open. If at all possible try not to move the vehicle whilst the repairs to the hydraulic system are carried out.

- Use only fresh hydraulic fluid to refill or top-up the system. Fluid could deteriorate if it has been kept in a tin or bottle for a long time. Remember this.

#### 11.3.1. FILLING THE HYDRAULIC SYSTEM

Fill the fluid reservoir to the upper edge with hydraulic fluid as used in automatic transmissions (VW recommends fluid under their Part No. G 002 000) after the steering has been removed and refitted, or if fluid is missing in the

system. Do not re-use the fluid you have drained from the system. Also remember to replace the filter if the steering box has been replaced or the fluid has been changed. Fill the system as follows:

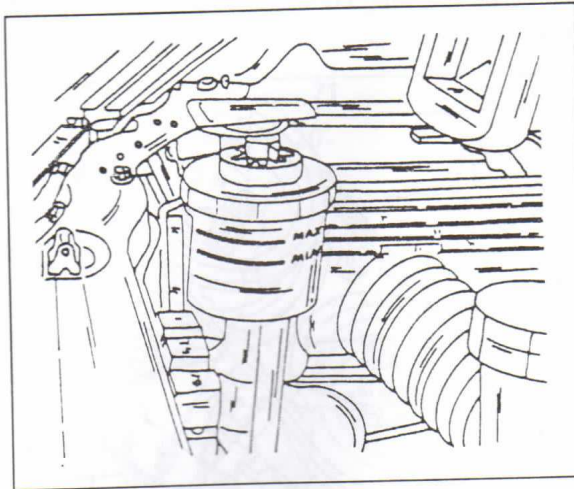


Fig. 11.6.  
View of the fitted fluid reservoir.

- Fill the fluid reservoir to the "Max" mark. Fig. 11.6 shows the reservoir, showing the "Min" and "Max" marks on the outside of the container.

- Start the engine and switch off immediately when it fires. This method will fill the complete system. The fluid level in the reservoir will sink rapidly during this operation and must be topped-up continuously. Do not allow the fluid level to drop to the bottom of the reservoir, as fresh air will be sucked in. When the fluid level remains steady, start the engine, run at idle speed and place the front wheels in the straight-ahead position. The fluid level should be between the "Min" and "Max" marks on the reservoir. The system will take approx. 1.0 litre.

#### 11.3.2. BLEEDING THE SYSTEM

With the system filled as described above, jack up the front end of the vehicle, start the engine and allow it to run at idle speed. Turn the steering wheel from lock to lock to expel the air from the hydraulic cylinder. The steering wheel must not be forced against the locks; it is sufficient to turn the wheel just to its stop.

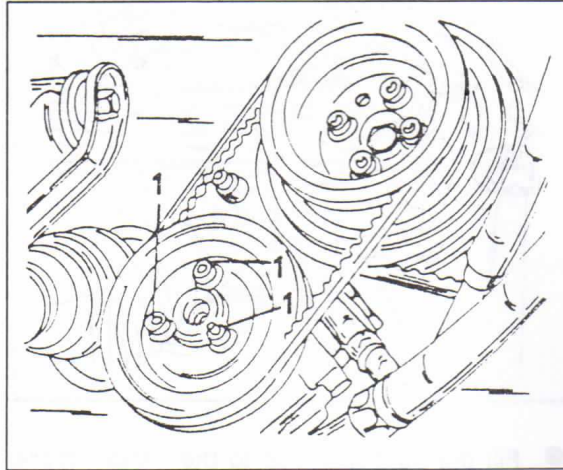
Check the fluid level in the reservoir and replenish as necessary. If the level drops during the bleeding operation, correct it to the "Max" mark. Check that no air bubbles are visible when the steering wheel is turned from lock to lock. Have a helper to operate the steering wheel as you observe the fluid reservoir.



## 11 Power-assisted Steering

### 11.3.3. CHECKING THE SYSTEM FOR LEAKS

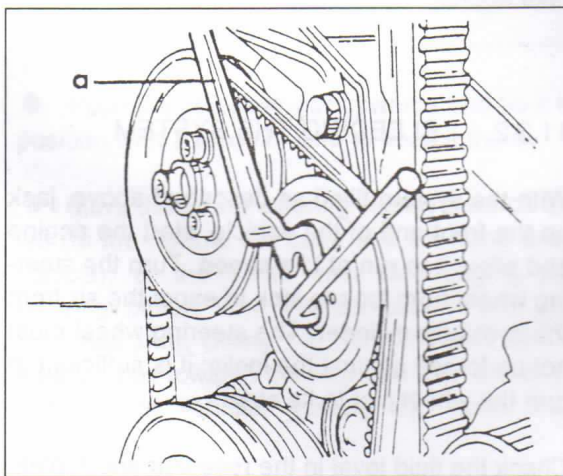
If fluid is continuously missing from the fluid reservoir, it is sometimes difficult to trace the leak. The following check may help you to do just this:



**Fig. 11.7.**  
Remove the three screws shown by the arrows to change the adjusting shims for the drive belt tension. This type of adjustment is used on the 4-cylinder engines.

- Ask a helper to turn the steering wheel from lock to lock, each time to the stop and have the steering wheel held in this position. This will create the max. pressure in the system and it will be possible to trace any dripping fluid.

- Jack up the vehicle and from underneath check the area surrounding the steering pinion (rotary valve), remove the rubber gaiters at the end of the steering rack and check the ends of the rack (rack oil seals), check the steering pump (hose connections) and check the pipe connections on the steering box. One of these locations will most probably show a fluid leak.



**Fig. 11.8.**  
Adjusting the drive belt tension for the steering pump in the case of a 5-cylinder engine. The special spanner (a) is used to turn the tensioner pulley.

If a leak can be spotted you will have to seek the advice of your dealer, as steering boxes cannot be overhauled. A new steering is most probably the only solution.

### 11.3.4. CHECKING AND ADJUSTING THE DRIVE BELT TENSION

The drive belt of the steering pump is correctly tensioned when it can be deflected in the centre of its run between the two pulleys by no more than 5 mm, when gripped between thumb and forefinger and moved to and fro. The adjustment of the belt tension is different on 4- and 5-cylinder engines. Adjusting shims between the two halves of the drive pulley are used on the 4-cylinder petrol and diesel engines; 5-cylinder engines use a tensioning pulley. When a drive belt is replaced, quote the engine and model to obtain the correct belt.

#### *Four-Cylinder Engines*

- Remove the three screws shown by the arrows in Fig. 11.7 and lift off the outer half of the drive pulley.

- Remove one shim at a time from between the pulley halves and place the outer pulley half in position. Place the removed shim on the outside of the pulley and refit the three screws. Tighten the screws evenly to 2.0 kgm (14.5 ft.lb.). To increase the belt tension move shims from the outside of the pulley to the inside of the two pulley halves.

#### *Five-Cylinder Engines*

A tensioner pulley is used to tension the drive belt for the steering pump in the case of the above engines. The pulley has holes to apply a peg spanner, designed by Matra (No. V159), without which it may be difficult to rotate the pulley. Also required is a cranked Allen key (90°) of suitable size. Provided that a suitable peg spanner is available:

- Slacken the Allen screw (hold the pulley against rotation) and apply the peg spanner as shown in Fig. 11.8.

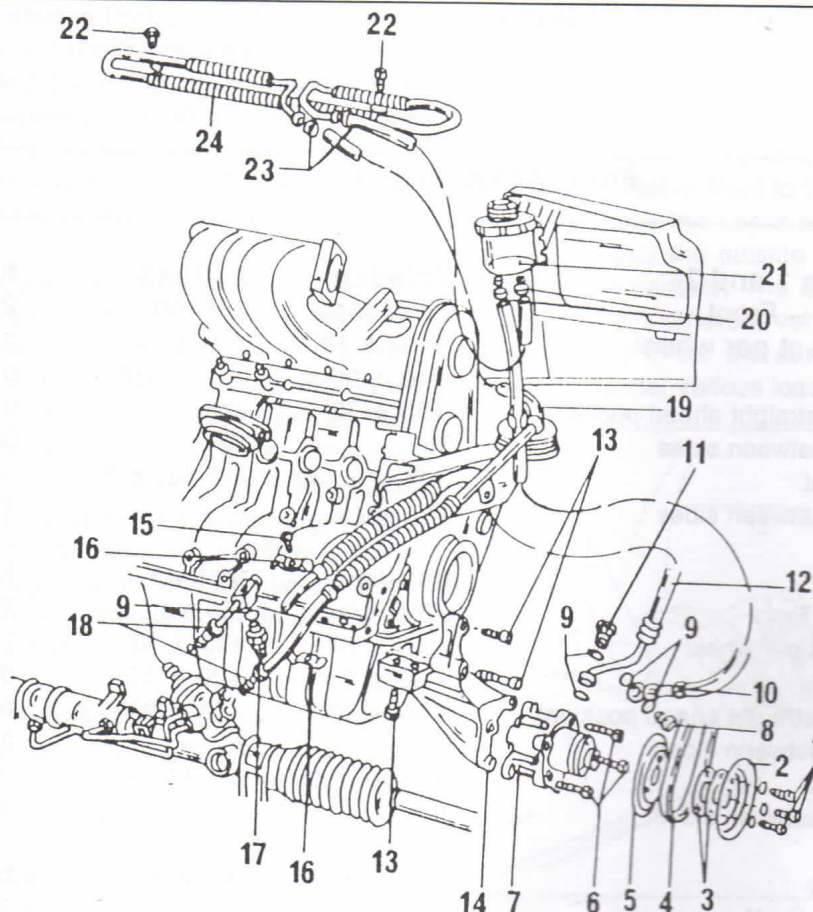
- Turn the outer half of the tensioner pulley until the correct tension is obtained. Tighten the socket head screw and re-check the tension. More than one attempt may be necessary to obtain the correct tension.

### 11.4. Steering Pump

The arrangement, attachment, etc. of the steering pump is different on four- and five-cylinder

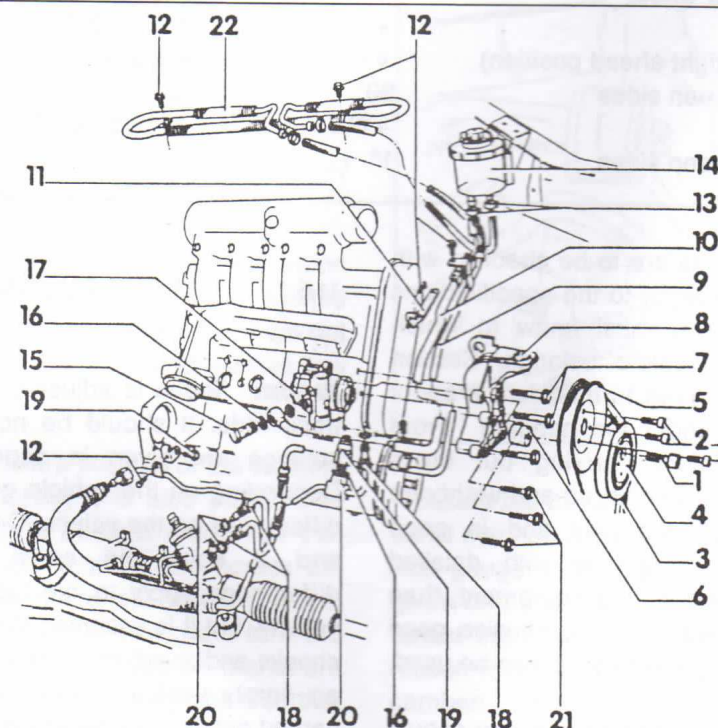


## 11 Power-assisted Steering



**Fig. 11.9.**  
Details for the removal and installation of the power steering pump as fitted to a four-cylinder engine.

- 1 Bolt, 3.5 kgm
- 2 Front half of drive pulley
- 3 Adjusting shims
- 4 Drive belt, 10 x 655 mm
- 5 Rear half of drive pulley
- 6 Bolts, 2.0 kgm
- 7 Steering pump
- 8 Banjo bolt, 4.0 kgm
- 9 Sealing washer, always replace
- 10 Suction hose
- 11 Banjo bolt, 3.0 kgm
- 12 Pressure hose
- 13 Bolt, 2.0 kgm
- 14 Mounting bracket
- 15 Screw, 1.5 kgm
- 16 Hose retainer
- 17 Pressure switch (petrol engine)
- 18 Union nuts, 3.0 kgm
- 19 Fluid return hose
- 20 Hose clip
- 21 Fluid reservoir
- 22 Screw, 0.8 kgm
- 23 Hose clip
- 24 Coolant pipe, attached to crossmember



**Fig. 11.10.**  
Details for the removal and installation of the power steering pump as fitted to a five-cylinder engine.

- 1 Bolt, 3.5 kgm
- 2 Bolts, 2.0 kgm
- 3 Pump drive belt
- 4 Tensioning roller
- 5 Vee-belt pulley
- 6 Spacer sleeve
- 7 Bolts, 4.0 kgm
- 8 Bracket
- 9 Return pipe
- 10 Suction pipe
- 11 Bracket
- 12 Screw, 1.0 kgm
- 13 Hose clip
- 14 Fluid reservoir
- 15 Banjo bolt, 4.0 kgm
- 16 Gasket, replace
- 17 Vane pump
- 18 Connection, 3.0 kgm
- 19 Pressure switch, 1.5 kgm
- 20 Round sealing ring
- 21 Bolts, 2.0 kgm
- 22 Cooling pipe

engines. Fig. 11.9 shows the component parts of the steering pump installation, as it is used on the four-cylinder engine. Fig. 11.10 shows the parts in the case of a five-cylinder engine. Removal and installation can be carried out by referring to the illustration. The vane pump

(steering pump) cannot be repaired in any way. If the pump is defective, replace it.

Follow the tightening torques given in the illustrations during the installation. All spring washers, self-locking nuts and bolts must be replaced.



## 11 Power-assisted Steering

### 11.5. Front Wheel Alignments

#### 11.5.0. INTRODUCTION

#### Front Wheel Alignment Data

| Vehicle Groups 1 and 2:                 | Unladen      | 1/2 load      | fully laden |
|-----------------------------------------|--------------|---------------|-------------|
| Vehicle height — Front                  | 280.0 mm     | 267 mm        | 255 mm      |
| Toe-in adjustment per wheel             | +20 ± 10'    | +10 ± 10'     | 0 ± 10'     |
| Total toe-in                            | +40 ± 20'    | +20 ± 20'     | 0 ± 20'     |
| Camber (wheels straight ahead position) | +35 ± 10'    | +15 ± 20'     | 0 ± 20'     |
| Max. difference between sides           | 30'          | 30'           | 30'         |
| Castor adjustment                       | +1° 40 ± 30' | +1° 50' ± 30' | +2° ± 30'   |
| Max. difference between sides           | 1°           | 1°            | 1°          |
| Vehicle Group 3:                        | Unladen      | 1/2 load      | fully laden |
| Vehicle height — Front                  | 273.0 mm     | 263 mm        | 255 mm      |
| Toe-in adjustment per wheel             | +15 ± 10'    | +10 ± 10'     | 0 ± 10'     |
| Total toe-in                            | +30 ± 20'    | +20 ± 20'     | 0 ± 20'     |
| Camber (wheels straight ahead position) | +20 ± 10'    | +10 ± 20'     | 0 ± 20'     |
| Max. difference between sides           | 30'          | 30'           | 30'         |
| Castor adjustment                       | +1° 40 ± 30' | +1° 50' ± 30' | +2° ± 30'   |
| Max. difference between sides           | 1°           | 1°            | 1°          |
| Vehicle Group 4:                        | Unladen      | 1/2 load      | fully laden |
| Vehicle height — Front                  | 265.0 mm     | 260 mm        | 255 mm      |
| Toe-in adjustment per wheel             | +10 ± 10'    | +5 ± 10'      | 0 ± 10'     |
| Total toe-in                            | +20 ± 20'    | +10 ± 20'     | 0 ± 20'     |
| Camber (wheels straight ahead position) | +10 ± 10'    | +5 ± 20'      | 0 ± 20'     |
| Max. difference between sides           | 30'          | 30'           | 30'         |
| Castor adjustment                       | +1° 50 ± 30' | +1° 55' ± 30' | +2° ± 30'   |
| Max. difference between sides           | 1°           | 1°            | 1°          |

Front wheel alignments are to be checked with the vehicle at kerb weight, to the specifications given above. First you must know to which vehicle group your vehicle belongs. Section "Front Suspension" gives further details about the vehicle groups under the heading "Front Vehicle Height". Before carrying out these checks, ensure that the track rod and wishbone ball joints are free from play and in good condition. If you are familiar with detailed handling of optical measuring equipment, then this method should be adopted. Otherwise, good mechanical measuring instruments can be used.

We must, however, stress that the owner should not attempt these alignments unless the proper equipment is available. Since the gauges to be used are of many different types we give here only the outline of the procedures and this should be supplemented by the detailed instructions applicable to the tools in use.

#### 11.5.1. WHEEL ALIGNMENT ADJUSTMENTS

**Toe-in:** Toe-in is adjusted equally on the two track rods. It should be noted that the toe-in settings are given in degrees and minutes. Depending on the vehicle group there are also differences on the values. Only vehicle groups 1 and 2 have the same settings. Further differences apply to the load condition of the vehicle, but it is assumed that in most cases the checks and/or adjustments will be carried out on an empty vehicle. Before any checks can be carried out, it is necessary to set the front wheels in the straight ahead position. To do this, proceed as follows:

- Turn the steering wheel to the full lock on one side and then turn it slowly to the other lock, at the same time counting the number of turns necessary.



## 11 Power-assisted Steering

- Turn the steering back by half the number of counted turns and check that the lug on the rubber washer and the notch in the steering box housing are opposite each other. This alignment is shown in Fig. 11.11. The steering pinion is now in the centre position, irrespective of the position of the front wheels.

All new Transporter models have a toe-in setting, i.e. the wheels are closer together at the front than at the rear. Measure the toe-in in the conventional manner, noting that values are given for "wheels unpressed", i.e. they must be free standing. A tracking gauge with a millimetre scale can be used in emergency. The degree values given are very small and the values indicated on the gauge must be just above zero. This will enable you to drive to the nearest dealer to have the toe in checked with an electronic or optical instrument.

To adjust the toe-in, slacken the locknuts of both track rods near the track rod ball joint ends and, using a pair of grips or pliers, turn the track rod in the direction of the arrows, as in Fig. 11.12, to increase or decrease the setting. Both track rods must be rotated by the same amount. If this precaution is not observed, you will find that the steering wheel spokes are out of alignment. Also check that the steering is still in the centre position before adjustments are carried out.

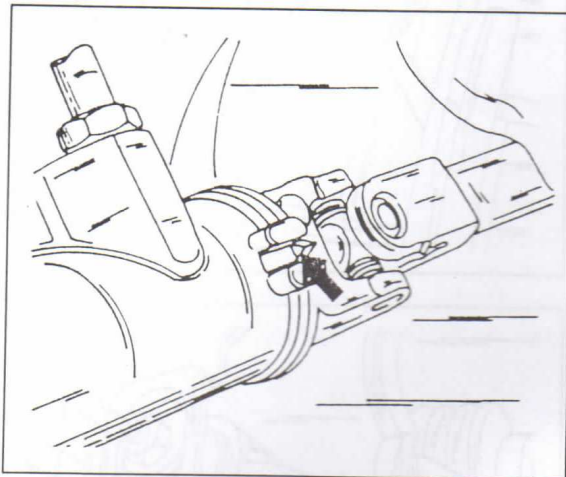
Tighten the locknuts provisionally and re-check the setting. Tighten the nuts to 5.5 kgm (40 ft.lb.) when no further adjustments are necessary.

Check the position of the two rubber gaiters on the steering box, as these may have twisted together with the track rods. Straighten them out before using the vehicle. Twisted gaiters will soon be damaged.

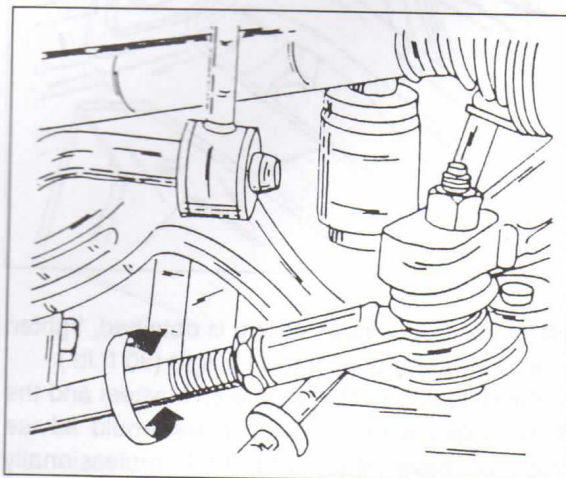
**NOTE:** To fix the centre position of the steering wheel and front wheels, it is also possible to drive the vehicle on a straight road. You can then use a pencil and mark a line across the steering column cover and the steering wheel hub. Return to the place of work and turn the steering wheel so that the two pencil marks are aligned. Remove the wheel and replace it so that the spokes are in the horizontal position.

The toe-in difference angle is not adjustable and if this cannot be met then it points to some distortion of the front suspension. The setting for ALL models is  $45 \pm 20'$  on one wheel when the other wheel is set exactly to  $20^\circ$ . Obviously turntables are required for this check.

**Camber:** The camber of the models covered in this Workshop Manual can be adjusted, but you will find there is no need to alter the setting. Having said that, we must point out that a special tool is required to alter the camber setting. An eccentric washer fitted to the upper wishbone is used to move the upper end of the steering knuckle towards the outside or inside, thereby changing the camber. The camber values are different for the different vehicle groups. Only Groups 1 and 2 are the same. Also note the differences under various load conditions.



**Fig. 11.11.**  
The steering (and hopefully the front wheels) is in the straight-ahead position when the lug shown by the arrow is aligned with the notch in the steering housing.



**Fig. 11.12.**  
After slackening the track rod locknut, turn the track rod in the direction of the arrow as required.

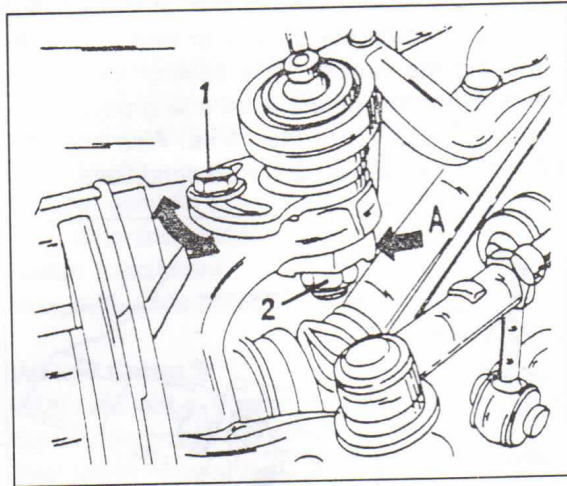
Measure the camber of the wheel in the conventional manner, either with a mechanical or an optical gauge. If the camber is outside the value given on page 108 and you are in a position to obtain the special tool (No. 3252), there is no reason why you should not attempt to adjust the camber:

- Refer to Fig. 11.13, and slacken the bolt (1) which is used to clamp the eccentric washer in position. From the bottom of the suspension ball joint slacken the joint nut (2). There is no need to remove it.
- Using the special spanner or any other

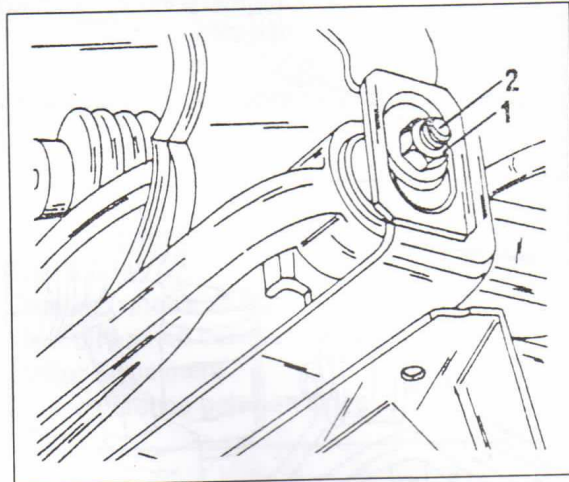


## 11 Power-assisted Steering

spanner that will fit the eccentric washer (A), turn the washer until the correct camber setting is obtained. You will find that only trial and error will lead to success, i.e. carry out a small adjustment, re-measure and if necessary carry out further adjustments.



**Fig. 11.13.**  
Details for the adjustment of the front wheel camber. The eccentric washer (A) can be rotated after slackening the bolt (1) and the nut (2).



**Fig. 11.14.**  
Details for the adjustment of the front wheel castor angle. Nut (1) and bolt (2) are used to adjust the castor.

- After the camber setting is obtained, tighten the nut (2) and bolt (1) to 11.0 kgm (80 ft.lb.). If the difference between the L.H. wheel and the R.H. wheel is more than 30' we would advise you to have the front end professionally measured, as there might be some distortion.

**Castor:** The castor is adjustable on these vehicles, but again it may be very unlikely that changes have taken place. If the vehicle pulls to

one side or there is wheel "whobble" when driving in a straight line, there may be a case to have the setting checked. An eccentric bolt is used for the adjustment, but be advised that a new bolt must be fitted if the castor adjusting nut has been slackened.

Check the castor in the conventional manner. If the value is outside the value given on page 108 (again note the different values) or the difference between the L.H. and R.H. side is more than 1°, you may want to attempt to adjust the castor angle(s):

- Fit the support struts to the front wishbones as described during the removal of the drive shafts (refer to page 98) and jack up the front end of the vehicle.
- Refer to Fig. 11.14 and mark the exact fitted position of the nut (1) and the eccentric washer. On the other side of the wishbone mark the fitted position of the bolt head.
- Remove the nut and carefully drive out the bolts. Take care that the suspension arm is not under tension during this operation. The support struts will prevent this.
- Transfer the mark from the old bolt to the new bolt and drive it in position without damaging the threads.
- Fit the eccentric washer in the original position. Bolt and washer are now fitted as they were found before removal and the adjustment of the bolt (2) enables the adjustment of the castor angle. Trial and error will be the only way to obtain the correct setting.
- After the adjustment, lower the vehicle onto its wheels and tighten the nut (1) to 7.5 kgm (54 ft.lb.). From this position use a ring spanner and tighten the nut a further one quarter of a turn. **Do not tighten the nut with the wheels in the air.**

If the castor setting is "way out", there is some distortion in the front suspension which must be located and rectified.

### 11.6. Tightening Torque Values

|                                        |                       |
|----------------------------------------|-----------------------|
| Clamp bolt for universal joints: ..... | 3.0 kgm (21.6 ft.lb.) |
| Steering wheel nut: .....              | 7.0 kgm (50 ft.lb.)   |
| Steering column switch housing: .....  | 1.0 kgm (7.2 ft.lb.)  |
| Track rod end locknut: .....           | 5.5 kgm (40.0 ft.lb.) |



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|                                   |                       |
|-----------------------------------|-----------------------|
| Track rod ball joint nuts: .....  | 4.0 kgm (29 ft.lb.)   |
| Steering gear to body nuts: ..... | 3.3 kgm (24.0 ft.lb.) |





## 12 FRONT SUSPENSION

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### 12.0. Technical Data

|                                            |                                                                                                     |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Type: .....                                | Independent suspension with upper and lower wishbones and torsion bars.                             |
| Shock absorbers: .....                     | Hydraulic, two-way acting. Upper end with special mounting, lower end together with stabiliser bar. |
| Stabiliser bar: .....                      | Fitted between chassis and lower wishbone. Connected by means of linkages.                          |
| Torsion Bars:                              |                                                                                                     |
| Identification (side allocation): .....    | R.H. bar marked with "R", L.H. bar marked with "L" in end face.                                     |
| Identification (tension):                  |                                                                                                     |
| Location of identification: .....          | approx. 75 mm (3 in) from flange                                                                    |
| White colour code: .....                   | 23.8 mm diameter                                                                                    |
| Green colour code: .....                   | 25.3 mm diameter                                                                                    |
| Brown colour code: .....                   | 26.4 mm diameter                                                                                    |
| Wheel alignment data: .....                | Refer to Page 108                                                                                   |
| Dimensions:                                |                                                                                                     |
| Wheelbase — Short: .....                   | 2920 mm (116.01 in.)                                                                                |
| Wheelbase — Long: .....                    | 3320 mm (131.90 in.)                                                                                |
| Front track, 5 1/2 x 14 rims: .....        | 1575 mm (62.57 in.)                                                                                 |
| Front track, 6J x 15 rims: .....           | 1598 mm (63.49 in.)                                                                                 |
| Turning circle, between kerb stones: ..... | 10.75 metres                                                                                        |
| Turning circle, between walls: .....       | 11.7 m (short wheelbase), 12.9 metres (long wheelbase)                                              |
| Ground clearance: .....                    | 180 mm                                                                                              |



## 12 Front Suspension

### 12.1. General

The front suspension consists of an upper and a lower wishbone, torsion bars and a stabiliser bar. Hydraulic shock absorbers are used to dampen the movement of the front suspension. All parts of the front suspension can be removed individually.

The front suspension assembly is fitted as a complete unit to a strong sub-frame. In the case of larger repair work, it is possible to remove the complete sub-frame which can then be dismantled. The removal of the sub-frame is only described briefly near the end of this section, as it will be rarely necessary.

As already mentioned during the removal of the drive shaft it will be necessary to take the tension out of the torsion bar. Refer to Page 98 and follow the instructions to insert the support struts. Whenever this operation is necessary, it will be described as "insert support struts".

### 12.2. Front Shock Absorbers — Removal and Installation

Fig. 12.1 shows the attachment of a shock absorber at the upper and lower ends. A single nut secures the shock absorber at the lower end, whereas a special mounting bracket is used at the upper end. Remove a shock absorber as follows:

- Insert support struts on both sides of the vehicle.
- Undo the shock absorber from its bottom mounting.
- Unscrew the upper shock absorber mounting from the body and take out the complete assembly. Clamp the shock absorber into a vice (Fig. 12.2) and remove it from the bracket. The special tool shown in the illustration is used to hold the shock absorber against rotation, but after a study of the upper shock absorber end you will be able to use an alternative tool.

Faulty shock absorbers make a rumbling noise, even when the vehicle is driven over a fairly level road. If this is the case, there is no need to check the shock absorber. Replace it immediately.

The removed shock absorbers should always be given a quick check. To do this, clamp the shock

absorber with the lower end into a vice and extend and compress the piston rod in a vertical direction. There should be equal resistance over the complete working travel of the piston rod, without free play. If the shock absorber has been stored in a horizontal position, clamp it into a vice before installation and pump the piston rod a few times up and down to remove any trapped air.

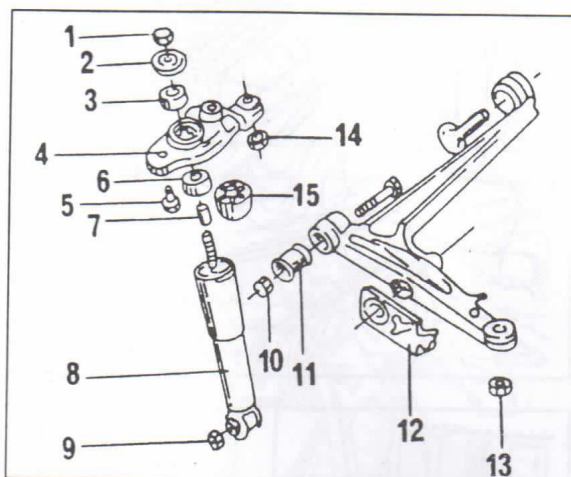


Fig. 12.1.

The attachment of a front shock absorber. Note that the collar of washer (2) must face downwards.

- 1 Nut, 2.5 kgm
- 2 Washer (see above)
- 3 Upper rubber bush
- 4 Shock absorber bracket
- 5 Bolt, 10.0 kgm
- 6 Lower rubber bush
- 7 Spacer sleeve
- 8 Shock absorber
- 9 Nut, 16.0 kgm
- 10 Nut, 16.0 kgm
- 11 Front wishbone bush
- 12 Air deflector plate (14 in. wheels)
- 13 Nut, 11.0 kgm
- 14 Nut, 10.0 kg
- 15 Bump stop

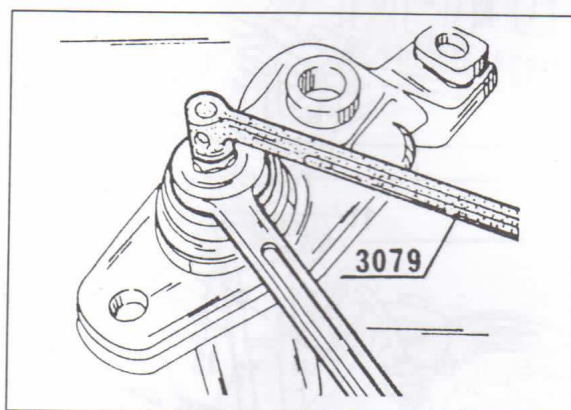


Fig. 12.2.

The shock absorber is removed together with the upper mounting bracket and must be removed as shown.

*Slight fluid leaks, i.e. moist areas around the entry of the piston rod, do not require the replacement of the shock absorber.*

The installation of the shock absorber is a reversal of the removal procedure. First attach the shock absorber to the bracket. Fit the spacer sleeve (7) and the rubber bush (6) over the piston rod, followed by the mounting bracket. Fit the upper bush (3) and the washer (collar downwards). Hold the piston rod against rotation as shown in Fig. 12.2 and tighten the nut (1) to 2.5 kgm (18 ft.lb.).

Fit the shock absorber into the vehicle and attach the mounting bracket with the bolt and nut to the chassis. Tighten bolt and nut to 10.0 kgm (72 ft.lb.). Do not tighten the nut at the lower end at this stage.

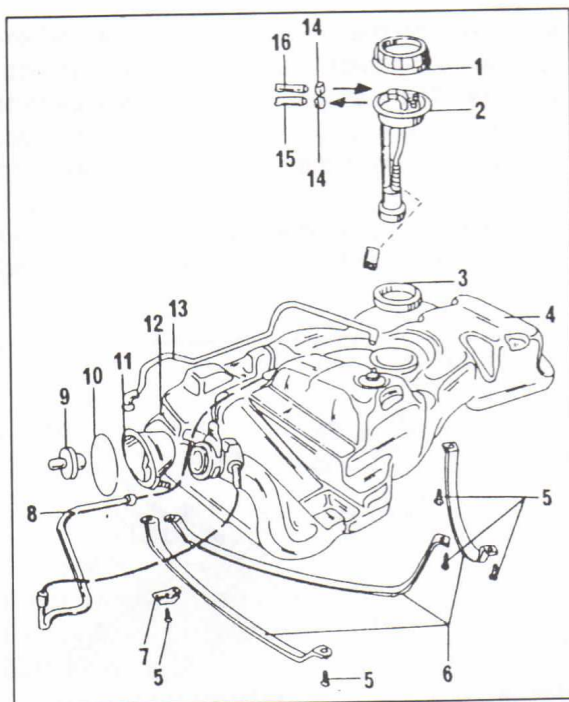
Remove the support struts, lower the vehicle to



## 12 Front Suspension

**Fig. 12.3.**  
Details for the removal and installation of the fuel tank and associated parts.

- 1 Screw cap
- 2 Fuel tank gauge
- 3 Sealing ring
- 4 Fuel tank
- 5 Securing bolts
- 6 Tank clamp bands
- 7 Clamp
- 8 Fuel pipe
- 9 Breather valve
- 10 Tensioning ring
- 11 Rubber elbow
- 12 Screw
- 13 Pipe
- 14 Hose clamp
- 15 Suction hose
- 16 Return hose



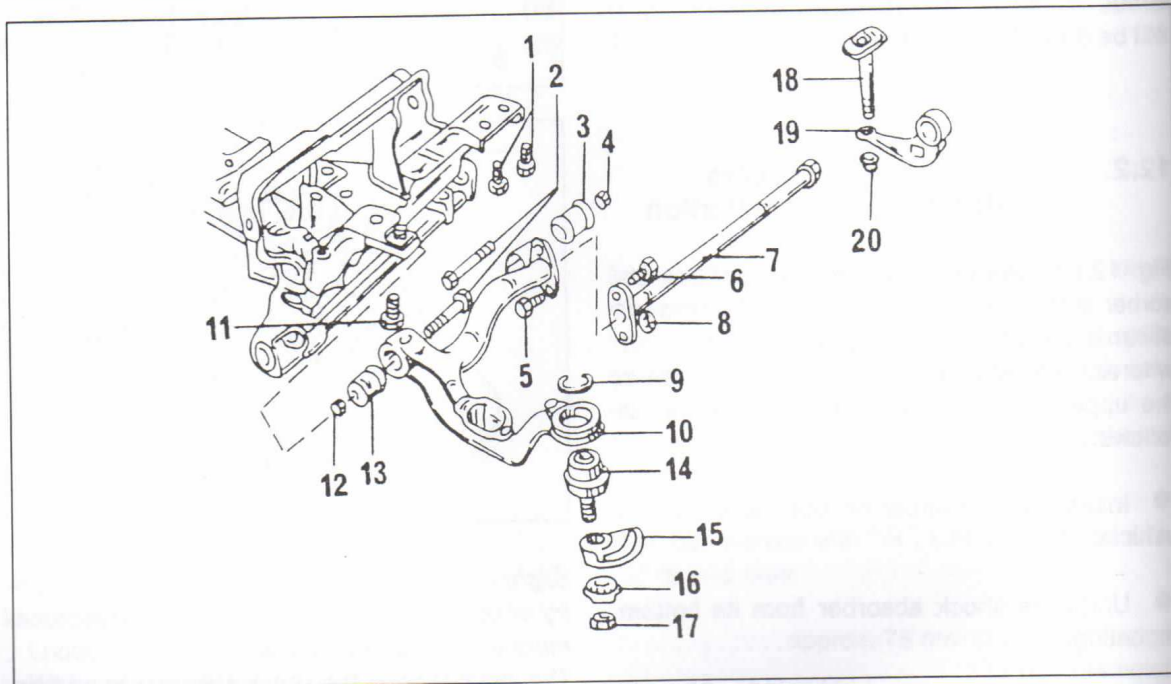
one with the same colour code (Page 112), as the code determines the diameter of the bar. If ever a torsion bar is replaced, you will find that it is supplied together with the tension arm.

We would like to point out that the replacement of a torsion bar is not a quick job, as the fuel tank must be removed, to reach some of the attachment points. If a bar must be removed, proceed as follows, referring to Fig. 12.3 for details involving the fuel tank. We recommend to first read the instructions before you attempt the removal.

- Disconnect the battery earth cable and drain the fuel tank before any other work.
- Remove the tensioning ring (10) from the rubber elbow (11) on the filler tube. Slacken the screw (12).

**Fig. 12.4.**  
The component parts of an upper wishbone together with the torsion bar on one side.

- 1 Bolts, 10.0 kgm
- 2 Bolt, 10.0 kgm
- 3 Wishbone rear mounting
- 4 Nut, 10.0 kgm
- 5 M14 bolt
- 6 Bolt, 16.0 kgm
- 7 Torsion bar
- 8 Nut, 16.0 kgm
- 9 Retaining ring
- 10 Upper wishbone
- 11 Bolt, 16.0 kgm
- 12 Nut, 11.0 kgm
- 13 Wishbone front mounting
- 14 Suspension ball joint
- 15 Eccentric bush (camber)
- 16 Eccentric washer
- 17 Nut, 11.0 kgm
- 18 Adjusting bolt
- 19 Tensioning arm
- 20 Nut



the ground and "bounce" the front end of the vehicle a few times up and down. This will settle the rubber bush in the lower mounting. Tighten the nut to 16.0 kgm (115 ft.lb.).

### 12.3. Torsion Bars — Removal and Installation

Torsion bars are selected for each side of the vehicle and are therefore marked accordingly. A letter is stamped into the end of the bar, letter "R" in the R.H. bar, letter "L" in the L.H. bar, very simple. If a torsion bar is replaced, always fit

- Slide a mobile jack underneath the fuel tank (wooden plank between jack and tank) and slightly lift it up until just under tension.

- Remove the tank clamp bands (6) and the bolts (5). The tank can now be lowered on the jack. Disconnect the return hose (16) and the suction hose (15) after slackening the hose clamps. Also withdraw the connector plug from the fuel tank sender unit (2). Completely remove the tank from underneath the vehicle.

For the remaining operations refer to Fig. 12.4:

- Remove the heat shield for the exhaust



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system, if one is fitted. If necessary disconnect the exhaust system from its suspension brackets and lower it towards the ground.

- Find the lever (19) on the side in question. At the bottom of the lever is a nut (20), which is screwed onto the adjusting bolt (18) for the torsion bar. This bolt determines the height of the vehicle at the front and must therefore be marked before it is disturbed. This can either be carried out by marking the threaded end and the nut as shown in Fig. 12.5, or even better measure the length of the thread protruding out of the nut with a good steel ruler.

- Slowly unscrew the nut (20). VW workshops use a special tool to release the tension of the torsion bar. As this is most probably not available, you can use a large pair of grips to hold the bar against the tension. *Any paint damage to the bar during this operation must be made good by painting the affected areas before the same bar is installed.*

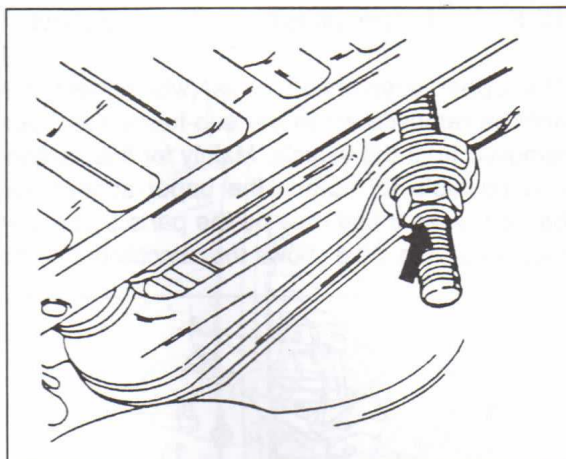
- After the lever (19) is free of tension, remove the nut (8) and the bolt (6) and remove the torsion bar.

The installation of the torsion bar is a reversal of the removal procedure. If the nut is screwed in its original position, in accordance with the marks made, there should be no need to check the front vehicle height. Otherwise check the height as described in the next section and adjust accordingly.

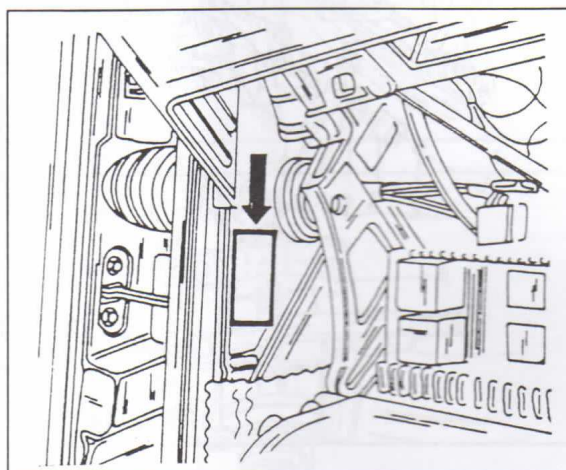
### 12.4. Front Vehicle Height

The various models in the new Transporter range have different vehicle heights at the front. The models are categorised in vehicle groups 1 to 4. The respective height for each group is listed on Page 108, but first you must establish to which group your particular vehicle belongs. For this reason there is a sticker attached to the door pillar at the position shown in Fig. 12.6, approx. at the level of the fuse/relay box. If no sticker is attached, then the vehicle comes under vehicle group 1. Once you know your vehicle group, refer to Page 108 and check the relevant vehicle height.

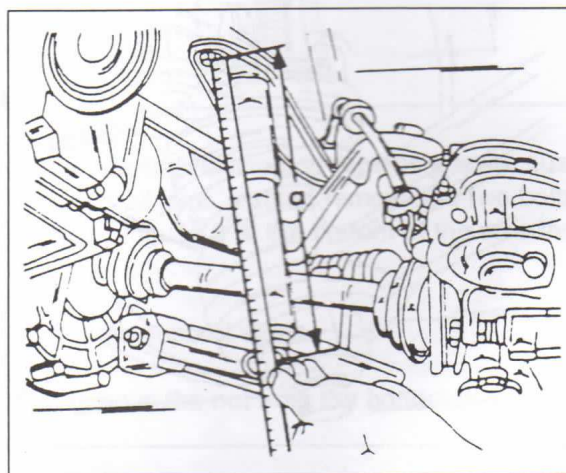
First measure the vehicle height when the vehicle is resting on its wheels. The vehicle must be empty. Measure as shown in Fig. 12.7, from the bolt head of the upper shock absorber mounting



**Fig. 12.5.**  
The arrow shows where the thread and nut can be marked with paint before removal of the torsion bar.



**Fig. 12.6.**  
The arrow shows where the sticker is attached to the door pillar, giving the vehicle group.



**Fig. 12.7.**  
Measuring the vehicle height "a" (see text).

to the centre of the lower shock absorber bolt. Write the obtained dimension on a piece of paper and measure the other side in the same manner, as the dimension could be different.

The nut shown in Fig. 12.5 is now tightened until the correct vehicle height has been obtained. The exact dimension can only be obtained by several attempts, i.e. measure, adjust and measure again. After each adjustment "bounce" the front end of the vehicle up and down to bring the torsion bar in the new position.



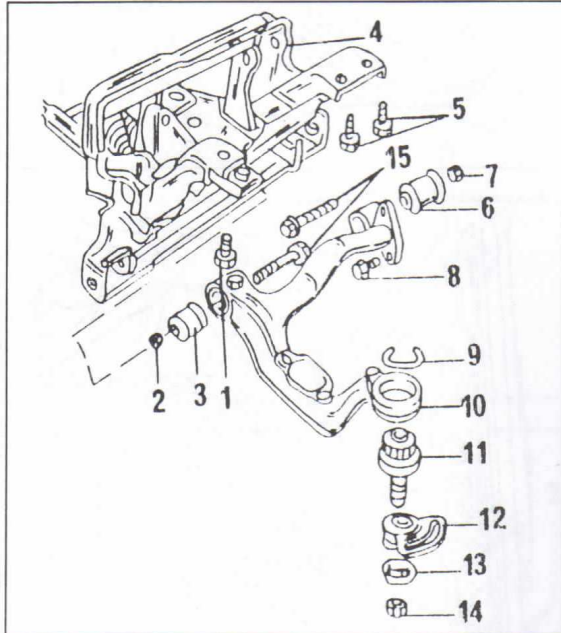
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### 12.5. Upper Wishbone Ball Joints

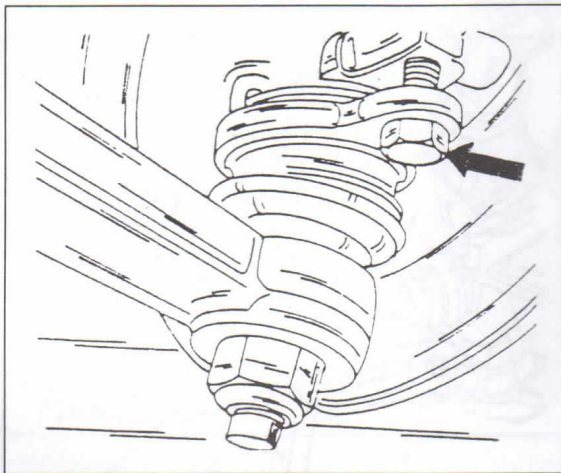
The upper suspension arms (wishbones) can only be removed when the sub-frame has been removed from the vehicle. Mainly for this reason, it is possible to replace the upper suspension ball joints, as these may be the parts that suffer most wear. Fig. 12.8 shows the attachment of the

**Fig. 12.8.**  
The component parts of an upper wishbone and the ball joint. The wishbone is bolted to the suspension sub-frame.

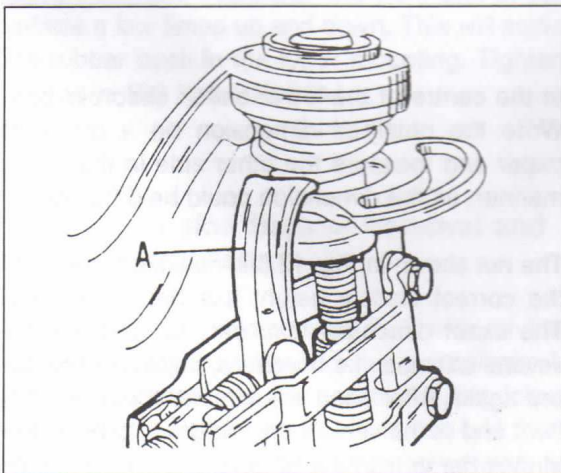
- 1 Bolt, 16.0 kgm
- 2 Nut, 11.0 kgm
- 3 Front wishbone mounting
- 4 Suspension sub-frame
- 5 Bolts, 10.0 kgm
- 6 Rear wishbone mounting
- 7 Nut, 10.0 kgm
- 8 Bolt
- 9 Retaining ring for ball joint
- 10 Upper wishbone
- 11 Suspension ball joint
- 12 Eccentric adjuster
- 13 Eccentric washer
- 14 Nut, 11.0 kgm
- 15 Bolt, wishbone



**Fig. 12.9.**  
Removal of lower suspension ball joint.



**Fig. 12.10.**  
The eccentric adjuster must be pulled off with a two-arm puller (A) and is pressed over the ball joint during installation.



upper ball joint to the wishbone and the steering knuckle (wheel bearing housing). Note the eccentric adjuster (12) which is used to adjust the camber and is clamped by means of a bolt to the wishbone. An eccentric washer (13) is fitted to the bottom of the ball joint. This washer is used to adjust the camber, but the special tool, already mentioned in Section 12.5.1, is required to do the adjustment. Replace a ball joint as follows:

- Insert the support struts.
  - Slacken the bolt in the centre of the drive shaft as long as the wheels are on the ground and jack up the front of the vehicle.
  - Unscrew the brake caliper and, using a piece of wire, tie it to some part of the front suspension to prevent the caliper from hanging down on the brake hose.
  - Refer to Fig. 12.9 and remove the two bolts shown by the arrow (one on each side) and push the ball joint together with the lower wishbone away from the steering knuckle.
  - Remove the nut from the lower shock absorber mounting and drive out the bolt. Take off the air deflector, if one is fitted. On the other side the linkage for the stabiliser bar will be freed.
- Important** — Mark the fitted position of the eccentric adjuster (12) on the steering knuckle.
- Remove the ball joint nut (14) at the bottom, but before mark the exact position of the eccentric washer (13). The nut must be replaced (self-locking). Remove the eccentric washer securing bolt from the steering knuckle.
  - Separate the track rod ball joint from the steering lever, using a suitable puller and in a similar manner disconnect the suspension ball joint from the steering knuckle.
  - Push the upper wishbone upwards as far as it will go and remove the steering knuckle. The ball joint must be replaced in a vice.
  - Refer to Fig. 12.10 and pull the eccentric adjuster off the ball joint stud. The claws of the two-arm puller are placed underneath the adjuster. Tighten the extractor bolt until the adjuster is free.
  - Remove the retaining ring (9) with a screwdriver from the wishbone/ball joint connection.



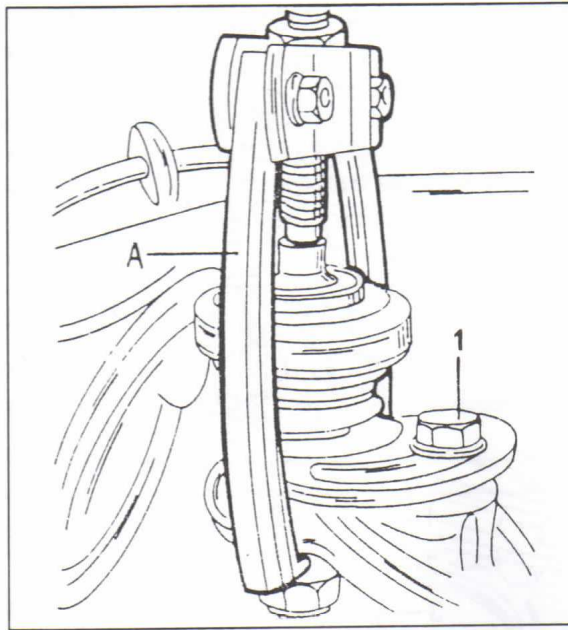
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The ball joint must now be pressed out of the wishbone. This again is carried out with a two-arm puller, this time as shown in Fig. 12.11. The illustration also shows the securing bolt for the eccentric adjuster.

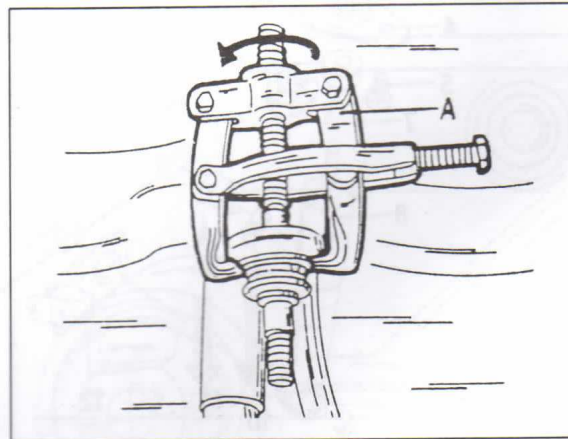
- Fit the new ball joint in the wishbone and use the puller shown in Fig. 12.11, but from the other side. Insert a new retaining ring (9) when the ball joint is in position. In a similar manner press the eccentric adjuster in position.
- Insert the steering knuckle into the front suspension and connect the upper suspension ball joint. Wipe the ball joint shank clean of grease. The position of the eccentric adjuster is not important at the moment.
- Push the eccentric washer over the ball joint stud, in accordance with the marks made before removal and screw on a new nut finger-tight.
- Now rotate the eccentric adjuster to align the marks made before removal and fit and tighten the bolt (1) in Fig. 12.11 to 6.0 kgm (46 ft.lb.).
- Tighten the ball joint nut to a torque of 11.0 kgm (80 ft.lb.). The nut must always be replaced. Sometimes it is possible that the ball joint stud turns when the nut is tightened. This can be prevented by using the two-arm puller as shown in Fig. 12.12, i.e. the stud is pushed into its conical seat and cannot rotate. Tighten the puller bolt just sufficiently enough to stop the stud from rotating.
- Fit the connecting linkage for the stabiliser bar in position, insert the long bolt through the linkage and the wishbone, if fitted, place the air deflector in position and fit the shock absorber to the other side. Fit and tighten the nut to 16.0 kgm (115 ft.lb.).
- Refit the brake caliper. Tighten the bolts to 16.0 kgm (115 ft.lb.).
- Refit the wheels, lower the vehicle to the ground and tighten the axle shaft bolt to 20.0 kgm (145 ft.lb.).
- Remove the support struts from the front suspension.

### 12.6. Lower Wishbone Ball Joints

There is no need to remove the steering knuckle



**Fig. 12.11.** Use a two-arm puller (A) to remove and refit the upper ball joint. The bolt (1) for the eccentric adjuster is tightened to 6.0 kgm (46 ft.lb.).



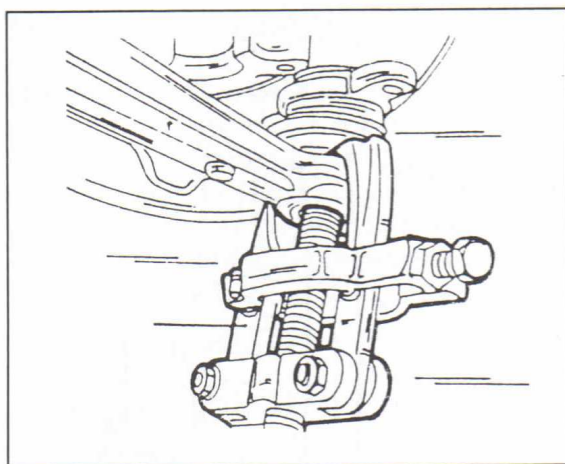
**Fig. 12.12.** Clamping a ball joint in position to prevent from rotating.

(wheel bearing housing) to replace a lower suspension ball joint. Instead remove the two bolts shown in Fig. 12.9 at the bottom of the steering knuckle.

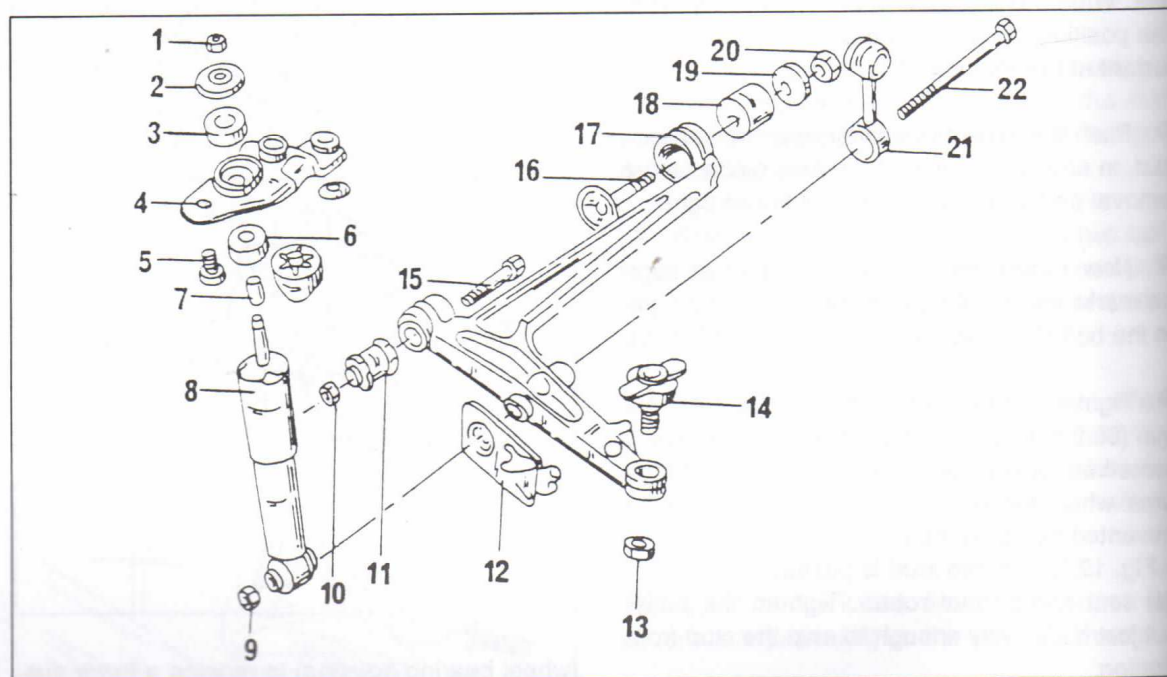
- Fit the support struts.
- Remove the nut from the bottom of the ball joint.
- At the bottom of the suspension remove the nut in front of the shock absorber and carefully knock out the long bolt. The connecting linkage for the stabiliser bar can be taken off on the other side.
- Remove the two bolts shown in Fig. 12.9 and push the lower wishbone away from the steering knuckle.
- Use a two-arm puller as shown in Fig. 12.13 and press the ball joint out of the wishbone.
- Fit the new ball joint into the wishbone and



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**Fig. 12.13.**  
Using a two-arm puller to separate a lower ball joint from the steering knuckle.



**Fig. 12.14.**  
Exploded view of a lower wishbone.

- 1 Nut, 2.5 kgm
- 2 Washer
- 3 Upper rubber bearing
- 4 Upper damper mounting
- 5 Bolt, 10.0 kgm
- 6 Lower rubber bush
- 7 Spacer sleeve
- 8 Shock absorber
- 9 Nut, 10.0 kgm
- 10 Nut, 16.0 kgm
- 11 Rubber bearing, front
- 12 Air deflector (14 in. wheels)
- 13 Nut, 11.0 kgm
- 14 Lower ball joint
- 15 Front bearing bolt
- 16 Eccentric bolt, rear
- 17 Lower wishbone
- 18 Rubber bush, rear
- 19 Eccentric washer
- 20 Nut, 7.5 kgm + 90°
- 21 Connecting linkage
- 22 Shock absorber bolt

pull the stud into position, again using the two-arm puller, but this time apply the claws to the mounting plate. Otherwise try to knock the ball joint into position, until the thread is protruding on the other side.

- Fit the mounting plate to the steering knuckle, insert the bolts and tighten them evenly to 5.5 kgm (40 ft.lb.).

- Screw a new nut onto the ball joint stud and tighten to 11.0 kgm (80 ft.lb.). The ball joint stud may rotate at first.

- Fit the shock absorber and the linkage for the stabiliser bar to the lower wishbone and tighten the nut to 16.0 kgm (115 ft.lb.).

- Carry out all other operations in reverse order to remove. Note the tightening torques not given in the above description.

### 12.7. Lower Wishbones

Fig. 12.14 shows the attachment of a lower wishbone. A special note should be made of the rear mounting, as provision is made for the adjustment of the castor. An M12 eccentric bolt on one side and an eccentric washer on the other side are used to correct the castor. If the nut of bolt (16) is slackened for any reason, as will be the case when the wishbone is removed, a new bolt must be fitted. Tighten the nuts and bolts of the wishbone mountings when the unladen weight of the vehicle is resting on the wheels. This will set the rubber mountings to

their correct tension. Removal and installation can be carried out as follows:

- Insert support struts, jack up the front end of the vehicle and remove the wheel on the side in question.

- Remove the two bolts securing the lower ball joint to the steering knuckle. Remove the nut (13) when the wishbone is to be replaced. Otherwise leave the ball joint in position.

- Remove the nut (9) and carefully knock out the long bolt (22). This will release the shock absorber (8), the air deflector (12), if fitted, and the connecting linkage for the stabiliser bar (21). Push the wishbone downwards to free it of the steering knuckle.

- Mark the head of the eccentric bolt (16) at the rear wishbone mounting and the eccentric



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washer (19) on the other side. This will give the castor setting which should not be disturbed if at all possible. As the bolt must be removed, transfer the mark to the new bolt before installation. After removal of the nut (20), knock out the bolt and take off the parts.

- At the front of the wishbone mounting remove the nut (10) and knock out the bolt (15). The wishbone can now be lifted out.

The installation is a reversal of the removal procedure. All tightening torques are given in Fig. 12.14. Tighten the nuts of the front and rear mountings when the wheels are back on the ground. Tighten the rear mounting (eccentric bolt and washer) as follows:

- Tighten the nut (20) to a torque of 7.5 kgm, using a torque spanner, and from this position a further  $90^\circ$  ( $\frac{1}{4}$  of a turn), using a ring spanner. After tightening the rear mounting check that the mating marks on eccentric bolt and eccentric washer are as originally found. If the steering pulls to one side or the wheels "wobble" during a road test, check the castor setting or have it checked.

### 12.7.0. REPLACING THE WISHBONE BUSHES

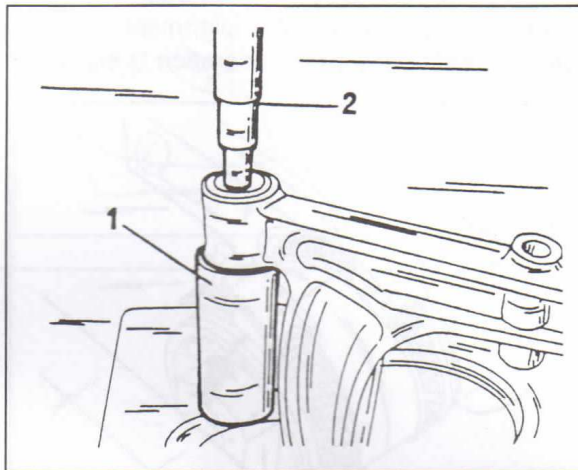
The bushes at the front and rear of a lower wishbone must be replaced under a press. Driving them out and in with a hammer and a mandrel is pointless, as the bushes will be damaged during installation. VW Workshops obviously use special press mandrels to remove and install the bushes, but by referring to Fig. 12.15 you will be able to make your own arrangements, should bushes require replacement. The following points must be noted when new bushes are pressed in, especially the rubber/metal bush of the rear mounting:

- Place the wishbone with the front mounting over a piece of tube ("1", Fig. 12.15) and with a suitable mandrel (2) press the bush out of the mounting eye. The old bush will drop into the tube.

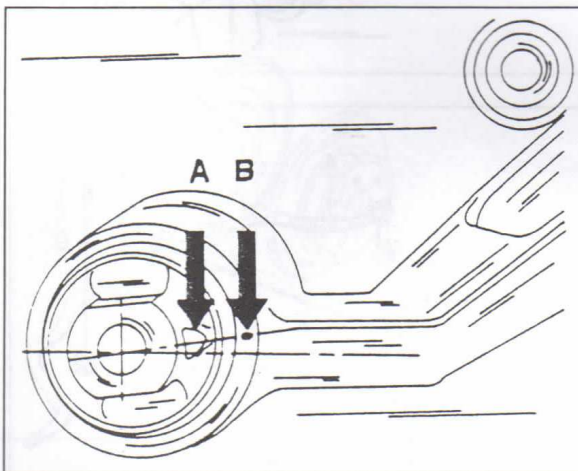
- Coat the outside of the new bush with soapy water and insert the bush into the bore. Again place the piece of tube under the mounting lug and press the bush into the wishbone until the shoulder of the bush protrudes by the same amount on both sides. The operation is to be

carried out slowly to obtain the correct installation depth.

- The new rubber/metal bush on the rear end must be fitted in a certain angle. As this angle cannot be measured, proceed as follows:



**Fig. 12.15.** Wishbone rubber mounting bushes can be removed and refitted with a mandrel (1) and a piece of tube (2).



**Fig. 12.16.** Correct installation of the rear rubber/metal (bonded) mounting bush. Punch a mark (B) opposite the tip of the lug (A) in the bush.

- Use a centre punch and mark the wishbone at the position shown in Fig. 12.16, i.e. the punch mark (B) must be exactly opposite the lug (A). The tip of the lug points  $11^\circ$  above the symmetrical axis of the wishbone.

- Place the wishbone under a press in a similar manner as shown in Fig. 12.15. and press out the old bush.

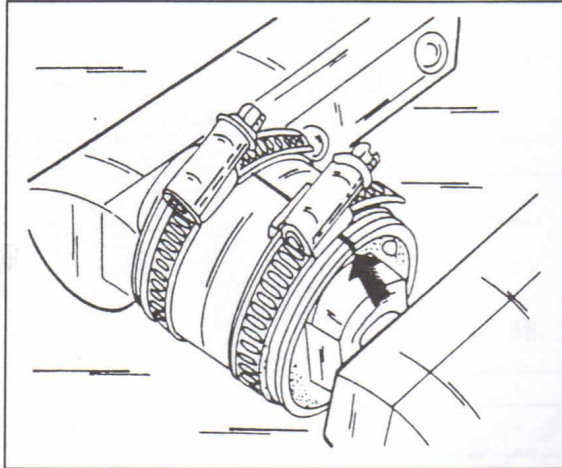
- The new bearing bush must now be pre-tensioned as it is larger than the bore in the wishbone. To do this, place two Jubilee clips around the bush as shown in Fig. 12.17 and tighten the clips until the two halves of the outer case touch each other, as indicated by the arrow in the illustration.

- Insert the prepared rubber mounting into the wishbone at the angle described. This operation is of course critical and also requires a measure-

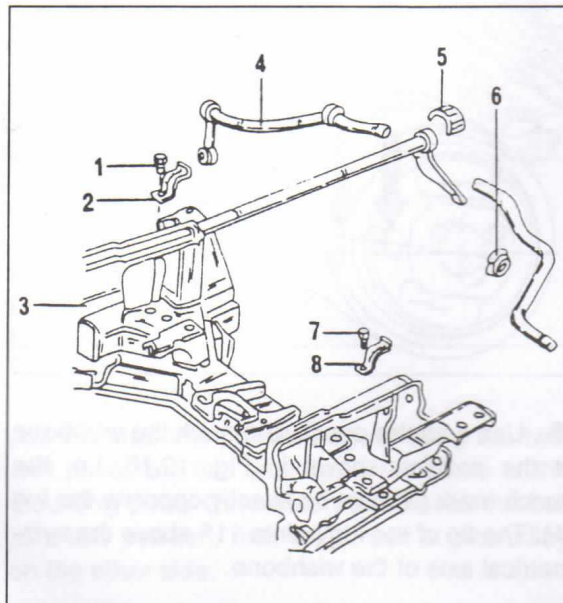


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ment. The bush is pressed into the wishbone until the dimension from the inner sleeve of the front rubber mounting to the inner sleeve of the rear rubber mounting must be exactly  $371 \pm 1$  mm. The Jubilee clips will slide off the bush as it is installed. The lug (A) and the centre punch mark (B) must coincide after the bush has been pressed in position, i.e. the alignment must be achieved before the press operation is started.



**Fig. 12.17.**  
Before fitting the rubber/metal mounting bush, compress the outer case with two Jubilee clips until the two halves meet at the point shown by the arrow.



**Fig. 12.18.**  
The component parts of the stabiliser bar.  
1 Bolt, 5.5 kgm (40 ft.lb.)  
2 Mounting clamp  
3 Sub-frame  
4 Stabiliser bar  
5 Rubber bush  
6 Stabiliser bush  
7 Bolt, 5.5 kgm (40 ft.lb.)  
8 Mounting clamp

### 12.8. Upper Wishbones

The suspension sub-frame must be removed to replace an upper wishbone (Section 12.11). This is a fairly complex operation and should only be carried out if the wishbone bearing bushes must be replaced. Figs. 12.4 and 12.8 show details of the attachment. The wishbone(s) can be removed after the sub-frame has been separated. The torsion bar must also be removed before a wishbone can be freed from its mountings. All necessary operations are described in Section

12.3, as is the removal of the wishbone ball joint from the steering knuckle (Section 6.5). After carrying out these operations, unbolt the wishbone from the sub-frame.

The installation is a reversal of the removal procedure. Follow the tightening torques in the two illustrations. Note that the torque values for the front and rear mountings are not the same. Both must be tightened when the unladen weight of the vehicle is resting on its wheels.

After installation of the sub-frame, check the front height of the vehicle or have it checked. Section 12.4 describes the necessary operations. The front wheel alignment should also be checked.

### 12.8.1. REPLACING THE WISHBONE MOUNTING BUSHES

Both mounting bushes of the upper wishbones can be replaced in a similar manner as described for the bushes of the lower wishbones in Section 12.7.0. The installation is easier, as the bushes are symmetrical. Coat the outside with soapy water and press the bushes in position until the mounting collar protrudes by the same amount on both sides.

### 12.9. Stabiliser (anti-roll) Bar

Fig. 12.18 shows the attachment of the stabiliser bar on the suspension sub-frame, using rubber bushes and mounting clamps. The ends of the stabiliser bar have a connecting linkage, which is attached together with the lower mounting bolt for the shock absorber to the lower wishbone (also holds air deflector on models with 14 in. wheels). Fig. 12.14 shows how this connection takes place. Remove and install as follows:

- Insert support struts, jack up the front end of the vehicle and remove the wheels.
- On both sides of the vehicle remove the nut of the lower shock absorber mounting, knock out the long bolt and take off the two linkages. The linkages are pressed over the stabiliser bar and come away with the latter. Remove the air deflector, if fitted.
- Remove the bolts (1) and (7) on both sides of the vehicle, take off the mounting clamps (2) and (8) and take out the bar.

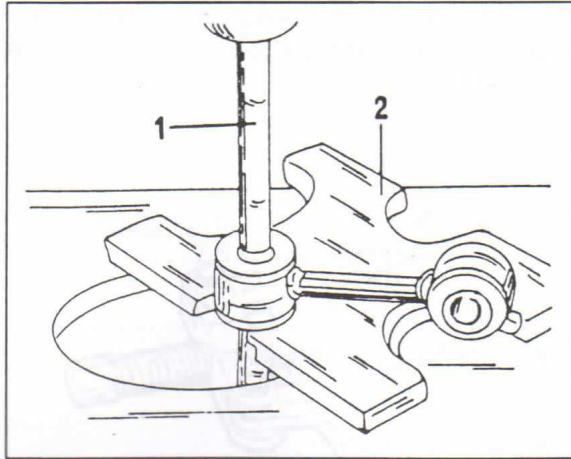


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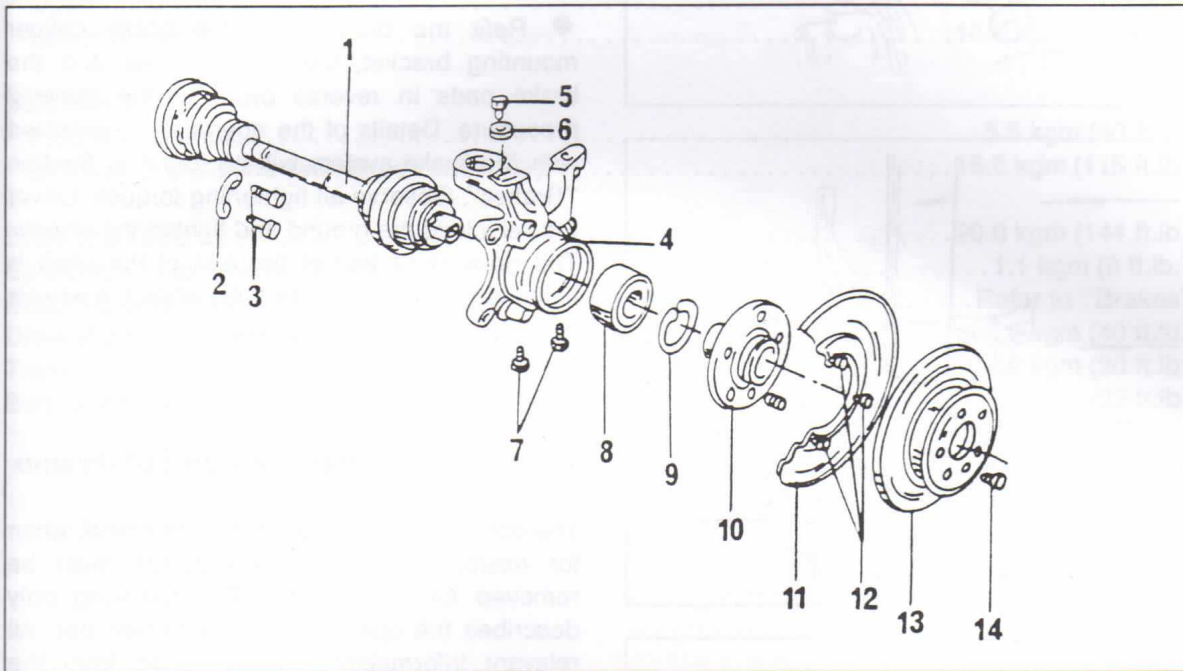
- To remove the linkages, place the stabiliser bar under a press, as shown in Fig. 12.19 and press the bar through the linkage bushes.

The mounting bushes of the stabiliser bar can easily be replaced. The linkages are also fitted with rubber bushes, but new linkages must be fitted if the bushes are worn.

The installation of the stabiliser bar is a reversal of the removal procedure. The tightening torques are given in Figs. 12.4 and 12.8 and must be followed. The mounting clamp bolts are tightened to 5.5 kgm (40 ft.lb.).



**Fig. 12.19.**  
Place the stabiliser bar onto a press plate (2) and use a mandrel (1) to press the bar ends out of the bushes.



**Fig. 12.20.**  
Exploded view of steering knuckle, wheel bearing and wheel hub.  
1 Drive shaft  
2 Reinforcement plate  
3 Bolts, 5.5 kgm  
4 Steering knuckle  
5 Bolt, 6.0 kgm  
6 Washer  
7 Bolts, 5.5 kgm  
8 Wheel bearing  
9 Circlip  
10 Wheel hub  
11 Splash guard panel  
12 Bolts, 0.8 kgm  
13 Brake disc  
14 Bolt, 0.5 kgm

### 12.10. Front Wheel Bearings

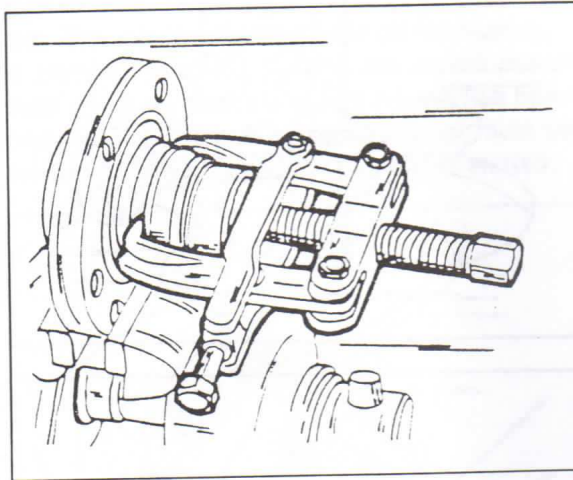
Fig. 12.20 shows an exploded view of the wheel bearing housing (steering knuckle), the wheel bearing and the wheel hub. The steering knuckle must be removed to replace the wheel bearing. Refer to Fig. 12.5, describing the removal of the upper suspension ball joint. Before removal of the steering knuckle carry out the following operations:

- Insert support struts.
- Slacken the drive shaft bolt and the wheel nuts, jack up the front of the vehicle, insert axle stands and remove the wheel on the side in question.
- Remove the brake pads as described in Section "Brakes" and remove the brake caliper. Suspend the caliper on a piece of wire to prevent it from hanging down on the brake hose.
- Unscrew the brake caliper mounting bracket from the steering knuckle.
- Remove the brake disc securing screw and take off the disc. The steering knuckle can now be removed as described in Section 12.4.
- Place the wheel hub together with the steering knuckle under a press and slowly press the hub carefully out of the steering knuckle, using a suitable mandrel.
- Unscrew the splash shield from the steering knuckle and remove the circlip from the outside of the steering knuckle.
- Press the bearing from the inside towards the outside out of the steering knuckle.
- The inner bearing race remains on the wheel hub and must be removed with a puller, in the manner shown in Fig. 12.21.

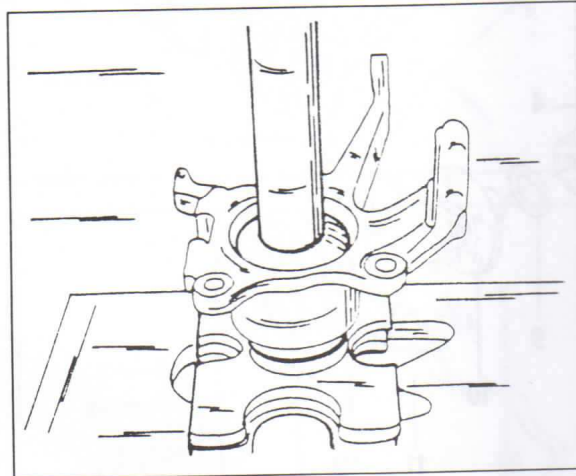


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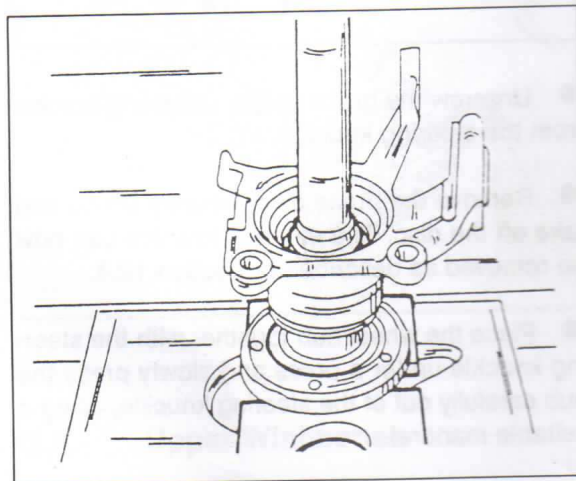
- Fit the circlip into the outside of the steering knuckle and coat the inside of the bearing bore with grease.



**Fig. 12.21.**  
The inner bearing race remains on the wheel hub and must be removed as shown.



**Fig. 12.22.**  
The new wheel bearing is pressed into position.



**Fig. 12.23.**  
Pressing the wheel hub into the bearing housing and steering knuckle.

- Place the wheel bearing housing under a press and press the wheel bearing from the inside into the housing. Arrange the steering

knuckle as shown in Fig. 12.22 and press the bearing into the steering knuckle until it rests against the circlip on the other side.

- Now press the wheel hub in position. To do this, place the wheel hub onto the press table and place the steering knuckle/bearing over the hub. The press tube must only be applied to the inner bearing race.

- Refit the splash guard.

- Refit the steering knuckle as described in Section 12.5.

- Refit the brake disc, the brake caliper mounting bracket, the brake caliper and the brake pads in reverse order to the removal procedure. Details of the operations connected with the brake system will be found in Section "Brakes". Observe all tightening torques. Lower the vehicle to the ground and tighten the wheels. The drive shaft bolt in the end of the shaft is tightened to 20.0 kgm (144 ft.lb.) when the wheels are back on the ground.

### 12.11. Front Suspension Sub-Frame

The complete sub-frame must be removed, when for example the upper wishbones must be removed for any reason. The following only describes the operations to be carried out. All relevant information can be taken from the section in question. The sub-frame must be lowered on a mobile jack, well supported, after the operations given below have been carried out.

Release the torsion bar tension, disconnect the steering box from the steering shaft, disconnect the power steering hoses and the brake pipe connections, unscrew the drive shafts from the transmission, remove the bolts securing the rubber/metal mountings, remove the sub-frame mounting bolts and lower the sub-frame as described.

Install the sub-frame in reverse order to removal. Tighten the rubber/metal bearings with 5.5 kgm (40 ft.lb.) and the sub-frame mounting bolts with 10.0 kgm (7.2 ft.lb.).

### 12.12. Tightening Torque Values — Front Suspension

Upper Wishbone to Body:

Front mounting: ..... 11. kgm (80 ft.lb.)







[illegible]



## 12 Front Suspension

Rear mounting: ..... 10.0 kgm (72 ft.lb.)  
Upper ball joint to steering knuckle: ..... 11.0 kgm (80 ft.lb.)  
Eccentric adjuster to steering knuckle: ..... 6.0 kgm (43.5 ft.lb.)  
Torsion bar to wishbone, bolt and nut: ..... 16.0 kgm (115 ft.lb.)

### Lower Wishbone to Body:

Front mounting: ..... 16.0 kgm (115 ft.lb.)  
Rear mounting: ..... 7.5 kgm + 90° (54 ft.lb. + 90°)

Ball joint to steering knuckle: ..... 5.5 kgm (40 ft.lb.)  
Ball joint to wishbone: ..... 11.0 kgm (80 ft.lb.)

### Shock Absorbers:

Upper mounting, nut: ..... 2.5 kgm (18 ft.lb.)  
Upper mounting bracket: ..... 10.0 kgm (72 ft.lb.)  
Lower mounting, nut: ..... 16.0 kgm (115 ft.lb.)

### Stabiliser Bar:

Mounting clamps: ..... 5.5 kgm (40 ft.lb.)  
Linkage to wishbone (with shock absorber): ..... 16.0 kgm (115 ft.lb.)

Drive shaft bolt: ..... 20.0 kgm (144 ft.lb.)  
Splash guard to steering knuckle: ..... 1.1 kgm (8 ft.lb.)  
Brake calipers: ..... Refer to "Brakes"  
Drive shafts to transmission: ..... 5.5 kgm (40 ft.lb.)  
Track rod ball joints to steering levers: ..... 4.0 kgm (30 ft.lb.)  
Bolt for wheel speed sensor: ..... 3.0 kgm (22 ft.lb.)



## 13 REAR AXLE AND REAR SUSPENSION

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| Removal and Installation ..... | 124 | <b>Rear Wheel Hubs and Wheel Bearings</b> ... | 127 |
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The rear suspension consists of trailing arms, coil springs, hydraulic telescopic shock absorbers and a stabiliser (anti-roll) bar. The wheel hubs are fitted to the trailing arms and have wheel shafts with the wheel bearing inserted into the arm.

Note that the coil springs are not the same for all models. As many models are available, some with heavy-duty springs at the rear, some with heavy-duty suspension front and rear, it will be confusing to list them all. As a basic rule, always fit springs with the same colour code, if ever

there is need to change one of the springs, or both.

Various special tools are used to carry out work on the rear suspension. An extensive tool kit is for example necessary to replace the rear wheel bearings, i.e. to remove the rear wheel hub out of the wheel bearing and to remove the rear wheel bearing out of the trailing arm. Various illustrations show the shape of these tools so that you may be able to substitute them with corresponding make-shift tools.

### 13.0. Technical Data

|                                     |                                                                                                 |
|-------------------------------------|-------------------------------------------------------------------------------------------------|
| Type: .....                         | See above. Stabiliser bar not for all models                                                    |
| Rear wheel hubs: .....              | Wheel bearing fitted to trailing arm, held in position with through bolt and nut at the inside. |
| Rear track, 5 1/2 x J14 rims: ..... | 1540 mm (61.18 in.)                                                                             |
| Rear track, 6J x 15 rims: .....     | 1554 mm (61.74 in.)                                                                             |
| Wheel bearing adjustment: .....     | Not required                                                                                    |
| Coil springs: .....                 | Colour coded, depending on model                                                                |
| Rear wheel alignment: .....         | See Section 7.6                                                                                 |

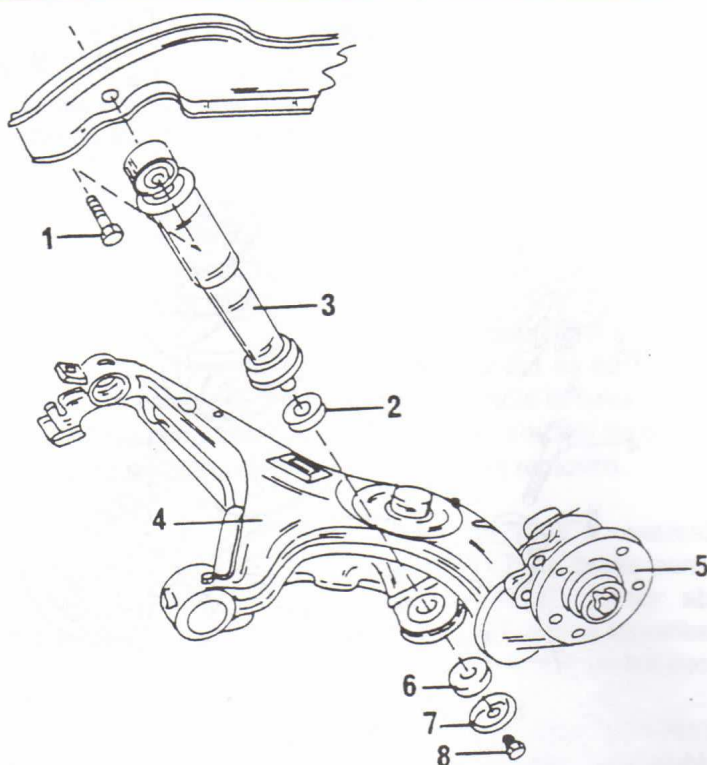
### 13.1. Rear Shock Absorbers

A large open-ended spanner may be required to hold the shock absorber against rotation when the securing bolt is inserted from the bottom.

Apply the spanner as shown in Fig. 13.2. Sometimes it may be possible to remove the bolt without the use of the spanner, as the shock



## 13 Rear Axle and Rear Suspension



**Fig. 13.1.**  
The attachment of a rear shock absorber.

- 1 Bolt, 10.0 kgm
- 2 Upper rubber bearing
- 3 Shock absorber
- 4 Trailing arm
- 5 Rear wheel hub
- 6 Lower rubber bearing
- 7 Dished washer
- 8 Bolt, 4.5 kgm (32.5 ft.lb.)

absorber is tight enough not to rotate. The mounting bolt is fitted from below, not horizontally as is the conventional design.

- Remove the bolt shown in Fig. 13.3 as long as the wheels are still on the ground. If access to the bolt is denied, lift the rear end of the vehicle until the bolt is visible above the wheel and slacken it with a socket and an extension. Do not remove the bolt at this stage.

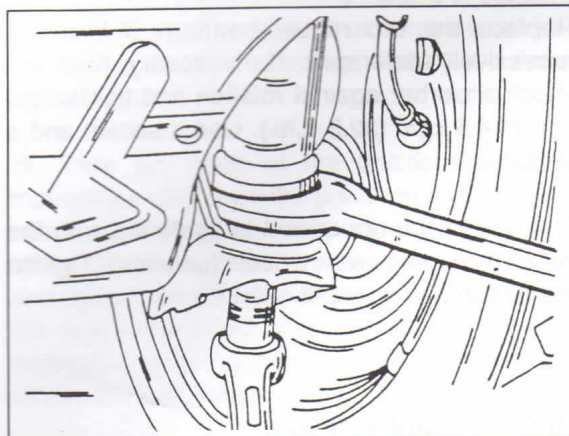
- Place the rear end of the vehicle on chassis stands and place a jack underneath the trailing arm. Jack up the trailing arm until the shock absorber is just commencing its compression stroke. Remove the bolt at the bottom with a socket and ratchet. Use the spanner shown in Fig. 13.2 if the damper shows tendencies to rotate.

- Remove the dished washer. The collar of the washer is facing against the rubber bush (6).

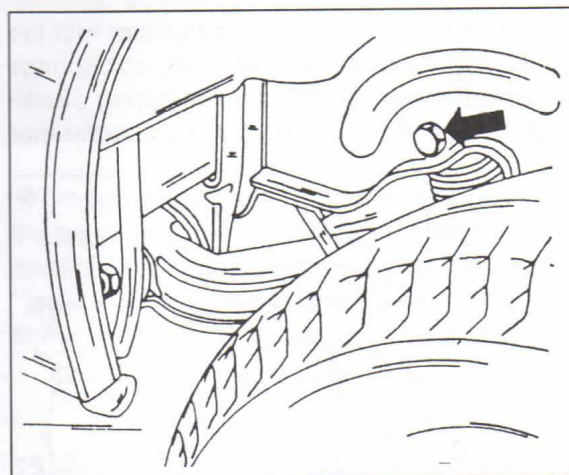
- Remove the washer (6) and remove the upper shock absorber bolt.

- Slowly lower the jack until the shock absorber is free of the upper and lower mounting brackets and remove it. The rubber bush (2) can be removed from the bottom.

Check a shock absorber for proper functioning, as described for the front dampers on page 113.



**Fig. 13.2.**  
Hold the shock absorber against rotation with a large spanner when the mounting bolt is removed or tightened.



**Fig. 13.3.**  
The upper shock absorber mounting bolt (arrow).

Shock absorbers cannot be repaired or refilled and must be replaced if their action is sluggish or "dead" travel is encountered.

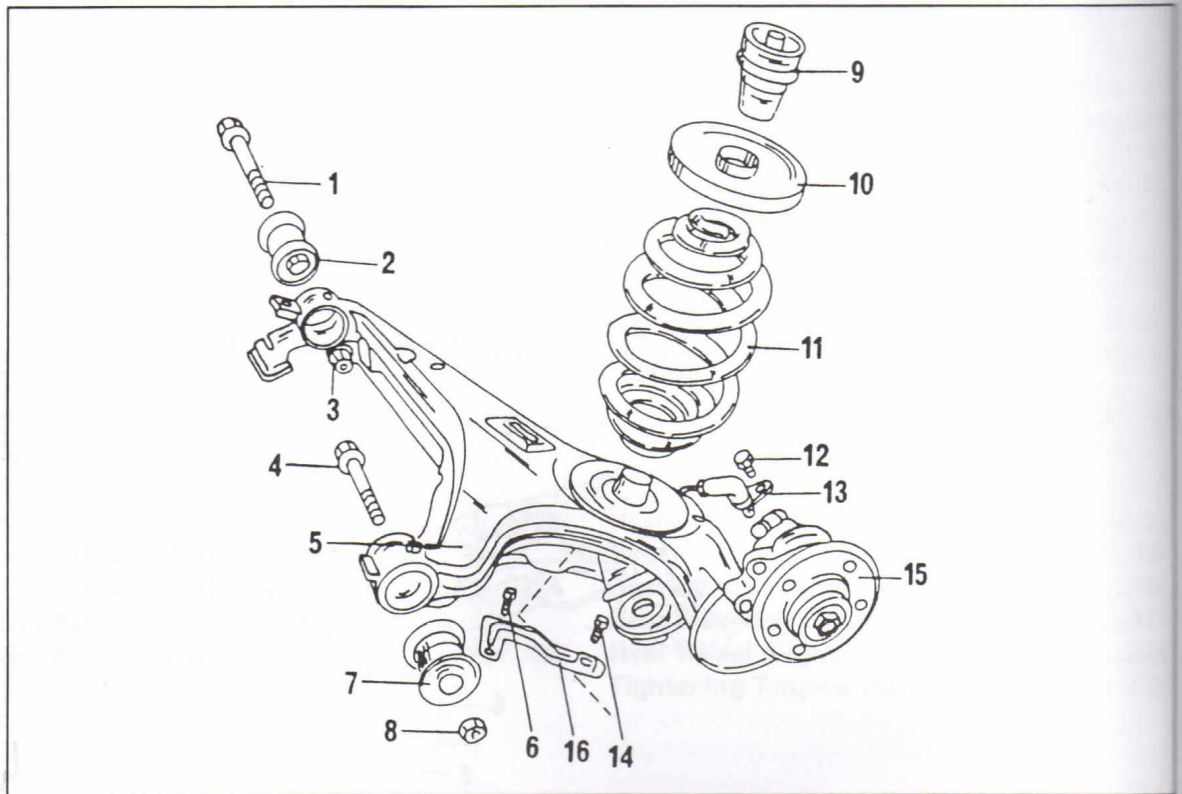
The installation is carried out in reverse order.



## 13 Rear Axle and Rear Suspension

**Fig. 13.4.**  
View of coil spring and trailing arm without shock absorber.

- 1 Trailing arm bolt
- 2 Inner rubber/metal bush
- 3 Nut, 10.0 kgm
- 4 Trailing arm bolt
- 5 Trailing arm
- 6 Self-tapping screw
- 7 Outer rubber/metal bush
- 8 Nut, 16.0 kgm
- 9 Rebound rubber
- 10 Upper spring seat
- 11 Coil spring
- 12 Bolt, 10.0 kgm
- 13 Speed sensor (with ABS)
- 14 Screw, 0.7 kgm
- 15 Rear wheel hub
- 16 Handbrake cable bracket

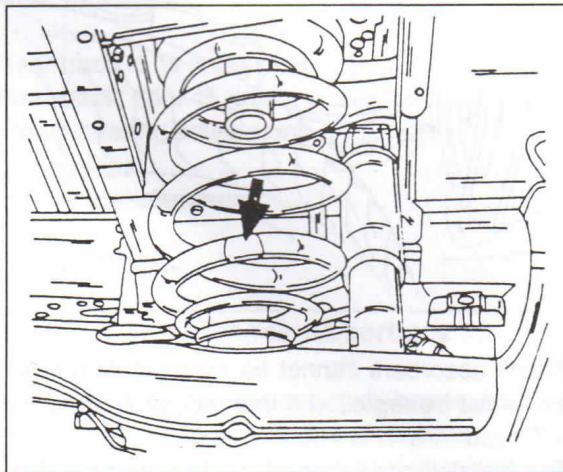


Replace the two rubber bearings if they are excessively deformed. If necessary hold the shock absorber against rotation and tighten the bolt to 4.5 kgm (32.5 ft.lb.). Use a socket and a torque wrench.

The bolt at the upper end is tightened with the vehicle standing on its wheels (unladen). Tighten the bolt to 10.0 kgm (72 ft.lb.).

### 13.2. Coil Springs

Fig. 13.4 shows the trailing arm together with the coil spring. As already mentioned, coil springs are colour-coded to indicate the spring classification. To find the colour-code look at the rear



**Fig. 13.5.**  
The arrow shows where the colour-code of the rear springs is marked (seen from the rear).

spring, in the direction of drive where a coloured mark will be visible at the position shown in Fig. 13.5, but remember, dirt will cover up the spring and the area must be cleaned first to identify the colour. The springs are "clamped" between body and trailing arm, but cannot dislodge because of the movement restrictions imposed by the shock absorbers. Replace a coil spring as follows:

- Slacken the wheels and remove the bolt shown in Fig. 13.3 (refer to description on page 125).

- Jack up the rear end of the vehicle, insert axle stands and remove the wheel. Place the jack underneath the trailing arm and lift the arm until the shock absorber is compressed.

- Remove the mounting bolt from the upper damper mounting. Slowly lower the jack until the trailing arm is low enough for the coil spring to be free to be taken out. Remove the upper spring seat. The rebound rubber can be unscrewed if no longer in good condition.

The installation of the coil spring is a reversal of the removal procedure, but the following points must be noted:

- Fit the spring seat (10) so that the spring end engages into the shape of the seat.

- Turn the spring until the colour-code is at the



rear of the spring, as can be seen in Fig. 13.5.

- Hold the spring and the spring seat in position and ask a helper to operate the jack until the spring is correctly fitted between trailing arm and body.

- Continue to operate the jack, at the same time engaging the upper end of the shock absorber into its mounting. Insert the bolt without tightening.

- Refit the rear wheel, lower the vehicle to the ground and tighten the upper mounting bolt to 10.0 kgm (72 ft.lb.). Tighten the wheel nuts to 16.0 kgm (115 ft.lb.).

### 13.3. Rear Trailing Arms

The rear mounting of the trailing arm determines the wheel alignment of the rear wheels. It is therefore necessary to mark the position of the bolt (1) in Fig. 13.4 exactly to avoid the adjustment of the rear wheels. A trailing arm can be removed by referring to Fig. 13.4:

- Remove the coil springs as described in the last section, with the difference that the shock absorber must be removed from the lower mounting in order to lift it out at a later stage.

- Mark the head of the bolt (1) and the mounting on the body in suitable manner. We recommend a centre punch to mark the bolt head near the outside and the mounting bracket exactly opposite.

- Remove the nut (3) at the inside and the nut (8) at the outside. If a stabiliser bar is fitted, remove it from the trailing arm and the body and lift it out.

- Remove the bolt securing the handbrake cable bracket to the trailing arm and take off the bracket.

- Disconnect the springs for the brake pressure regulator from the horizontal beam. *A new trailing arm requires the brake pressure regulator to be adjusted.*

- If an ABS is fitted, remove the screw securing the wheel speed sensor (13) and withdraw the sensor. Wrap some tape around the end of the sensor or cover it with a piece of plastic to protect it from contamination.

## 13 Rear Axle and Rear Suspension

- Remove the brake drum as described in Section "Brakes" and remove the brake back plate. The handbrake cable can remain connected to the brake shoes, but the necessary precautions must be taken not to stretch it. The brake pipe must, however, be unscrewed. Beware of possible brake fluid escape.

- Knock out the two bolts securing the trailing arm and remove it from the inside.

The rubber/metal bushes of the trailing arm can be replaced, but as special tools are required, you may be able to have the bushes replaced at a VW dealer. You will be able to decide after the arm has been removed.

The installation is a reversal of the removal procedure. Fit the brake parts as described in section "Brakes". Shock absorber and coil spring are refitted as described under the corresponding heading in this section.

Tighten the two nuts and bolts of the trailing arm mountings initially finger-tight. They are tightened to their torque when the vehicle is standing on its wheels. A garage-pit or ramps would be ideal to tighten the mountings. Note the order of tightening:

- Turn the head of the bolt on the inner mounting until the centre punch marks stamped in before removal are once more opposite each other. Counterhold the bolt head in this position and tighten the nut on the other side to 10.0 kgm (72 ft.lb.). Re-check the alignment marks. If necessary slacken the bolt once more and repeat the operation.

- Hold the head of bolt (4) with a ring spanner and tighten the nut (8) to 16.0 kgm (115 ft.lb.).

- Tighten the stabiliser bar mountings (if a bar is fitted) to 3.0 kgm (21.5 ft.lb.).

- If the trailing arm has been replaced, have the brake pressure regulator adjusted as soon as possible or adjust it as described in Section "Brakes". Otherwise re-connect the two springs to the horizontal beam.

### 13.4. Rear Wheel Hubs and Wheel Bearings

Fig. 13.6 shows a dismantled trailing arm with the attachment of the wheel hub and the arrangement of the wheel bearing. Wheel hub and

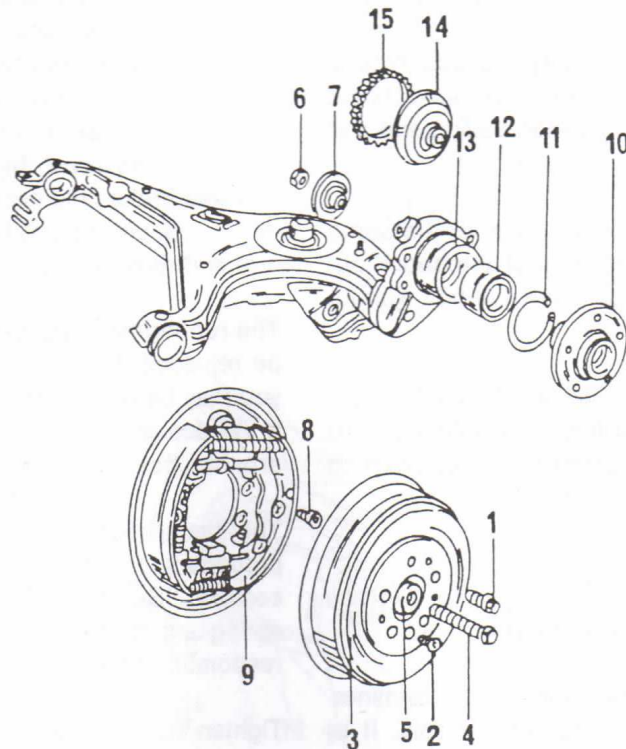


## 13 Rear Axle and Rear Suspension

**Fig. 13.6.**

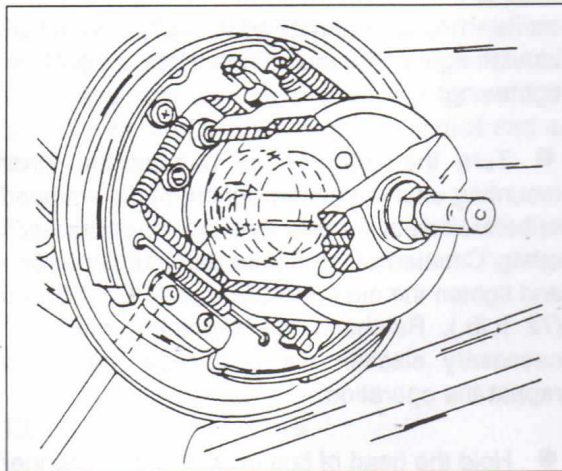
The component parts of a rear wheel bearing and a wheel hub.

- 1 Wheel bolt, 16.0 kgm
- 2 Socket head screw
- 3 Brake drum
- 4 Wheel hub bolt
- 5 Washer
- 6 Self-locking nut, 20 kgm
- 7 Clamp plate washer
- 8 Socket head bolt, 15.0 kgm
- 9 Brake back plate
- 10 Wheel hub
- 11 Circlip
- 12 Wheel bearing
- 13 Trailing arm
- 14 Clamping plate washer (with ABS)
- 15 Toothed rotor for speed sensor (with ABS)



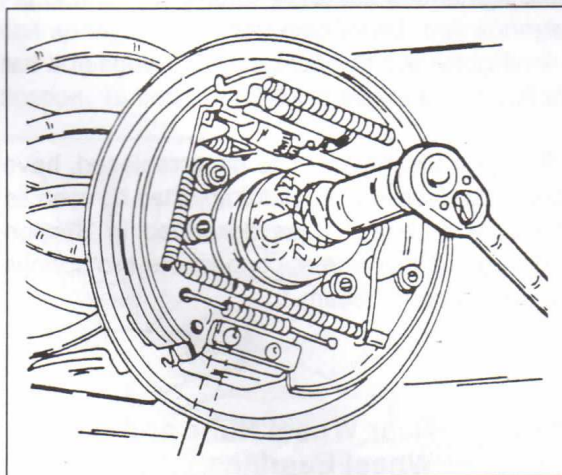
**Fig. 13.7.**

Removal of the wheel hub or the wheel bearing with the special puller. Place a trolley jack underneath the axle to support the assembly.



**Fig. 13.8.**

Pulling the wheel bearing in position, using the special tools. See alternative methods in the text.



bearing are held in position by means of a long bolt with a washer and nut on the inside of the trailing arm.

The removal and installation of the wheel hub and wheel bearing is normally carried out using extensive special tools, but on studying you will find that the parts can be removed with a hammer and some suitable mandrels. It is also possible to remove the trailing arm from the vehicle to replace the hub and bearing under a press. The following description is based on the instructions issued by VW:

- Jack up the rear end of the vehicle and remove the brake drum. The drum is secured by a single screw, but can be tight on the brake shoes. Refer to Section "Brakes", if the latter is the case.

- Hold the bolt on the outside of the wheel hub with a ring spanner and at the inside slacken the nut (6) in Fig. 13.6. Remove the clamp plate washer. As can be seen from the illustration, different plates are used for models with and without ABS.

- Extract the wheel hub out of the trailing arm and the wheel bearing. If a puller is used, refer to Fig. 13.7, as it should be of the shape shown. Otherwise try to apply a soft-metal drift from the inside against the wheel hub and drive it out. Make sure that the vehicle is well supported on the chassis stands before knocking out the hub.

- Remove the large circlip (11) in front of the wheel bearing and remove the bearing. Again



## 13 Rear Axle and Rear Suspension

the puller shown in Fig. 13.7 must be used, but this time the claws are placed underneath the wheel bearing.

*The wheel bearing must always be replaced if it has been removed, irrespective of its condition. Don't be tempted to refit the old bearing.*

- Remove the inner bearing race from the wheel hub. The puller shown in Fig. 12.21 is also suitable for the rear wheel bearing.

- If an ABS is fitted there is a toothed rotor (14) at the outside of the clamping plate washer. A tow-arm puller is required to pull it off. When fitting the rotor, direct the chamfer towards the wheel bearing.

- Thoroughly clean all parts of the trailing arm without contaminating the brake shoes. The brake back plate can easily be removed, if this is preferred.

- Fit the new wheel bearing from the rear of the trailing arm and pull into the trailing arm.

Professionally the fitting tool shown in Fig. 13.8 is used. A large washer, placed against the outside of the bearing, pulls it in position when the bolt of the fitting tool is tightened. The bearing can also be fitted with a large piece of tube, a long bolt, two large plate washers and a nut. To do this, start the bearing in the bore, place the plate washer over the bearing and insert the long bolt from the rear. On the outside place the tube against the trailing arm, place another plate washer over the tube and fit the nut to the bolt. Tighten the nut until the bearing is fully in position. The other alternative is to drive the bearing in position with a soft-metal drift.

- In the outside of the trailing arm bore fit the circlip. Make sure it is entered properly.

- The next operation is the installation of the wheel hub. The same tools as for the wheel bearing are used, with the difference that the pressure must be applied against the outside of the wheel hub. If the alternative method described above is used, place the tube against the outside of the inserted hub and tighten the hub until it is fully drawn into the wheel bearing.

- Fit the long bolt (4) in the front of the wheel bearing and at the rear fit the clamp plate washer (7) or (14), depending on the version. Use a new nut (6) and fit it over the bolt.

- Hold the head of bolt (4) and tighten the nut on the inside to 20.0 kgm (145 ft.lb.). As the torque is fairly high, make sure that the vehicle is well supported on the jack.

- All other operations are carried out in reverse order to the removal procedure.

### 13.5. Rear Stabiliser Bar

Four mounting clamps, two on each side, are used to secure the stabiliser bar to the body and the trailing arms. Removal and installation is straight forward. Tighten the mounting clamp bolts to 3.0 kgm (22 ft.lb.).

### 13.6. Rear Wheel Adjustment

As already mention several times, you will have to know to which vehicle group your particular Transporter belongs. Check in accordance with the table commencing below. The following values apply to the individual vehicle groups:

---

#### Rear Wheel Alignment Data

---

| Vehicle Group 1:              | Unladen    | 1/2 load      | fully laden   |
|-------------------------------|------------|---------------|---------------|
| Toe-in adjustment per wheel   | + 10 ± 20' | + 10 ± 10'    | + 30 ± 10'    |
| Total toe-in                  | + 20 ± 20' | + 40 ± 20'    | 1° ± 20'      |
| Max. difference between sides | max. 30'   | max. 30'      | max. 30'      |
| Camber                        | + 30 ± 30' | —1° 10' ± 30' | —1° 35' ± 30' |
| Max. difference between sides | 30'        | 30'           | 30'           |
| Vehicle Group 2:              | Unladen    | 1/2 load      | fully laden   |
| Toe-in adjustment per wheel   | + 3 ± 10'  | + 12 ± 10'    | + 20 ± 10'    |
| Total toe-in                  | + 6 ± 20'  | + 24 ± 20'    | + 40 ± 20'    |



## 13 Rear Axle and Rear Suspension

### Vehicle Group 2 — Continued:

|                               | Unladen      | 1/2 load      | fully laden            |
|-------------------------------|--------------|---------------|------------------------|
| Max. difference between sides | 30'          | 30'           | 30'                    |
| Camber                        | $-0 \pm 30'$ | $-40 \pm 30'$ | $-1^\circ 30' \pm 30'$ |

### Vehicle Group 3:

|                               | Unladen       | 1/2 load               | fully laden            |
|-------------------------------|---------------|------------------------|------------------------|
| Toe-in adjustment per wheel   | $+10 \pm 10'$ | $+20 \pm 10'$          | $+30 \pm 10'$          |
| Total toe-in                  | $+20 \pm 20'$ | $+40 \pm 20'$          | $+1^\circ \pm 20'$     |
| Max. difference between sides | 30'           | 30'                    | 30'                    |
| Camber                        | $-30 \pm 30'$ | $-1^\circ 10' \pm 30'$ | $-1^\circ 35' \pm 30'$ |
| Max. difference between sides | 30'           | 30'                    | 30'                    |

### Vehicle Group 4:

|                               | Unladen       | 1/2 load               | fully laden            |
|-------------------------------|---------------|------------------------|------------------------|
| Toe-in adjustment per wheel   | $+12 \pm 10'$ | $+22 \pm 10'$          | $+27 \pm 10'$          |
| Total toe-in                  | $+24 \pm 10'$ | $+44 \pm 10'$          | $+54 \pm 10'$          |
| Max. difference between sides | 30'           | 30'                    | 30'                    |
| Camber                        | $-40 \pm 30'$ | $-1^\circ 10' \pm 30'$ | $-1^\circ 30' \pm 30'$ |
| Max. difference between sides | 30'           | 30'                    | 30'                    |

Only the toe-in can be adjusted. The adjustment is carried out at the inner mounting of the trailing arm, i.e. the trailing arm can be pushed in its mounting towards the front or rear, to adjust the toe-in. The adjustment must be carried out when the wheels are standing on the ground. The correct toe-in setting can only be obtained when the camber angles correspond to the given values.

- Check the toe-in setting of the rear wheels as described for the front wheels on page 108. If the difference between the two wheels is greater than 30', adjust the setting or take the vehicle to a dealer.
- Refer to Fig. 13.9 and slacken the nut (1) of

the rear trailing arm mounting. Using a screwdriver, push the trailing arm towards the front or rear until the correct value is obtained. This is a case of trial and error. Make the adjustment in very small stages, continuously checking and adjusting. Finally tighten the nut to 10.0 kgm (72 ft.lb.).

The camber angles of the wheels is expressed in "minutes" and therefore an optical camber checking instrument is practically a "must". Have the camber checked at a wheel alignment centre or a VW Dealer. As incorrect camber angles lead to excessive tyre wear we recommend you to have the wheel alignment seen to as soon as excessive wear on the inner or outer edges of the tyres can be noted.

### 13.7. Tightening Torque Values — Rear Suspension

|                                         |                       |
|-----------------------------------------|-----------------------|
| Rear wheel bolts: .....                 | 16.0 kgm (115 ft.lb.) |
| Brake back plate to trailing arm: ..... | 15.0 kgm (108 ft.lb.) |
| Lower shock absorber bolt: .....        | 4.5 kgm (32.5 ft.lb.) |
| Upper shock absorber mounting: .....    | 10.0 kgm (72 ft.lb.)  |
| Inner trailing arm mounting, nut: ..... | 10.0 kgm (72 ft.lb.)  |
| Outer trailing arm mounting: .....      | 16.0 kgm (115 ft.lb.) |
| Wheel hub/bearing nut: .....            | 20.0 kgm (144 ft.lb.) |
| Handbrake cable clamp, bolt: .....      | 0.7 kgm (5 ft.lb.)    |
| Self-tapping screw: .....               | 0.7 kgm (5 ft.lb.)    |
| Bolt for wheel speed sensor: .....      | 3.0 kgm (22 ft.lb.)   |



## 14 BRAKE SYSTEM

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### 14.0. Introduction

Disc brakes are fitted to the front wheels of all models, but different brake calipers and discs are used, depending on the size of the wheels, i.e. 14 inch or 15 inch wheels. Vehicles with 15 in. wheels have ventilated brake discs. The brake pads and the method of fitting is not the same on the two caliper types.

The rear wheels can have self-adjusting drum

brakes. A dual-line brake circuit is employed. A brake servo unit is standard fitting, but there is a brake pressure regulator fitted to some models only. Some models are fitted with an ABS system, which for reasons of road safety should not be tampered with.

The master cylinder cannot be repaired or overhauled and must be replaced as a complete unit if faulty.

**Warning:** Due to the possible complexity of any ABS system, any problems encountered or if in doubt, consult your VW Dealer or Service Station.  
**Do not attempt the unknown.**

### 14.1 Technical Data

Type: ..... See above  
Handbrake: ..... Acting on rear wheels through cables.

#### Front Brakes

|                                                  | 14 in. Wheels                 | 15 in. Wheels                 |
|--------------------------------------------------|-------------------------------|-------------------------------|
| Disc diameter: .....                             | 260.0 mm (10.33 in.)          | 280.0 mm (11.124 in.)         |
| Disc thickness: .....                            | 16.0 mm (0.636 in.)           | 24.0 mm (0.954 in.)           |
| Min. disc thickness: .....                       | 14.0 mm (.556 in.)            | 22.0 mm (0.874 in.)           |
| Permissible re-grinding: .....                   | 0.5 mm (0.02 in.)<br>per side | 0.5 mm (0.02 in.)<br>per side |
| Max. run-out of discs: .....                     | 0.10 mm (0.004 in.)           | 0.10 mm (0.004 in.)           |
| Max. difference in thickness at any point: ..... | 0.01 mm                       | 0.01 mm                       |
| Pad material thickness: .....                    | 6.3 mm (0.25 in.)             | 6.3 mm (0.25 in.)             |



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|                                                | 14 in. Wheels       | 15 in. Wheels       |
|------------------------------------------------|---------------------|---------------------|
| Min. brake pad thickness with plate: . . . . . | 7.0 mm (0.278 in.)  | 7.0 mm (0.278 in.)  |
| Min. pad material thickness: . . . . .         | 1.0 mm (0.04 in.)   | 1.0 mm (0.04 in.)   |
| Caliper cylinder diameter: . . . . .           | 54.0 mm (2.145 in.) | 54.0 mm (2.145 in.) |

### Rear Drum Brakes

|                                    |                                            |
|------------------------------------|--------------------------------------------|
| Drum Diameter: . . . . .           | 287.0 mm (11.403 in.)                      |
| Max. re-grind Diameter: . . . . .  | 288.0 mm (11.442 in.)                      |
| Wheel cylinder diameter: . . . . . | 19.05 mm (0.75 in.) or 20.64 mm (0.82 in.) |
| Brake lining thickness: . . . . .  | 6.3 mm (0.25 in.)                          |
| Min. lining thickness: . . . . .   | 2.0 mm (0.08 in.)                          |
| Brake lining width: . . . . .      | 55.0 mm (2.185 in.)                        |

### Master Brake Cylinder

|                                         |                     |
|-----------------------------------------|---------------------|
| Diameter: . . . . .                     | 22.2 mm (0.882 in.) |
| Diameter of brake servo unit: . . . . . | 9 in.               |

### 14.2. Adjusting the Foot Brakes

The front disc brakes require no adjustment for the wear of the pads since the pistons automatically bring the pad surfaces inwards as the pad material wears down.

The rear drum brakes require no adjustment, as the brake shoes are moved nearer the brake drum with each application of the foot brake.

### 14.3. Front Disc Brakes

#### 14.3.0. BRAKE PAD REPLACEMENT

**ATTENTION!** If it is possible that the brake pads can be re-used, mark them in relation to the side of the car and to the inside or outside position of the caliper. Never interchange brake pads from left to right or from the inside to the outside, or visa versa, as this could lead to unequal braking.

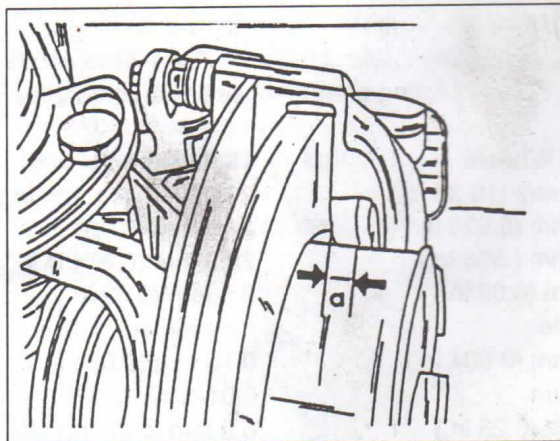


Fig. 14.1.  
The remaining pad material thickness is measured at the position shown by "a".

#### With 14 in. Wheels

Bolts with socket heads and separate guide bolts are used to secure the brake calipers to their mounting brackets. To check the thickness of the remaining pad material, remove the wheel on one side and measure the thickness of the visible brake pad with a ruler or estimate it. If the thickness of the pad approaches 7 mm, replace the brake pads as a set. Fig. 14.1 shows where the remaining brake pad material thickness can be seen. Remove this type of brake calipers as follows. A ring spanner and an open-ended spanner is required to remove the caliper cylinder from the caliper mounting bracket:

- Jack up the front end of the vehicle, support on chassis stands and remove both road wheels.
- Remove the lower cylinder bolt. To do this, counterhold the hexagon at the inside of the guide bolt with an open-ended spanner and slacken the bolt with a ring spanner. Fig. 14.2 shows how the two spanners are used.
- Swing the cylinder housing towards the top and remove the brake pads from the sides of the brake disc.
- Using a piece of wood and carefully push the piston into its bore. This will displace the brake fluid inside the system. Take care not to overflow the master cylinder reservoir (ask a helper to keep an eye on the fluid level). Either empty out some fluid or alternatively release the bleeder screw to allow some fluid to escape.

Thoroughly clean the caliper opening with a clean rag. Check the rubber dust seal in the



## 14 Brake System

cylinder for good condition. Damaged or brittle dust seals must always be replaced. Check the condition of the brake disc before the pads are fitted. If grooves are visible, remove the brake disc and have the disc refaced or fit a new disc.

The thickness of the pad material can now be measured exactly. If the remaining material thickness of one of the pads is below 7.0 mm (0.278 in.), replace the complete set. The thickness of the actual lining must not be less than 2.0 mm (0.08 in.).

Refit the brake pads as follows, referring to Fig. 14.4 for details:

- Fit the brake pads to the side of the brake disc, grip the caliper as shown in Fig. 14.3 and carefully lower it in position over the brake pads and the brake disc. If necessary push the piston further towards the inside (with a hammer handle) if the caliper housing cannot be placed fully downwards. If a piston re-setting clamp is available, of the shape shown in Fig. 14.5, insert the legs between the caliper and the case of the piston and push the piston into the bore by tightening the handle.

- Secure the guide bolt with the self-locking bolts. A new bolt is included in the repair kit and must be used at all times. Tighten the bolts to 3.5 kgm (25 ft.lb.).

- Check, and if necessary correct the fluid level in the master cylinder reservoir and depress the brake pedal several times. This will bring the brake pads to their correct operating position.

- Refit the wheels, tighten the wheel bolts to 16.0 kgm (115 ft.lb.) and road test the vehicle.

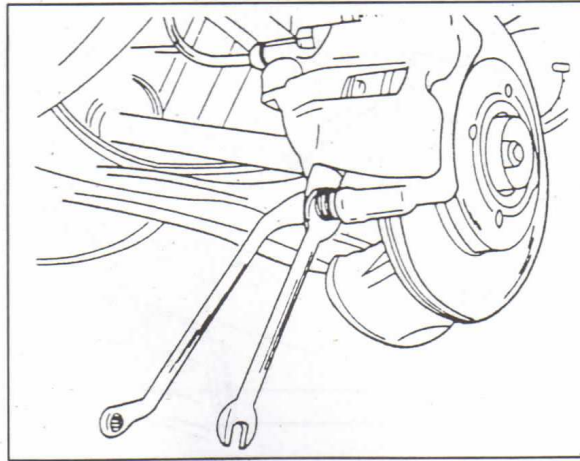
### With 15 in. Wheels

Retaining pins and spring clips are used to secure the brake pads on this type of caliper. The remaining lining thickness is checked in the same manner as described on page for the other type. Also see Fig. 14.1. Remove the brake pads as follows:

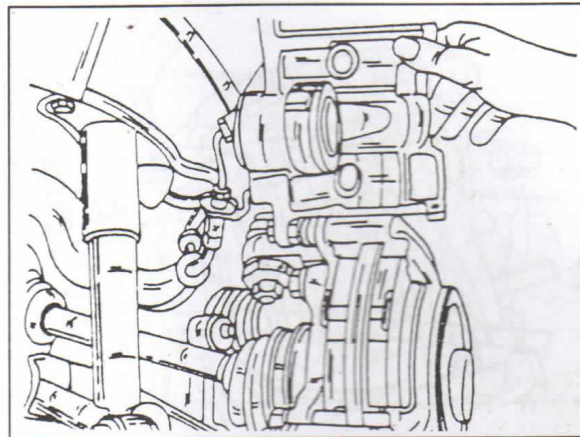
- Slacken the wheel nuts, place the front end of the vehicle on chassis stands and remove the two wheels.

- Remove the spring clips (1) in Fig. 14.6 on both sides of the vehicle.

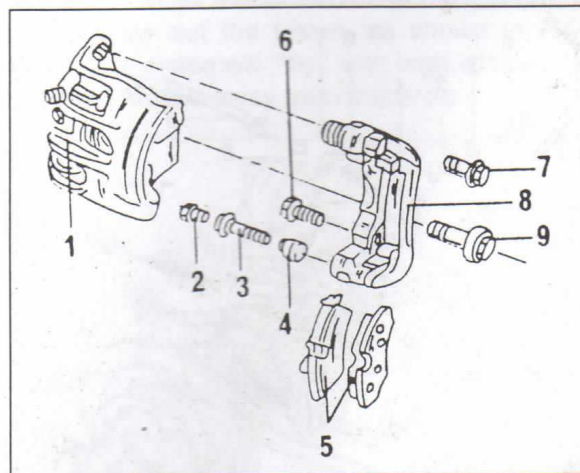
- Use a suitable drift, applied as shown in Fig.



**Fig. 14.2.**  
Removal of the lower caliper mounting bolt by means of a ring spanner. An open-ended spanner is used to counterhold the guide bolt.

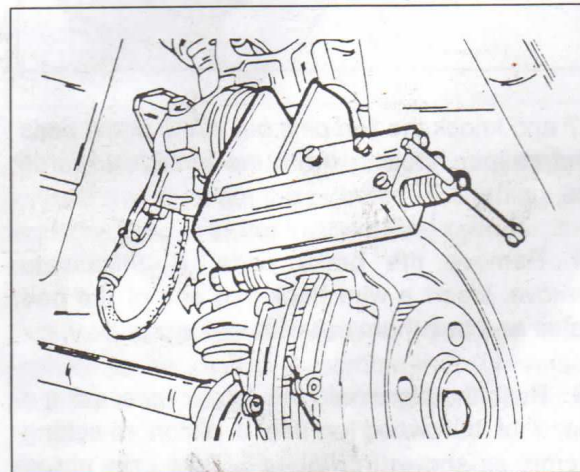


**Fig. 14.3.**  
Fitting the caliper housing over the brake pads.



**Fig. 14.4.**  
Details for the removal and installation of a brake caliper when 14 in. wheels are fitted.

- 1 Brake caliper cylinder
- 2 Self-locking bolt, 3.5 kgm (25 ft.lb.)
- 3 Guide bolt
- 4 Rubber boot
- 5 Brake pad set
- 6 Bolt, 27.0 kgm (194 ft.lb.)
- 7 Bolt, 16.0 kgm (115 ft.lb.)
- 8 Brake caliper mounting bracket
- 9 Drive shaft bolt, 20.0 kgm (144 ft.lb.)

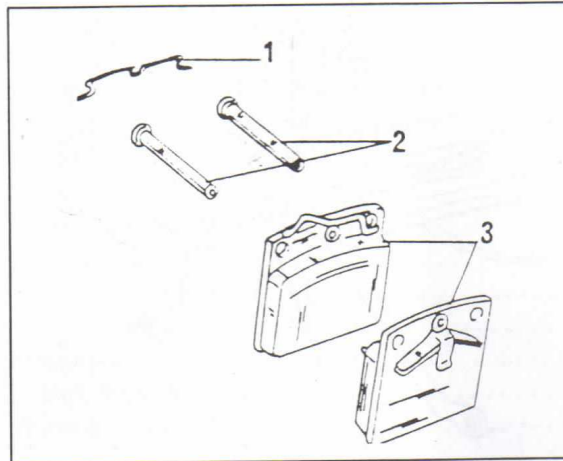


**Fig. 14.5.**  
Pushing the piston into the caliper, using a special clamp. May not apply to calipers used with ABS.

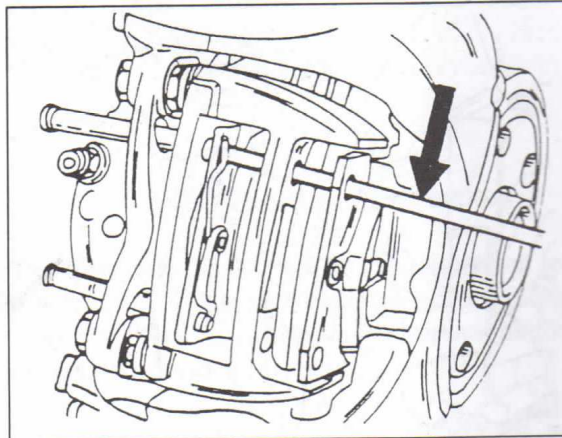


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**Fig. 14.6.**  
The spring clip (2) and the retaining pins (2) secure the brake pads (3) in position, if 15 in. wheels are fitted.

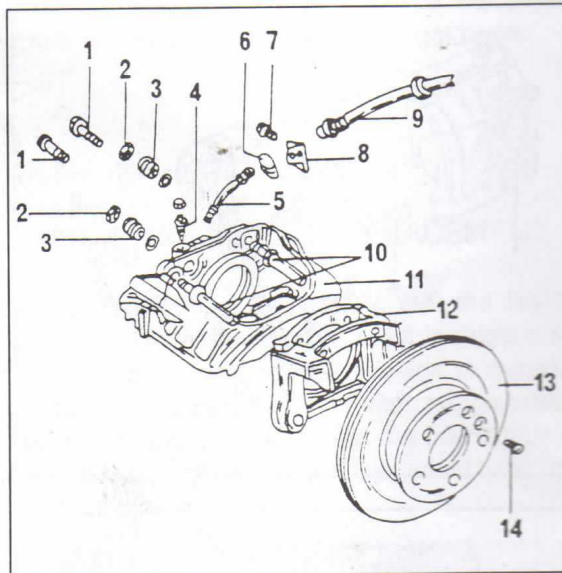


**Fig. 14.7.**  
Brake pads retaining pins are driven out with a small cylindrical drift (arrow) from the side shown.



**Fig. 14.8.**  
The component parts of a brake caliper (with 15 in. wheels) without brake pads.

- 1 Bolts, 27 kgm (195 ft.lb.)
- 2 Locknuts, 7.0 kgm (51 ft.lb.)
- 3 Rubber boots
- 4 Bleeder screw
- 5 Brake pipe
- 6 Spring plate
- 7 Screw, 1.0 khm (7 ft.lb.)
- 8 Brake hose bracket
- 9 Brake hose
- 10 Guide pins
- 11 Brake caliper housing
- 12 Brake pad carrier
- 13 Brake disc
- 14 Brake disc screw, 0.5 kgm



9.7 and knock the two pins out of the brake pads and caliper housing (from the outside towards the inside).

- Remove the brake pads. If difficult to remove, insert a wire hook into one of the pad holes and pull them out with a sharp pull.

- Push the piston into the caliper bore, using a piece of hardwood or use a piston re-setting clamp, as shown in Fig. 14.5. Take care not to

overflow the master cylinder reservoir (ask a helper to keep an eye on the fluid level). Either empty out some fluid or alternatively release the bleeder screw to allow some fluid to escape.

Clean the caliper opening with compressed air, or if not available, with a rag. Petrol or sharp tools must not be used to clean off dirt. Check the dust seal in the brake caliper for damage. Damaged or brittle dust seals must always be replaced. Check the condition of the brake disc before new pads are fitted.

The installation of the brake pads is a reversal of the removal procedure. Insert the two pads into the opening and use a small drift to align the pad "eyes" and the holes in the caliper cylinder. Fit the retaining pins from the inside towards the outside and secure with new spring clips.

After completed installation operate the brake pedal a few times to set the brake pads against the brake disc. Check the fluid level in the master cylinder reservoir and correct if necessary. Tighten the wheel bolts to 16.0 kgm (115 ft.lb.). Remember that new pads must "bed" in and that the full performance of the brakes is not immediately available.

### 14.3.1. SERVICING THE CALIPER UNITS

Remove the caliper from the steering knuckle and carry out all servicing on the bench, under the cleanest possible conditions. Fig. 14.8 shows an exploded view of a brake caliper, as fitted to models with 15 in. wheels. The caliper for models with 14 in. wheels is similar, with the difference that the brake cylinder carrier (12) is different, due to the attachment of the cylinder. Before commencing any servicing, note the general points below, these being applicable to the servicing of any of the brake hydraulic units:

- Always replace all seals each time the units are dismantled. These seals slowly deteriorate in service and even though they may look quite good, they should nevertheless be replaced in the interest of your own safety.

- Do not ever attempt to re-use any piston or cylinder if the surfaces are worn, scored or corroded. Obtain a complete new unit and discard the old one.

- Follow at all times the general precautions



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regarding the hydraulic system servicing in Section 0.4.

- Use only hydraulic brake fluid of the recommended specification and **DO NOT** use fluid that has been kept over a long period. Brake fluid to specification SAE J1703 is suitable.

- Lubricate the seals and pistons either with clean brake fluid or, better still, a proprietary brake paste or lubricant (VW, ATE, Girling).

The overhaul is similar for both types, but there are differences in the removal:

- If 14 in. wheels are fitted, remove the union nut from the brake pipe or disconnect the brake hose. Remove the upper caliper bolt and lift off the caliper. Similar bolts are used at top and bottom.

- If 15 in. wheels are fitted, remove the brake caliper before any repairs can be carried out. The brake pads must be removed. Proceed as follows:

- Remove the bolt (14) in Fig. 14.8 and take off the brake disc.

- Unscrew the brake pipe union nut from the connection on the brake hose, withdraw the spring plate from the brake hose bracket and fully unscrew the brake pipe from the hose.

- Remove the union nut connecting the brake pipe to the caliper cylinder and withdraw the pipe.

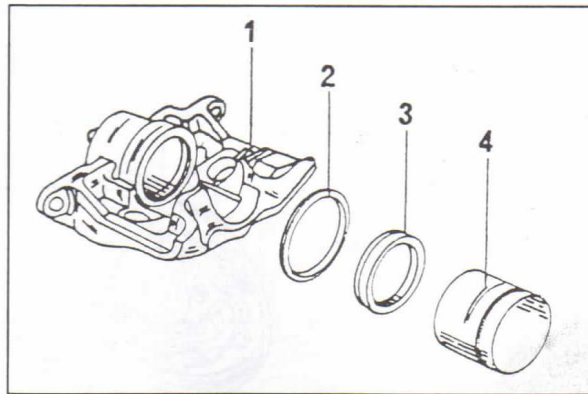
- Slacken the locknuts (2) and the bolts (1). The two bolts will be very tight.

- Remove the brake caliper from the two guide bolts (10).

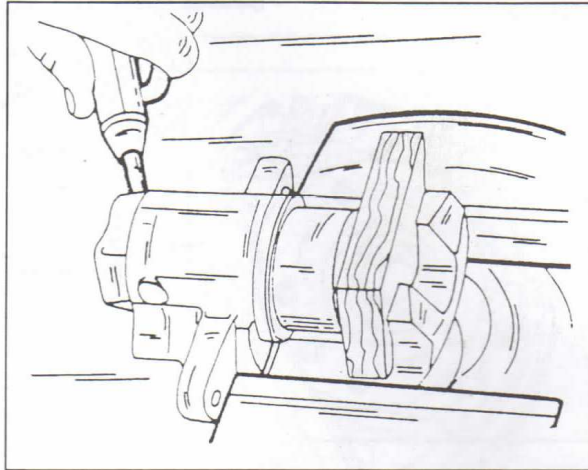
The overhaul of the two caliper types are now carried out in similar manner. Repair kits are normally available for the brake calipers. All parts contained in the kit must be fitted during assembly, even if some of the old parts are in good condition. Fig. 14.9 shows the internal parts of a caliper for a vehicle with 14 in. wheels. The "internals" of the other caliper type look similar, only the caliper housing has a different shape.

- Clamp the caliper cylinder into a vice and, using a screwdriver, remove the dust cover from the cylinder housing and the piston.

- Insert a piece of wood into the caliper jaw

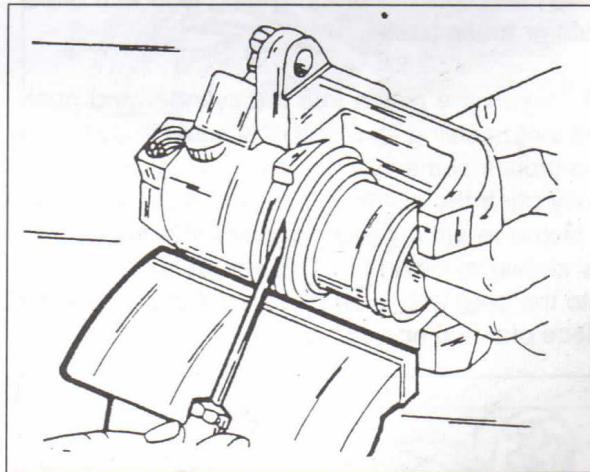


**Fig. 14.9.**  
The internal parts of a caliper.  
1 Brake caliper  
2 Cylinder sealing ring  
3 Dust seal  
4 Piston



**Fig. 14.10.**  
Removal of a piston by means of compressed air. Cover the assembly with a rag to avoid a "flying" piston and/or fluid.

and apply an air line to the brake hose connection to blow out the piston, as shown in Fig. 14.10. The piston will "fly" with high velocity — Keep the fingers away from this area.



**Fig. 14.11.**  
Fitting the dust seal into the cylinder housing groove by means of a small screwdriver. Take care not to damage the seal (a blunt blade will be ideal).

- Using a non-metal instrument or a small screwdriver, take out the cylinder sealing ring (2) from the groove in the inside of the cylinder, as shown in Fig. 14.11.

Examine all parts for wear or damage and replace as necessary. Assemble in the reverse sequence to dismantling, noting the following points:

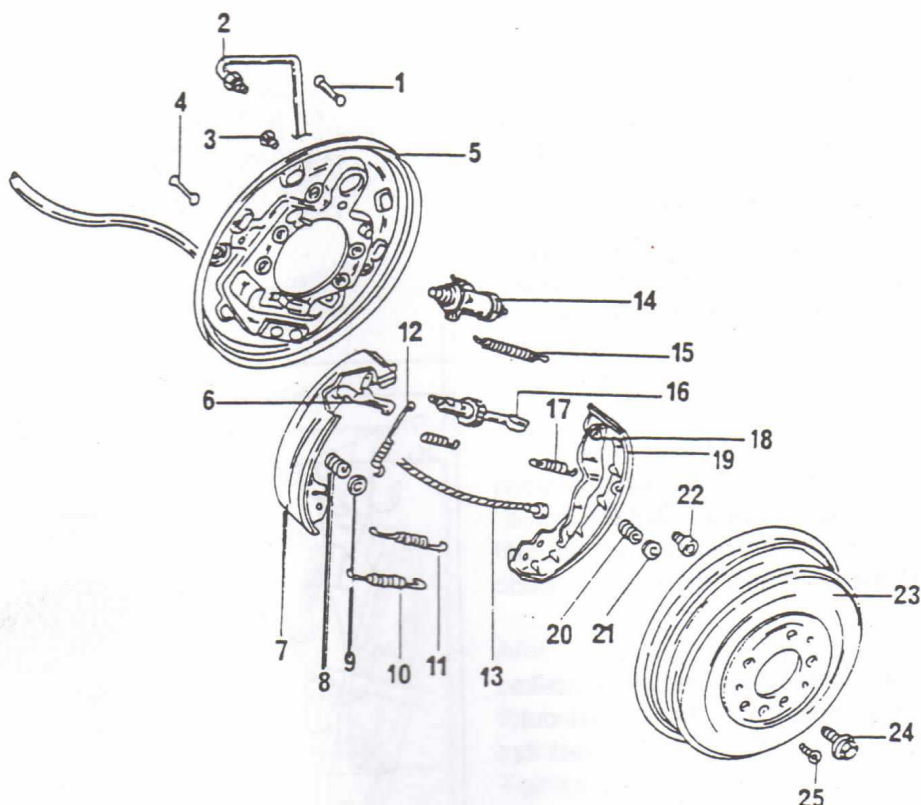
- Fit the cylinder seal into the bore with the



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**Fig. 14.12.**  
Exploded view of a rear  
brake assembly on one side.

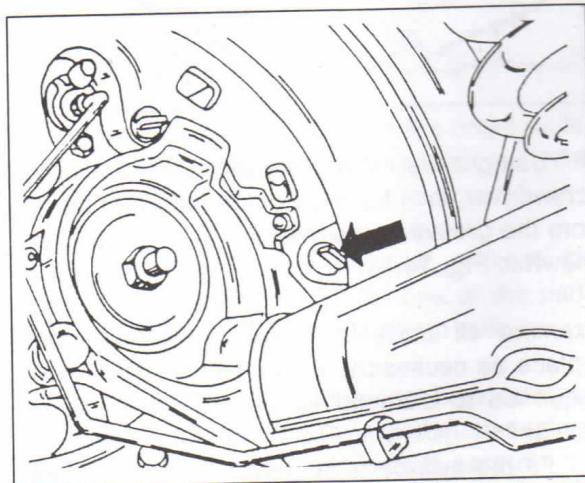
- 1 Hold-down pin
- 2 Brake pipe
- 3 Screw, 1.7 kgm
- 4 Hold-down pin
- 5 Brake back plate
- 6 Adjuster lever
- 7 Brake shoe
- 8 Compression spring
- 9 Spring seat
- 10 Lower return spring
- 11 Lower return spring
- 12 Adjuster lever spring
- 13 Handbrake cable
- 14 Wheel brake cylinder
- 15 Upper return spring
- 16 Push rod and adjuster wheel
- 17 Return springWheel bolt
- 18 Handbrake operating lever
- 19 Brake shoe
- 20 Compression spring
- 21 Spring seat
- 22 Socket head bolt, 15 kgm
- 23 Brake drum
- 24 Wheel bolt, 16 kgm
- 25 Drum securing screw



fingers only. The seal must be generously coated with either clean brake fluid or rubber grease (brake paste).

- Fit the dust seal (3) with the outer lip to the piston and coat the piston gliding face with brake fluid or brake paste.

- Insert the piston into the cylinder and push the inner sealing lip of the dust seal carefully into the groove of the cylinder, as shown in Fig. 14.11. Fully push the piston in position. If possible use a piston re-setting tool, inserted into the caliper as shown in Fig. 14.5. This will push the piston into the bore with even pressure. Otherwise a flat piece of metal or wood will do.



**Fig. 14.13.**  
The thickness of the  
remaining brake linings  
can be checked after  
removal of the plug at the  
position shown. A torch  
will be useful for this  
check.

### 14.4. Rear Drum Brakes

#### 14.4.0. BRAKE SHOES

Plug are fitted into the rear of the brake back plate, after removal of which it is possible to check the thickness of the brake linings. If the thickness of the linings is down to approx. 2.0 mm (0.08 in.), replace the brake shoes as a set. Fig. 14.12 shows where the plug is located on the inside of the brake back plate.

Remove the brake shoes as follows:

- Jack up the rear end of the vehicle and place on stands. Chock the front wheels. Remove both rear wheels.

- Release the brake adjuster to avoid pulling the brake shoes off together with the brake drum. To do this, insert a screwdriver into the rear of the brake back plate at the position shown in Fig. 14.13 and "feel" for the adjuster wheel of the push rod (16) in Fig. 14.12. Once the blade is inserted between two teeth of the wheel, move the screwdriver blade up or down. The movement to release the adjuster wheel are opposite to each other on the two sides. Instead of giving a perhaps confusing description, try first one way and then the other. You will soon find out which way the shoes come away from the drum.



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- With a finger push against the hold-down pins (1) and (4) in Fig. 14.12 from the rear of the brake back plate and remove the spring seat on the outside by pressing it inwards and at the same time turning it, until the head of the pin can be released from the spring seat. Fig. 14.15 shows the removal of one of the pins. Take off seat and spring and withdraw the pin. Both brake shoes must be detached in this manner.

- Refer to Fig. 14.16 and disengage the spring (1) on one side. The spring (2) for the adjuster lever can also be disengaged.

- Use a screwdriver and turn back the adjuster wheel until the brake shoes are as close together as possible and disengage the spring (4).

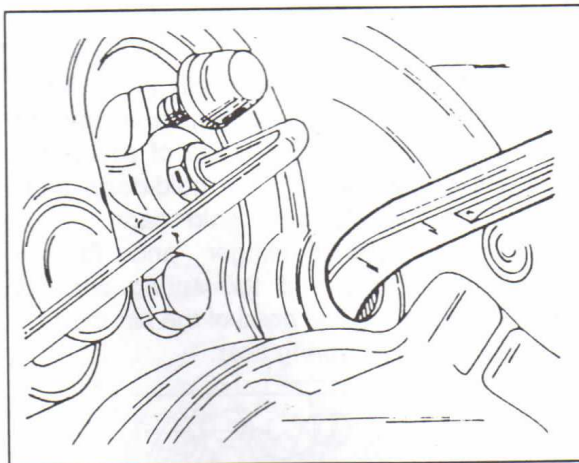
- Grip the brake shoe on one side at the lower end, as shown in Fig. 14.17 and lift it off the abutment bracket. The return spring will have lost its tension and can be removed.

- Tilt the shoe with the handbrake cable downwards and disconnect the handbrake cable from the lever. To do this, compress the spring with a pair of pliers as shown in Fig. 14.18 until the cable end can be disengaged from the lever end.

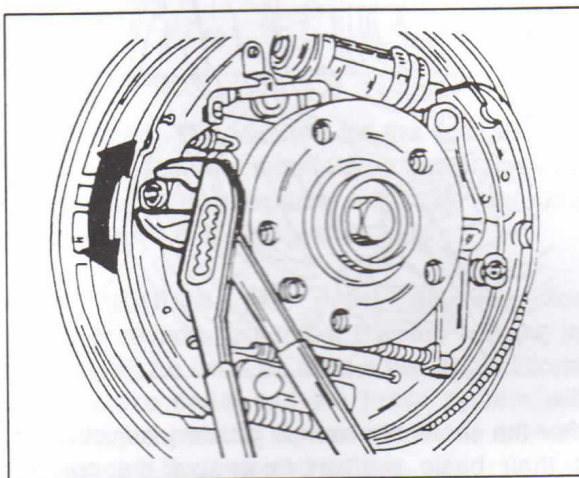
Special attention should be paid to the push rod between the brake shoes. Apart from the necessity to screw the push rods apart to clean and grease the threads, you will find that the adjustable push rod on the L.H. side has a R.H. thread and the push rod on the R.H. side has a L.H. thread. The ends of the fork are not symmetrical. The longer fork must always be nearer the brake back plate.

The installation of the brake shoes is a reversal of the removal procedure. The contact points for the shoes on the back plate, the ends of the shoes (where engaged in the abutment bracket) and the swivel point of the handbrake lever should be coated with graphited grease, but just a small smear. First engage the handbrake cable end with the operating lever. Refer to Fig. 14.18 and push the spring back on the cable until the cable end can be engaged. Now release the spring against the lever and check that the cable end is held in position.

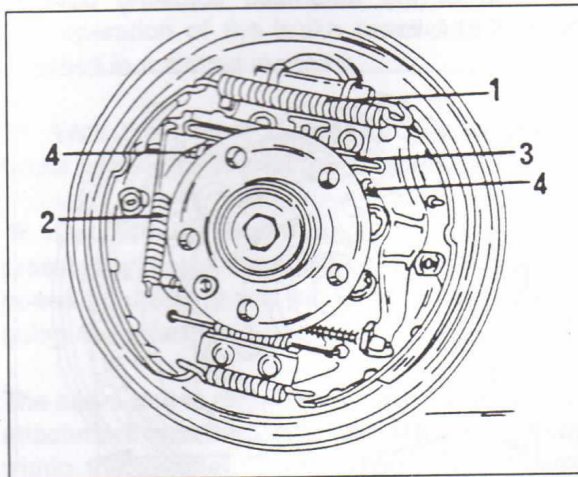
Fit the lower return springs to the shoes, insert one shoe into its abutment bracket and then pull the other shoe to the other side until it can be inserted behind the bracket, in a similar manner as



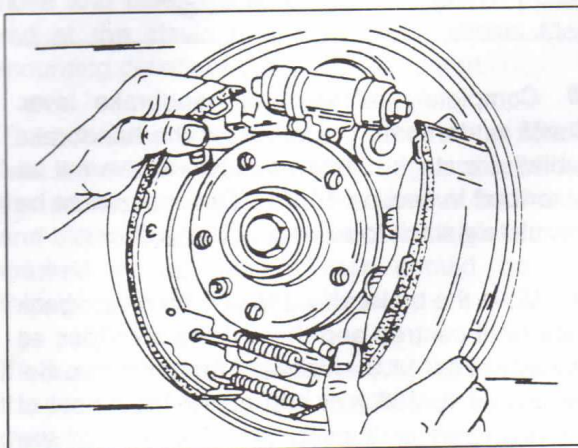
**Fig. 14.14.**  
Rotating the adjuster wheel inside the brake assembly by means of a screwdriver.



**Fig. 14.15.**  
Turn the spring seat of the shoe hold-down pins/springs either towards the left or right until the pin can be withdrawn.



**Fig. 14.16.**  
View of a rear brake assembly with location of the parts mentioned in the text.



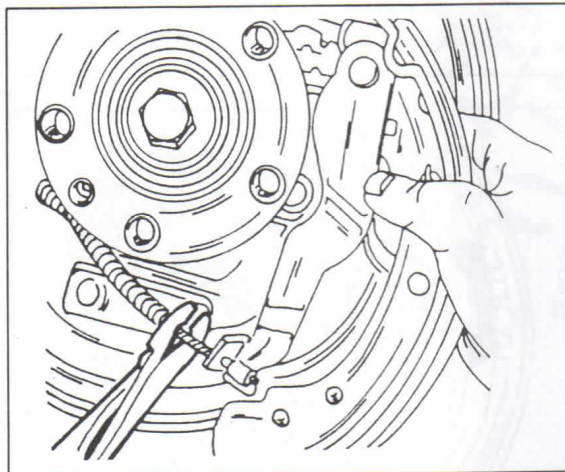
**Fig. 14.17.**  
Removal of the brake shoes.



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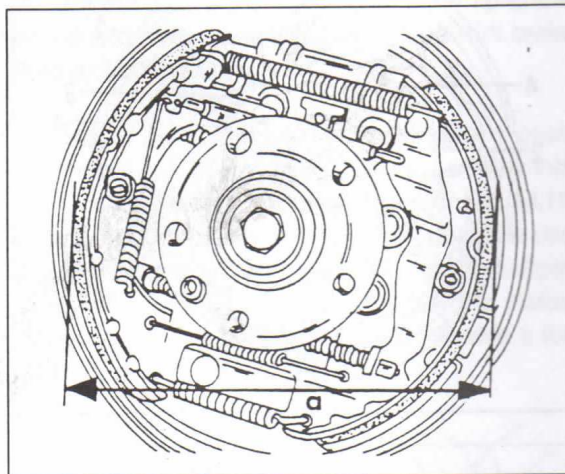
shown in Fig. 14.17.

- Fit the correct push rod with the adjuster tappet to the upper end and engage all springs shown in Fig. 14.16, using a pair of pliers or a small screwdriver. To refit the hold-down pins, insert them from behind, hold each pin in position with the forefinger and fit the compression spring and the spring seat as shown in Fig. 14.15. The head of the pin must be in the recess of the spring seat.



**Fig. 14.18.**  
To remove the handbrake cable, push back the spring until the cable end can be disengaged.

After the shoes are back in position, adjust them to their basic position to ensure the correct operation of the automatic adjusting device. Proceed as follows:



**Fig. 14.19.**  
Measure the diameter of the fitted brake shoes between the points shown and adjust to the dimension given in the text.

- Completely release the handbrake lever. Check underneath the vehicle if the handbrake cables are slack. Otherwise slacken the nut as described in section 14.10.0. The cable must be completely slack to adjust the brake shoes.

- Move the brake shoes to and fro on the back plate until centred and then, using a caliper, as shown in Fig. 14.19, measure the diameter. Set the caliper to 286 mm and adjust the wheel of the push rod at the top until the jaws of the

caliper can just be moved over the shoes. The dimension assumes that the brake drum still has its original diameter. Otherwise set the brake shoes to a smaller diameter.

- Adjust the handbrake as described in Section 14.10.0.

All other operations are carried out in reverse order to the removal procedure. Operate the brake pedal a few times to settle the shoes inside the drums.

### 14.4.1. BRAKE BACK PLATES

A brake backplate can be removed after rear wheel hub, brake shoes and wheel brake cylinder have been removed. The plates are bolted to the trailing arm. Socket head bolts are used which must be tightened to 15.0 kgm (108 ft.lb.)

### 14.4.2. WHEEL BRAKE CYLINDERS

Wheel brake cylinders are of conventional construction and can be overhauled in the well known manner. Repair kits are available, but we advise you to quote the model and model year, as wheel cylinders are sometimes changed without prior notice.

## 14.5. Brake Drums and Brake Discs

Brake drums and brake discs can, if required, be re-machined to the dimensions given in Section 14.1. When brake discs are re-ground, note that the same thickness must be taken off both sides of the disc.

Replace the discs if their minimum thickness has been reached or replace the drums if the outer diameter is greater than given in Section 14.1. under "Max. re-grind Diameter" (Page 132).

### 14.6. Brake Master Cylinder

#### 14.6.0. INTRODUCTION

The brake master cylinder is of the tandem type, with a twin reservoir so that both of the brake lines have a separate supply of brake fluid. The



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brake lines are split diagonally so that the primary piston (the one nearest the push rod) supplies the left-hand side front brake and the right-hand side rear brake and the secondary piston supplies the right front and the left rear brakes.

The cylinder cannot be repaired or overhauled and must be replaced if it no longer serves its function.

### 14.6.0. REMOVAL AND INSTALLATION

The master cylinder is attached to the front of the servo unit and is removed from the engine compartment. Fig. 14.20 shows the attachment of the cylinder and the brake servo unit. Disconnect the fluid lines and the electrical lead for the brake warning light switch (if fitted) and unscrew the cylinder. Take care not to spill brake fluid over painted surfaces when the cylinder is lifted out. A sealing ring is fitted to the cylinder mounting face.

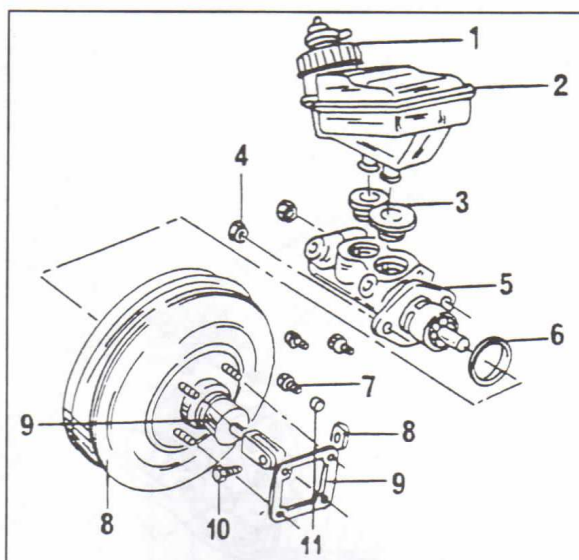
Install in the reverse sequence to removal. Tighten the cylinder securing nuts to 2.0 kgm (14.5 ft.lb.). Make sure that the sealing ring is still in good condition. If a brake fluid warning indicator is fitted, check its function. To do this, switch on the ignition, release the handbrake and push the contact pin on the cap towards the inside. The light in the dashboard should now be on.

### 14.6.1. MASTER CYLINDER CHANGE

If the cylinder is replaced it will be necessary to remove the fluid reservoir from the old one. The two rubber grommets (3) in Fig. 14.20 are inserted in the cylinder body and, if still in good condition, must be transferred to the new unit. Replace the grommets if they have deteriorated. Coat the grommets with brake fluid before fitting.

### 14.7. Brake Servo Unit

It is not recommended that the owner should attempt to repair the servo unit. This is best left to your dealer who has special tools to deal with it's overhaul. Remember that a failure of the servo unit to act will not affect the efficiency of the braking system but, of course, additional effort will be required for the same braking distance to



**Fig. 14.20.** Details for the removal and installation of the brake master cylinder and the brake servo unit.

- 1 Reservoir cap
- 2 Fluid reservoir
- 3 Rubber grommets
- 4 Nut, 2.0 kgm
- 5 Master cylinder
- 6 "O" sealing ring
- 7 Bolt, 2.5 kgm
- 8 Brake servo unit
- 9 Push rod with clevis
- 10 Clevis pin
- 11 Spring washer

be achieved. The vacuum for the operation is taken from the inlet manifold on petrol engines or is produced by a separate exhaustor (vacuum) pump when a diesel engine is fitted.

**ATTENTION!** If you coast downhill, for whatever reason, remember that the vacuum in the unit will be used up after a few applications of the brake pedal and the brake system will from then onwards operate without power-assistances. Be prepared for this.

The operation of the brake servo unit can be checked in a simple manner:

- With the engine switched off, operate the brake pedal until the vacuum is exhausted.
- Depress the brake pedal with moderate pressure and start the engine. If the servo unit is operating properly you will feel the brake pedal going down further.

The servo unit is removed by taking off the four attachment nuts from the mounting studs, (from within the vehicle), disconnecting the vacuum hose and disconnecting the brake servo push rod at the clevis fork. Fig. 14.20 shows the mounting details of the brake servo unit.

The hose leading to the brake servo unit is fitted with a non-return valve. If there is a possibility that no vacuum enters the unit, remove the valve and blow through it in the direction of the arrow, marked in the valve. There should be no throughflow from the other side.

If a new servo unit is fitted, adjust the length of the push rod to the same length as the original dimension. To do this, screw the push rod into

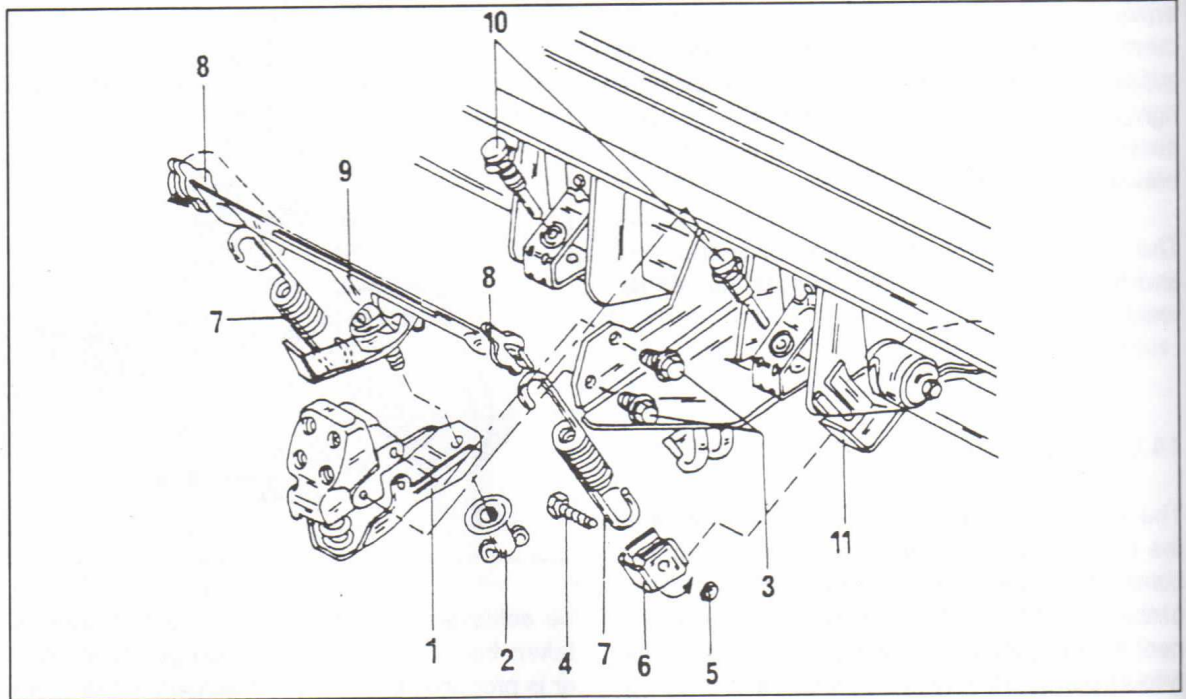


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Fig. 14.21.

The brake pressure regulating valve and associated parts.

- 1 Pressure regulating valve
- 2 Securing clip
- 3 Nut, 2.0 kgm
- 4 Bolt, 2.0 kgm
- 5 Nut
- 6 Spring mounting
- 7 Spring
- 8 Clip
- 9 Horizontal beam
- 10 Buffer stop
- 11 Trailing arm



the new servo until the dimension is obtained from the end of the threaded rod to the brake servo surface. Then screw on the clevis fork until the distance between the centre of the bore for the clevis pin and the brake servo face again the same as the original dimension.

### 14.8. Bleeding the Brakes

Bleeding of the brake system should be carried out at any time that any part of the system has been disconnected, for whatever reason. Bleeding must take place in the order left-hand rear side, right-hand rear, left-hand front and right-hand front. The procedure given below should be followed and it should be noted that an assistant will be required, unless a so-called "one-man" bleeding kit is available. In this case follow the instructions of the manufacturer.

Always use clean fresh brake fluid of the recommended specification and **never** re-use fluid bled from the system. Be ready to top up the reservoir with fluid (a brake bleeding kit will do this automatically) as the operations proceed. If the level is allowed to fall below the minimum the operations will have to be re-started.

Obtain a length of plastic tube, preferably clear, and a clean container. Put an inch or two of brake fluid into the container and then go to the first bleed point. Take off the dust cap and attach the tube to the screw, immersing the other end of the tube into the fluid in the container.

Open the bleed screw about three quarters of a turn and have your assistant depress the brake pedal firmly to its full extent while you keep the end of the tube well below the fluid level in the container. Watch the bubbles emerging from the tube and repeat the operation until no more air is seen. Depress the brake pedal once more, hold it down and tighten the bleed screw firmly.

Check the fluid level, go to the next point and repeat the operations in the same way. Install all dust caps, depress the brake pedal several times and finally top up the reservoir.

### 14.9. Brake Pressure Regulating Valve

This valve is fitted to the underfloor of the body and is connected by means of two springs to a horizontally fitted beam. Fig. 14.21 shows the individual parts associated with the regulating valve. The pressure regulating valve must always be adjusted if one of the trailing arms has been replaced, if one of the spring mountings (6) in Fig. 14.21 is not marked or has been removed and one has omitted to mark their fitted position. The minimum requirement is the adjustment of the valve in its basic setting.

Although at first glance the adjustment may look complicated, there is less to it than appears. Some make-shift tools will do the job, without using the special tools used in a VW Workshop. The setting can, if required, be checked in a



## 14 Brake System

workshop after the initial adjustment.

- Remove the rear shock absorber as described in Section 13.1. Make up a metal rod of the same length as the shock absorber, with a mounting eye at one end and a thread at the other end. Fit it into the rear suspension in place of the removed shock absorber. One of the rubber bushes, removed from the shock absorber must be fitted at the bottom between a washer and the trailing arm. The installed assembly will be in the position shown in Fig. 14.22.

- The trailing arm must now be pre-tensioned, i.e. a certain dimension must be established between the steel plate in the spring mounting (arrow "A" in Fig. 14.23) and the upper edge of the mounting hole in the trailing arm (arrow "B"). The dimension "X" is different on the various vehicle groups and can be found on the sticker, attached to the door pillar (see Fig. 12.6) at the height of the fuse/relay unit. Some vehicles, however, were produced without the sticker. If your vehicle is one of them, adjust dimension "X" in accordance with the spring colour:

| Spring Colour Code | Dimension "X" in Fig. 14.23 |
|--------------------|-----------------------------|
| green              | 285 mm                      |
| orange             | 260 mm                      |
| white              | 250 mm                      |
| violet             | 275 mm                      |
| brown              | 285 mm                      |
| blue               | 240 mm                      |

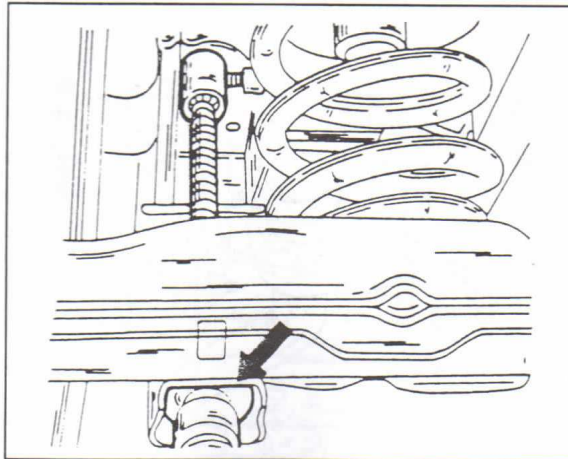
To establish the required dimension, tighten the nut at the bottom of the inserted metal rod until the trailing arm is lifted to the correct height.

- Align the beam (4) in Fig. 14.24 horizontally by eye. This is part (9) in Fig. 14.21. To do this, turn both buffer stops (1) towards the top until they just touch the beam, but there must be no load on the buffer stops.

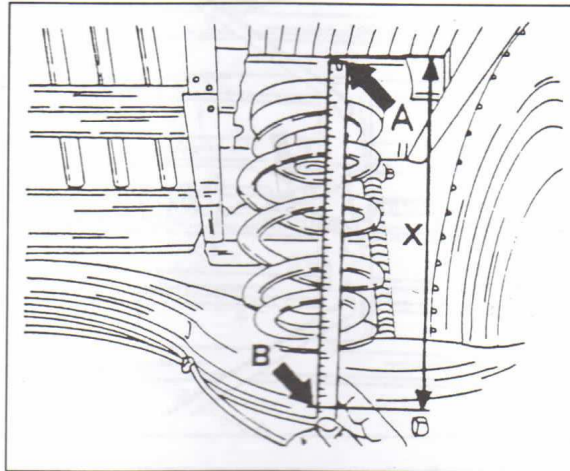
- Move one of the spring mountings (2) down until there is a gap of approx. 2 mm between the buffer stop (1) and the beam (4) on the opposite side. This is shown by the arrow in Fig. 14.24. Now move the second spring mounting (2) down in the same manner until the beam is once more in horizontal position.

- Screw both buffer stops (1) fully back so that there is the largest possible gap between the beam (4) and the buffer stops (1).

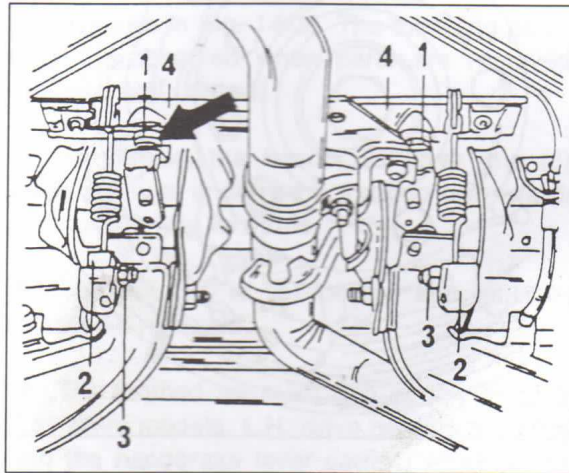
- A fine adjustment of the brake pressure



**Fig. 14.22.**  
The special VW tool inserted in the rear suspension. An alternative tool is described on the left.



**Fig. 14.23.**  
Measuring the height for the adjustment of the brake pressure regulating valve. Measure between "A" and "B" as described in the text.



**Fig. 14.24.**  
Details for the adjustment of the brake pressure regulating valve (refer to text).

regulating is now required. Two pressure gauges are necessary for the adjustment which your VW workshop will have. The front brakes must have a pressure of 50 bar, whereas the rear brakes only have 20 bar. The difference in brake pressure will ensure that the front axle is braked before the rear axle. The brake regulating valve, together with the springs and the horizontal beam, controls this brake pressure. The brake pressure is measured on the R.H. front caliper and the L.H. rear wheel brake cylinder. A VW workshop will adjust the brake pressure regulator as follows:



## 14 Brake System

Fig. 14.25.

The difference in the gaps at the positions shown by the arrows must not exceed 4 mm. The numbers are referred to in the text.

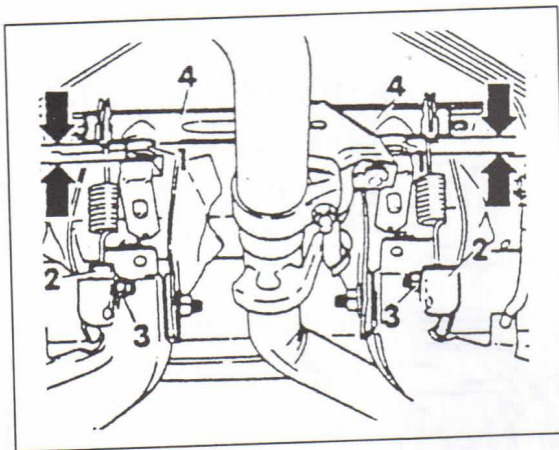


Fig. 14.26.

The arrow shows the adjusting nut for the handbrake cables underneath the vehicle.

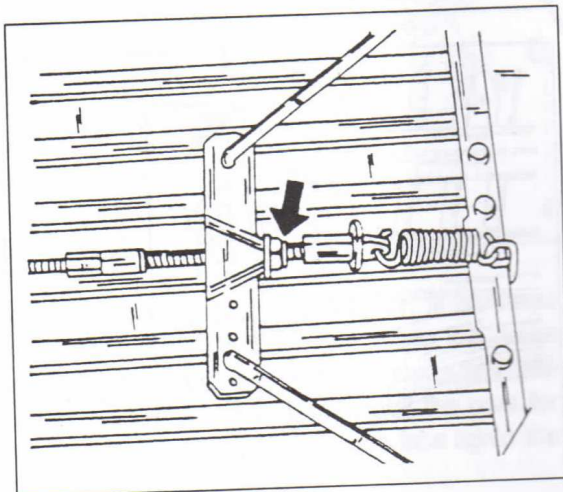
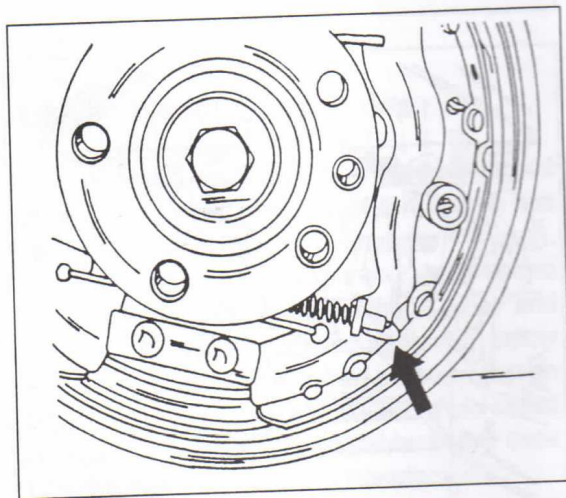


Fig. 14.27.

Tighten the nut in Fig. 14.26 until the handbrake lever lifts by approx. 2 mm from the brake shoe.



- The two buffer stops (1) in Fig. 14.24 are screwed fully back.

- The position of the spring mounting (2) is marked with a felt pen or adhesive tape on the trailing arm.

- The bolt (3) is slackened and the spring mounting (2) is moved. Moving the mounting downwards will increase the pressure, moving the mounting upwards will decrease the pressure. Sometimes it is only necessary to adjust the second spring mounting when the horizontal beam is excessively inclined at the

positions shown by the arrows in Fig. 14.25 (by more than 4 mm). A movement of 1 mm of the spring mounting (2) corresponds to a pressure change of approx. 4 bar at the rear axle. If necessary adjust the regulator setting on the second spring mounting in the manner described.

- The screw (3) is tightened without moving the position of the spring mounting.

- The metal rod inserted in place of the shock absorber can now be removed and the shock absorber refitted as described in Section 13.1. Note the tightening torques.

The removal and installation of the regulating valve is straight forward, but remember to mark the fitted position of both spring mountings in a precise manner, to avoid the immediate adjustment of the regulating valve. We recommend you to have the setting checked at your dealer, if you are not at all happy with the front brake/rear brake balance. The brake system must be bled of air after installation. Take care not to mix-up the brake pipe connections.

### 14.10. Handbrake

#### 14.10.0. HANDBRAKE ADJUSTMENT

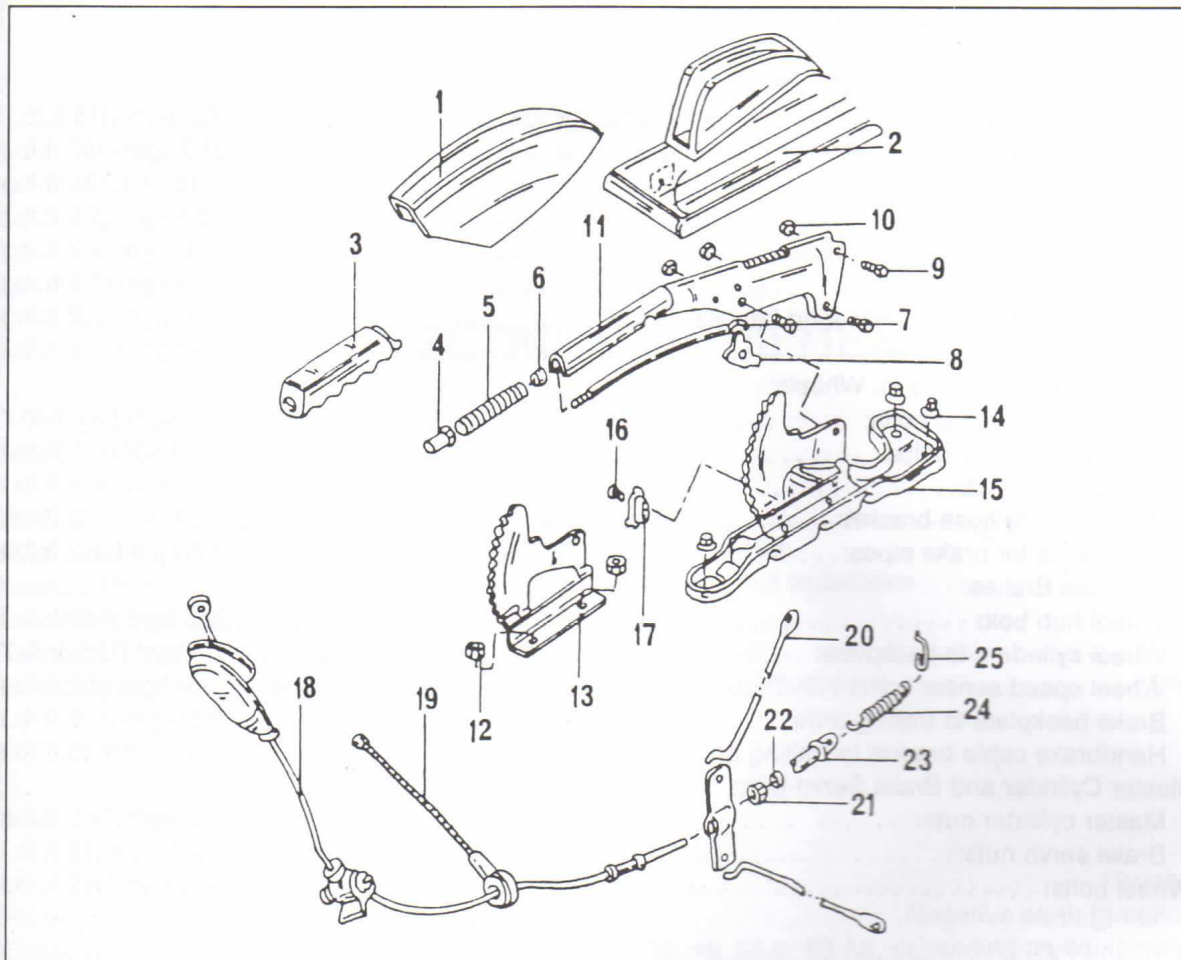
The adjustment of the handbrake cables is carried out underneath the vehicle at the cable equaliser bracket, at the position shown in Fig. 14.26. A routine adjustment of the handbrake is normally not required, as any wear in the brake shoe linings is continuously taken up by the automatic adjusting mechanism, thereby retaining the travel of the brake shoes and handbrake cables. Only if brake shoes or the brake back plate have been removed will it be necessary to adjust the handbrake cables. The brake drums will have to be removed for this operation:

- Place the rear end of the vehicle on chassis stands and remove the wheels. Fully release the handbrake.

- Remove the brake drums as described in Section 14.4. Included therein is the resetting of the brake adjusters inside the brake drums.

- Ask a second person to tighten the nut shown by the arrow in Fig. 14.26 whilst the movement of the handbrake operating lever on





**Fig. 14.28.**  
The component parts of the handbrake mechanism.

- 1 Trim
- 2 Handbrake lever trim
- 3 Handbrake lever grip
- 4 Push button
- 5 Return spring
- 6 Spring seat
- 7 Pawl rod
- 8 Pawl
- 9 Pin
- 10 Retainer
- 11 Handbrake lever
- 12 Nut
- 13 Toothed segment (R.H.D.)
- 14 Self-locking nut
- 15 Handbrake lever carrier
- 16 Rivet
- 17 Contact switch
- 18 Handbrake cable
- 19 Cable
- 20 Pull rod
- 21 Nut
- 22 Locknut
- 23 Cable end
- 24 Return spring
- 25 Retainer

the outside of the brake shoe is observed. As soon as the lever has lifted by approx. 2 mm from the brake shoe the correct handbrake cable adjustment is obtained. Check that the lever on the other rear brake has moved in the same manner.

- Refit the brake drums and the wheels and rotate the wheels. The handbrake lever must be released. Again pull the handbrake and check that both rear wheels are locked. If the brake shoes have been set to their basic position as described during the installation of the shoes in Section 14.4, you will find that the travel of the handbrake lever is slightly longer at the beginning. After a few drives and applications of the brake pedal the adjusting mechanism will settle and the handbrake lever will have its normal travel.

### 14.10.1. HANDBRAKE CABLES

The component parts of the handbrake assem-

bly is shown in Fig. 14.28. The following points must be observed when parts are removed, replaced and refitted:

- To remove the handbrake lever grip (3), press the lugs underneath the grip downwards and pull the grip forwards.
- The nut (12) is self-locking and must be replaced if removed.
- The toothed segment (13) is only fitted to R.H. drive models. L.H. drive models are fitted with the handbrake lever carrier, which in the case of a R.H.D. vehicle is welded to the body.
- The cable (19) is not fitted to all models (dropside vehicles only).
- The brake drums and the brake shoes must be removed in order to replace the handbrake cables. Refer to Section 14.4.0 for further details of the removal and installation operations concerning the brake shoes.

**TIGHTENING TORQUE VALUES — SEE NEXT PAGE**



## 14 Brake System

### 14.11. Tightening Torques

#### Front Disc Brakes — 14 in. Wheels:

|                                                                |                       |
|----------------------------------------------------------------|-----------------------|
| Brake caliper mounting bracket to steering knuckle, top: ..... | 16.0 kgm (115 ft.lb.) |
| Brake caliper mounting bracket to steering knuckle: .....      | 27.0 kgm (197 ft.lb.) |
| Brake caliper to mounting bracket: .....                       | 3.5 kgm (25 ft.lb.)   |
| Brake disc to hub: .....                                       | 0.5 kgm (3.5 ft.lb.)  |
| Splash guard to steering knuckle: .....                        | 1.0 kgm (7.2 ft.lb.)  |
| Brake hose bracket, bolt: .....                                | 1.0 kgm (7.2 ft.lb.)  |
| Wheel speed sensor to steering knuckle (ABS): .....            | 1.0 kgm (7.2 ft.lb.)  |
| Union nuts, brake pipes: .....                                 | 1.7 kgm (12.5 ft.lb.) |

#### Front Disc Brakes — 15 in. Wheels:

|                                    |                       |
|------------------------------------|-----------------------|
| Large brake caliper bolts: .....   | 27.0 kgm (197 ft.lb.) |
| Locknuts or large bolts: .....     | 7.0 kgm (51 ft.lb.)   |
| Brake disc to hub: .....           | 0.5 kgm (3.5 ft.lb.)  |
| Bolt for brake hose bracket: ..... | 1.0 kgm (7.2 ft.lb.)  |
| Union nuts for brake pipes: .....  | 1.7 kgm (12.5 ft.lb.) |

#### Rear Drum Brakes:

|                                                |                       |
|------------------------------------------------|-----------------------|
| Wheel hub bolt: .....                          | 20.0 kgm (144 ft.lb.) |
| Wheel cylinders to backplate: .....            | 1.7 kgm (12.5 ft.lb.) |
| Wheel speed sensor bolt: .....                 | 1.0 kgm (7.2 ft.lb.)  |
| Brake backplate to trailing arm: .....         | 15.0 kgm (108 ft.lb.) |
| Handbrake cable bracket to trailing arm: ..... | 0.7 kgm (5 ft.lb.)    |

#### Master Cylinder and Brake Servo Unit:

|                             |                       |
|-----------------------------|-----------------------|
| Master cylinder nuts: ..... | 2.0 kgm (14.5 ft.lb.) |
| Brake servo nuts: .....     | 2.5 kgm (18 ft.lb.)   |

|                    |                       |
|--------------------|-----------------------|
| Wheel bolts: ..... | 16.0 kgm (115 ft.lb.) |
|--------------------|-----------------------|



## 15 ELECTRICAL EQUIPMENT

### Index

|                                |     |                                |     |
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### 15.0. Battery

|                         |                                             |
|-------------------------|---------------------------------------------|
| Voltage: .....          | 12 volts                                    |
| Polarity: .....         | Negative earth (ground)                     |
| Capacity: .....         | 36, 45, 54 or 63 Ah, depending on equipment |
| State of Charge:        |                                             |
| Fully discharged: ..... | 1.120, specific gravity                     |
| Fully charged: .....    | 1.280, specific gravity                     |

### 15.1. Alternator

#### 15.1.0. ROUTINE PRECAUTIONS

The vehicles covered in this manual employ an alternator with an output of either 65 or 90 amps, depending on the equipment. This equipment contains polarity-sensitive components and the precautions below **must** be observed to avoid damage.

- Check the battery polarity **before** connecting the terminals. Immediate damage will result to the silicon diodes from a wrong connection — even if only momentarily.
- Never disconnect the battery or alternator terminals **whilst** the engine is running.
- Never allow the alternator to be rotated by the engine unless **ALL** connections are made.

- Disconnect the alternator multi-pin connector **before** using electric welding equipment anywhere on the vehicle.

- Disconnect the battery leads if a rapid battery charger is to be used.
- If an auxiliary battery is used to start the engine, take care that the polarity is correct. **Do** not disconnect the cables from the vehicle battery.

#### 15.1.1. DRIVE BELT TENSION

The checking and tensioning of the drive belt for the alternator has already been described in Section 4 on pages 71 and 72, also referring to Figs. 4.7 to 4.8. Always tension the drive belt whenever the alternator, water pump or drive belt have been removed or slackened for any reason.



## 15 Electrical Equipment

### 15.1.2. TECHNICAL DATA

Manufacturer: ..... Bosch or Valeo  
 Part No. — Petrol Engine:  
     65 amps, Bosch make: ..... 026 905 015A  
     90 amps, Bosch make: ..... 026 905 015B  
     65 amps, Valeo make: ..... 026 903 015E

Part No. — Diesel Engine:  
     65 apms, Bosch make: ..... 068 903 031  
     90 amps, Bosch make: ..... 068 903 029K  
     65 amps, Valeo make: ..... 068 903 031H

Length of Brushes:  
     New — Bosch: ..... 10.0 mm (0.4 in.)  
             — Valeo: ..... 9.0 mm (0.35 in.)  
     Wear limit: ..... 5.0 mm (0.2 in.)

Resistance of stator windings: ..... 0.10 - 0.11 ohms  
 Resistance of rotor windings: ..... 2.8 - 3.0 ohms

### 15.1.3. REMOVAL AND INSTALLATION

A different mounting arrangement is used on the various engines, for example Fig. 15.1 shows the type fitted to a four-cylinder petrol engine. Remove the alternator as follows:

- Disconnect the battery earth cable.
- Disconnect the cables by withdrawing the

plug at the rear end of the alternator and unscrewing the single cable connection.

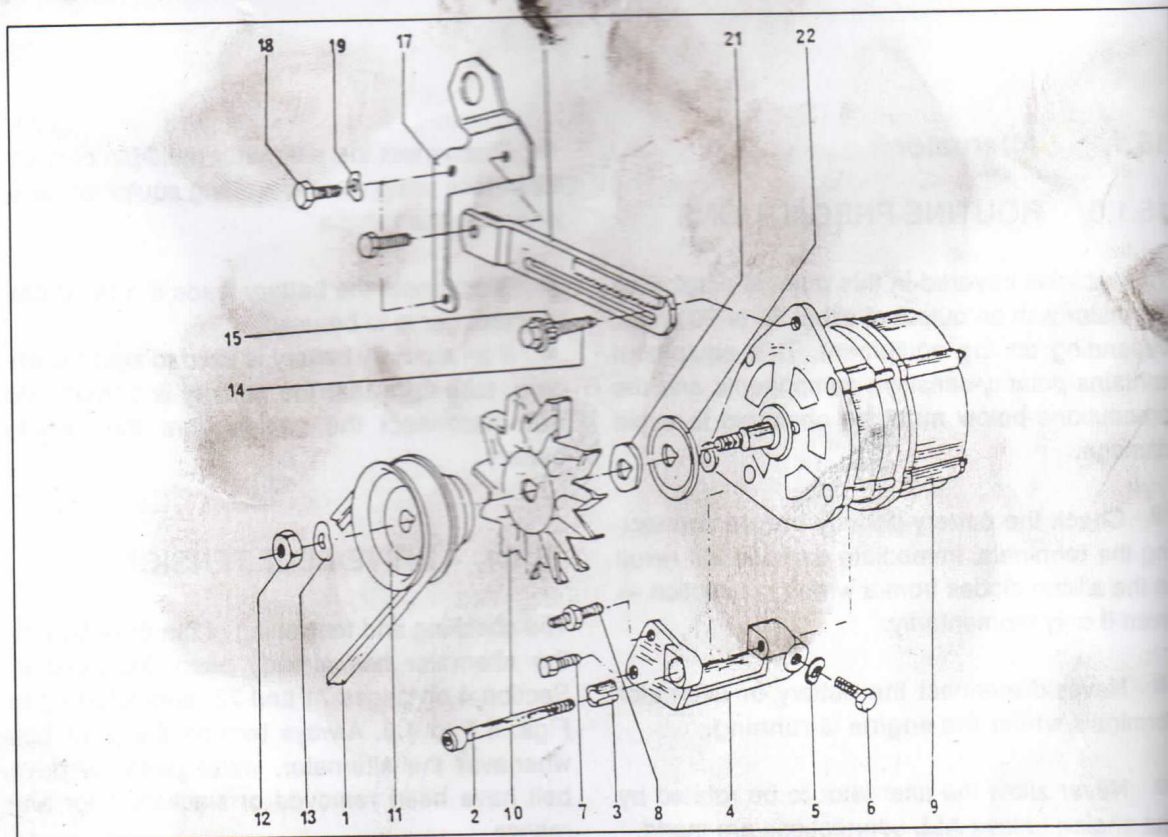
- Slacken the tensioning device for the alternator drive belt and the two (or one) alternator mounting bolts at. To slacken the drive belt, refer to Section 4.3 and Figs. 4.6 to 4.8. Lift off the drive belt.

- Remove the long bolt at the bottom of the

Fig. 15.1.

Alternator mounting as fitted to a four-cylinder petrol engine.

- 1 Drive belt
- 2 Socket head bolt, 3.5 kgm
- 3 Spacer bush
- 4 Mounting bracket
- 5 Washer
- 6 Bolt
- 7 Bolt
- 8 Stud
- 9 Alternator
- 10 Cooling fan
- 11 Pulley, 130 mm diameter
- 12 Nut, 5.0 kgm
- 13 Washer
- 14 Bolt, 3.5 kgm
- 15 Tensioning nut (drive belt)
- 16 Tensioning bracket
- 17 Engine lifting eye
- 18 Bolt, 2.0 kgm
- 19 Washer
- 20 Bolt, 2.0 kgm
- 21 Spacer
- 22 Washer





## 15 Electrical Equipment

alternator after removing the self-locking nut and lift out the alternator.

- If the mounting bracket(s) is to be replaced, refer to the illustration.

Install in the reverse sequence to removal. If the mounting bracket has been removed, refer to the illustration for the tightening torques. The following points should be noted when alternator and bracket are refitted:

- Loosely attach the bracket and secure the alternator with the long bolt. Make sure that the spacer bush (3) is inserted.
- Adjust the drive belt tension as described in Section 1.8.2.2. Tighten the adjusting bar bolt with 2.0 kgm (14.5 ft.lb.).
- Tighten the long mounting bolt to 3.5 kgm (25 ft.lb.). Tighten the bracket securing bolts.

Check the Vee belt tension finally once the securing and adjustment bolts have been fully tightened.

### 15.1.3. SERVICING

Either a Bosch or a Valeo alternator can be fitted, having an output of 60 or 90 amps, depending on the engine and equipment.

We do not recommend that the alternator or control unit should be adjusted or serviced by the owner. Special equipment is required in the way of test instruments and the incorrect application of meters could result in damage to the circuits.

The alternator is fitted with sealed-for-life bearings and no routine attention is required for lubrication. Keep the outside of the alternator clean and do not allow it to be sprayed with water or any solvent.

The alternator brush gear runs in plain slip rings and the brushes have a long life, requiring inspection only after a high mileage has been covered. To inspect the brushes, it is not necessary to remove the alternator. Take off the battery negative terminal and remove the alternator plug. Take out the two screws from the brush holder assembly and withdraw for inspection. New brushes will have to be soldered in position. We would like to point out that it is not an easy operation to guide the brushes over the slip

rings when the slip ring cover is being fitted.

### 15.2. Starter Motor

#### 15.2.0. TECHNICAL DATA

Make: ..... Bosch

Part No.:

AAB engine: ..... 028 911 023A

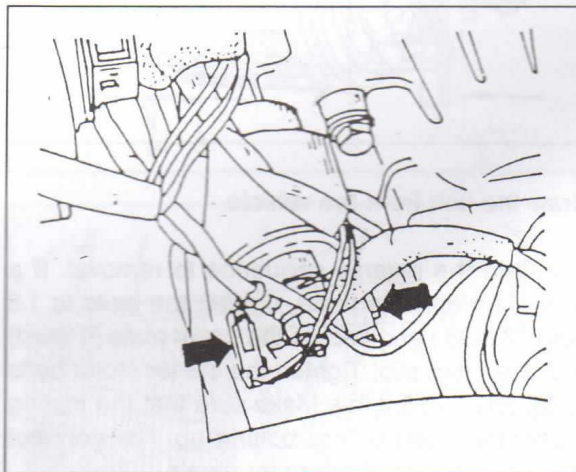
AAC engine: ..... 028 911 023B

1X/AAF engines: ..... 028 911 023C

Min. brush length: ..... 13.0 mm (0.52 in.)

#### 15.2.1. REMOVAL AND INSTALLATION

- Disconnect the battery earth (ground) cable and jack up the front end of the vehicle.
- Release the two cable clamps for securing the wiring from the alternator and the wiring from the alternator terminal "50" from the ignition starter switch. Remember to attach the cables with the clamps after installation of the starter motor.
- At the back of the starter motor take off the cables and wires, taking care from where each cable is disconnected. The two connectors are shown in Fig. 15.2.



**Fig. 15.2.**  
The arrows show the location of the white and black connectors on the starter motor.

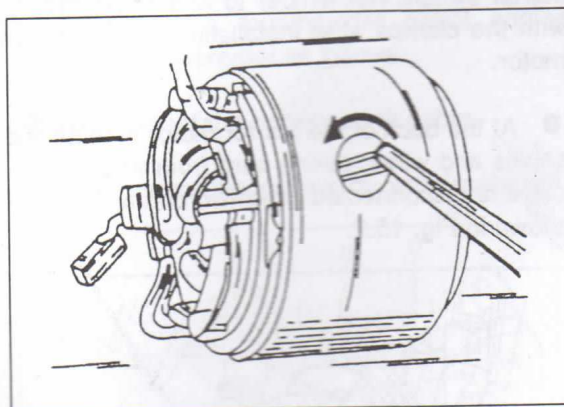
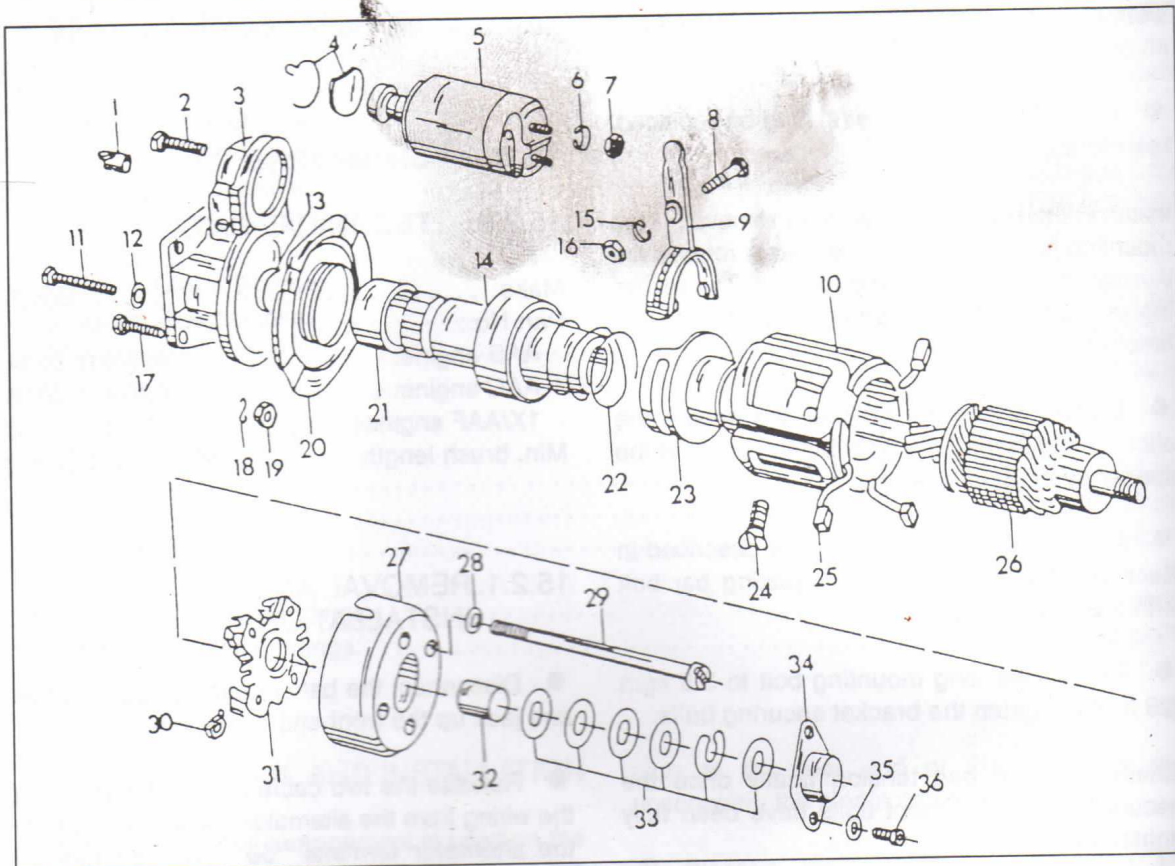
- Disconnect the wire from the alternator "B+" terminal and the wire from the battery positive terminal from the starter motor terminal after removal of the nut.
- Loosen the starter motor bolts and nuts (and support bracket, if fitted). Hold the starter motor while the bolts are completely removed. With-



## 15 Electrical Equipment

**Fig. 15.3.**  
Exploded view of a typical starter motor.

- 1 Starter motor bush
- 2 Starter motor bolt
- 3 Drive end bracket
- 4 Sundry parts
- 5 Solenoid switch
- 6 Spring washer
- 7 Nut, M8
- 8 Bolt, engagement lever
- 9 Engagement lever
- 10 Field coils
- 11 Bolt, M10
- 12 Plain washer
- 13 Stop ring
- 14 Starter motor drive
- 15 Spring washer
- 16 Nut, M6
- 17 Bolt, M8
- 18 Spring washer
- 19 Nut, M8
- 20 Intermediate bracket
- 21 Engagement bush
- 22 Engagement spring
- 23 Engagement bush
- 24 Pole piece screw
- 25 Carbon brush
- 26 Armature
- 27 Commutator end cover
- 28 Plain washer
- 29 Through bolt
- 30 Brush spring
- 31 Brush holder
- 32 Commutator end bush
- 33 Sundry parts, commutator end
- 34 Cover
- 35 Spring washer
- 36 Screw, M4



**Fig. 15.4.**  
Removing the starter motor pole screws to allow the field coil and brush assembly to be extracted.

draw the unit from the vehicle.

Install in the reverse sequence to removal. If a support bracket is fitted, tighten the bolts to 1.6 kgm (11 ft.lb.) and secure the cover plate (if fitted) with the hose clip. Tighten the starter motor bolts to 6.0 kgm (43.5 ft.lb.). Make sure that the mating faces are clean before bolting up. Re-connect the wires and the battery terminals.

### 14.3.1. SERVICING

A typical starter motor is shown in Fig. 15.3. If it is intended to dismantle the starter motor, proceed as follows:

- First remove the wire nut and take off the

cable tag. From the front end of the solenoid take off the two mounting bolts and disengage from the pinion lever to allow the solenoid unit to be removed.

- From the non-drive end of the starter motor, take off the two bolts securing the cover. Unscrew the two through bolts and from the commutator cover.

- Ease off the lock clip from the end of the armature shaft and take off the sundry parts. Take off the end cover. Collect all fitted washers.

- Pull both field coil brushes from the holder and take off the holder. Pull the field housing (yoke) from the drive end bracket. Take out the lever pivot screw and nut to allow the lever to be taken out.

The field coil brushes are welded to the field coil windings and can only be renewed by replacing the complete field coil/brush assembly. If you want to do this yourself, proceed as follows:

- Remove the four pole shoes by first tapping with a brass drift as shown in Fig. 15.4.

- Remove the shoes and slide out the field coil and brush assembly.

To remove the armature, or the drive pinion as-



## 15 Electrical Equipment

sembly, refer to Fig. 15.5. Push down the stop ring with a suitable mandrel and expose the wire clip. Pry out the clip from the groove and pull off the pinion, as shown in Fig. 15.6. Make sure that the shaft is not burred or scored.

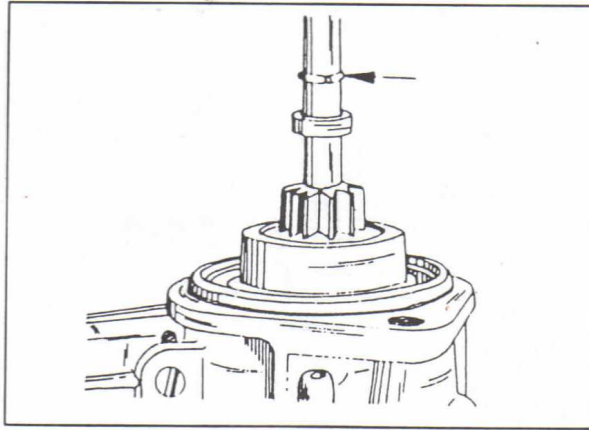
Assemble in the reverse sequence to dismantling, noting the following points:

Slide the pinion along the shaft, followed by the stop ring and a new spring clip. Support the stop ring on two plates and press the clip into the ring by pressure on the end of the armature shaft.

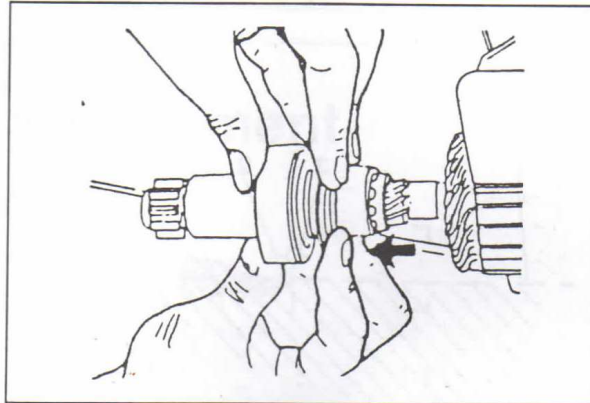
When installing the solenoid unit, make sure that the rod engages correctly with the release lever.

Refer to Fig. 15.7 and coat the areas shown with "D3" sealing compound to seal off the assembled starter motor against water, etc.

Before closing off the rear end of the starter motor check the end float of the armature. If this exceeds 0.3 mm (0.012 in.) change the washers between the end of the bush in the commutator cover and the "C" washer on the armature shaft.



**Fig. 15.5.**  
The starter motor armature, showing the clip (arrowed) and the stop ring. Always fit a new clip when the starter motor is assembled.

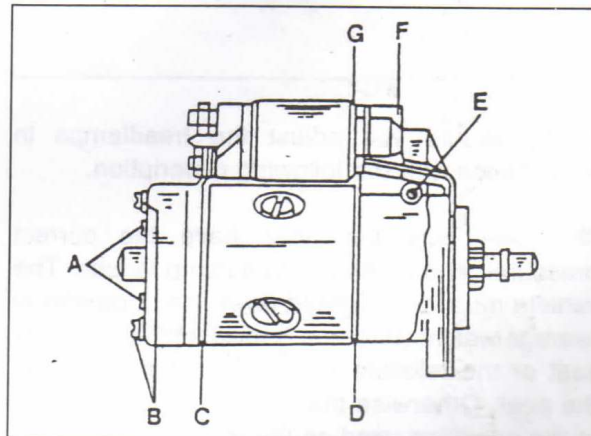


**Fig. 15.6.**  
Removal of the starter motor drive after stop ring and securing clip have been removed from the shaft end.

### 15.3. Headlamps

#### 15.3.0. REMOVAL

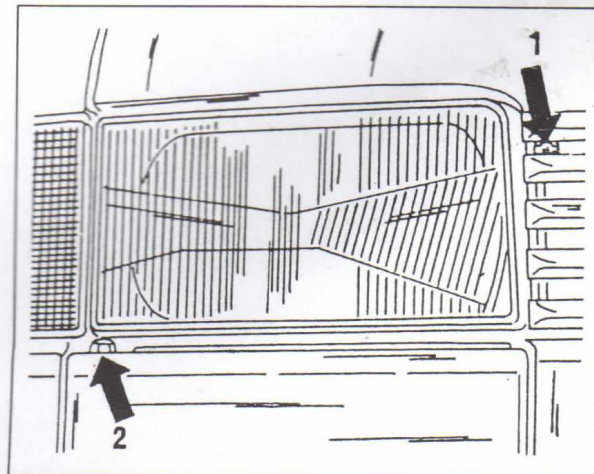
The replacement of the headlamp bulbs is described in the Owner's Manual and is not described in the following text. The bulb is replaced from the engine compartment side. Do not touch the bulb glass with the fingers during installation. Fit the bulb with the lug engaging into the cut-off of the bulb holder. The headlamps must be adjusted when a headlamp bulb has been replaced.



**Fig. 15.7.**  
Coat the points shown with the letters with "D3" sealing compound before assembling the respective parts of the starter motor.

#### 15.3.2. HEADLAMP ADJUSTMENT

The adjustment of the headlamps is carried out from the outside. Two adjusting screw, at the positions shown in Fig. 15.8, are used to align the headlamp beams horizontally (1) or vertically (2). Note that the R.H. light unit is shown. The screws are arranged in mirror image on the other headlamp. At the time the headlamp alignment is checked, it is possible to adjust the fog lamps. A screwdriver is used to turn the adjusting screw, at the position shown in Fig. 15.9.

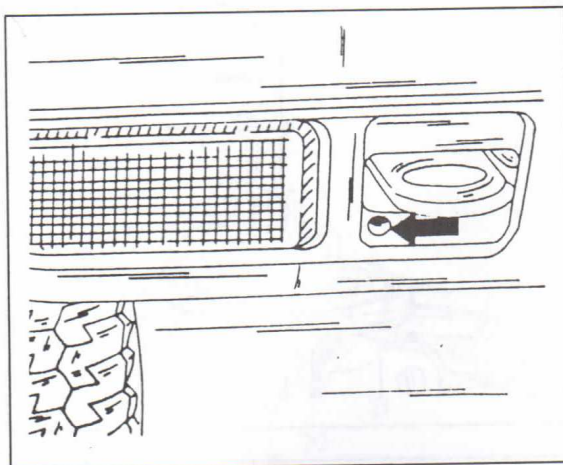


**Fig. 15.8.**  
The position of the horizontal adjusting screw (1) and the vertical adjusting screw (2) on the R.H. headlamp.

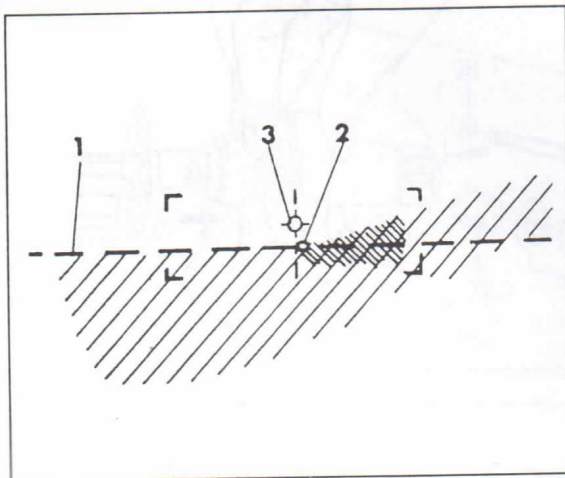
The adjustment of the headlamps should be carried out with an optical instrument. Only in emer-



## 15 Electrical Equipment



**Fig. 15.9.**  
The opening where a screwdriver is inserted to adjust the fog lamps. On vehicles without spoiler it will be possible to turn the adjuster wheel by hand.



**Fig. 15.10.**  
Adjusting diagram for the headlamps. The numbers are referred to in the text.

gency should you adjust the headlamps in accordance with the following description.

- Make sure the tyres have the correct pressures and clean the headlamp lenses. The vehicle must be weighted down, i.e. a person of average weight (11 stone ?) must sit in the drivers seat or the relevant weight must be placed on the seat. Otherwise the vehicle must be empty, in the condition used on the road, ie. with spare

wheel, tools, etc. The tank, however, must be 90 % full. If not fill the tank before proceeding with the adjustment.

- Drive the vehicle in front of a dark wall or the garage door, positioning it square to the wall/garage door. Push the car backwards or forward to obtain a distance of 10 meters between wall/door and headlamp fronts. Transfer the diagram shown in Fig. 15.10 to the wall/door, i.e. mainly the headlamp centres. To do this, measure the height from the floor to the headlamp centres.

- Switch on the headlamps and change to low beam. Check where the light beams are in relation to the markings on the wall/door. The light/dark border line must touch the adjusting line (1) in the diagram. The point (2) between the L.H. horizontal line and the R.H. ascending part of the light/dark border line must meet in the centre of point (3).

- To adjust the fog lamps, transfer the height of the lamps to the wall/door and switch on the fog lamps. Adjust the lamps as already described (Fig. 15.9). The light/dark border must be just below the centre of the transferred fog lamp heights.

As the above description will show you, we do not consider it easy to adjust the headlamps. It is even more difficult to deal with vehicles with headlamp range adjustment, as further preliminary tasks must be performed. We therefore recommend to have the headlamp adjustment finally checked at your Dealer. The above procedure will get you on the road without endangering other road users.



## 16 DIESEL ENGINES

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### 16.0. Main Features

|                                          |                                                                                                                                                                                                                                            |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type: .....                              | 4- or five-cylinder, in-line, water cooled diesel engine with distributor pump (indirect injection).                                                                                                                                       |
| Valve gear: .....                        | Overhead camshaft, timing belt drive to camshaft and injection pump drive gear on 4-cylinder. Injection pump on 5-cylinder driven by separate belt. Camshaft operating directly onto inverted, hydraulically operated bucket-type tappets. |
| Engine Code:                             |                                                                                                                                                                                                                                            |
| Four-cylinder engine: .....              | 1X                                                                                                                                                                                                                                         |
| Five-cylinder engine: .....              | AAB                                                                                                                                                                                                                                        |
| Swept volume:                            |                                                                                                                                                                                                                                            |
| 1X engine: .....                         | 1.9 Litre                                                                                                                                                                                                                                  |
| AAB engine: .....                        | 2.4 Litre                                                                                                                                                                                                                                  |
| Bore: .....                              | 79.5 mm (3.0393 in.)                                                                                                                                                                                                                       |
| Stroke, 4- and 5-cylinder engines: ..... | 95.5 mm (3.794 in.)                                                                                                                                                                                                                        |
| Compression ratio:                       |                                                                                                                                                                                                                                            |
| 4-cylinder engine: .....                 | 22.5 : 1                                                                                                                                                                                                                                   |
| 5-cylinder engine: .....                 | 23.0 : 1                                                                                                                                                                                                                                   |



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### Output (DIN):

|                          |                         |
|--------------------------|-------------------------|
| 4-cylinder engine: ..... | 45 kW (DIN) at 3700 rpm |
| 5-cylinder engine: ..... | 57 kW (DIN) at 3700 rpm |

### Max. torque:

|                          |                                          |
|--------------------------|------------------------------------------|
| 4-cylinder engine: ..... | 12.7 kgm (91 ft.lb.) at 1700 - 2500 rpm  |
| 5-cylinder engine: ..... | 16.4 kgm (118 ft.lb.) at 1800 - 2200 rpm |

### Valve Timing:

|                        | 4-cyl.                                                  | 5-cyl.         |
|------------------------|---------------------------------------------------------|----------------|
| Inlet valve opens:     | 6° A.T.D.C.                                             | 6° A.T.D.C.    |
| Inlet valve closes:    | 20° A.B.D.C                                             | 20° A.B.D.C.   |
| Exhaust valve opens:   | 25.5° B.B.D.C                                           | 25.5° B.B.D.C. |
| Exhaust valve closes:  | 6.5° B.T.D.C                                            | 6.5° B.T.D.C.  |
| Checking values: ..... | 1 mm (0.04 in.) valve stroke and "Zero" valve clearance |                |

BTDC = Before top dead centre

ABDC = After bottom dead centre

BBDC = Before bottom dead centre

ATDC = After top dead centre

Engine Tightening Torques Summary: .....Page 188

### 16.1. Engine — Removal and Installation

The removal of the 1.9 litre engine is carried out in a similar manner as the removal of the petrol engine, i.e. the engine is removed without the transmission from below the vehicle. The 2.4 litre engine is removed together with the transmission.

#### Four-Cylinder Engine:

Follow the general outline of the removal as described in Section 1.1. After removal of the radiator carry out the following operations:

- Disconnect the throttle control cable from the lever on the injection pump, remove the clip from the cable bracket and free the cable from its attachment.
- Disconnect the two fuel lines from the injection pump. Beware of a syphon flow.
- Disconnect the operating cable from the cold start device. To do this, pull the cable in Fig. 16.1 tight, screw in the adjusting screw (1), separate the plugs (2) and (3) and unclip the cable.
- Follow the remaining removal steps in Section 1.1 until the engine can be lowered to the ground.

The installation is a reversal of the removal procedure. Follow the tightening torques on Page 188.

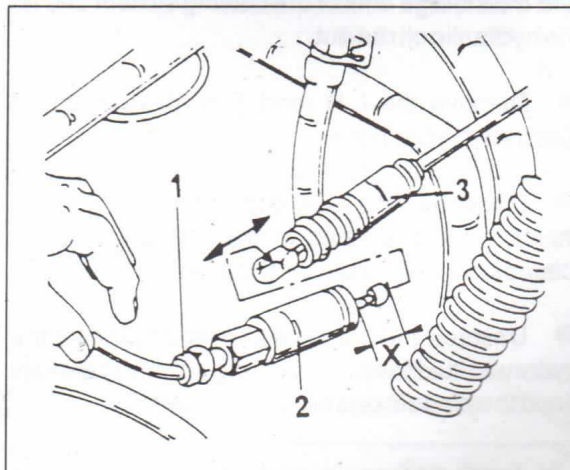


Fig. 16.1.  
Details for the removal of the cold start operating cable. The numbers are referred to in the text.

#### Five-Cylinder Engine

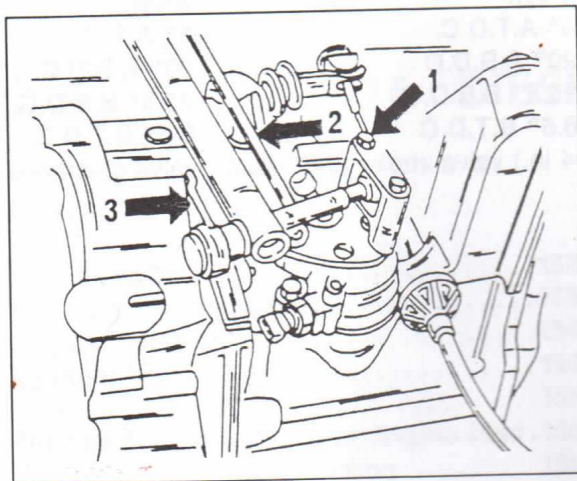
- Disconnect the battery earth cable, remove the noise dampening panel underneath the vehicle and tilt the front end of the vehicle downwards in the familiar manner. Remove the radiator (refer to Section 1.1.).
- Disconnect the throttle cable from the lever on the injection pump and the cold start operating cable as described for the four-cylinder engine (refer to Fig. 16.1).
- Unscrew the clutch release cylinder from the transmission without disconnecting the hydraulic fluid pipe.
- Disconnect all electrical cables from engine,



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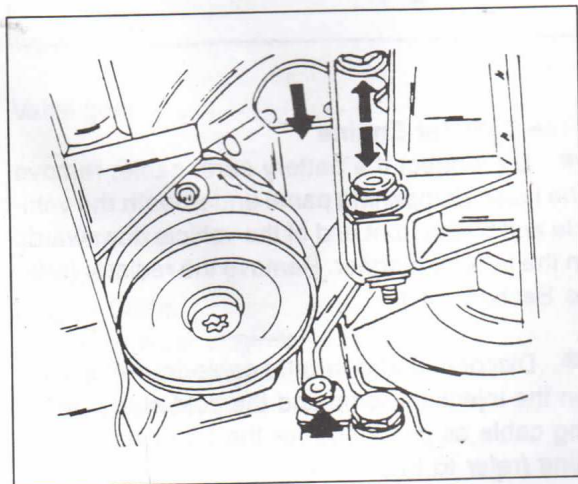
transmission, starter motor, etc.

- Remove the gear actuating unit as follows, referring to Fig. 16.2. Unscrew the clevis (1) and lever up the gear stick at the front from the gear control lever (2). Unscrew the bearing block with the selector rod (3).



**Fig. 16.2.**  
Disconnecting the gear actuating unit from the transmission. The numbers are referred to in the text.

- Disconnect the oil pipes for the steering pump and the storage tank of the cooling system and let the hydraulic oil run out.
- Remove the L.H. and R.H. drive shaft as described in Section 4.
- Disconnect the exhaust pipe from the exhaust manifold as described in the relevant section. Clamps are used to connect the two parts.
- Unscrew the pressure and return pipe for the hydraulic fluid from the steering box and carefully bend the pipes to one side, out of the way.



**Fig. 16.3.**  
The arrows show where the transmission mountings of a 2.4 litre engine are attached.

- Refer to Fig. 16.3 and remove the four bolts shown by the arrows. This will free the transmission from the transmission mounting.
- Place a mobile jack underneath the trans-

mission (wooden block between jack head and transmission), until the assembly is under slight tension and remove the central bolts for engine and transmission mountings on the L.H. and R.H. side.

- Lower the engine and transmission with the jack until it can be removed. Continuously check that none of the connections, cables, leads, pipes, etc. have been left in position and that none of these can get caught in parts of the engine or transmission. A second person should hold the power unit on the jack as it is lowered.
- After removal of transmission and engine remove the starter motor and separate the transmission from the engine. Take care not to rest the weight of the transmission on the clutch shaft. The transmission must be withdrawn horizontally.

The installation of the transmission is a reversal of the removal procedure. Note the following points:

- Check the clutch release bearing for wear before the engine is connected to the transmission.
- Slightly coat the clutch release bearing and the input shaft splines with graphited grease. The release bearing sleeve must not be lubricated.
- Re-connect the fuel feed and return pipes. The return pipe has a smaller diameter and also is marked with the word "OUT" on the hexagon.
- Adjust the throttle cable as described in the "Diesel Fuel System" section.
- Fill the cooling system.

The following main tightening torques must be observed:

Engine to Transmission:

|              |                       |
|--------------|-----------------------|
| 12 mm bolts: | 8.0 kgm (58 ft.lb.)   |
| 10 mm bolts: | 6.0 kgm (44 ft.lb.)   |
| 8 mm bolts:  | 2.0 kgm (14.5 ft.lb.) |

Transmission Mountings:

|                    |                       |
|--------------------|-----------------------|
| M10 x 60 mm bolts: | 6.5 kgm (47.5 ft.lb.) |
| M10 x 28 bolts:    | 4.5 kgm (32.5 ft.lb.) |
| Drive shaft bolts: | 5.5 kgm (40 ft.lb.)   |

### 16.2. Engine Dismantling

The basic information to be followed during the dismantling of the engine are the same as described in Section 1.2 for the petrol engine. The dismantling of the engine is described on the



## 16 Diesel Engines

following pages, there will, however, be operations which are identical as described for the pe-

trol engine and reference will be made to the relevant section.

### 16.3. Cylinder Head

#### 16.3.0. Technical Data

##### Valves

##### Valve Head Diameters:

|                       |                     |
|-----------------------|---------------------|
| Inlet valves: .....   | 36.0 mm (1.43 in.)  |
| Exhaust valves: ..... | 31.0 mm (1.220 in.) |

##### Valve Length:

|                                 |                    |
|---------------------------------|--------------------|
| Inlet and exhaust valves: ..... | 95.0 mm (3.74 in.) |
|---------------------------------|--------------------|

##### Valve Stem Diameters:

|                       |                     |
|-----------------------|---------------------|
| Inlet valves: .....   | 7.97 mm (0.314 in.) |
| Exhaust valves: ..... | 7.95 mm (0.313 in.) |

Valve seat angle: ..... 45°

Valve edge thickness: ..... 0.5 mm (0.02 in.) min.

##### Valve Seats

##### Valve Seat Diameters:

|                       |                     |
|-----------------------|---------------------|
| Exhaust valves: ..... | 30.4 mm (1.197 in.) |
| Inlet valves: .....   | 34.8 mm (1.291 in.) |

##### Valve Seat Widths:

|                       |                     |
|-----------------------|---------------------|
| Inlet valves: .....   | 2.05 mm (0.081 in.) |
| Exhaust valves: ..... | 2.7 mm (0.107 in.)  |

Valve seat angle: ..... 45°

Upper correction angle: ..... 15°

##### Valve Guides

Installation temperature: ..... Cylinder head cold

Inner diameter: ..... 8.013 - 8.035 mm (0.3154 - 0.3163 in.)

Running clearance of valve stems ..... See Fig. 1.16.

#### 16.3.1. Introduction

The cylinder head can be removed with the engine in position in the engine compartment. Due to the design of the valve gear, tappets and camshaft there are a number of special points arising which the reader is advised to study before attempting any work on the cylinder head.

The overhead camshaft of a four-cylinder engine is supported in five bearings, the shaft of a five-cylinder engine in four bearings, the rear one providing axial location. There is a special procedure for removing the camshaft for access to the valve springs and tappets and this must be followed to avoid distortion of the camshaft from the

pressure of the valve springs. A number of special tools, or suitably made-up alternatives, will be required for servicing and the reader is advised not to undertake such work unless the proper equipment is available.

Routine adjustment of the tappet clearance is not required, as any clearance will be taken up by the hydraulic tappets.

The valve retainers, springs and stem seals are rather inaccessible, being in pockets in the head. We shall be describing the removal and installation procedures, using the special tools and



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procedures recommended and will mention those that are essential for the work.

### 16.3.1. Head Removal — Engine fitted

Only remove the cylinder head when the engine temperature is less than 40° C. Figs. 16.4 and 16.7 shows exploded views of the the cylinder heads. The removal of the individual parts takes place in their numbered order.

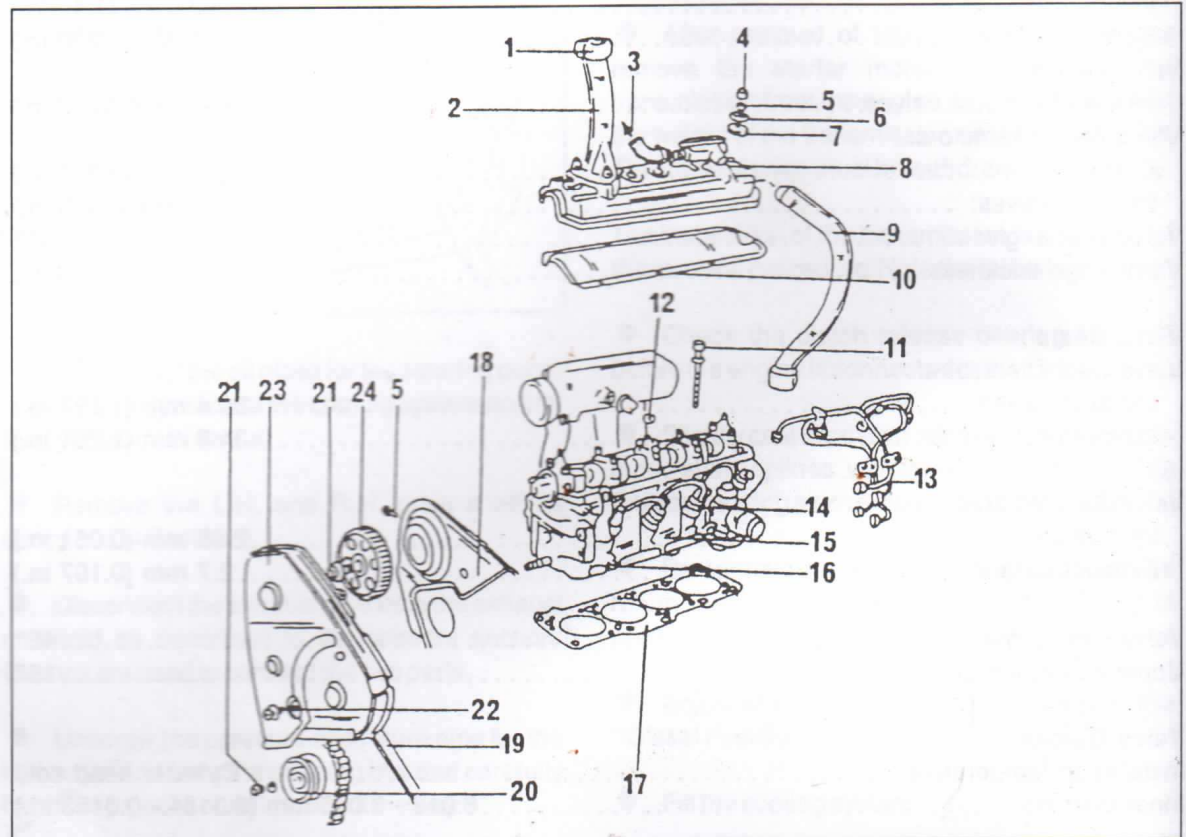
on the cylinder head. Also disconnect the pipes belonging to the fuel injection system between cylinder head and body. Protect the pipe ends against entry of foreign matter.

- Remove the exhaust manifold and the front exhaust pipe.

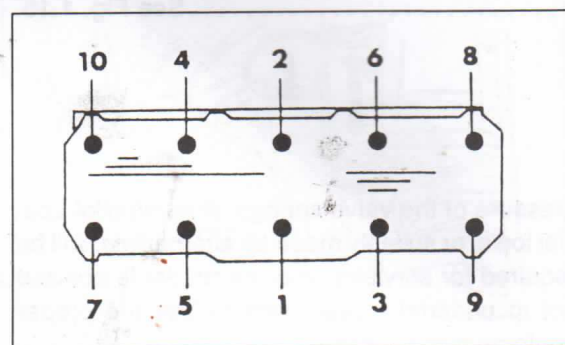
- Unscrew the cylinder head cover. Carefully remove the gaskets as they can be re-used, if still in good condition.

**Fig. 16.4.** Details for the removal and installation of the cylinder head — 1.9 litre engine.

- 1 Oil filler cap
- 2 Oil filler tube
- 3 To induction tube
- 4 Cap
- 5 Nut, 1.0 kgm
- 6 Dished washer
- 7 Upper seal
- 8 Cylinder head cover
- 9 Crankcase breather hose
- 10 Cover gasket
- 11 Cylinder head bolts
- 12 Lower seal
- 13 Injector pipes, 2.5 kgm
- 14 Injector, 7.0 kgm
- 15 Cylinder head
- 16 Glow plug
- 17 Cylinder head gasket
- 18 Inner belt cover plate
- 19 Timing belt
- 20 Timing belt tensioner
- 21 Nut, 4.5 kgm
- 22 Spreader clip
- 23 Upper timing belt cover
- 24 Camshaft timing gear



**Fig. 16.5.** Tightening sequence for the cylinder head bolts of a four-cylinder engine. Slacken the bolts in reverse order.



- Remove the timing belt as described later on under the relevant heading. Also remove the camshaft timing gearwheel from the end of the camshaft. On a five-cylinder engine there is the drive belt for the injection pump. The removal is described in conjunction with the injection pump.

- Using a socket head wrench slacken the cylinder head bolts in reverse order to the one shown in Fig. 16.5 or 16.6, depending on the engine. Slacken the bolts in several stages. The cylinder head and the gasket can now be removed.

- Tilt the front end of the vehicle forward, as described on page 11 and disconnect the battery earth cable.

- Drain the cooling system and disconnect the coolant hoses from the cylinder head.

- Disconnect the electrical cables from all parts

### 16.3.2. Cylinder Head — Dismantling

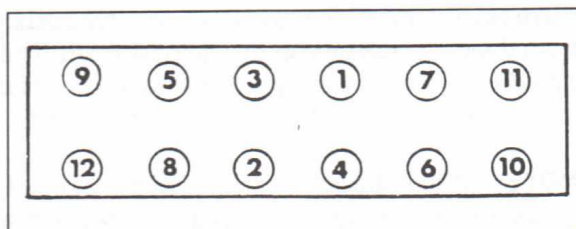
Remove all auxiliary parts from the cylinder head. Unscrew the four or five injectors from the cylinder



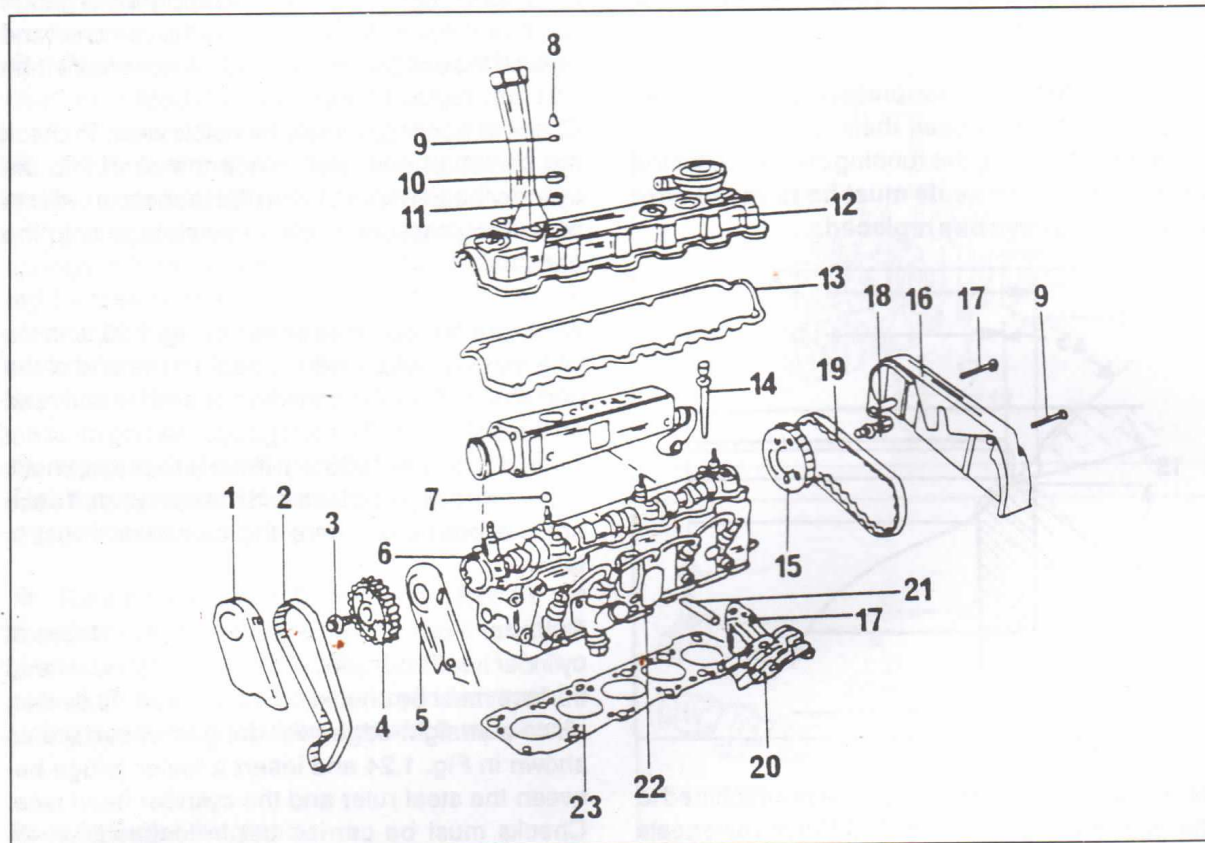
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head and put them away safely where they cannot suffer damage during the work on the cylinder head. Make up a bracket which can be attached to the studs for the exhaust manifold and clamp the bracket into a vice.

Remove the camshaft as described in Section



**Fig. 16.6.**  
Tightening sequence of the cylinder head bolts of a five-cylinder engine. Slacken the bolts in reverse order.



**Fig. 16.7.**  
Details for the removal and installation of the cylinder head — 2.4 litre engine.

- 1 Timing belt cover
- 2 Timing belt
- 3 Bolt, 8.5 kgm
- 4 Camshaft timing gearwheel
- 5 Inner belt cover
- 6 Cylinder head
- 7 Seal
- 8 Cap
- 9 Nut, 1.0 kgm
- 10 Dished washer
- 11 Sealing washer
- 12 Cylinder head cover
- 13 Cover gasket
- 14 Cylinder head bolts
- 15 Injection pump wheel
- 16 Timing belt cover
- 17 Bolt, 2.0 kgm
- 18 Bolt, 10.0 kgm
- 19 Injector pump belt
- 20 Vacuum pump
- 21 Push rod
- 22 "O" sealing ring
- 23 Cylinder head gasket

16.5. Remove the half-round sealing insert from the bearing cap, if it is still in the cap. Otherwise remove the seal from the cylinder head.

Carefully lift the camshaft out. Using soft-metal jaws, clamp the camshaft into a vice and remove the bolt securing the camshaft gearwheel. Remove the gearwheel and slide the camshaft oil seal from the end of the shaft.

Remove the tappets. Keep the adjusting disc with its tappets (if applicable) and lay each of the tappets out in order (on a sheet of paper) so that they can be replaced in the same position. Mark the tappets by marking them as shown in Fig. 1.14.

A valve lifter is necessary for the removal of the valves and should be as shown in Fig. 1.15 or working with a similar principle. Press down the retainer to allow the collets to be extracted with a pair of thin-nosed pliers. An alternative method is to place a piece of tube over the valve spring retainer and to tap the tube with a short blow of a hammer. The valve cotter halves will be freed

and collect in the inside of the tube. If this method is used, support the valve head from the other side. The valve lifter should, however, be available for the installation.

The lower valve spring seat can perhaps be removed with a pair of circlip pliers. Special tool 3047 is available for this purpose. The valve stem seal can also be extracted with the same tool (Fig 1.29).

**Valve Guides:** Valve guides and valve stems should first be inspected for visible wear. The operations are the same as described on pages 18 and 19 for the petrol engines, but note that the side play of the valves, if checked in the manner shown in Fig. 1.16 can be up to 1.3 mm for both inlet and exhaust valves. If this value is exceeded, either the valves or the valve guides, or both must be replaced.

To replace the valve guides, press out the old guides from the cylinder head (from the camshaft side), using a suitable mandrel or carefully drive

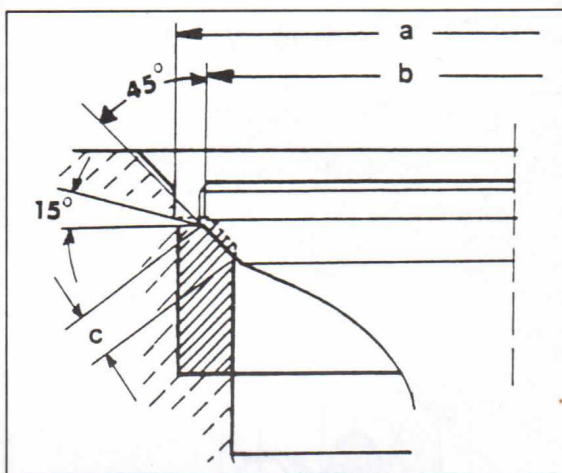


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them out with a drift. Press in the new valve guides from the camshaft side of the cylinder head. The cylinder head must be cold and the guides must be coated with engine oil before they are pressed in.

**NOTE:** If the correct VW mandrel is not used, measure the protruding end of the guides with a depth gauge before pressing them out. Refit to the same dimension.

After all guides have been pressed in position, use an 8 mm reamer to open them up to the correct diameter, observing the running clearance for the valve stems. **Valve seats must be re-faced after valve guides have been replaced.**



**Fig. 16.8.**  
The valve seat re-finishing sizes. The dimensions are given in Section 16.3.0 (different for four- and five-cylinder engine).  
a = Valve seat diameter  
b = Valve head diameter  
c = Valve seat width

**Valve Seats:** Valve seats can be re-machined to the dimensions given in Fig. 16.8. When valve seats are re-cut, determine the maximum permissible re-cutting depth. If this is exceeded there is no guarantee that the tappets can work properly.

**Valves:** Valves are treated in the same manner as the valves of a petrol engine and page 23 should be consulted. Grinding or straightening of valve stems is not permissible. Inlet valves can be re-ground in a valve grinding machine. This is **not permissible** in the case of exhaust valves (special coating). These must be reconditioned by grinding in with lapping paste or replaced. Make sure that the minimum valve head thickness "d" in Fig. 1.23 is retained at all times.

**Valve Springs:** Springs should be compared with new springs and rejected if weak or cracked. Lay each spring on a surface plate and check that the ends of the springs are square. Slide the originally fitted spring and a new spring together over a long bolt (with large washers under bolt head and nut) and screw a nut onto the end of the bolt. Clamp the bolt head into a vice and slowly tighten the nut. If the coils of the original spring close before the coils of the new spring, replace the springs as a set, as the

other springs will have similar defects.

**Camshaft:** If a camshaft is replaced, always quote the engine number to obtain the correct camshaft.

Place the camshaft with the two end journals into V-blocks or clamp the shaft between the points of a lathe, as shown in Fig. 1.27 and apply a dial gauge to the centre journal. Slowly rotate the camshaft and read off the dial gauge. If the indication is more than 0.01 mm, replace the shaft, as it is bent.

Check all bearing journals for visible wear. To check the camshaft end float, place the shaft into the cylinder head without fitting the tappets in order to avoid the pressure of the valve springs onto the camshaft.

Arrange a dial gauge as shown in Fig. 1.28, with the stylus of the gauge resting against the end of the camshaft. Move the camshaft to and fro and read off the dial gauge. The dial gauge reading must not exceed 0.15 mm (0.006 in.). If this is the case, check the bearing cap end face and the camshaft. These are the positions where the camshaft thrust is taken.

**Cylinder Head:** Thorough clean the surfaces of cylinder head and cylinder block. The cylinder head surface must be checked for distortion. To do this, place a straight-edge over the gasket surface as shown in Fig. 1.24 and insert a feeler gauge between the steel ruler and the cylinder head face. Checks must be carried out in longitudinal, diagonal and transverse directions. If a feeler gauge of more than 0.10 mm (0.004 in.) in thickness can be inserted, replace the cylinder head, as it cannot be refaced.

### 16.3.3. Cylinder Head Assembly

Re-assemble the cylinder head components in accordance with the notes below, following the dismantling procedure in the reverse sequence. Fig. 16.9 shows an exploded view of the cylinder head for a five-cylinder engine. Similar parts are fitted to a four-cylinder engine, with the exception of the camshaft.

- With a pair of pliers as shown in Fig. 1.29 fit the bottom valve spring seat into the recess for each valve. The illustration shows the special tool. If not available, use a pair of circlip pliers.

- Fit new valve stem seals. A special tool (10-204) is available for this purpose. A plastic sleeve is pushed over the valve guide and the well oiled seal



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placed over the sleeve. The installation of the seals is carried out as described on Page 21 and as shown in Fig. 1.30 for the petrol engine.

- Lubricate the valve stems and guides before installation of the valves. If valves have been lapped, make sure that each valve is fitted to its correct seat.

- Check the end float of the camshaft as described on Page 158.

- Fit the the inner and outer valve springs, place the upper spring retainer over the valves and using the valve compressor, compress the springs until the valve cotter halves can be inserted by means of a thin-nosed pair of pliers. Remove the valve compressor and check that the cotters have engaged in their groove by tapping the ends of the valve stems lightly with a hammer.

- Insert the tappets into their bores (well oiled). If the same tappets are used, insert them into their original bores.

- Refit the camshaft. Generously lubricate the camshaft journals and the bearing bores with engine oil. Place the camshaft in position. The two cams for the valves of the first cylinder must be facing upwards. Install the camshaft as follows:

### Four-Cylinder Engine

- Fit Nos. 2 and 4 camshaft bearing caps, referring to Fig. 1.12. The caps are slightly off-centre and must be fitted the correct way round. Fig. 1.31 shows the correct fitting of the caps.

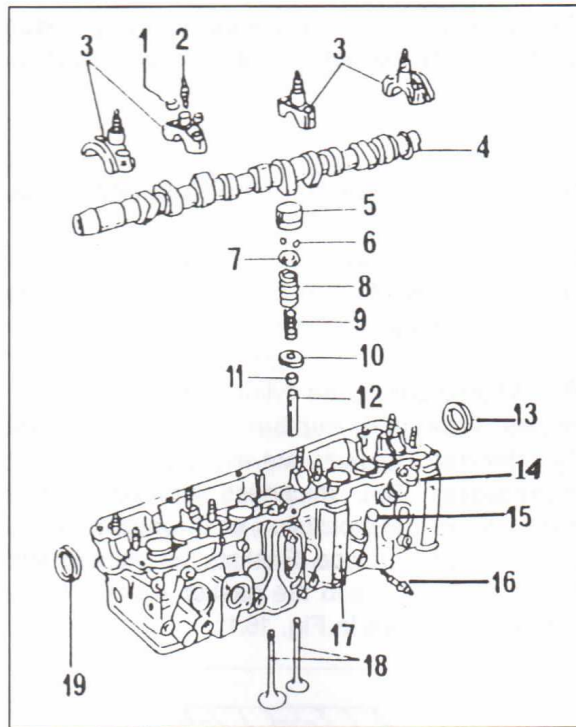
- Tighten the nuts of the fitted bearing caps diagonally by a few turns to a final torque reading of 2.0 kgm (14.5 ft.lb.). Check that the bearing caps are flush against the cylinder head face.

- Fit the remaining bearing caps Nos. 5, 1 and 3 and tighten the nuts in a diagonal manner. All nuts are tightened to 2.0 kgm (14 ft.lb.).

### Five-Cylinder Engine

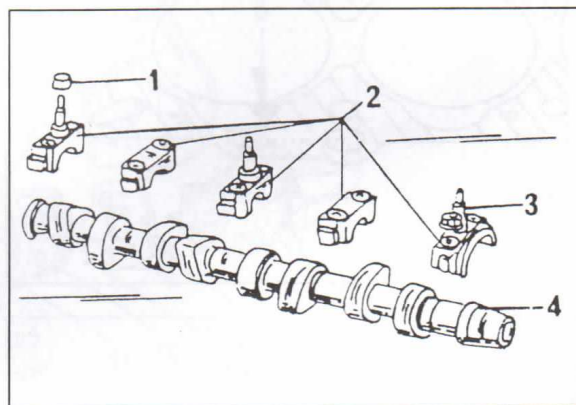
- Fit the camshaft bearing caps Nos. 2 and 4 and evenly tighten the four nuts. Again refer to Fig. 1.31 to make sure that the offset is shown. Fit the remaining bearing caps Nos. 1 and 3 in the same manner.

- Using a piece of tube of a suitable diameter, fit the camshaft oil seal over the shaft and into



**Fig. 16.9.**  
Exploded view of the cylinder head of a five-cylinder engine.

- 1 Nuts, 2.0 kgm
- 2 Stud, 1.5 kgm
- 3 Camshaft bearing cap
- 4 Camshaft
- 5 Hydraulic tappet
- 6 Valve cotter halves
- 7 Upper valve cup
- 8 Outer valve spring
- 9 Inner valve spring
- 10 Lower valve spring seat
- 11 Valve guide seal
- 12 Valve guide
- 13 Rear oil seal
- 14 Injector
- 15 Thermal protection gasket
- 16 Glow plug, 3.0 kgm
- 17 Cylinder head
- 18 Valves
- 19 Front oil seal



**Fig. 16.10.**  
The camshaft of the four-cylinder engine. The remaining parts are similar as shown for the five-cylinder engine.

- 1 Oil seal
- 2 Camshaft bearing caps
- 3 Nuts, 2.0 kgm
- 4 Camshaft

the bore. The spring inside the oil seal must be facing towards the cylinder head. Lubricate the oil seal lip and the running area on the camshaft with engine oil before fitting. A second oil seal is fitted to the head of a five-cylinder engine on the other end of the cylinder head. The camshaft oil seal(s) can also be fitted as described later on under "Camshaft and Camshaft Oil Seal".

- Slide the camshaft timing gear over the camshaft (do not forget the Woodruff key) and fit the bolt with the washer. Hold the timing gear against rotation and tighten the bolt to 8.5 kgm (62 ft.lb.) in the case of a five-cylinder engine or 4.5 kgm (32.5 ft.lb.) in the case of a four-cylinder engine..

- Refit the inlet and exhaust manifolds to the cylinder head (new gaskets), refit the injectors and the glow plugs. Refit the remaining parts to the cylinder head in reverse order to the removal procedure.



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The exploded view of the cylinder head(s) should be used for reference during the assembly operations.

### 16.3.4. Installation of the Cylinder Head

Thoroughly clean the cylinder block and cylinder head surfaces. The following points must be noted before installation:

- When ordering the cylinder head gasket the engine type and number must be quoted. Cylinder head gaskets are available in different thicknesses. The thickness of the gasket depends on the protrusion of the piston above the cylinder block face. Gaskets are marked with 1, 2 or 3 notches and the gasket is selected by Part No, as shown in Fig. 16.11.

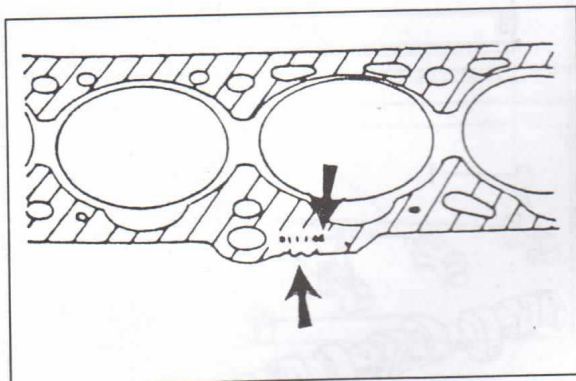


Fig. 16.11.  
View of the cylinder head gasket. The lower arrow points to notches; the upper arrow shows where the Part No. is located.

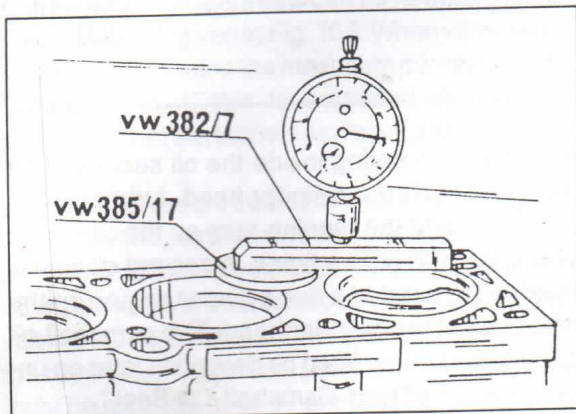


Fig. 16.12.  
Measuring the projection of a piston above the cylinder block face.

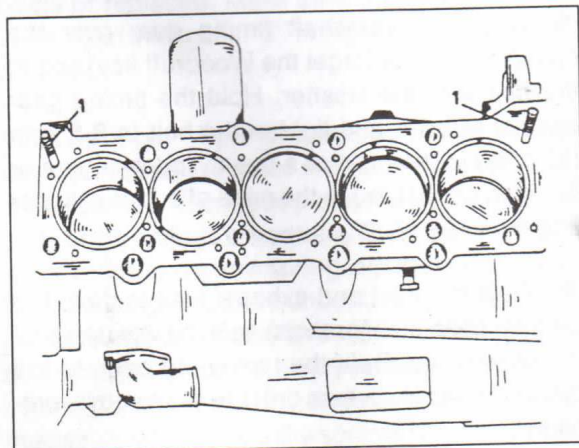


Fig. 16.13.  
The two guide pins (1) fitted to the cylinder block or a five-cylinder engine to assist in fitting the cylinder head gasket and the head.

- To establish the thickness of the cylinder head gasket, set one of the pistons to T.D.C. position and with a steel ruler and a depth gauge, or with a dial gauge, as shown in Fig. 16.12, measure by how much the crown of the piston is above the cylinder block face. From the obtained dimension and the table below, select the correct cylinder head gasket.

| Piston Projection | No. of grooves |
|-------------------|----------------|
| 0.66 - 0.86 mm    | 1              |
| 0.87 - 0.90 mm    | 2              |
| 0.91 - 1.02 mm    | 3              |

- Special guide studs are available for the fitting of the cylinder head. These are fitted to the positions shown in Fig. 16.13. on the side of the exhaust manifold. Alternatively studs can be prepared to screw in position.

Fit the cylinder head as follows:

- Thoroughly clean the cylinder head and cylinder block faces. Place the cylinder head gasket over the engine block, the correct way round.

- Place the cylinder head over the block, engaging it with the two guide studs.

- Insert new cylinder head bolts and tighten them finger-tight. The cylinder head bolts must always be replaced. Remove the two studs and screw the cylinder head bolts in their place.

- Refer to Figs. 16.5 or 16.6 and tighten all bolts in the order shown to a torque reading of 4.0 kgm (29 ft.lb.).

- Tighten all cylinder head bolts in the order shown to a torque reading of 6.0 kgm (45 ft.lb.) A special spline bit is used to tighten the bolts, together with a torque wrench. Your VW dealer or other suppliers may have these in stock and no attempt should be made to tighten the bolts with make shift tools.

- Insert the spline bit into each bolt, in the order shown in the two illustrations, make a note of the position of the torque wrench. Tighten each bolt by exactly one half of a turn. Tightening of the bolts by two quarter turns ( $2 \times 90^\circ$ ) is also permissible.

- After the engine has reached its operating temperature, tighten each bolt in the correct order by a quarter a turn ( $90^\circ$ ) without slackening them first. Do not pause during this operation. All other operations are carried out in reverse order to the removal procedure. The installation



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of the timing parts and the adjustment of the timing is described under a separate heading. Replace the cylinder head cover gasket and the half-round rubber seal in the camshaft bearing cap.

ments should only be carried out, if the special tools can be obtained or hired.

Provided that the belt is not damaged during the operation of the engine, there should be no reason why it should last for at least 60,000 miles.

### 16.4. CAMSHAFT AND TIMING DRIVE

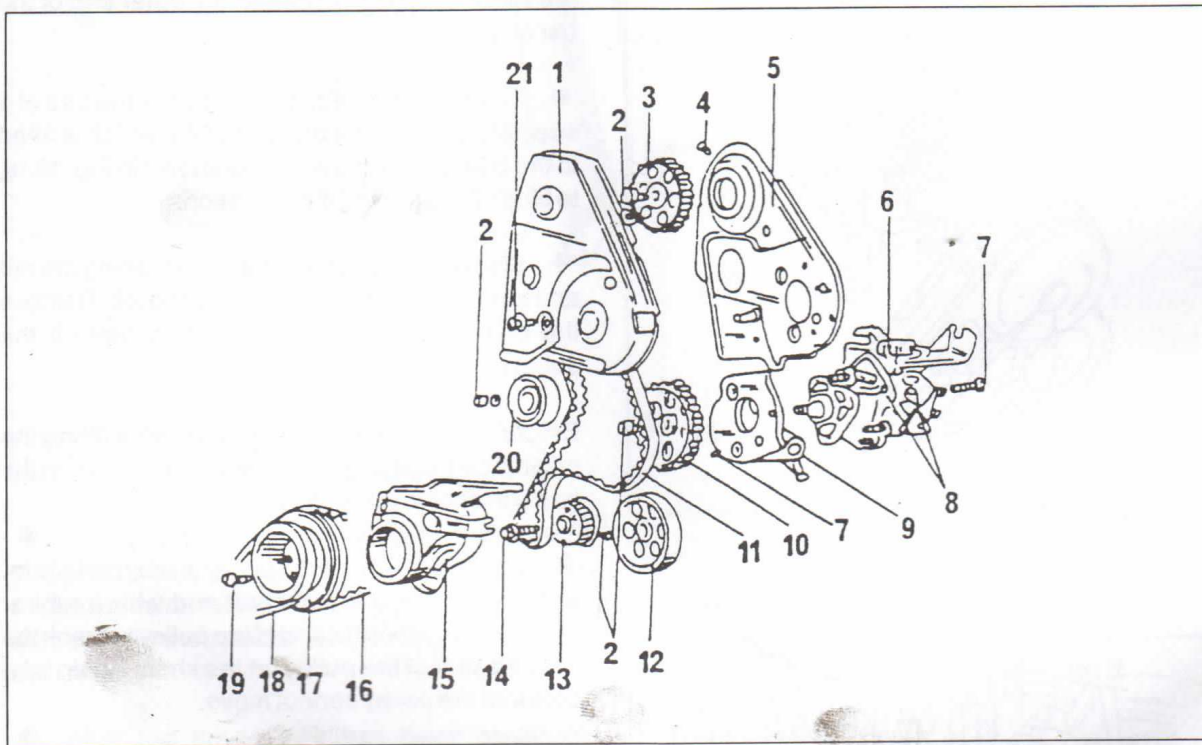
#### 16.4.0. 1.9 Litre Engine

The component parts of this engine are shown in Fig. 16.14. The drive to the overhead camshaft is provided by a toothed belt running on toothed sprockets at the camshaft, crankshaft, intermediate shaft and the injection pump shaft. The inter-

#### 16.4.1. Timing Belt — Removal and Installation

The following text assumed that the belt is replaced with the engine fitted.

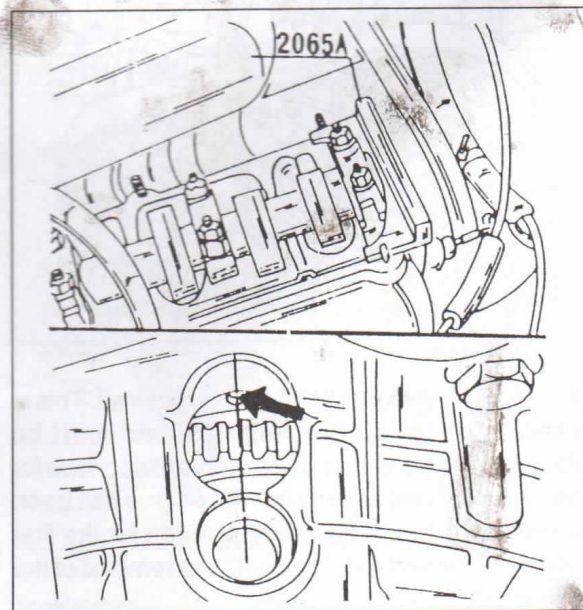
- Remove the timing belt cover and also the guard panels at the side and at the bottom.



**Fig. 16.14.**  
The component parts of the timing gear of a 1.9 litre engine.  
1 Upper timing belt cover  
2 Nut, 4.5 kgm  
3 Camshaft gearwheel  
4 Bolt, 1.0 kgm  
5 Rear toothed belt guard  
6 Injection pump  
7 Bolt, 2.0 kgm  
8 Retainer  
9 Support bracket  
10 Injection pump drive gear  
11 Timing belt  
12 Idler pulley  
13 Crankshaft timing gear  
14 Bolt, 9.0 kgm + 90°  
15 Lower timing belt cover  
16 Alternator drive belt  
17 Vibration damper  
18 Belt for steering pump  
19 Bolt  
20 Timing belt tensioner  
21 Bolt, 1.0 kgm

mediate shaft is driven by a kind of pulley without teeth. The tension of the timing belt is adjusted by a pulley with eccentric adjuster. It is needless to say that no mistakes can be afforded to be made when repairs on the timing drive are carried out, as wrong assembly of the timing belt or timing gearwheels will immediately cause damage to pistons, valves, etc., as open valves would hit the pistons as they are at the top dead centre position, if the relationship between crankshaft and camshaft is not retained.

We would like to point out that certain special tools are necessary to re-time the engine, i.e. to time the injection pump and the camshaft, without which the adjustment should not be undertaken. Also the adjustment of the timing belt tension requires a special tool and the following adjust-



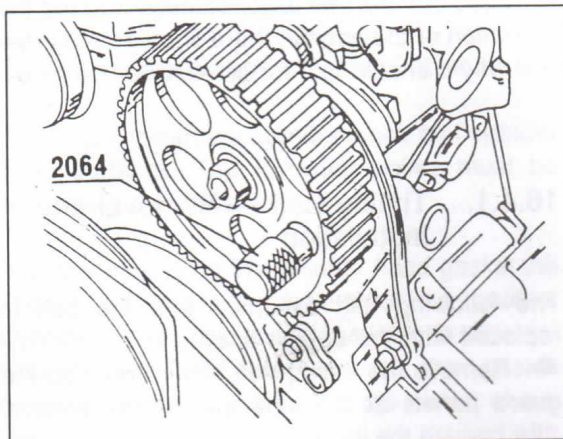
**Fig. 16.15.**  
Details of the timing adjustment when replacing the timing belt (see Section 16.4.1).



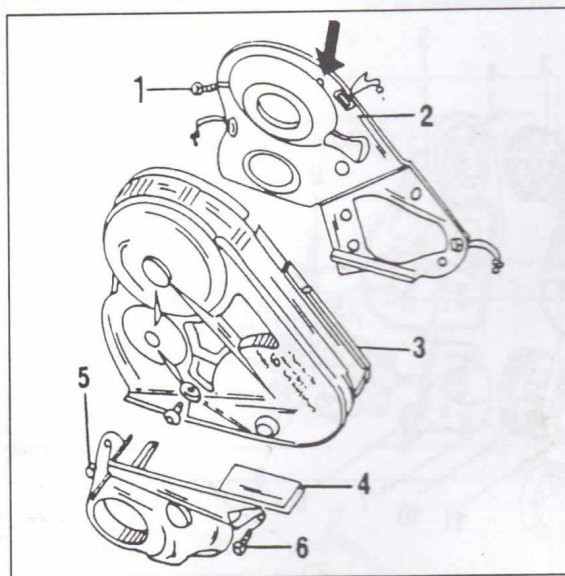
## 16 Diesel Engines

Remove the cylinder head cover.

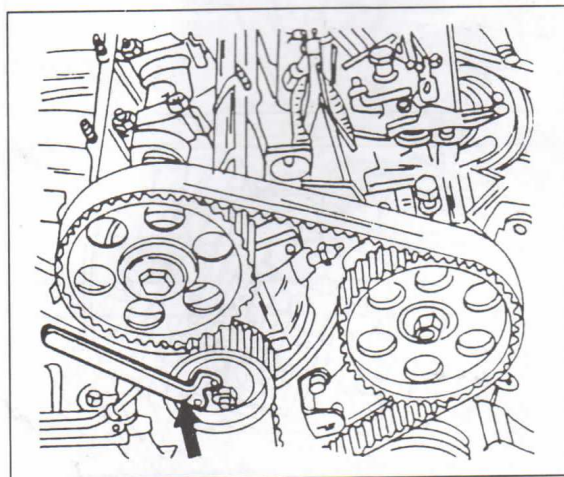
- Slacken the alternator mounting and remove the drive belt.



**Fig. 16.16.**  
The arrester pin inserted into the injection pump timing wheel to lock it against rotation.



**Fig. 16.17.**  
The component parts of the timing belt covers. A drift can be applied through the hole shown by the arrow to break the cone of the camshaft timing gear.  
1 Bolt, 1.0 kgm  
2 Rear cover  
3 Upper belt cover  
4 Lower belt cover  
5 Bolt, 1.0 kg  
6 Bolt, 2.0 kgm



**Fig. 16.18.**  
The special tool VW 210 is used to check the tension of the timing belt and is applied as shown. The L.H. arrow shows where the special Matra tool is applied.

- The special tool 2065A is now required. This is a setting gauge for the camshaft, and must be placed on the transmission side onto the surface for the cylinder head cover, after the engine has been turned to the top dead centre position for the first cylinder. Proceed as follows with the removal of the timing belt:

- Turn the engine until the mark in the flywheel is in line with the timing pointer (remove the plug from the transmission case opening, with a sawn-off plug spanner). Fig. 16.15 shows the alignment.

- Turn the camshaft until one end of the setting bar in Fig. 16.15 touches the cylinder head. Measure the gap at the other end with feeler gauges.

- Take half of the thickness of the feeler gauges and insert this thickness between the setting bar and the cylinder head.

- Now turn the camshaft until the bar rests on the feeler gauges and insert the second feeler gauge of the same thickness between the other end of the bar and the head.

- The next operation also requires the use of a special tool, this time number 2064, which is fitted to the injection pump wheel as shown in Fig. 16.16, to block the wheel against rotation.

- Slacken the timing belt after loosening the nut and turning the tensioner towards the left. Remove the belt pulley and take the timing belt off the pulleys.

Before fitting a new belt and also before fitting the original belt, first check that the flywheel is still in the position shown in Fig. 16.15.

- Slacken the camshaft pulley bolt by half a turn, without rotating the camshaft and with a rubber mallet, tap against the end of the pulley to break the tapered seat of the pulley on the shaft. Again take care that the pulley cannot move.

- Carefully place the timing belt over the pulleys and remove the locking pin (Fig. 16.16) from the injection pump gear.

- Special tool VW 210 is now required to adjust the tension of the timing belt. Apply the tool as shown in Fig. 16.18 between the camshaft and injection pump timing gearwheels and tension the belt by turning the belt tensioner in a clock-wise direction, until the indication on the tool is between 12 and 13 when pressed down. To rotate the belt tensioner, a special tool (Matra V 159) is used. This tool has two pegs which are inserted into the tensioner as shown in Fig. 16.18 (L.H. arrow).

- Tighten the belt tensioner locknut to 4.5 kgm (33 lb.ft.). Tighten the camshaft pulley bolt to the same torque reading and remove the setting gauge from the other side of the engine.



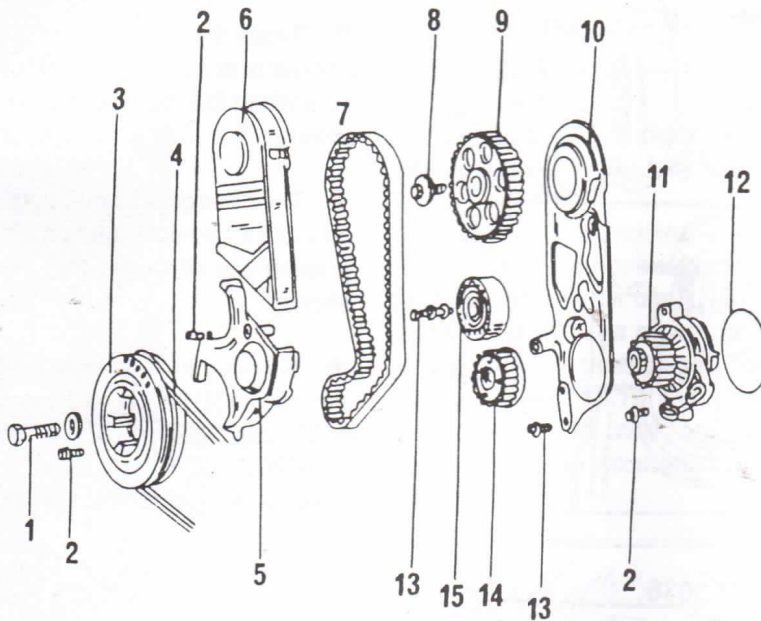
## 16 Diesel Engines

- Refit the remaining parts in reverse order to their removal. Fit the crankshaft pulley with the vibration damper to the crankshaft pulley and tighten the 4 bolts to 2.0 kgm (14.5 ft.lb.). The crankshaft must be held against rotation when the bolts are tightened. Fit the timing belt covers in accordance with Fig. 16.17.

- Turn the engine by two complete turns by applying a spanner to the crankshaft pulley bolt.

are available or can be obtained. If this is not the case, do not attempt the replacement of the timing belt.

The drive of the overhead camshaft is by means of a toothed belt, running on toothed sprockets on the crankshaft, camshaft, water pump and an idler wheel. The drive gear for the injector pump is located on the opposite side of the timing drive. The injection pump is driven by a separate



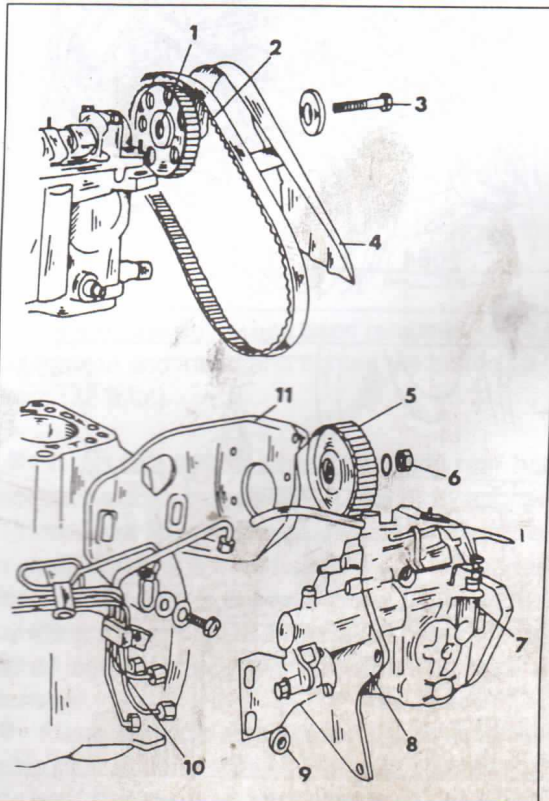
**Fig. 16.19.**  
The component parts of the timing drive for a 2.4 litre engine.  
1 Bolt, 46 kgm (330 ft.lb.)  
2 Bolt, 2.0 kgm (14.5 ft.lb.)  
3 Vibration damper  
4 Alternator drive belt  
5 Lower belt cover  
6 Upper belt cover  
7 Timing belt  
8 Bolt, 8.5 kgm (102 ft.lb.)  
9 Camshaft timing gear  
10 Rear timing belt guard  
11 Water pump  
12 "O" sealing ring  
13 Bolt, 1.0 kgm (7.2 ft.lb.)  
14 Crankshaft timing gear  
15 Idler pulley

- Use a rubber mallet and give a short and sharp blow to the timing belt at the point where the belt tension was checked. Re-check the belt tension with the special tool, and re-adjust if necessary.

- After the timing belt has been replaced, check the injection timing as described in Section Fuel System.

### 16.4.1. Timing Drive — 2.4 Litre Engine

The component parts of the timing drive are shown in Fig. 16.19. Study the illustration before any work is carried out. Follow each instruction step by step to avoid mistakes, as wrong installation of the timing belt can lead to immediate damage to the engine. Camshaft and crankshaft must not be rotated when the timing belt is removed as the valves may hit the pistons. The following text assumes that the necessary special tools or other means to counterhold the camshaft timing gear, locking the injection pump gear, etc.



**Fig. 16.20.**  
The component parts of the injection pump drive of the 2.4 litre engine.  
1 Injection pump drive gear  
2 Timing belt  
3 Bolt, 10.0 kgm (72 ft.lb.)  
4 Timing belt cover  
5 Pump wheel  
6 Nut, 4.5 kgm (32.5 ft.lb.)  
7 Bolt, 2.5 kgm (18 ft.lb.)  
8 Injection pump  
9 Nut, 2.5 kgm (18 ft.lb.)  
10 Injection pipes  
11 Mounting bracket

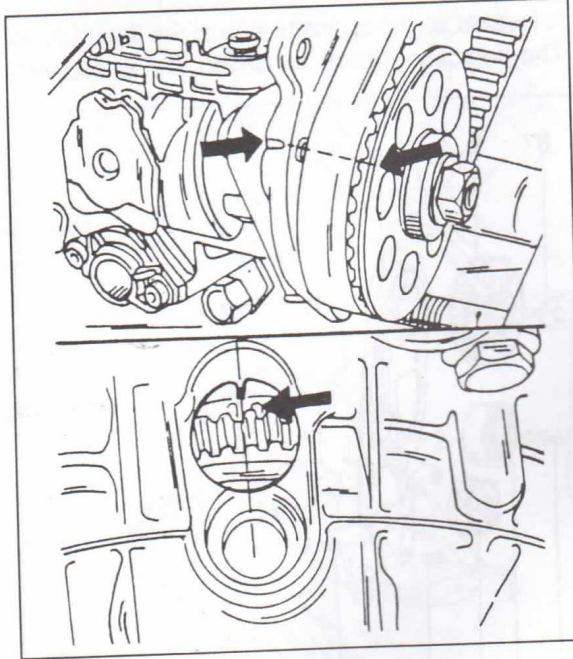
toothed belt. The layout is shown in Fig. 16.20.



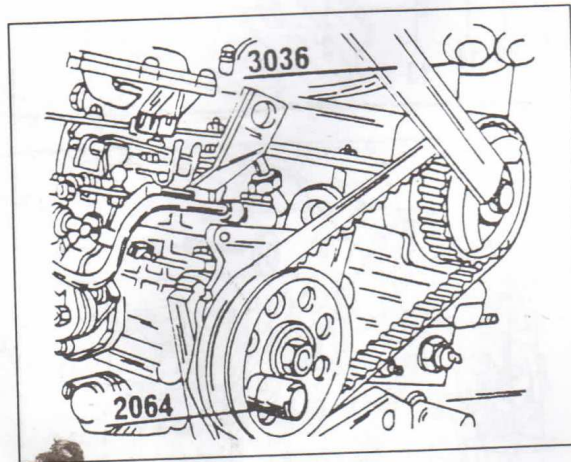
## 16 Diesel Engines

### Timing Belt Replacement

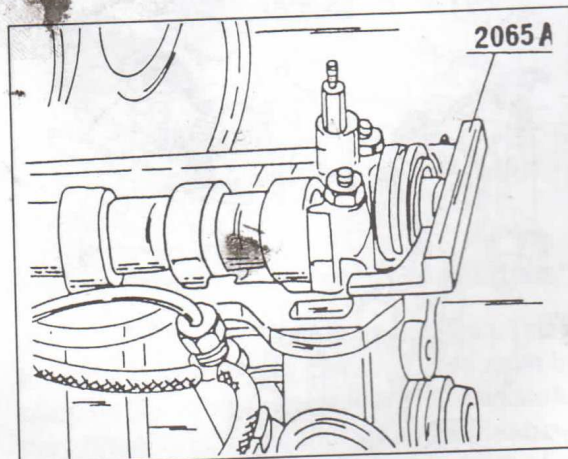
Figs. 16.19 and 16.20 should be referred to during the following operations. The front of the vehicle must be tilted down and the noise dampening panels underneath the vehicle must be removed to gain access to the individual parts. Proceed as follows:



**Fig. 16.21.** Aligning the timing marks on injection pump sprocket and bracket (top) and fly-wheel and clutch housing (bottom) before removal of the timing belt.



**Fig. 16.22.** Removal of the injection pump drive belt. The arrester pin is inserted at the left; the drive gear is held against rotation on the right.



**Fig. 16.23.** Locking the camshaft in position with the special tool before removal of the timing belt.

- Slacken the alternator belt adjusting device, push the alternator towards the inside and remove

the drive belt. The belt tensioning device is the same as used on a petrol engine, described in Section 1.8.2.2.

- Slacken the steering pump belt adjuster and remove the drive belt.
- Remove the large timing belt cover (6) and the small cover (5) in Fig. 16.19. Remove the nuts along the cylinder head cover and remove the cover. Disconnect the hose in the centre of the cover.
- Rotate the engine until the piston of the No. 1 cylinder is at top dead centre position. This is the case when the marks in Fig. 16.21 are aligned as shown.
- The drive gear for the injection pump must now be blocked against rotation. To do this, insert the arrester pin shown in Fig. 16.22 at the position shown.
- Remove the cover (4) for the injection pump timing belt (4) in Fig. 16.21. Hold the drive gear for the injection pump in a similar manner as shown in Fig. 16.22 and slacken and remove the bolt. Remove the gearwheel and the drive belt.
- Block the engine against rotation (apply handbrake and engage a gear) and slacken the vibration damper bolt. VW workshops use a special restraining lever for this operation (see Fig. 16.24). The tightening torque is very high.
- Without rotating the camshaft lock the shaft with the setting bar shown in Fig. 16.23 at the rear of the cylinder head.
- Slacken the water pump securing bolts and release the timing belt tension by rotating the pump in its elongated holes. Remove the belt together with the vibration damper and the crankshaft timing gear from the front of the engine. The damper can be unscrewed from the timing gear if required.
- Also if required, remove the idler pulley from the front of the engine. This requires the use of a puller.

Before the new belt is fitted, on a removed engine, align the flywheel and the injection pump as shown in Fig. 16.21. The marks should still be in the set position if the engine is fitted. Fit the belt as follows:

- Place the toothed belt over the crankshaft timing gear at the rear of the vibration damper and fit timing gear/damper over the crankshaft end. Take care not to trap the belt between oil pump and



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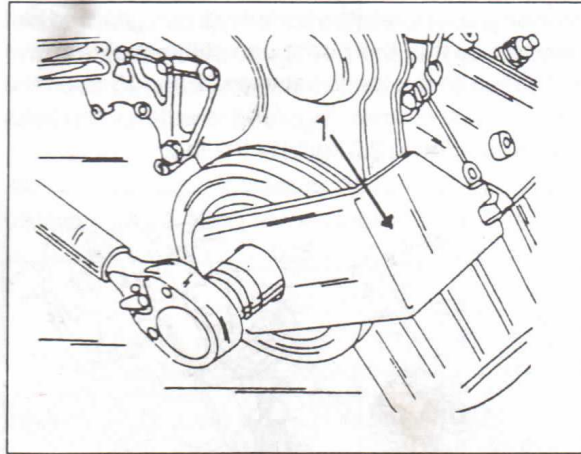
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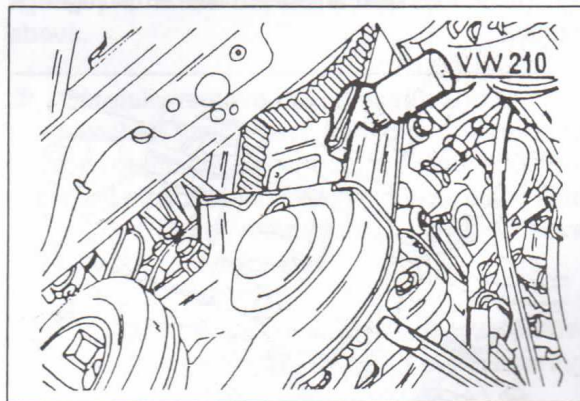
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**Fig. 16.24.**  
Holding the crankshaft against rotation when tightening the large bolt for the vibration damper/timing gear. The restraining lever (1) is used in a VW workshop and is engaged as shown.

timing gear. Use a piece of tube and drive the damper/timing gear fully into position.

- Insert the restraining lever in Fig. 16.24 into the vibration damper and allow the lever to rest against the cylinder block, as shown. If the engine is fitted, engage a gear and apply the hand-brake. Coat the threads and the underside of the bolt (1) in Fig. 16.19 with thread locking compound (AMV 188 0002) and screw the bolt into the end of the crankshaft. Tighten the bolt to 46 kgm (330 ft.lb.).



**Fig. 16.25.**  
The special checking tool for the timing belt tension is applied at the position shown.

- If the idler pulley has been removed, drive it in position and insert and tighten the bolt to 10.0 kgm (72 ft.lb.).
- If the bolt for the camshaft timing rear has not been slackened, slacken it now by approx. 1 turn. Then release the gearwheel by means of a small drift and a hammer. The drift is inserted through the hole in the rear guard plate, shown by the arrow in Fig. 16.17 and will break the tapered seat of the gearwheel when hit with a hammer.
- Place the toothed belt over the camshaft timing gear and the water pump gear and tension the belt. This requires another special tool, which is applied as shown in Fig. 16.25 against the flat side of the timing belt. Rotate the water pump in



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its elongated holes (the bolts must be tightened just enough so that the pump can still move) until the indication on the tool is between 12 and 13 when the tool is pressed down. Tighten the water pump bolts in this position to 2.0 kgm (14.5 ft.lb.).

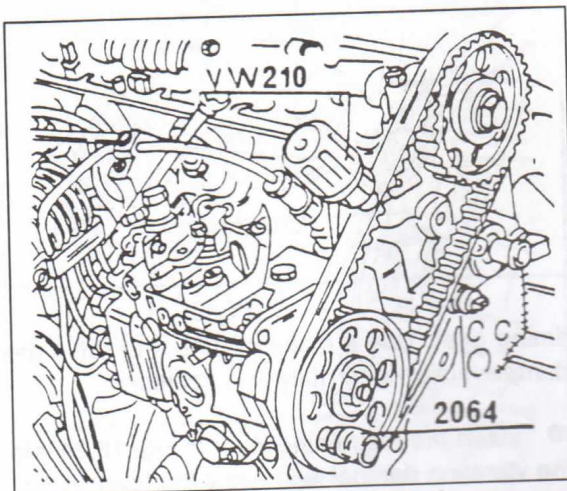


Fig. 16.26.  
Checking the tension of the injection pump drive belt. Apply the checking tool at the position shown.

- Check once more that the TDC marks on flywheel and injection pump gear are still in line and remove the camshaft setting tool (Fig. 16.23) from the rear end of the cylinder head.

- Re-tighten the camshaft timing gear bolt to 8.5 kgm (102 ft.lb.). The camshaft must be held against rotation.

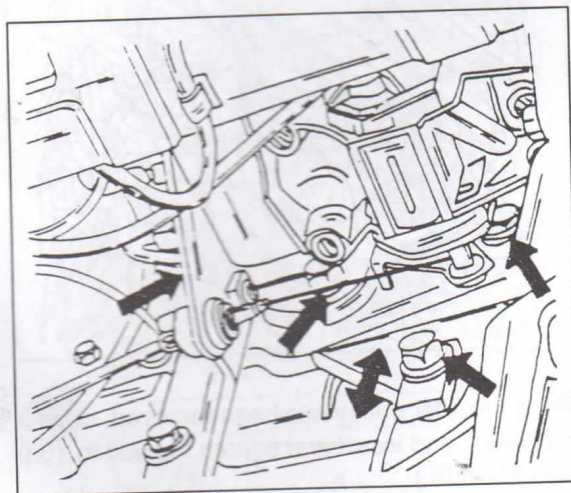


Fig. 16.27.  
The arrows show the securing bolts for the injection pump mounting bracket.

- Fit the toothed belt for the injection pump drive together with the drive wheel for the pump. Tighten the securing bolt for the drive wheel only sufficiently so that the drive wheel can still be turned by hand. Adjust the belt tension as described on the next page.

- Again check that the engine is still at TDC, hold the drive gear for the injection pump drive belt (at the camshaft) against rotation as shown in Fig. 16.22 and tighten the bolt to 10.0 kgm (72 ft.lb.). Remove the arrester pin from the injection pump gearwheel.

- Rotate the engine until the piston of No. 1 cylinder is once more in the top dead centre position and check that the timing marks are again aligned as shown in Fig. 16.21. Try to insert the arrester pin into the injection pump gear. The setting is correct, if the pin can be inserted. The setting is wrong if the pin cannot be inserted and the engine should not be started under any circumstances.

- If the vibration damper has been removed from the crankshaft timing gear, tighten the bolts to 2.0 kgm (14.5 ft.lb.).

- After all parts have been refitted, check the timing of the injection pump or have it checked. Refit the timing belt covers and adjust the alternator belt tension as described in Section "Cooling" for the petrol engine.

### Replacing the Injection Pump Drive Belt

Refer to Fig. 16.20 for the following instructions:

- Tilt the front panel of the vehicle forward as described on page 11 and remove the noise dampening panels underneath the vehicle.

- Slacken the alternator belt tension and remove the belt.

- Remove the timing belt cover (4) and rotate the engine until the piston of No. 1 cylinder is at top dead centre, as shown in Fig. 16.21, i.e. both the flywheel and injection pump marks must be aligned.

- Insert the arrester pin 2064 into the injection pump gearwheel as shown in Fig. 16.22, to lock the gearwheel against rotation. Also as shown in the same illustration, prevent the drive wheel at the end of the camshaft from rotating and slacken the bolt in the centre of the gearwheel.

- Remove the injection pump gearwheel together with the drive belt.

- Place the new belt over the injection pump drive gear and the gearwheel on the camshaft and tighten the securing bolt for the injection pump until it can just be rotated by hand.

- Fit the belt tension checking tool as shown in Fig. 16.26 and check the tension by pushing against the tool handle. The indication should be between 12 and 13. If this is not the case the mounting bracket for the injection pump must be moved after slackening the securing bolts. These are located at the positions shown in Fig. 16.27. Move the bracket



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little by little, re-tighten the bolts and re-check the tension. Once more check the TDC marks.

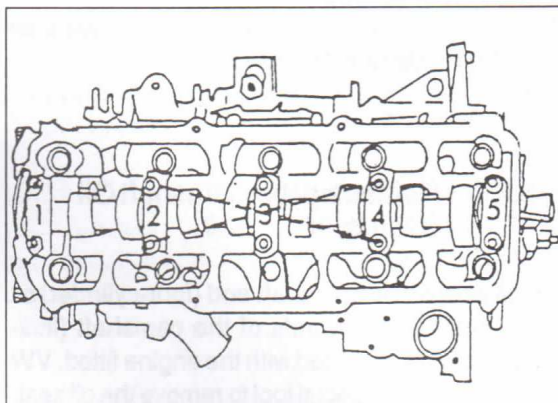
- Hold the gearwheel on the camshaft against rotation and tighten the bolt to 10.0 kgm (72 ft.lb.). Remove the arrester pin from the injection pump gearwheel.

- Check the injection timing or have it checked.

- The remaining operations are carried out in reverse order. If the drive gearwheel at the rear end of the camshaft has been removed, you will be able to replace the camshaft oil seal in the same manner as described in the next section. The oil seal has an arrow which must face in the direction of rotation of the camshaft.

metal jaws, clamp the camshaft into a vice and remove the bolt securing the camshaft gearwheel. Remove the gearwheel and slide the camshaft oil seal from the end of the shaft.

- The tappets can either be removed or left in position (mark where the came from).



**Fig. 16.28.** The camshaft bearing caps in their numbered order. The cross-line indicates the No. 2 and No. 4 bearing caps which must be slackened alternately until the spring pressure is released.

### 16.5. Camshaft

#### 16.5.0. Camshaft — Removal and Installation

The camshaft on both engines can be removed with the cylinder head fitted. Prepare the vehicle to have access to the engine compartment. The removal and installation is carried out in a similar manner on the four- and five-cylinder engines, the differences being, of course, the number of bearing caps. First remove the cylinder head cover.

- Rotate the engine until the piston of No. 1 cylinder is at top dead centre position.

- Remove the timing belt (four-cylinder engine) or the timing belt and the injection pump drive belt (five-cylinder engine) as described in the last section.

- On a four-cylinder engine refer to Fig. 16.28 and slowly slacken the nuts of the bearing caps 5, 1 and 3 in a diagonal mannner. At this stage do not slacken the the nuts of bearing caps Nos. 2 and 4.

- Now unscrew the nuts of bearing caps No. 2 and No. 4 in a diagonal fashion until the spring pressure is released and the two caps are fully free. The pressure will be retained to the last moment as the springs will push the camshaft upwards. Remove the half-round oil seal from the No. 1 bearing cap, if it is still in the cap. Otherwise remove the seal from the cylinder head.

- Carefully lift the camshaft out. Using soft-

- On a five-cylinder engine proceed as described for the four-cylinder engine, but first slacken the nuts of bearing caps No. 1 and 3. After the caps have been removed, slacken the nuts of bearing caps No. 2 and 4 alternately and diagonally until the caps are free as described above.

- Carefully remove the camshaft and remove the camshaft timing gear from one end and the injection pump drive gear from the other end. The camshaft must be clamped into a vice, using soft-metal jaws. Either remove the tappets or leave them in the cylinder head.

The installation is a reversal of the removal procedure, but the tightening sequence of the bearing caps is important:

- If the tappets have been removed, check them as described in the next section. Then insert each tappet (well oiled) into its original bore (if the same tappets are used), in accordance with the markings.

- Generously lubricate the camshaft bearing journals and the bearing bores with engine oil. Place the camshaft in position. The two cams for the valves of the first cylinder must be facing upwards. On a four-cylinder engine fit the bearing caps No. 1, 3 and 5, referring to Fig. 16.28. On the five-cylinder engine fit the bearing caps Nos. 2 and 4. The caps are slightly off-centre and must be fitted the correct way round. Fig. 1.31 shows the correct and incorrect installation of the bearing caps and should be referred to.



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- Tighten the nuts of the fitted bearing caps diagonally by a few turns until the caps are down on the cylinder head and then to a final torque of 2.0 kgm (14.5 ft.lb.).

- Fit the remaining bearing caps and tighten the nuts in a diagonal manner to 2.0 kgm (14.5 ft.lb.).

- Fit the camshaft oil seal or the two seals as described in Section 16.5.1.

### 16.5.1. Replacing the Camshaft Oil Seal(s)

The oil seal at the camshaft end (four-cylinder) or the oil seals at both ends of the camshaft (five-cylinder) can be replaced with the engine fitted. VW Workshops use a special tool to remove the oil seal, but it is also possible to remove the bearing cap to remove and install the seal(s). The oil seal is located behind the timing wheel, the second oil seal of a five-cylinder engine is located behind the drive wheel for the injection pump, i.e. the wheel (and drive belt) will have to be removed as described on page 166. Proceed as follows to remove the seal(s):

- Slacken the alternator mountings, push the unit towards the inside and remove the drive belt.
- Unscrew the three screws securing the timing belt guard. Also remove the cylinder head cover.

- Rotate the engine until the piston of the first cylinder is at top dead centre. This is indicated when both valves of this cylinder are closed. Turn the engine by applying a socket or ring spanner to the crankshaft pulley centre bolt.

- Slacken the timing belt tensioner, as described in Section 16.4 for the respective engine and lift off the timing belt. Tie the belt in position to prevent it

from slipping off the other timing wheels.

- Counterhold the camshaft timing wheel and slacken the camshaft timing gear bolt by one turn.

- Insert a small drift into the bore shown by the arrow in Fig. 16.17 (on a four-cylinder engine) and hit the end of the drift with a short blow of a hammer. The cone seating of the gearwheel will be split and the gearwheel can be removed after fully removing the bolt and the washer. Using a pair of side cutters remove the Woodruff key.

- Unscrew the rear toothed belt guard from the cylinder head. The bearing cap can now be unscrewed (or both bearing caps in the case of the five-cylinder engine) and the oil seal replaced. The arrow in the oil seal on the injection pump side (5-cyl.) must face in the direction of camshaft rotation.

The installation of the oil seals is a reversal of the removal procedure. Clean the camshaft journal and the inside of the bearing cap and lubricate the oil seal lip and the journal with engine oil. Orientate the spring side of the seal towards the camshaft and place the seal over the shaft and into the bearing cap. Use a suitable piece of tube and carefully knock the oil seal in position until flush.

Fit the Woodruff key, slide the timing wheel over the shaft and the key and fit the bolt and washer. Counterhold the timing wheel and tighten the bolt to the correct torque.

Carry out all other operations in reverse order to the removal procedure.

### 16.5.2. Hydraulic Tappets

The hydraulic tappets should be checked in the same manner as described on Page 23. Also read the notes on the handling of tappets.

## 16.6. Pistons and Connecting Rods

### 16.6.0. Technical Data

#### Piston Diameters:

|                                        |                                                                       |
|----------------------------------------|-----------------------------------------------------------------------|
| Nominal Diameter:                      | 79.48 mm                                                              |
| 1st oversize:                          | 79.73 mm                                                              |
| 2nd oversize:                          | 79.98 mm                                                              |
| Position for checking piston diameter: | 10 mm (0.40 in.) from bottom edge of skirt, at 90° to piston pin axis |

Max. allowable wear on piston diameter: 0.04 mm (0.0016 in.) from the specified size



## Clearance of piston in cylinder bore:

|           |                      |
|-----------|----------------------|
| Standard: | 0.03 mm (0.0012 in.) |
| Maximum:  | 0.07 mm (0.0028 in.) |

## Piston Rings

Number of rings: ..... 3

### Side clearance — All rings:

|                                |                                      |
|--------------------------------|--------------------------------------|
| Standard, upper rings:         | 0.09 - 0.12 mm (0.0001 - 0.0035 in.) |
| Standard, centre rings:        | 0.05 - 0.08 mm (0.002 - 0.003 in.)   |
| Standard, oil control rings:   | 0.03 - 0.06 mm (0.001 - 0.002 in.)   |
| Wear limit, compression rings: | 0.25 mm (0.01 in.)                   |
| Wear limit, oil control rings: | 0.15 mm (0.006 in.)                  |

### Ring Gaps:

|                           |                                   |
|---------------------------|-----------------------------------|
| Top and second ring:      | 0.25 - 0.40 mm (0.01 - 0.016 in.) |
| Oil control ring:         | 0.25 - 0.50 mm (0.01 - 0.02 in.)  |
| Max. — Upper ring:        | 1.2 mm (0.03 in.)                 |
| Max. — Second rings:      | 0.6 mm (0.024 in.)                |
| Max. — Oil control rings: | 1.2 mm (0.03 in.)                 |

## Connecting Rods

### Bearing axial play:

|           |                                    |
|-----------|------------------------------------|
| Standard: | 0.05 - 0.31 mm (0.002 - 0.012 in.) |
| Max.:     | 0.40 mm (0.016 in.)                |

Big end journals: ..... See under "Crankshaft"

## 16.6.1. Servicing

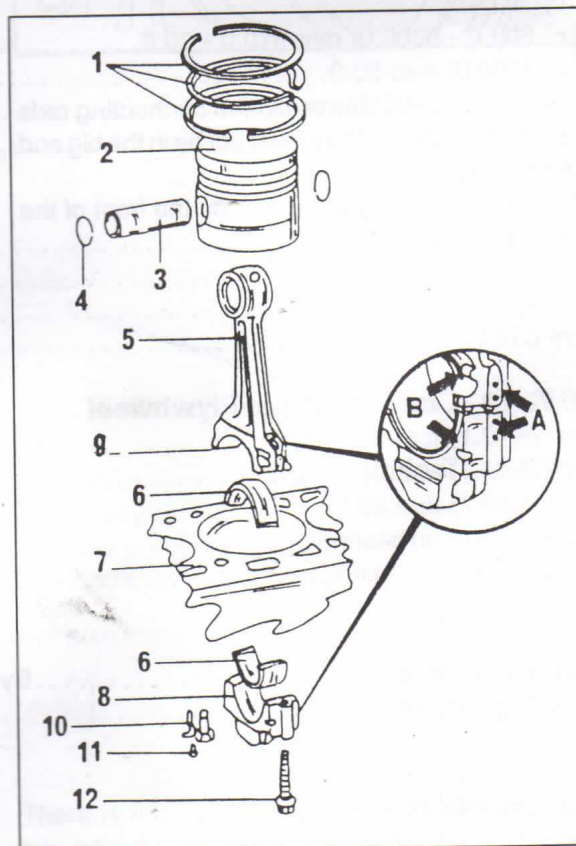
The piston and connecting rod is shown in Fig. 16.29. The construction is similar as for the petrol engines, but the pistons have a bowl in the piston crowns. The engine must be removed from the vehicle to remove the piston and connecting rods. Remove the assemblies in the same manner as described from page 25 onwards. Make a note on which side of the engine the bowl for the valve heads is located. Also note the following points when checking and assembling pistons and connecting rods:

- The pistons of both diesel engines have a recess for the oil jets on one side (Fig. 16.30) to prevent contact of the jets and the pistons at the bottom top dead centre. These sides of the pistons must be on the same side as the oil jets.

- The checking of the pistons, piston rings, etc. is carried out as described on pages 26 and 27 and the following pages. The oil jets must be removed to check the piston ring gaps. Fig. 16.31 shows where the jets are located.

- The running clearance of the big end bearings is checked with "Plastigage" as described for the petrol engine.

- Fit the connecting rods in accordance with



**Fig. 16.29.**  
Exploded view of a piston and connecting rod. Both diesel engines use the same assemblies.

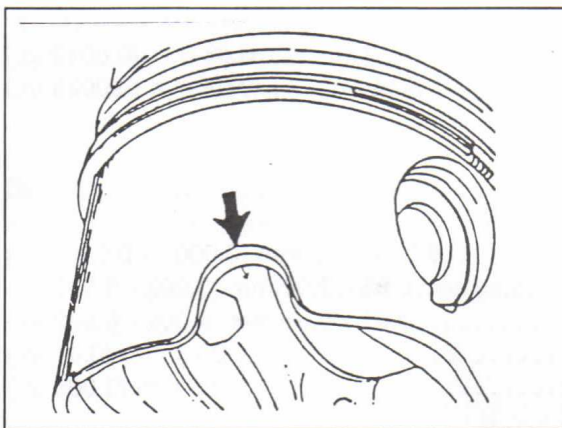
- 1 Piston rings
- 2 Piston
- 3 Piston pin
- 4 Retaining rings
- 5 Connecting rod
- 6 Bearing shell
- 7 Cylinder block
- 8 Big end bearing cap
- 9 Dowel pins
- 10 Oil jet
- 11 Screw, 1.0 kgm
- 12 Connecting rod bolt

Fig. 16.29, i.e. the cast lugs (B) and the cylinder identifications (A) must be towards the crankshaft pulley side of the engine. Dowel pins are inserted into the bottom of the connecting rod face which must engage into the bearing caps. Make

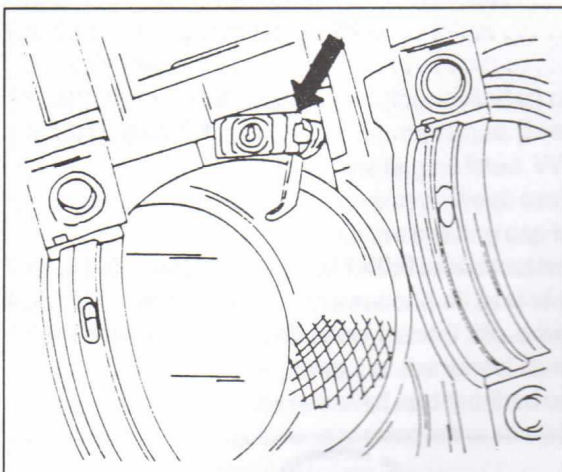


## 16 Diesel Engines

**Fig. 16.30.**  
The pistons for a diesel engine are recessed on one side to prevent contact between oil jets and pistons. The piston side with the recess must be on the same side as the oil jets in the cylinder block.



**Bild 16.31**  
The location of the oil jet in the cylinder block.



sure these dowel pins are in the connecting rods and have a tight fit. They must not be in the big end bearing caps.

- All arrows must face towards the front of the engine.

- When installing the piston rings, note that the rings are marked on one side with "Top" or "Oben". This marking must be facing towards the piston crown when the rings have been fitted. Rings can easily break and we suggest you carry out this operation very slowly and with the greatest care.

- Before fitting the pistons into the cylinder bores, arrange the bottom ring gap so that it faces the front of the engine, with the other two rings arranged at 120° to each other and facing the rear.

- The connecting rod bolts must always be replaced. Oil the threads and bolt head contact faces and tighten the two bolts in turn to 3.0 kgm (22 ft.lb.). From this position tighten the bolts a further 90°.

- After installation of the connecting rod bearings, check with a feeler gauge at the position shown in Fig. 1.47 to make sure that the connecting rod side play is less than 0.40 mm (0.016 in.). Temporarily fit the crankshaft pulley with the bolt, apply a socket to the bolt head and rotate the crankshaft assembly a few times. Any hard spots will be spotted immediately and can be rectified before the engine is further assembled.

- After completed installation refit the oil sump to the bottom of the crankcase as described in Section "Engine Lubrication". All other operations are carried out in reverse order to the removal procedure.

### 16.7. Crankshaft and Flywheel

#### 16.7.0. Technical Data

Number of main bearings: ..... 5 (four-cylinder), 6 (five-cylinder)  
Markings (main bearing caps): ..... 1 to 5 or 1 to 6, commencing at the crankshaft pulley end of the engine

Axial play taken at: ..... By means of thrust half washers, at one of the bearings  
Main/big end bearings: ..... Thin-wall shell type. Shells in block with oil drillings, shells in caps without oil drillings.

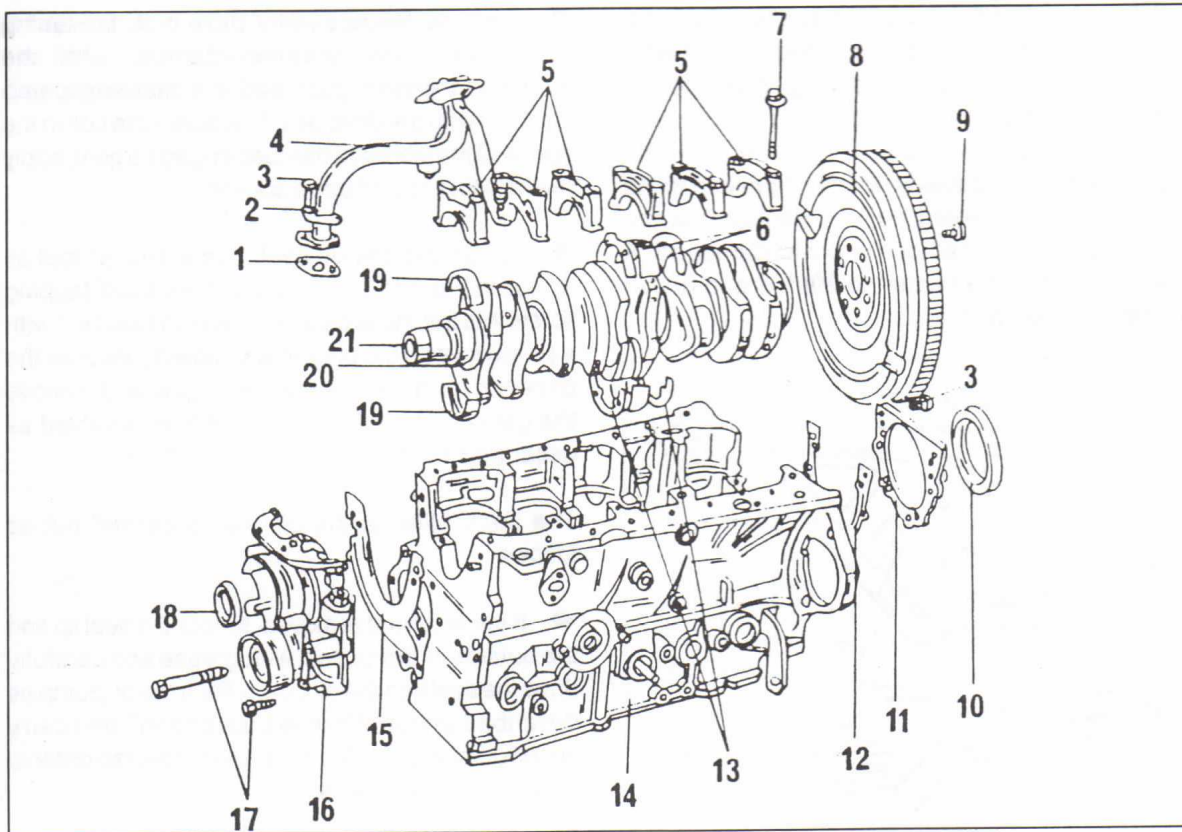
#### Crankshaft End Clearance:

Std.: ..... 0.07 - 0.18 mm (0.0028 - 0.0069 in.)  
Wear limit: ..... 0.25 mm (0.10 in.)

#### Main Bearing Running Clearance:

Std.: ..... 0.016 - 0.075 mm (0.001 - 0.003 in.)  
Wear limit: ..... 0.16 mm (0.006 in.)





**Fig. 16.32.**  
The component parts of cylinder block, crankshaft and flywheel of a five-cylinder engine.

- 1 Gasket
- 2 Lock plate
- 3 Bolt, 1.0 kgm
- 4 Oil suction pipe
- 5 Bearing cap
- 6 Thrust washer
- 7 Bearing cap bolts, 6.5 kgm
- 8 Flywheel
- 9 Flywheel bolt, 3.0 kgm + 90°
- 10 Oil seal
- 11 Oil seal flange
- 12 Gasket
- 13 Thrust washers
- 14 Cylinder block
- 15 Gasket
- 16 Oil pump
- 17 Bolts
- 18 Oil seal
- 19 Bearing shell
- 20 Oil pump drive dog
- 21 Crankshaft

## Big End Bearings:

|                         |                                      |
|-------------------------|--------------------------------------|
| Std. running clearance: | 0.02 - 0.076 mm (0.0008 - 0.003 in.) |
| Max. clearance:         | 0.08 mm (0.0035 in.)                 |
| Std. axial clearance:   | 0.05 - 0.31 mm (0.002 - 0.0122 in.)  |
| Max. clearance:         | 0.40 mm (0.016 in.)                  |

## Main Journal Diameters:\*

|              |                      |
|--------------|----------------------|
| Basic:       | 58.00 mm (2.304 in.) |
| Undersize 1: | 57.75 mm (2.294 in.) |
| Undersize 2: | 57.50 mm (2.284 in.) |
| Undersize 3: | 57.25 mm (2.275 in.) |

## Crankpin Journal Diameters:\*

|              |                       |
|--------------|-----------------------|
| Basic:       | 47.80 mm (1.8819 in.) |
| Undersize 1: | 47.75 mm (1.8799 in.) |
| Undersize 2: | 47.30 mm (1.8622 in.) |
| Undersize 3: | 47.05 mm (1.8523 in.) |

\* All diameters are toleranced at  $-0.022$  to  $-0.042$  mm

## 16.7.1. Crankshaft — Removal and Installation

The crankshaft of the four-cylinder engine is practically the same as the crankshaft of the four-cylinder petrol engine. The component parts of the five-cylinder engine are shown in Fig. 16.32. The crankshaft end float of the shaft must be measured before removal in the manner described on page 30. The end float for the diesel engine is 0.07 - 0.18 mm (0.0028 - 0.0069 in.).

There is a difference in the end float limit. This can be 0.37 mm (0.015 in.) on the four-cylinder, but is restricted to 0.25 mm (0.01 in.) on the five-cylinder engine. New half thrust washers must be used to correct the end float.

The oil pump must be removed from the front of the engine when the crankshaft of a five-cylinder engine is removed. The bearing caps are marked



## 16 Diesel Engines

with numbers 1 to 6, commencing at the pulley end. The bearing shells have an oil drilling when fitted in the cylinder block and no oil drilling when fitted on the bearing caps.

A driver for the oil pump is fitted into the end of the crankshaft, but should only be removed if the crankshaft is replaced or the driver damaged. A new driver must be heated to 200° C and driven over the crankshaft end.

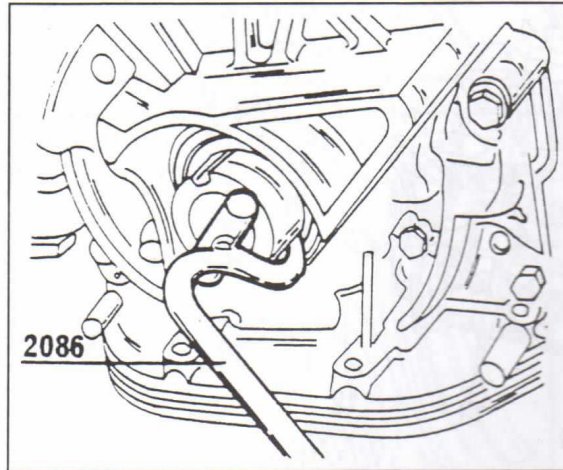


Fig. 16.33.  
Removal of the front crankshaft oil seal with the special extractor lever. See text for alternative.

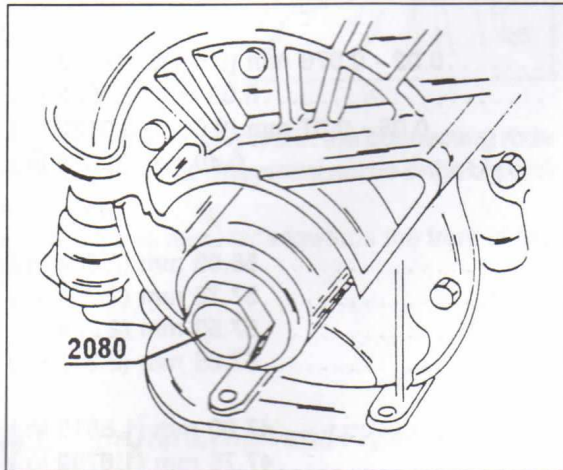


Fig. 16.34.  
Installation of the front oil seal with the special fitting tool. See text for alternative.

### 16.7.2. Crankshaft Oil Seals

The front and rear oil seals of the crankshaft must be replaced any time the crankshaft or the sealing flanges (or the oil pump in the case of the 5-cylinder engine) have been removed. The replacement of the seals on a four-cylinder engine and the rear oil seal of a five-cylinder engine is carried out in the same manner as described on pages 31 to 32, using the same special tools or respective alternatives. The operations to replace the front oil seal is different on a five-cylinder engine, mainly due to the arrangement of the oil pump. Proceed as described in the following text:

- Remove the alternator drive belt, the timing belt covers, the vibration damper with the crankshaft timing gear and the steering pump together with the drive belt. To slacken the bolt in the centre of the vibration damper, engage a gear, apply the handbrake and use a socket.

- To remove the oil seal, use a similar tool as shown in Fig. 16.33. Otherwise screw a self-tapping screw into the metal case and lever the seal out with a screwdriver. If the engine is removed, unscrew the oil pump from the front of the engine and remove the gasket. The oil seal can then be removed as described, but the work is facilitated.

The installation of the oil seal is carried out as follows:

- If the engine is removed, smear the seal lip and the outside of the oil seal with grease and carefully drive the seal into the oil pump. Refit the oil pump as described under "Engine Lubrication" and carry out all other assembly operations in reverse order to the removal procedure.

- To fit the oil seal to a fitted engine, use the special tool shown in Fig. 16.34. This is a piece of tube which presses against the outer diameter of the oil seal. A bolt in the end of the tube is screwed into the end of the crankshaft. By tightening the bolt, the oil seal is pulled into the flange. If this tool is not available, use a piece of tube of suitable diameter and place a large washer over the end. Screw a long bolt into the crankshaft end and tighten the bolt until the seal is in position. Alternatively try to drive the oil seal carefully in position with a drift and a hammer, but be careful not to damage it.

### 16.7.3. Crankshaft — Checking and Bearings

The operations are the same as described for the petrol engine. This includes the checking of the bearing running clearance, but note the values given in Section 16.7.0. Main bearing and crankpin journals can be re-ground to the sizes given so that oversize bearing shells can be used.

### 16.7.4. Crankshaft — Installation

The installation is a reversal of the removal procedure. Use the exploded view of the engine in question. The flywheel bolts must always be replaced. The bolts are tightened to 3.0 kgm (22



## 16 Diesel Engines

ft.lb.) and from this position tightened by a further 90°, without torque wrench. The main bearing cap bolts are tightened to 6.5 kgm (47 ft.lb.).

### 16.8. Cylinder block and Intermediate Shaft (Four-cylinder)

The cylinder block and the intermediate shaft are treated in the same manner as described for the petrol engine and the relevant pages should be referred to for all information.



## 17 ENGINE LUBRICATION — DIESEL ENGINES

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The engine lubrication of the four-cylinder diesel engine takes place in the same manner as described for the petrol engine. The 0.3 bar oil pressure switch is still fitted, but the second oil pressure switch is only calibrated to 0.9 bar. The drive to the ignition distributor is used to drive the exhaust pump (vacuum pump) for the operation of the brake servo unit.

A different oil pump arrangement is used on the five-cylinder engine. The pump is located at the lower front face of the engine and is driven directly by the crankshaft. The pump is removed as a complete unit (also with the engine fitted) and can be dismantled after unscrewing the pump cover. Two ring gears are operating inside

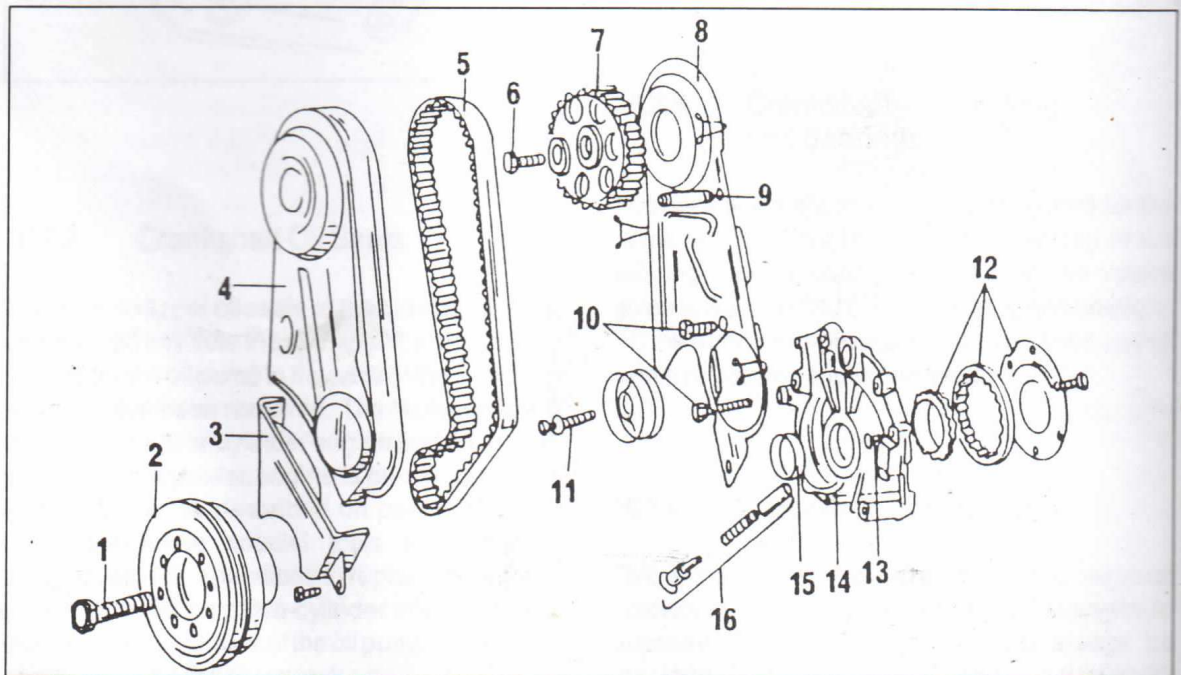
the pump and produce the oil pressure. Fig. 17.1 shows an exploded view of the oil pump and its associated parts.

The removal and installation of the pump of a four-cylinder engine is carried out in a similar manner as described on page 63.

The following description refers to the removal, overhaul and installation of the oil pump fitted to a five-cylinder engine. We would like to point out that the crankshaft must be prevented from rotating when the bolt in the centre of the vibration damper is slackened and tightened to the very high torque.

**Fig. 17.1.**  
The component parts of the oil pump of a five-cylinder engine and the parts to be removed to gain access to the pump.

- 1 Bolt, 46 kgm
- 2 Vibration damper
- 3 Lower timing belt cover
- 4 Upper timing belt cover
- 5 Timing belt
- 6 Bolt, 8.5 kgm (61.5 ft.lb.)
- 7 Camshaft timing gear
- 8 Rear timing belt guard
- 9 Stud, 1.0 kgm
- 10 Bolts, 2.0 kgm
- 11 Bolts, 1.0 kgm
- 12 Oil pump gearwheels
- 13 Bolt, 1.0 kgm
- 14 Oil pump body
- 15 Oil seal
- 16 Oil pressure relief valve





## 17 Engine Lubrication — Diesel Engines

### 17.1. Oil Pump

#### 17.1.1. Removal and Installation

- Remove the steering pump together with the drive belt, slacken the alternator belt tensioner adjuster and remove the drive belt and unscrew the upper timing belt cover from the front of the engine.

- Slacken the bolt on the centre of the vibration damper. VW workshops use the restraining lever shown in Fig. 16.24. If not available, engage a low gear, apply the handbrake and slacken the bolt with a socket. Fully remove the bolt and, using two tyre levers, applied at opposite points, press off the damper.

- Remove the oil dipstick. The timing drive is now removed as described in the relevant section. The engine must not be rotated with the belt removed.

- Remove the oil sump. From the bottom of the crankcase knock back the lockplates securing the oil suction pipe bolts, unscrew the bolts and remove the suction pipe (Fig. 17.2).

- Unscrew the oil pump from the front of the cylinder block (Fig. 17.3). The crankshaft must not be rotated.

The installation of the oil pump is a reversal of the removal procedure. The following points must be noted:

- The oil pump gasket and the crankshaft oil seal in the pump body must always be replaced.

- Tighten the oil pump securing bolts to 2.0 kgm (14.5 ft.lb.) evenly around the body.

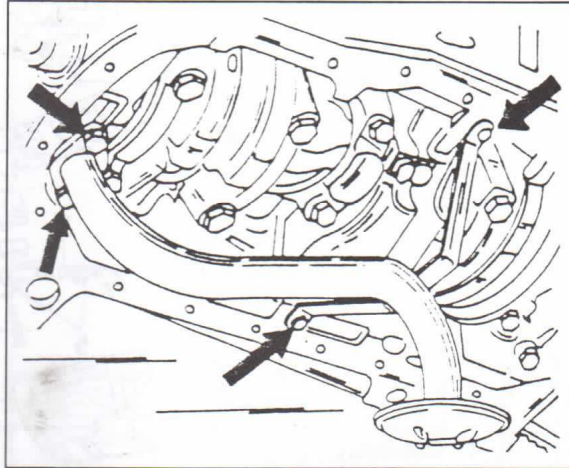
- Replace the oil suction pipe gasket, fit the pipe to the crankcase and tighten the bolts shown by the arrows in Fig. 17.3 to 1.0 kgm (7.2 ft.lb.). New lockplates must be used and knocked over the bolt heads to secure the bolts in position.

- Refit the timing belt as described for the five-cylinder engine. All timing marks should be in line as the crankshaft has not been rotated. Refit the oil sump and fill the engine with engine oil.

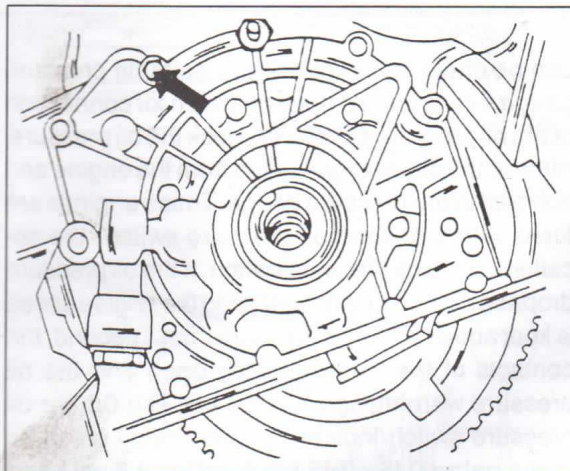
#### 17.1.2. Pump Overhaul

The pump gearwheels can be removed after un-

screwing the rear cover (12) in Fig. 17.1. If the gearwheels show wear, replace them as a set. The gearwheels have marks which must be on the outside after the gearwheels have been fitted into the pump housing. The cover can be replaced separately if it shows grooves or other damage. If the pump has been removed, unscrew the relief valve plug and withdraw the piston and return spring. The complete pump must be replaced if the piston shows excessive wear. Tighten the plug to 4.0 kgm (30 ft.lb.) on assembly. The cover screws are tightened to 1.0 kgm (7.2 ft.lb.).



**Fig. 17.2.**  
The arrows show the securing screws for the oil suction pipe at the bottom of the crankcase.



**Fig. 17.3.**  
The arrow shows where the oil pump bolts are situated.

### 17.2. Oil Filter

The oil filter should be replaced in accordance with the service intervals given in the Operator's Handbook and every time the engine has been overhauled. Refer to Page 66 for other information.

### 17.3. Checking the Oil Pressure

The oil pressure of the engine lubrication system

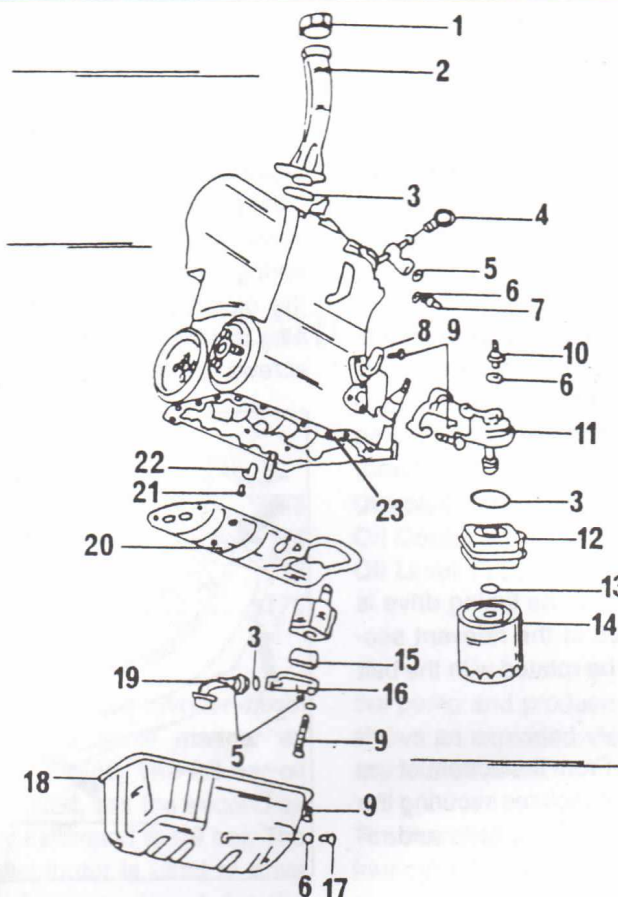


## 17 Engine Lubrication — Diesel Engines

**Fig. 17.4.**

Parts of the engine lubrication system.

- 1 Oil filler cap
- 2 Oil filler tube
- 3 "O" sealing ring
- 4 Oil dipstick
- 5 Nut, 1.0 kgm
- 6 "O" sealing ring
- 7 Oil pressure switch, 0.3 bar
- 8 Crankcase breather
- 9 Bolt, 2.0 kgm
- 10 Oil pressure switch, 0.9 bar
- 11 Oil filter bracket
- 12 Oil cooler
- 13 Nut, 2.5 kgm
- 14 Oil filter
- 15 Oil pump gear wheels
- 16 Oil pump cover and oil pressure relief valve
- 17 Oil drain plug
- 18 Oil sump
- 19 Oil suction tube
- 20 Oil baffle plate
- 21 Bolt for 22
- 22 Oil splash jet
- 23 Gasket



can be checked by means of a suitable pressure gauge, which should have provision for connection of the oil pressure switch. To check the oil pressure, remove the oil pressure switch from the engine and connect to the pressure gauge. These engines are fitted with a second oil pressure switch, the so-called 0.9 bar oil pressure switch. If the oil pressure drops below 2.0 bar (28.5 psi.) and the engine speed is kept above 2000 rpm for more than 1 second, the contacts of the 0.9 bar switch open and the oil pressure warning light comes on. The 0.3 bar oil pressure switch indicates when the oil pressure drops below 0.15 - 0.45 bar (approx. 4.5 psi.) and lights up the oil pressure warning light. The checking of the oil pressure should be carried out by a VW Dealer, but the oil pressure switches can be checked for functioning as follows:

- Check the engine oil level and correct if necessary.
- Switch on the ignition. The oil pressure warning light must come on. Start the engine and check that the warning light goes out.
- Pull the cable off the 0.3 bar oil pressure switch (see Fig. 1.79 for location — the switch with the brown lead) and hold the cable end against earth. The warning light must come on.

- Re-connect the plug to the switch.
- Pull the connector off the 0.9 bar switch (see Fig. 1.79 for location — the switch with the grey lead).
- Accelerate the engine to more than 2000 rpm for more than 1 second. The oil warning light must light up. Otherwise replace the switch.
- If the above tests do not show the required results, have the oil pressure checked professionally by a VW Dealer. A special gauge and a test lamp are required to check the oil pressure during idle speed and under acceleration.

### 17.3. Oil Cooler

An oil cooler is fitted between the oil filter bracket and the oil filter, as shown in Fig. 1.83, a similar arrangement being used on the diesel engines. Refer to Page 67 for further information.

### 17.4. Oil Level

See Section 1.7.6.



## 18 ENGINE COOLING SYSTEM — DIESEL ENGINES

The cooling system of the petrol engines and the diesel engines are of similar construction, but the connections are different on four- and five-cylinder engines. Study the layouts in Figs. 18.1 and 18.2 to get familiar with the system of your particular vehicle.

All operations described in Section 1.8 also apply more or less to the diesel engines, with the exception of the water pump of the five-cylinder engine. The removal and installation of the pump of a four-cylinder diesel is carried out as described on the relevant page.

### 18.1. Water Pump — 5-Cylinder

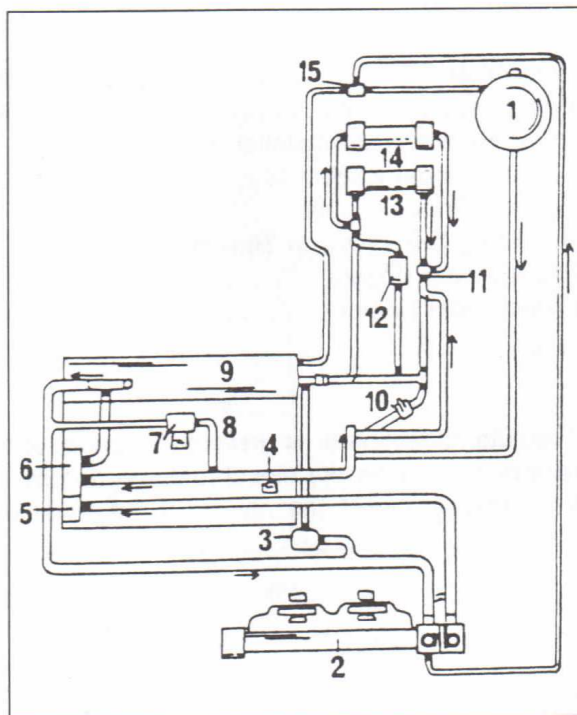
- Drain the cooling system as described in Section "Cooling". Collect the anti-freeze if still in good condition.

- Remove the alternator and the steering pump drive belts. Remove the steering pump and tie it with a piece of wire somewhere in the engine compartment without disconnecting the hoses.

- Remove the timing belt as described earlier on for the 5-cylinder diesel engine until the water pump is free and can be fully unscrewed from the cylinder block.

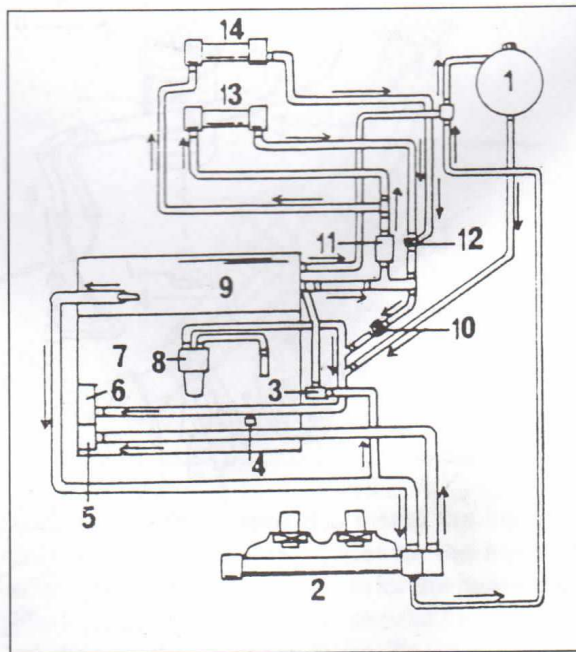
The installation of the water pump is a reversal of the removal procedure. Fit the pump finger-tight only, as it must be tightened during the tensioning of the timing belt. The belt is fitted and adjusted as described in Section 16.4.1. Before the engine is finally closed off, re-check the setting once more to make sure that crankshaft or camshaft have not been rotated whilst the pump has been out of the engine. Follow the installation and tensioning details step by step to avoid mistakes and consequent engine damage.

The water pump cannot be repaired and must be



**Fig. 18.1.**  
Cooling system diagram —  
Four-cylinder engine.

- 1 Expansion tank
- 2 Radiator
- 3 Coolant circulation pump
- 4 Drain plug
- 5 Thermostat
- 6 Water pump
- 7 Oil cooler
- 8 Cylinder block
- 9 Cylinder head
- 10 Solenoid valve (with additional heating)
- 11 Regulating valve
- 12 Additional heater
- 13 1st heat exchanger
- 14 2nd heat exchanger
- 15 "T"-piece connector



**Fig. 18.2.**  
Cooling system diagram —  
Five-cylinder engine.

- 1 Expansion tank
- 2 Radiator
- 3 Coolant circulation pump
- 4 Drain plug
- 5 Thermostat
- 6 Water pump
- 7 Cylinder block
- 8 Oil cooler
- 9 Cylinder head
- 10 Solenoid valve (with additional heater)
- 11 Additional heater
- 12 Regulating valve
- 13 1st heat exchanger
- 14 2nd heat exchanger

replaced in case of damage.



## 19 DIESEL INJECTION SYSTEM

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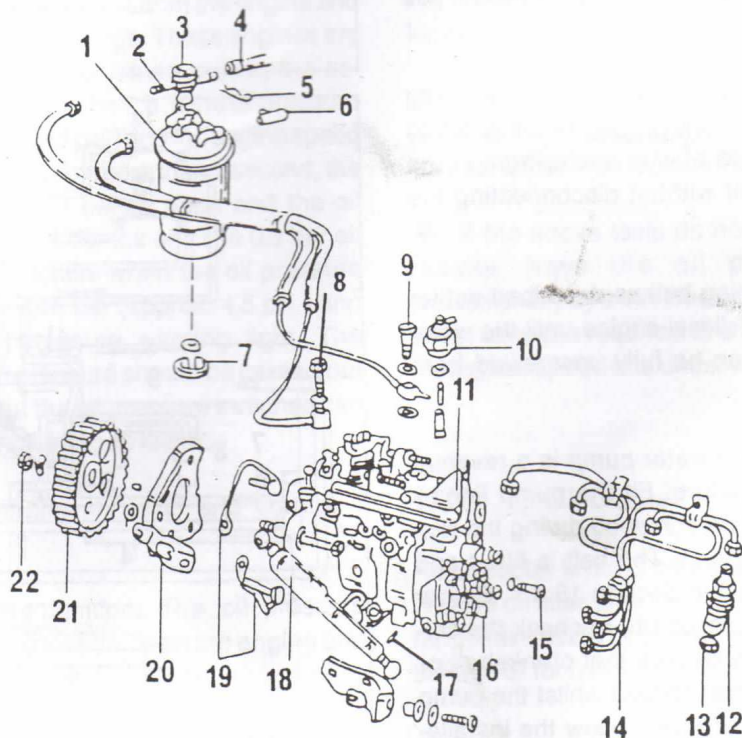
Absolute cleanliness is essential during any repairs or work on the diesel fuel injection system, irrespective of the nature of the work in

question. Thoroughly clean union nuts before unscrewing any of the injection pipes.

The fuel injection pump must be repaired or

**Fig. 19.1.**  
The main component parts of the fuel injection system of a four-cylinder engine.

- 1 Fuel filter
- 2 "O" sealing ring
- 3 Control valve
- 4 Return pipe to tank
- 5 Retaining clip
- 6 Fuel supply line
- 7 Drain plug
- 8 Banjo bolt,
- 9 Banjo bolt, 2.5 kgm
- 10 Electro-magnetic stop control
- 11 Fuel injection pump
- 12 Injector, 7.0 kgm
- 13 Heat shield
- 14 Injector pipes, 2.5 kgm
- 15 Bolt, 1.5 kgm
- 16 Connection
- 17 Securing clip
- 18 Shock absorber
- 19 Bracket
- 20 Mounting bracket
- 21 Injection pump gear
- 22 Bolt, 4.5 kgm





## 19 Diesel Injection System

overhauled by a specialist fuel injection engineer, an exchange pump or a new pump may be fitted in case of malfunction or damage.

The adjustment of the injection timing and also the removal and installation of the injection pump requires certain special tools and these operations should not be undertaken if these are not available. The following text describes these operations, in case that the listed special tools can be obtained or hired.

### 19.1. Fuel Filter

The fuel filter should be replaced every 20,000 miles (30,000 km), but must be drained approximately every 10,000 miles (15,000 km) or once a year to empty the water collected through condensation. The filter is located at the position shown in Fig. 19.1 in the engine compartment. Fig. 19.3 shows the connections on the top of the filter.

To drain the water, open the drain plug (arrow in Fig. 19.2) at the bottom of the filter housing and allow about 100 c.c. to drain off. Then close the drain plug. If no fuel can be seen coming from the plug opening, slacken one of the filter pipes to allow air into the filter.

A control valve is fitted to the top of the filter. This held in position by a retaining clip (5) in Fig. 19.3. When the filter must be replaced, remove the clip and withdraw the control valve together with the hoses towards the top. The filter is held in position by means of a clamp (A, Fig. 19.2). The valve can be released from the filter to bleed the fuel system.

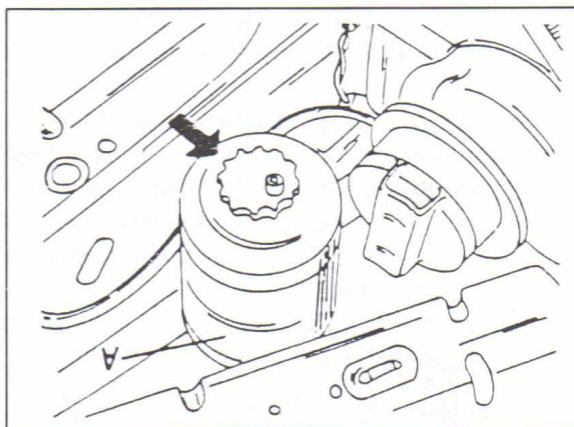
To replace the filter, mark the two connecting hoses on both sides and remove them after opening the clamps. Slacken the filter mounting clamp and withdraw the filter upwards.

Install the filter in reverse order to the removal procedure. Refer to Fig. 19.3.

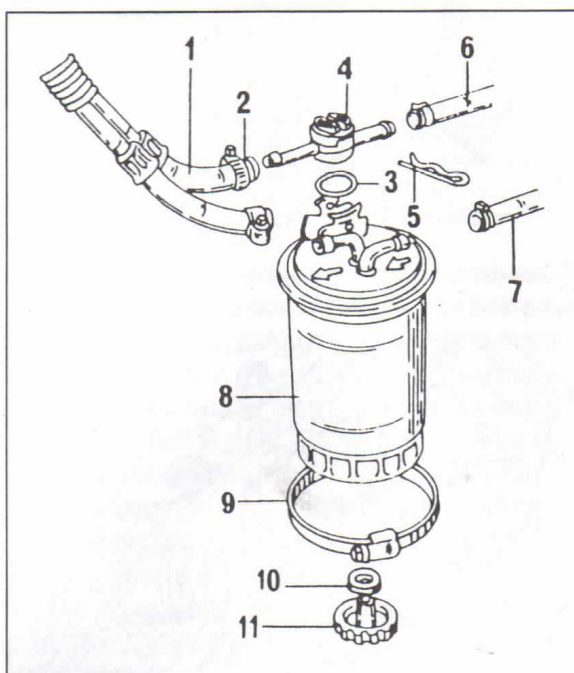
Start the engine and accelerate a few times. The fuel should be visible in the transparent hose. The fuel system can be bled by removing the retaining clip for the control valve and withdrawing the valve out of its location. The function of the valve is given under item (4) in Fig. 19.3.

### 19.2. Fuel Injection Pump

The special tools given in the following text must

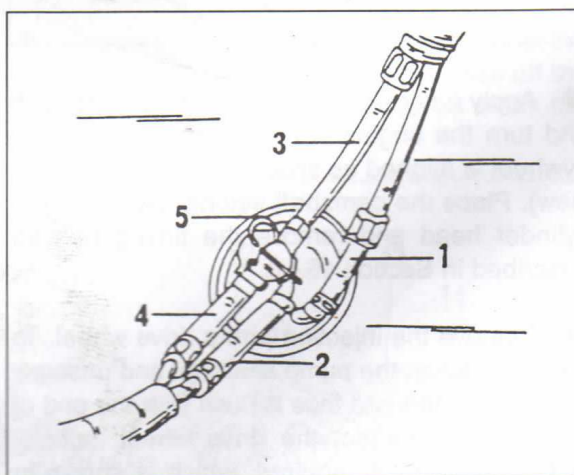


**Fig. 19.2.**  
The location of the bleed-screw at the bottom of the fuel filter.



**Fig. 19.3.**  
View of the fuel filter. Both engines use a similar filter.

- 1 Transparent supply line to injection pump
- 2 Return pipe, blue, from the injection pump
- 3 "O" seal ring, always replace
- 4 Control valve, below 15° C flow to filter open; above 31° flow to filter closed
- 5 Retaining clip
- 6 Return pipe, blue, to fuel tank
- 7 Supply pipe, black, from fuel tank
- 8 Fuel filter
- 9 Securing strap
- 10 Sealing washer
- 11 Drain plug



**Fig. 18.4.**  
Connections at the top of the fuel filter.

- 1 Hose from fuel tank
- 2 Line to injection pump
- 3 Return line from fuel pump
- 4 Return line to tank (marked with arrow)
- 5 Retaining clip

be available to remove and install the injection pump. Required are the puller for the injection pump gear and the arrester pin for the gearwheel. The injection timing must be checked and adjusted after installation of the pump. To preserve your excellent performance of your engine, have the timing checked after installation of the pump, if in any doubt about the running of the engine.



## 19 Diesel Injection System

### 19.2.1. Removal and Installation — Four-Cylinder Engine

- Turn the engine so that the piston of the No. 1 cylinder is at the top dead centre. This is best done by removing the cylinder head cover and then unscrewing the plug from the transmission housing with a sawn-off plug spanner, in order to observe the marks in the flywheel.

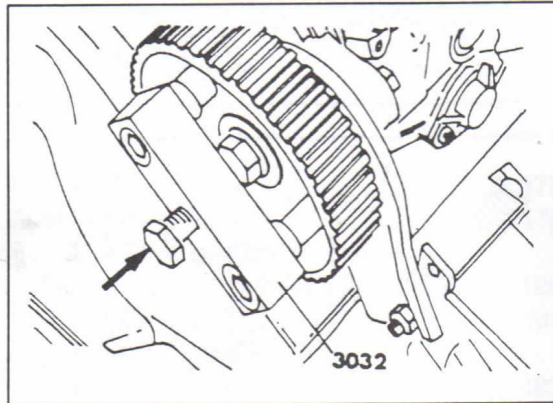


Fig. 19.5.  
Removal of the injection pump drive wheel with the special puller. Tap the end of the centre spindle with a hammer to break the seat.

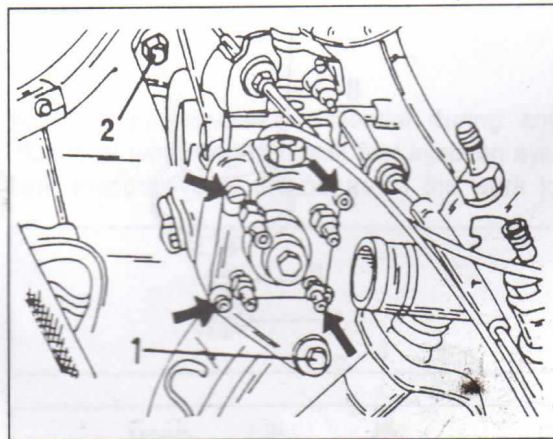


Fig. 19.6.  
When removing the injection pump do not slacken the bolts shown by the arrows. Only loosen bolts (1) and (2).

- Apply a socket on the crankshaft pulley bolt and turn the engine over until the mark in the flywheel is aligned as shown in Fig. 11.15 (lower view). Place the camshaft setting gauge on the cylinder head and remove the timing belt as described in Section 16.4.0.

- Remove the injection pump drive wheel. To do this, slacken the pump shaft nut and unscrew the nut until the end face is flush with the end of the shaft. To extract the drive wheel, special puller VW 3032 is required, which is shown in Fig. 19.5 in applied condition. Insert the two claws of the puller into the holes of the drive wheel at right angles to the centre spindle and counterhold the drive wheel with one hand. Tighten the centre spindle and when under tension, tap the end of the centre spindle with a short blow of a hammer. The impact will loosen the drive wheel from its cone seat. Remove the puller, fully unscrew the nut and withdraw the

drive gear.

- Unscrew all injection pipe union nuts at the pump end and use suitable caps to close off the pipes, whilst the pump is removed from the engine.

**ATTENTION:** The union nuts for the fuel feed and return lines have the same diameter, but the union nut for the return line contains a restrictor. The word "Out" is marked into the union nut for identity purposes and this should be observed when the parts are refitted in order to avoid mistakes.

- Disconnect the operating cable for the stop control and also the accelerator control cable and the cold starting device control cable from the pump.

- Referring to Fig. 19.6, remove the three bolts (2) from the mounting and the single screw (1) from the support bracket. Under no circumstances remove the bolts shown by the arrows in the illustration, as this could lead to the breakage of the distributor piston, if the pump head is dislocated. Mark the fitted position of the pump in the most convenient fashion to have a reference mark on the pump and the mounting bracket for ease of installation. Even if a new pump is fitted, you will have a guide of the approximate position during installation.

The installation of the injection pump is a reversal of the removal procedure. The following points must be noted in particular:

- Fit the pump to the mounting bracket and rotate it until the bolt holes are in the centre of the elongated holes. Fit the bolts and tighten them to a torque reading of 2.5 kgm (18 ft.lb.).

- Check that the Woodruff key is in position in the pump shaft and carefully tap the drive wheel over the key and shaft. Fit the shaft nut and tighten to 4.5 kgm (33 ft.lb.) whilst restraining the pump wheel.

- Refit the union nuts of the injection pipes to the pump and tighten them to 2.5 kgm (18 ft.lb.). Read the "Attention" note regards the flow marking (above) before installing the pipes.

- Rotate the pump wheel until the marks on the edge and the mounting bracket are in line. In this position insert the arrester pin (shown in Fig. 16.16) to block the wheel against rotation. Unscrew the camshaft wheel bolt by  $\frac{1}{2}$  a turn



## 19 Diesel Injection System

and with a rubber mallet tap against the end of the shaft to break the taper seat.

- Re-check that the engine is still at the top dead centre position for the No. 1 cylinder.

- Fit the timing belt as described in Section 16.4.1. and carry out all other operations described in this section, until the timing belt is correctly tensioned.

- Have the injection timing checked as soon as possible.

### 19.2.2. Removal and Installation — Five-Cylinder Engine

The front end of the vehicle must be tilted forward to gain access to the pump. Then proceed as follows:

- Turn the engine so that the piston of the No. 1 cylinder is at the top dead centre. This is best done by removing the cylinder head and then unscrewing the plug from the transmission housing with a sawn-off plug spanner, in order to observe the marks in the flywheel. Also check the marks in injection pump drive gear and mounting bracket, which should be aligned as shown in Fig. 16.21.

- Remove the belt cover on the injection pump side.

- Insert the arrester pin for the injection pump gear as shown in Fig. 16.22, to keep the gear in the injection position.

- Hold the camshaft timing gearwheel against rotation (see Fig. 16.22) and remove the gearwheel bolt. Remove the gearwheel together with the toothed belt. Fig. 16.20 shows the parts on this side of the engine.

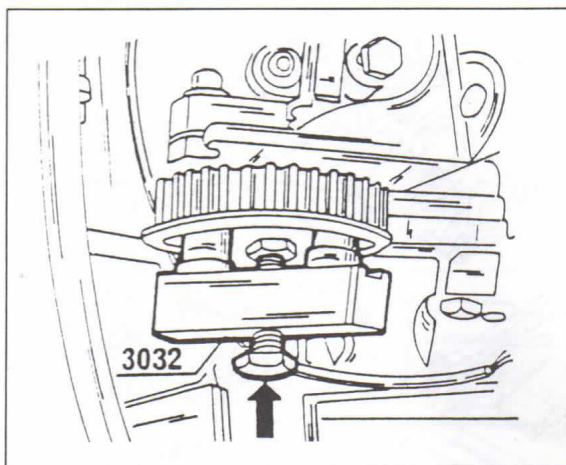


Fig. 19.7.  
Removal of the injection pump drive gear (5-cylinder engine).

- Remove the injection pump drive wheel. To do this, slacken the pump shaft nut by half a turn and fit the special extractor 3032 in the manner shown in Fig. 19.7. To extract the drive wheel, insert the two claws of the puller into the holes of the drive wheel at right angles to the centre spindle and counterhold the drive wheel with one hand. Tighten the centre spindle and when under tension, tap the end of the centre spindle with a short blow of a hammer. The impact will loosen the drive wheel from its cone seat. Remove the puller, fully unscrew the nut and withdraw the drive gear.

- Unscrew all injection pipe union nuts at the pump end and use suitable caps to close off the pipes, whilst the pump is removed from the engine.

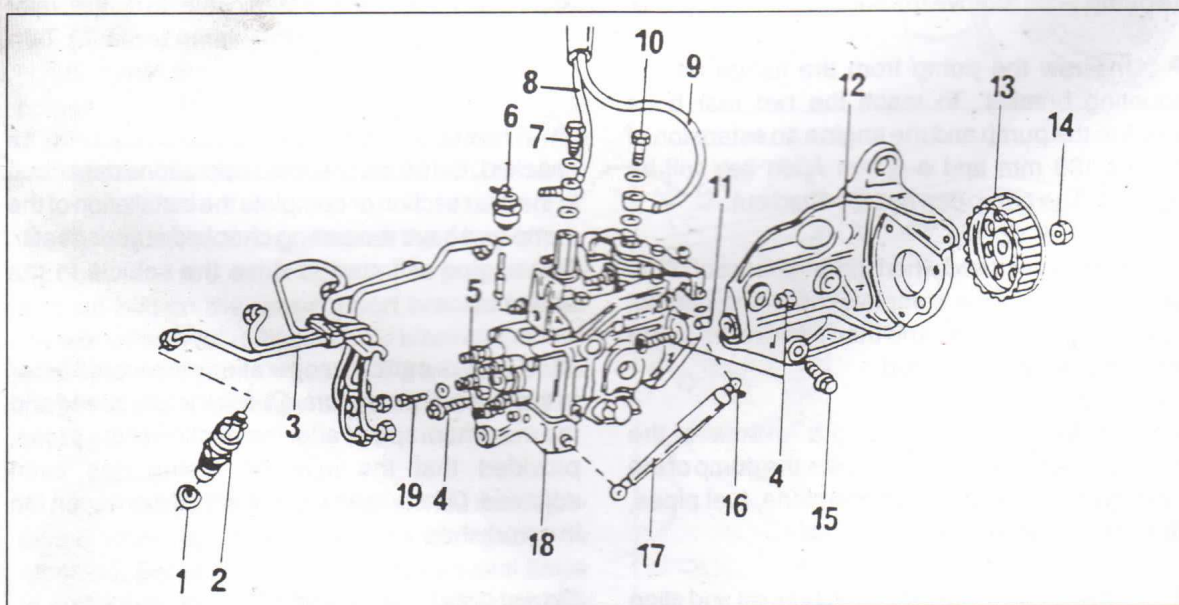


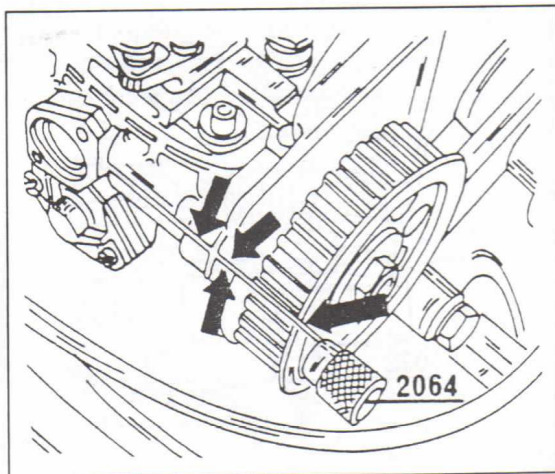
Fig. 19.8.  
Injection pump and associated parts of a five-cylinder engine.

- 1 Heat shield
- 2 Injector, 7.0 kgm
- 3 Injector pipes, 2.5 kgm
- 4 Bolt, 2.5 kgm
- 5 Connection on pump
- 6 Electro-magnetic stop control
- 7 Banjo bolt, 2.5 kgm
- 8 Return pipe to fuel filter
- 9 Supply from fuel filter
- 10 Banjo bolt, 2.5 kgm
- 11 Curved-washer
- 12 Mounting bracket
- 13 Injection pump gearwheel
- 14 Nut, 5.0 kgm
- 15 Bolt, 5.0 kgm
- 16 Securing clip
- 17 Shock absorber for load shock absorption
- 18 Injection pump
- 19 Bolt, 1.5 kgm

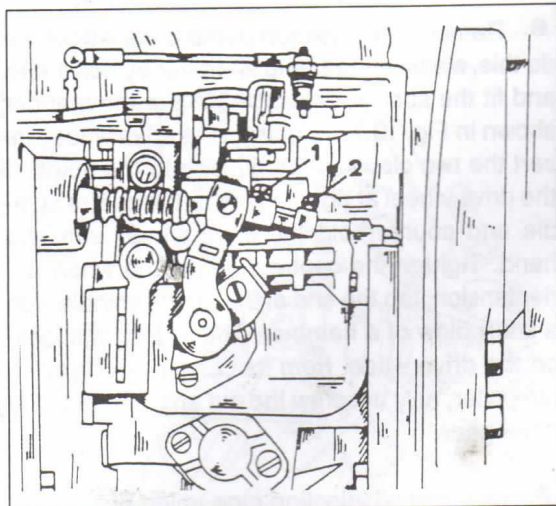


## 19 Diesel Injection System

**ATTENTION:** The union nuts for the fuel feed and return lines have the same diameter, but the union nut for the return line contains a restrictor. Refer to the "Attention" note on page 180. The word "Out" is marked into the union nut for identity purposes.



**Fig. 19.9.** Aligning the marks in pump gearwheel and mounting bracket (R.H. arrows) and mounting bracket and pump flange (L.H. arrow). The drive gearwheel must be locked with the arrester pin, shown on the right.



**Fig. 19.10.** Details for the re-connection of the cold start cable (refer to text).

- Disconnect the operating cable for the stop control and also the accelerator control cable from the pump. Also remove the shock absorber.
- Unscrew the pump from the flange on the mounting bracket. To reach the two rear bolts between the pump and the engine an extension of at least 180 mm and a 6 mm Allen key will be required. The pump can now be lifted out.

If the pump is removed when the engine is out of the vehicle, unscrew the complete mounting bracket together with the pump and then remove the pump from the bracket, if required.

The installation of the pump is a reversal of the removal procedure. Fig. 19.8 shows the pump of the five-cylinder engine with connections, fuel pipes, etc and will help to locate the parts.

- Fit the pump to the mounting bracket and align

the two parts until the matching marks on pump and bracket are aligned as shown in Fig. 19.9. Tighten the bolts finger-tight.

- Fit the rear support bracket without tension to the cylinder block and the pump and tighten the bolts to 2.5 kgm (14.5 ft.lb.).
- Fit the pump drive gearwheel over the shaft and turn the gearwheel until the alignment marks on pump gear and mounting bracket are in line. The alignment can also be seen in Fig. 19.9.
- Insert the arrester pin (Fig. 19.9) to lock the gearwheel against rotation and tighten the pump shaft nut to 5.0 kgm (36 ft.lb.).
- Refit the timing belt to the gearwheel for the camshaft and place the camshaft gearwheel over the shaft, at the same time engaging the belt with the injection pump gearwheel. Fit the bolt and tighten it until the camshaft gearwheel can just be turned by hand.

- Check the tension of the pump drive belt as described on pages 166 and 167 and adjust as required. Tighten the bolts on the mounting bracket to 5.0 kgm (36 ft.lb.) and the bolts on the support bracket to 2.5 kgm (14.5 ft.lb.) before the belt tension is re-checked. Fig. 16.27 shows the location of the securing bolts with the arrows. Check once more that the engine is still in the position shown in Fig. 16.21, i.e. the alignment marks must be in line.

- Counterhold the gearwheel on the camshaft in suitable manner and tighten the bolt to 10.0 kgm (72 ft.lb.). The arrester pin can now be removed from the injection pump gearwheel.

- Re-connect the cold start cable. To do this, refer to Fig. 19.10 and slacken the clamp screw (1). Turn the clamp by 90°. Never slacken the screw (2).

- The injection timing of the pump must now be checked. Either carry out the operations described in the next section or complete the installation of the pump and have the setting checked at your dealer. The engine will start to drive the vehicle to the workshop.

- Carry out all other operations in reverse order to the removal procedure. Check the idle speed and the maximum speed after installation of the pump, provided that the injection timing has been adjusted. Otherwise have the adjustment seen too in a workshop.

**Do not break any seals.**



### 19.3. Adjusting the Injection Timing

The adjustment requires a dial gauge together with the guide 2066. The guide is screwed into the rear of the pump after removal of the closing plug. The timing belt must be correctly tensioned and the operating cable for the cold starting device must be fully pushed in. The lever on the injection pump must be in the rest position. The adjustment is described separately for the two engine types. Proceed as follows:

#### Four-Cylinder Engine

- Rotate the engine until the TDC mark in the flywheel is correctly aligned as shown in Fig. 19.11 and the marks on the pump wheel and the mounting bracket are in line.

- If the engine is removed, adjust the adjusting gauge 2068A to a dimension of 98.5 mm and fit the gauge to the flywheel end of the engine as shown in Fig. 19.12.

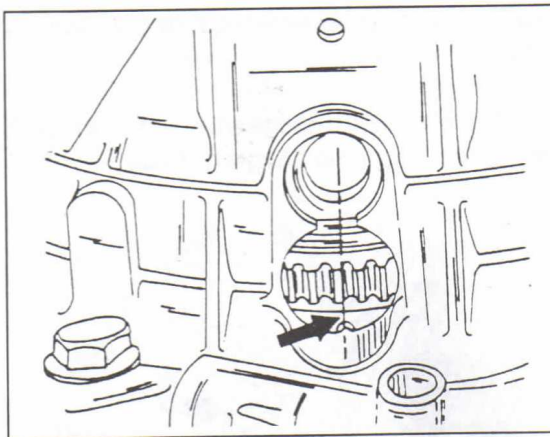
- Rotate the engine until the TDC mark in the flywheel is in line with the tip of the gauge (B in Fig. 19.12). The marks on pump timing wheel and mounting bracket must be in line.

- The next adjustment requires the dial gauge mentioned above. Remove the plug and screw the guide into the threaded bore for the plug. Adjust the dial gauge to a pre-load of 2.5 mm. Now turn the crankshaft in an anti-clockwise direction until the dial gauge needle comes to rest. In this position, set the dial gauge to "Zero" with a pre-load of approx. 1.0 mm. Fig. 19.13 shows the gauge in position.

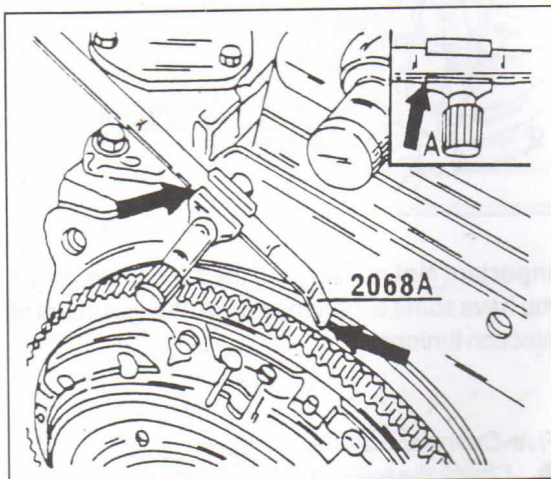
- Now turn the crankshaft slowly clockwise, until the mark in the flywheel is in line with the pointer. The dial gauge should show a reading of 0.93 - 1.07 mm. If an adjustment must be carried out, obtain the ideal value of  $1.00 \pm 0.2$  mm.

- To adjust the timing, slacken the pump securing bolts. The two upper bolts on the pump flange and the bolt on the rear support bracket can be slackened without difficulties. To slacken the lower bolt, turn the pump wheel until the bolt appears in one of the wheel openings as shown in Fig. 19.14.

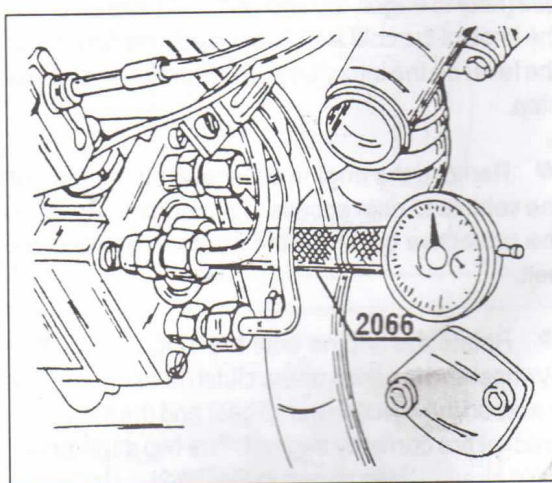
- Turn the pump until a value of 1.00 mm is obtained when the check with the dial gauge is repeated. Repeat the measurement several times to make sure to obtain the correct indication. Fi-



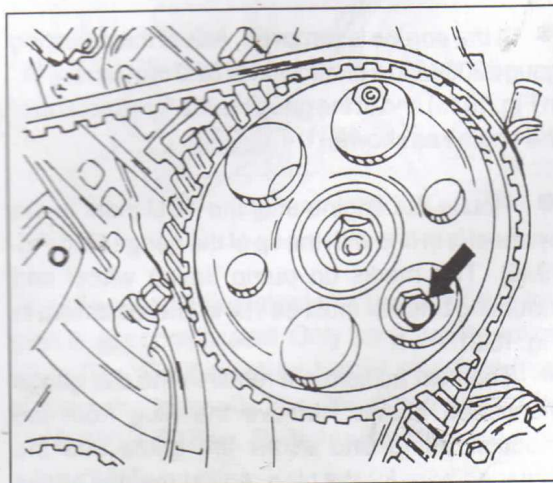
**Fig. 19.11.**  
The TDC mark must be aligned in the flywheel housing opening as shown.



**Fig. 19.12.**  
Adjusting gauge fitted to the flywheel side of the engine to adjust the injection timing.



**Fig. 19.13.**  
The dial gauge in position in the pump.



**Fig. 19.14.**  
Slacken one of the mounting bracket bolts through one of the pump wheel holes.



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nally tighten the pump securing bolts to 2.5 kgm (18 ft.lb.).

- Remove the dial gauge and guide, fit the plug and tighten the plug to 1.5 kgm (11 ft.lb.).

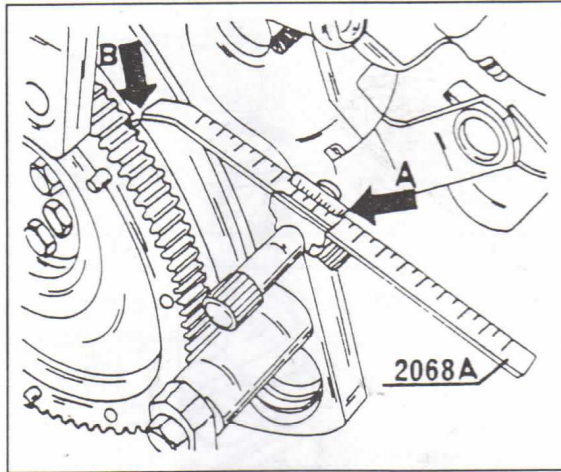


Fig. 19.15.  
Adjusting gauge fitted to the flywheel side of the engine to adjust the injection timing.

**Important Note:** Carry out the adjustment only if you have some experience with the adjustment of injection timings.

### Five-Cylinder Engine

- Check the tension of the injection pump drive belt (refer to Pages 166 and 167) and make sure that the knob of the cold start cable is pushed fully in, i.e. the lever on the injection pump must be against its stop.

- Remove the engine cover and tilt the front of the vehicle to gain access to the engine. Remove the protective cover for the injection pump drive belt.

- Rotate the engine until the TDC mark in the flywheel and the boss on the clutch housing and the marks on the injection pump gear and the mounting bracket are correctly aligned. The two alignments have already been shown in Fig. 16.21.

- If the engine is removed, adjust the adjusting gauge 2068A to a dimension of 82.0 mm (arrow "A" in Fig. 19.15) and fit the gauge to the flywheel end of the engine as shown.

- Rotate the engine until the TDC mark in the flywheel is in line with the tip of the gauge (B in Fig. 19.15). The marks on pump timing wheel and mounting bracket must be still in line, as shown in Fig. 16.21.

- The next adjustment requires the dial gauge mentioned above. Remove the plug from the injection pump and screw the guide into the threaded bore for the plug. Adjust the dial gauge

to a pre-load of 2.0 mm. Now turn the crankshaft in an anti-clockwise direction until the dial gauge needle comes to rest. In this position, set the dial gauge to "Zero". Fig. 19.13 shows the gauge in position on the four-cylinder engine, but the arrangement is similar on a five-cylinder engine.

- Now turn the crankshaft slowly clockwise, until the mark in the flywheel is in line with the pointer. The dial gauge should show a reading of 0.93 - 1.07 mm. If an adjustment must be carried out, obtain the ideal value of  $1.00 \pm 0.2$  mm.

- To adjust the timing, one of two methods can be employed. Either slacken the pump securing bolts and adjust by rotating the pump or by rotating the injection pump gearwheel. The latter method is more complicated and we do not recommend it, as a further special tool for the rotation of the gearwheel is required. Turn the pump until a value of 1.00 mm is obtained when the check with the dial gauge is repeated. Repeat the measurement several times to make sure to obtain the correct indication. Finally tighten the securing bolts to 2.5 kgm (18 ft.lb.).

**NOTE:** If the above dial gauge and extension or the adjusting gauge are not available, do not attempt to try the adjustment. The description is given all the same, as experience has shown that the "Owner-Repairer" is sometimes able to borrow special tools from workshops, hire them, etc., therefore being able to do the work.

## 19.4. Adjustment on the Fuel Injection System

### 19.4.0. Adjusting the Accelerator Cable

The adjustment of the accelerator cable on models with automatic transmission is very complicated and we strongly recommend you have this seen to by a VW Dealer. The adjustment on a model with manual transmission is carried out as follows:

- Have the accelerator pedal pressed to the floor by a second person and check that the lever on the injector pump is resting against the stop without being under tension.

- If necessary remove the retaining clip of the cable at the mounting bracket (Fig. 19.16) and re-insert it into a different groove of the outer sleeve.

- Re-check the adjustment and if necessary carry out further adjustments.



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### 19.4.1. Adjusting the Idling Speed

The adjustment of the idle speed is carried out in similar manner on the two engines, but the adjusting screw is located at a different position on the injection pump. Note the following before checking and/or adjusting the idle speed:

- The engine must be at operating temperature before the idling speed can be adjusted.
- Make sure the knob of the cold start cable is pushed fully in.
- All electrical consumers must be switched off. The electric fan must not be operating.
- The gearlever must be in the neutral position. Apply the handbrake before starting the engine.
- Connect a revolution counter in accordance with the manufacturer. Not all revolution counters are suitable for diesel engines.

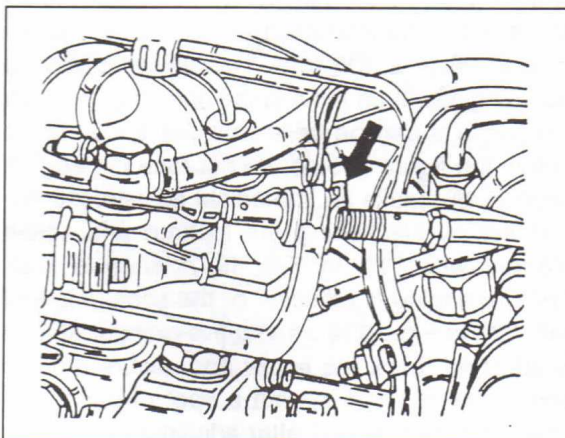
The idle adjusting screw of the **four-cylinder engine** is located at the position shown in Fig. 19.17. To adjust the idle speed on this engine proceed as follows:

- Start the engine and wait until it runs at idle speed. Read off the revolution counter. An adjustment is necessary if the engine speed is outside  $850 \pm 50$  rpm. Turn the screw (1) in Fig. 19.17 to correct the idle speed.
- Pull the knob of the cold start cable to the first stage and check that the idle speed increases by approx. 60 rpm. Pulling the cable to its full extent will increase the idle speed to  $1050 \pm 50$  rpm.

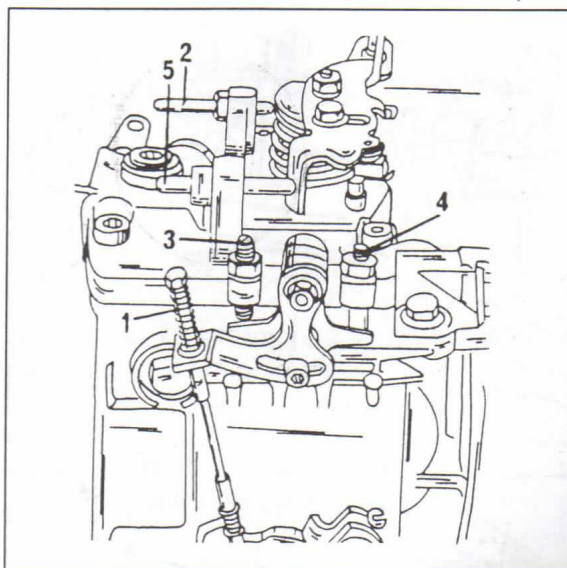
The basic idle speed is adjusted at the factory and the idle speed can normally be adjusted in the simple manner described above. The increased idle speeds on pulling out the cable should then be obtained. It may, however, happen sometime that the idle speed cannot be adjusted or the increased idle speed cannot be obtained. If this is the case, try the following adjustment:

- If the idle speed cannot be adjusted to below 880 rpm by turning the screw (1), because the limiting screw (3) touches the stop, slacken the locknut of screw (3) and unscrew the screw. Now turn the screw (1) until the idle speed is 850 rpm. Screw the limiting screw (3) IN until it just contacts its stop and then tighten the locknut without disturbing the screw.
- If the increased idle speed (cold start cable

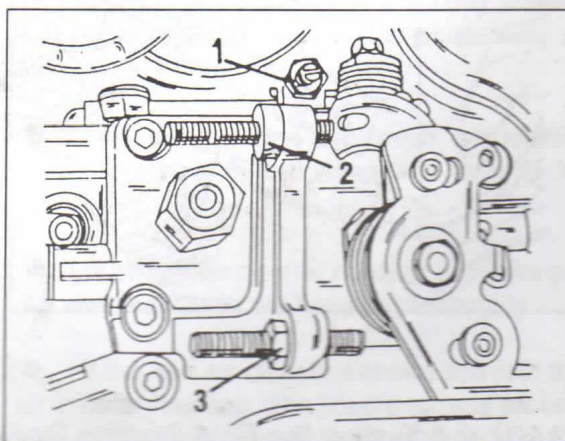
pulled) cannot be obtained, slacken the locknut of stop screw (4) and turn the stop screw until the engine idles with 1050 rpm. Again make sure that the cold start cable is fully out. Re-tighten the locknut.



**Fig. 19.16.**  
The arrow shows the retaining clip for the accelerator cable adjustment.



**Fig. 19.17.**  
The various adjusting screws on the injection pump of a four-cylinder engine.  
1 Idle adjusting screw  
2 Maximum speed adjusting screw  
3 Idle speed limiting screw  
4 Increased idle speed limiting screw  
5 Sealed adjusting screw



**Fig. 19.18.**  
The various adjusting screws on the fuel injection pump of a five-cylinder engine.  
1 Idle speed adjusting screw  
2 Sealed adjusting screw  
3 Max. speed adjusting screw

The idle speed adjustment of a **five-cylinder engine** is less complicated. Only the adjusting screw (1) in Fig. 19.18 must be turned to adjust (first slacken the locknut). The idle speed should be set to  $850 \pm 50$  rpm. Re-tighten the locknut after adjustment.



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### 19.4.2. Adjusting the max. Speed

Bring the engine to operating temperature (a short drive) and set the operating lever of the injection pump to full load. Connect a revolution counter (tachometer) in accordance with the instructions of the manufacturer and adjust the engine to  $4800 \pm 100$  rpm. This value applies to both engines. If on moving the operating lever on the pump it can be seen that the speed is far above the figure quoted, do not race the engine beyond, but make an immediate adjustment. Adjust the by slackening the locknut and screw marked with "2" in Fig. 19.17 when a four-cylinder engine is adjusted or the screw marked with "3" in Fig. 19.18 when a five-cylinder engine is adjusted. Lock the screw and secure the nut and screw in position with a spot of paint. Re-check the max. speed after adjustment.

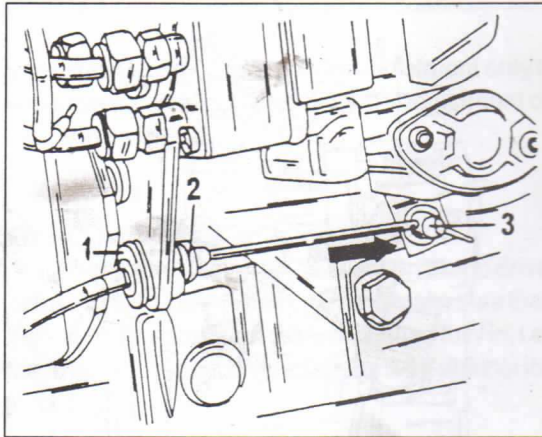


Fig. 19.19.  
Details for the adjustment  
of the cold starting device  
(5-cylinder engine). The  
numbers are referred to in  
the text.

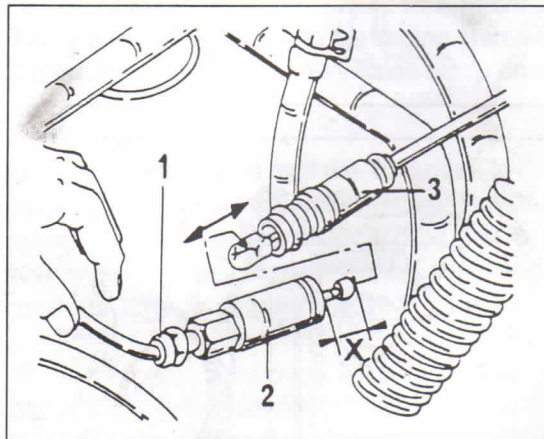


Fig. 19.20.  
Details for the adjustment  
of the cold starting device  
(4-cylinder engine). The  
numbers are referred to in  
the text.

### 19.4.3. Adjusting the Cold Starting Device

**Five-Cylinder Engine:** If the operating cable has been removed, place the washer (1) in Fig. 19.19 over the cable and insert the cable with the rubber grommet into the support bracket. Secure the outer cable with the lock washer (2). Connect the inner cable to the pin on the injection pump

lever without tightening the clamp bolt fully. Move the lever towards the left as shown by the arrow, pull the inner cable tight and secure by tightening the clamp screw (3). Check the operation of the lever when the cable is moved in and out.

**Four-Cylinder Engine:** Move the operating lever to the "on" position. Refer to Fig. 19.20 and screw in the adjusting screw (1) until dimension "x" is between 14 and 15 mm. Clip the bottom cold start cable into the shell of the upper plug and connect the plugs (2) and (3).

### 19.4.4. Residual Volume

The so-called residual volume ensures that the fuel injection pump receives fuel under all conditions. The adjusting screw (5) in Fig. 19.17 (4-cylinder) or (2) in Fig. 19.18 (5-cylinder) is secured with an anti-tamper cap and normally must not be adjusted. The screws must only be disturbed if the engine idle speed is excessive and cannot be adjusted. The residual volume is in this case too high. Unscrew the screw and re-lock.

If the engine shows a flat spot during "moving-off" or accelerating from low engine speeds and/or "jerking" in all gears, the residual volume is too low. Screw the screw further in and re-lock. A new anti-tamper cap should be fitted if the screw has been disturbed.

## 19.5. Injectors

**NOTE:** The injection pressure of the injectors should only be tested in a specialist shop. Never attempt to carry out this operation yourself.

To find a faulty injector, unscrew the union nuts one after the other at the injector connection, with the engine running. Special wrenches are available to unscrew injector pipe union nuts. These have the shape of a ring spanner with a slot to place over the injector pipe. The spanner can then be placed over the union nut. This prevents damage to the hexagon which can occur when an open-ended spanner is used. Run the engine at increased speed. If the engine noise does not change after a certain injection pipe has been disconnected, the faulty injector has been found.

To remove an injector, unscrew the pipe union nut and with a spanner of 27 mm A/F unscrew



## 19 Diesel Injection System

the injector from the cylinder head. When fitting the injector, use new heat-protecting washers with the turned-up edge towards the top, as shown in Fig. 19.22. Tighten the injector to 7.0 kgm (50.5 ft.lb.) and the injection pipe union nuts to 2.5 kgm (18 ft.lb.). The system does not need priming after an injector has been replaced.

### 19.6. Glow Plugs

The glow plugs are used to pre-heat the combustion mixture during starting. Glow plugs cannot be repaired and must be replaced in case of malfunctioning.

Automatically operating glow plugs are fitted, together with a glow plug relay which controls the automatic operation of the glow plugs. The glow plugs start to operate immediately after the starter key is switched "on" and the pre-heating period is determined by the temperature of the engine at the moment of starting.

The automatic glow plugs operate as follows:

When the ignition/starter key is switched "on", the voltage is fed to the glow plug relay and the automatic glowing process commences. A warning light lights up to show you that the glow plugs operate.

The duration of the glow plug operation and therefore the time the warning light remains "on" depends on the coolant temperature of the engine, which is detected by the temperature sender unit. As soon as the warning light goes "off" the plugs will glow another 15 seconds and it is during this period that the engine must be started.

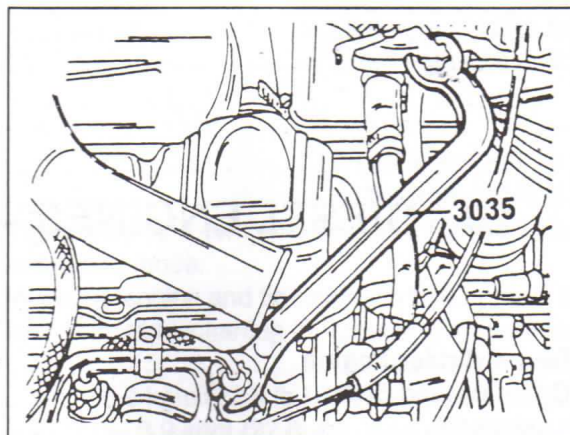
If one of the glow plugs is faulty, it can normally spotted with the engine cold. As the fuel in the remaining cylinders will ignite, you may notice that the cylinder with the faulty plug cuts-in later.

#### 19.6.0. Glow Plug — Removal and Installation

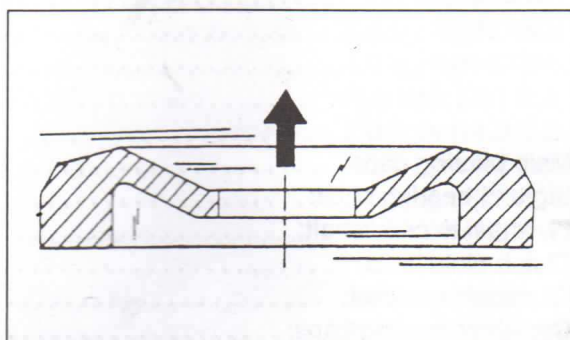
Remove the bus bars and the feed cable (on the L.H. plug, seen in direction of drive). Unscrew the glow plug with an open-ended or ring spanner (12 mm A/F, see Fig. 19.21). The space behind the injection pump is very limited and the injection

pipes should be disconnected.

The installation is a reversal of the removal procedure. Tighten the glow plugs to 3.0 kgm (22 ft.lb.).



**Fig. 19.21.**  
A ring spanner of similar shape can be used to slacken and re-tighten the union nuts at the ends of the injection pipes.



**Fig. 19.22.**  
The heat shield must be fitted as shown over the injector, with the arrow pointing to the cylinder head.

Do not exceed this torque value to avoid premature failure of the glow plug.

### 19.7. Air Cleaner

The air cleaner is fitted with a dry paper element. The removal and installation are fairly simple. Remove and install the air cleaner element as follows:

- Open the securing clip, push the locking handle downwards and disengage from its location.
- Lift off the air cleaner housing and take out the element. Clean the housing thoroughly.
- Fit the new air cleaner element and refit the air cleaner housing. The plastic tongue on one side of the filter element must engage into the opening of the retainer.
- Secure the filter housing and lock it in position with the securing clip.



## 20 DIESEL ENGINES — TIGHTENING TORQUES

### Four-Cylinder Engine

#### Cylinder Head Bolts:

|                  |                                                                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1st stage: ..... | 4.0 kgm (29 ft.lb.)                                                                                                                 |
| 2nd stage: ..... | 6.0 kgm (43 ft.lb.)                                                                                                                 |
| 3rd stage: ..... | 7.5 kgm (54 ft.lb.)                                                                                                                 |
| 4th stage: ..... | Angle tighten by 180° (or 2 x 90°) without torque wrench, without slackening. Re-tighten in the same manner after approx. 600 miles |

|                                                       |                                            |
|-------------------------------------------------------|--------------------------------------------|
| Main bearing caps: .....                              | 6.5 kgm (47.0 lb.ft.)                      |
| Big end bearing caps: .....                           | 3.0 kgm (22 ft.lb.), then by a further 90° |
| Flywheel to crankshaft: .....                         | 3.0 kgm (22 lb.ft.), then a further 90°    |
| Clutch plate bolts: .....                             | 2.5 kgm (18 ft.lb.)                        |
| Camshaft sprocket: .....                              | 4.5 kgm (33.0 lb.ft.)                      |
| Camshaft bearing caps: .....                          | 2.0 kgm (14.5 ft.lb.)                      |
| Crankshaft timing sprocket: .....                     | 9.0 kgm (65 ft.lb.), then a further 90°    |
| Crankshaft pulley: .....                              | 2.5 kgm (18 ft.lb.)                        |
| Injection pump sprocket: .....                        | 4.5 kgm (33 lb.ft.)                        |
| Belt tensioner locknut: .....                         | 4.5 kgm (33.0 lb.ft.)                      |
| Intermediate shaft pulley: .....                      | 4.5 kgm (33.0 lb.ft.)                      |
| Injection pump to bracket: .....                      | 2.5 kgm (18.0 lb.ft.)                      |
| Injection pump bracket: .....                         | 2.5 kgm (18.0 ft.lb.)                      |
| Oil sump (pan) .....                                  | 2.0 kgm (14 lb.ft.)                        |
| Timing belt guard: .....                              | 1.0 kgm (7.2 lb.ft.)                       |
| Cylinder head cover: .....                            | 1.0 kgm (7.2 lb.ft.)                       |
| Exhaust to inlet manifold: .....                      | 2.5 kgm (18.0 ft.lb.)                      |
| Vacuum pump retainer plate: .....                     | 2.5 kgm (18.0 ft.lb.)                      |
| Oil filter bracket to engine: .....                   | 2.0 kgm (14.5 ft.lb.)                      |
| Oil cooler to oil filter (nut): .....                 | 2.5 kgm (18.0 ft.lb.)                      |
| Water pump: .....                                     | 2.0 kgm (14.5 ft.lb.)                      |
| Pulley to pump: .....                                 | 2.0 kgm (14.5 ft.lb.)                      |
| Engine mounting bracket/engine, rear: .....           | 4.5 kgm (32.5 ft.lb.)                      |
| Engine mountings/bracket, rear to transmission: ..... | 2.0 kgm (14.5 ft.lb.)                      |
| Starter motor bolts: .....                            | 2.0 kgm (14.5 ft.lb.)                      |
| Engine to transmission:                               |                                            |
| 8 mm thread: .....                                    | 2.0 kgm (14.5 ft.lb.)                      |
| 10 mm thread: .....                                   | 6.0 kgm (43 ft.lb.)                        |
| 12 mm thread: .....                                   | 8.0 kgm (58 ft.lb.)                        |
| Oil pump to crankcase: .....                          | 2.0 kgm (14.0 lb.ft.)                      |
| Oil pump cover:                                       |                                            |
| Long bolts: .....                                     | 2.0 kgm (14.5 ft.lb.)                      |
| Short bolts: .....                                    | 1.0 kgm (7.2 ft.lb.)                       |
| Oil drain plug: .....                                 | 3.0 kgm (22.0 lb.ft.)                      |
| Thermostat housing: .....                             | 1.0 kgm (7.2 lb.ft.)                       |
| Intermediate shaft flange: .....                      | 2.5 kgm (18.0 lb.ft.)                      |



## 20 Diesel Engines — Tightening Torques

|                                                   |                                                                                                |
|---------------------------------------------------|------------------------------------------------------------------------------------------------|
| Exhaust manifold to head:                         | 2.5 kgm (18.0 lb.ft.)                                                                          |
| Injectors:                                        | 7.0 kgm (50.0 lb.ft.)                                                                          |
| Injector pipe union nuts:                         | 2.5 kgm (18.0 lb.ft.)                                                                          |
| Oil pressure switch:                              | 1.0 kgm (7.2 lb.ft.)                                                                           |
| Drive shaft to flanges:                           | 5.5 kgm (40.0 lb.ft.)                                                                          |
| Temperature sender unit:                          | 0.7 kgm (5.0 lb.ft.)                                                                           |
| <b>Five-Cylinder Engine</b>                       |                                                                                                |
| <b>Cylinder Head Bolts:</b>                       |                                                                                                |
| 1st stage:                                        | 4.0 kgm (29 ft.lb.)                                                                            |
| 2nd stage:                                        | 6.0 kgm (43 ft.lb.)                                                                            |
| 3rd stage:                                        | Tighten by ½ a turn or 2 x ¼ of a turn in tightening sequence.                                 |
| 4th stage:                                        | Warm-up engine and tighten each bolt by ¼ of a turn without slackening in tightening sequence. |
| Main bearing caps:                                | 6.5 kgm (47.0 lb.ft.)                                                                          |
| Big end bearing caps:                             | 3.0 kgm (22 ft.lb.), then by a further 90°                                                     |
| Flywheel to crankshaft:                           | 3.0 kgm (22 lb.ft.), then a further 90°                                                        |
| Clutch plate bolts:                               | 2.5 kgm (18 ft.lb.)                                                                            |
| Camshaft sprocket:                                | 8.5 kgm (61.0 lb.ft.)                                                                          |
| Camshaft bearing caps:                            | 2.0 kgm (14.5 ft.lb.)                                                                          |
| Crankshaft timing sprocket:                       | 46.0 kgm (331 ft.lb.)                                                                          |
| Crankshaft pulley:                                | 2.0 kgm (14.5 ft.lb.)                                                                          |
| Injection pump sprocket:                          | 5.0 kgm (36 lb.ft.)                                                                            |
| Drive sprocket for injection pump on camshaft:    | 10.0 kgm (72 ft.lb.)                                                                           |
| Idler pulley bolt:                                | 1.0 kgm (7.2 lb.ft.)                                                                           |
| <b>Injection pump to cylinder block:</b>          |                                                                                                |
| Mounting bracket to block:                        | 6.5 kgm (47 ft.lb.)                                                                            |
| Pump to mounting bracket:                         | 2.5 kgm (18.0 lb.ft.)                                                                          |
| Oil sump (pan)                                    | 2.0 kgm (14 lb.ft.), M8 bolts, 1.0 kgm (7.2 ft.lb.), M6 bolts                                  |
| <b>Upper timing belt guard to cylinder block:</b> |                                                                                                |
| Stud at top:                                      | 1.0 kgm (7.2 lb.ft.)                                                                           |
| Bolt at centre:                                   | 2.0 kgm (14.5 ft.lb.)                                                                          |
| Bolt at bottom:                                   | 1.0 kgm                                                                                        |
| Lower timing belt guard:                          | 2.5 kgm (18 ft.lb.)                                                                            |
| Belt guard cover for injection pump belt:         | 1.0 kgm (7.2 ft.lb.)                                                                           |
| Cylinder head cover:                              | 1.0 kgm (7.2 lb.ft.)                                                                           |
| Rear oil seal flange:                             | 1.0 kgm (7.2 ft.lb.)                                                                           |
| <b>Exhaust manifold to cylinder head:</b>         |                                                                                                |
| 6 mm thread:                                      | 0.5 kgm (3.5 ft.lb.)                                                                           |
| 8 mm thread:                                      | 2.3 kgm (17 ft.lb.)                                                                            |
| 10 mm thread:                                     | 4.0 kgm (30 ft.lb.)                                                                            |
| Exhaust pipe clamps:                              | Depending on thread size, see above                                                            |
| Exhaust pipe to silencer:                         | Depending on thread size, see above                                                            |
| Vacuum pump bolts:                                | 2.0 kgm (14.5 ft.lb.)                                                                          |
| Banjo bolt in oil filter bracket:                 | 7.0 kgm (52 ft.lb.)                                                                            |
| Oil cooler to oil filter (nut):                   | 2.5 kgm (18.0 ft.lb.)                                                                          |
| Water pump:                                       | 2.0 kgm (14.5 ft.lb.)                                                                          |
| Engine to transmission:                           | See page 201                                                                                   |
| <b>Oil pump to crankcase:</b>                     |                                                                                                |
| 8 mm thread:                                      | 2.0 kgm (14.0 lb.ft.)                                                                          |
| 6 mm thread:                                      | 1.0 kgm (7.2 ft.lb.)                                                                           |
| Oil splash jets to cylinder block:                | 1.0 kgm (7.2 ft.lb.)                                                                           |
| Oil pump cover:                                   | 1.0 kgm (7.2 ft.lb.)                                                                           |
| Oil suction pipe to crankcase bottom:             | 1.0 kgm (7.2 ft.lb.)                                                                           |
| Plug for oil pressure relief valve:               | 4.0 kgm (30 ft.lb.)                                                                            |
| Oil drain plug:                                   | 5.0 kgm (36.0 lb.ft.)                                                                          |
| Thermostat housing:                               | 1.0 kgm (7.2 lb.ft.)                                                                           |



## 20 Diesel Engines — Tightening Torques

|                                                  |                       |
|--------------------------------------------------|-----------------------|
| Water elbow: .....                               | 1.0 kgm (7.2 ft.lb.)  |
| Radiator mounting (rubber bearings): .....       | 2.0 kgm (14.5 ft.lb.) |
| Thermo switch for cooling fan: .....             | 2.5 kgm (18 ft.lb.)   |
| Injectors: .....                                 | 7.0 kgm (50.0 lb.ft.) |
| Injector pipe union nuts: .....                  | 2.5 kgm (18.0 ft.lb.) |
| Glow plugs: .....                                | 3.0 kgm (22 ft.lb.)   |
| Oil pressure switch: .....                       | 1.5 kgm (11 lb.ft.)   |
| Drive shaft to flanges: .....                    | 5.5 kgm (40.0 lb.ft.) |
| Alternator to mounting bracket: .....            | 4.5 kgm (32.5 ft.lb.) |
| Oil dipstick guide tube to cylinder block: ..... | 2.0 kgm (14.5 ft.lb.) |



## 21 Bodywork

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### 21.1 Front Doors

#### 21.1.1 INNER DOOR TRIM PANELS

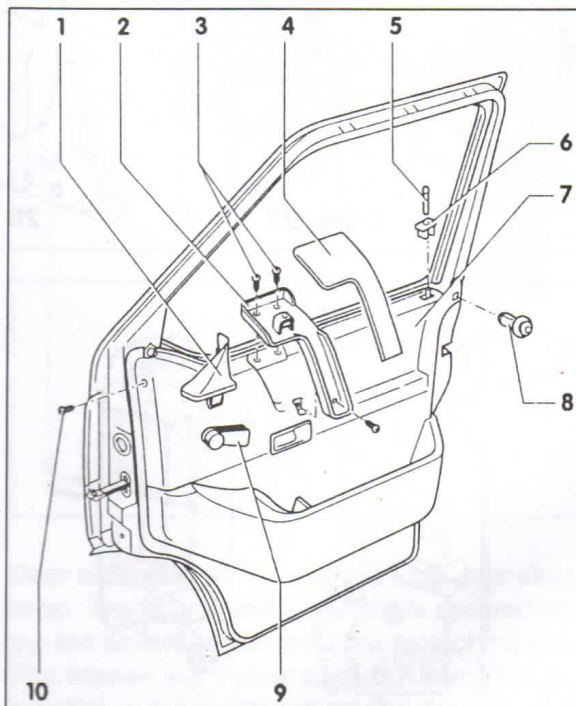
Fig. 21.1 shows details of the inner door trim panel. A trim panel is removed as follows. A version with window winder handle is shown.

- Crank down the window and remove the window winder (9). To do this, carefully lift the cover off the handle. Underneath you will find a cross-headed screw. Unscrew it and take off the star washer. The handle can now be pulled off.
- Unscrew the locking button (5) and lever out the surround (6).
- Unscrew the inner part of clip (8), using a socket.
- Lever off the trim cover (4), remove the screws (3) and take off the handle (2).
- Unscrew the cross-headed screw (10) and take off the trim (1).
- Lift the door trim together with the inner window slot seal towards the top, tilt it away from the door panel and lift it out of mounting holes.

The installation of the door trim is a reversal of the removal procedure.

#### 21.1.2 DISMANTLING A FRONT DOOR MECHANISM

Fig. 21.2 shows a dismantled front door. The following notes give additional information when removing the various parts from the inside of the front door:



**Fig. 21.1.**  
Details for the removal and installation of the front door trim panel. The numbers are referred to in the text.

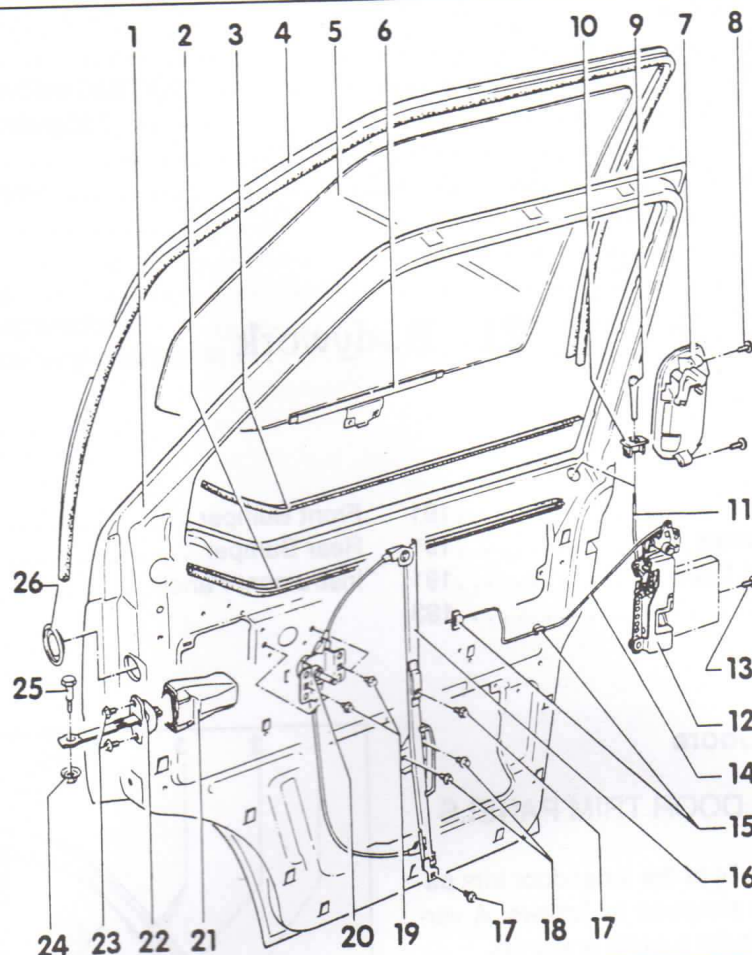
#### *Front Door (1) — Removal*

The description also refers to models with central locking, electric window lifters, heated outside mirrors and/or door loudspeakers:

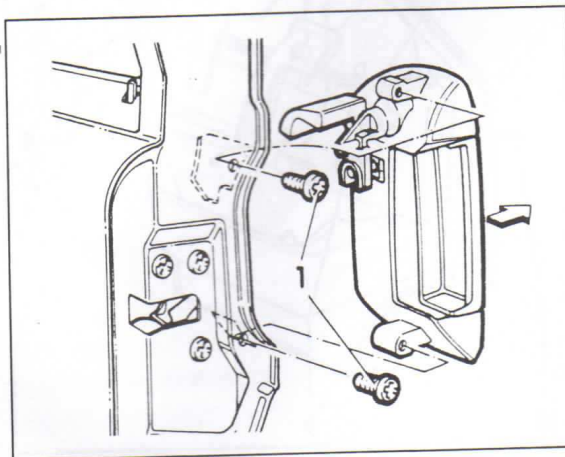
- Remove the door trim as described above.
- Find all electrical leads, separate the connector plugs and pull the leads out of the door.
- Open the door and locate a nut in the centre between the two hinges. Remove the nut and take out the pin. These parts are shown with (24) and (25) in Fig. 21.1. Ask a helper to hold the door in position and unscrew the upper and lower door hinge bolts. The door can now be lifted



## 21 Bodywork



**Fig. 20.2.**  
Details for the removal and installation of the various parts on the inside of a front door. The numbers are referred to in the text.



**Fig. 20.3.**  
The two screws (1) secure the outside door handle. Remove the handle in the direction of the arrow.

away.

The installation is a reversal of the removal procedure. The door can be adjusted in the elongated holes of the hinges. The front door is correctly adjusted when an even gap exists all around in the opening when the door is closed. The hinge securing bolts allow an adjustment up and down and in and out. Slacken the hinges as required by trial and error until the gap is obtained. Then tighten the screws without moving the door. Tighten the two hinge bolts to 5.5 kgm (40 ft.lb.)

after installing the pin (25) and the nut (24) in Fig. 21.1. The nut must be tightened carefully (0.5 kgm).

*The inner window slot seal (2) is removed together with the door trim panel as already described.*

*The outer window slot seal (3) is pushed into the flange.*

*The door window (5) is removed as follows:*

- Remove the door trim panel as already described.
- Fully lower the window and unscrew the window lifter rail (6) from the window lifter (16).
- Tilt the door window forward and lift it out of the window slot.

During installation insert the window in the door slot, align it to its fitted position and provisionally screw the window lifter rail to the window lifter with the two bolts.

Raise the window fully, using the window lifter and tighten the two bolts to 0.7 kgm (5 ft.lb.)

*The window lifter rail (6) can be removed after removal of the window.*



## 21 Bodywork

The outside door handle (7) is removed as follows:

- Refer to Fig. 21.3 and remove the two screws (1). Withdraw the handle in the direction of the arrow. The installation is a reversal of the removal procedure.

The countersunk screw (8) is tightened to 0.8 kgm (6 ft.lb.).

The locking button (9) is screwed onto the locking rod (11).

To remove the door lock (12), remove the door trim panel and the outside door handle as already described. Raise the window fully and unclip the pull rod (14) from the clips (15) on the inner door panel. Unscrew the screws (1) in Fig. 21.4 and remove the door lock together with the pull rod and the locking rod. The installation is a reversal of the removal procedure.

The countersunk screw (13) is tightened to 0.8 kgm 6 ft.lb.).

The clips (15) secure and guide the pull rod (14) on the door panel.

The window lifter (16) can be removed as follows:

- Remove the door trim panel as already described.
- Unscrew the lifter rail (6) with the door window from the window lifter.
- Slide the window door upwards and secure in this position with sticky tape.

The window lifter can now be removed as follows:

- If a mechanical lifter is fitted, unscrew a bolt at the top and one at the bottom and carefully remove the window lifter with the crank mechanism out of the top opening.
- If an electrical window lifter is used, separate the connector plug from the lifter motor and unscrew the securing bolts. There is one at the top and one at the bottom of the window lifter. Three bolts secure the lifter motor. Remove the lifter and the motor as an assembly.

The installation is a reversal of the removal procedure.

The hexagonal bolts (17), (18) and (19) are tightened to 0.7 kgm (6 ft.lb.).

The window lifter crank mechanism (21) is removed together with the window lifter (see above description).

The sleeve (21) is clipped in position of the door check strap (22).

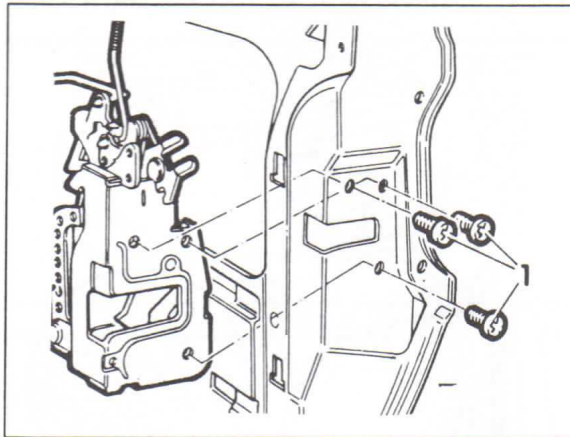


Fig. 21.4.  
The screws (1) secure the door lock to the closing face of the front door.

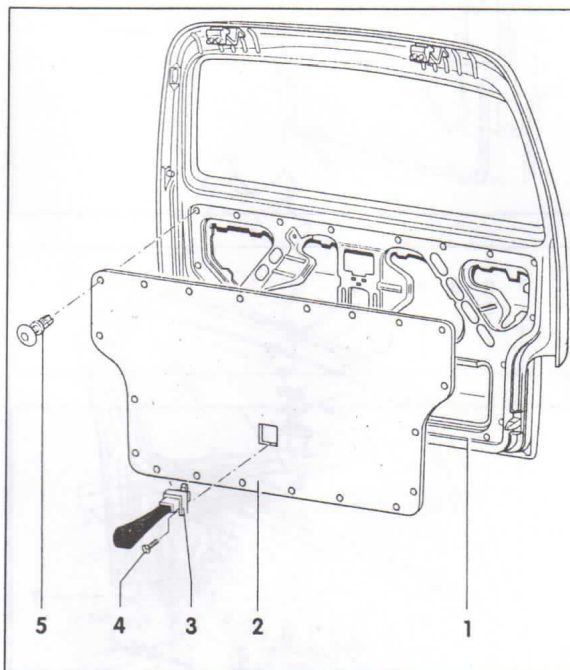


Fig. 21.5.  
Removal and installation of the tailgate trim panel.  
1 Tailgate  
2 Trim panel  
3 Strap  
4 Cross-headed screw  
5 Two-part clip

Door closing by itself? Replace the door check strap. The door check strap (22) is secured with the two screws (23) to the inner face of the door. The screws are tightened to 0.7 kgm (6 ft.lb.). Nut (24) and pin (25) secure the door check to the body.

The cover (26) is fitted to doors with mechanical window operation. On models with electric window operation, central locking, etc., a rubber boot is fitted.

### 21.2 Tailgate

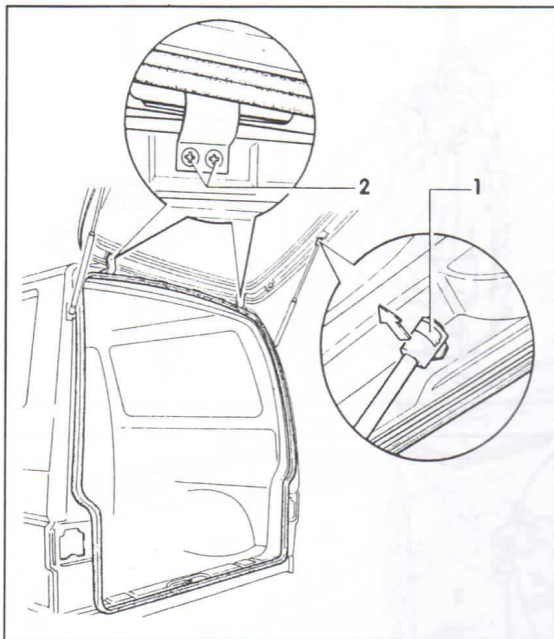
#### 21.2.1 TAIL GATE TRIM PANEL

Fig. 21.5 shows the trim panel removed from the tail gate. The clips (5) are made of two parts. To

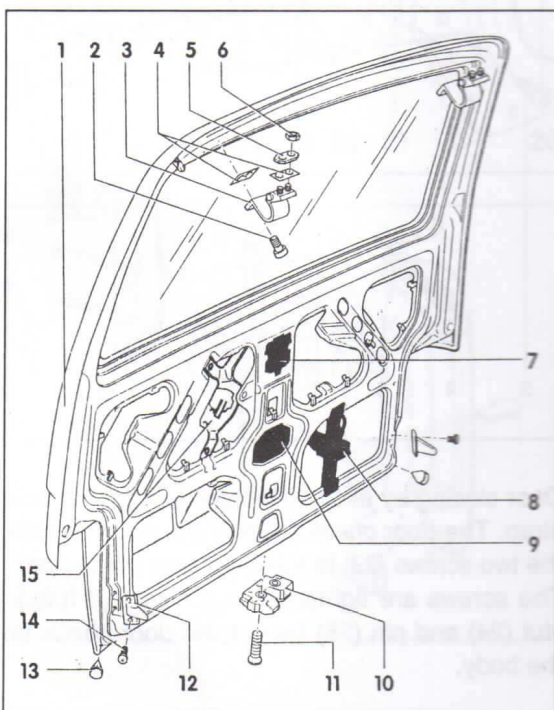


## 21 Bodywork

remove the inner part of the clips, use a socket wrench. To refit the clips, press the outer part and inner part in turn into the mounting holes.



**Fig. 21.6.**  
Removal of the tailgate.  
1 Locking tabs  
2 Securing screws



**Fig. 21.7.**  
The parts fitted to the inside of the tailgate.  
1 Tailgate  
2 Cross-headed screw  
3 Hinge  
4 Sealing plate  
5 Spacer plate  
6 Bolt, 3.0 kgm  
7 Inside door opener  
8 Motor, central locking  
9 Tailgate lock mechanism  
10 Tailgate lock  
11 Countersunk screw  
12 Guide pin, L.H. and R.H.  
13 Plug  
14 Cross-head screw, 0.8 kgm  
15 Motor, rear window winder

### 21.2.2. TAILGATE — REMOVAL (See Fig. 21.6)

- Open the tailgate and remove the trim panel as already described (Fig. 21.5).
- Disconnect the leads for rear window heater, number plate lights, rear window wiper motor and central locking motor (depending on the version) and pull the cables out of the tail gate.
- Ask a helper to support the tail gate and lift

the locking tab (1) with a screwdriver. Pull the gas-filled struts on both sides out of the ball-head pins. The locking tabs must not be removed completely (damage).

- Unscrew the two screws (2) from the hinges and take off the tail gate.

The installation is a reversal of the removal procedure. There is no need to adjust the tailgate, if the original tailgate is fitted.

### 21.2.2 DISMANTLING THE TAILGATE

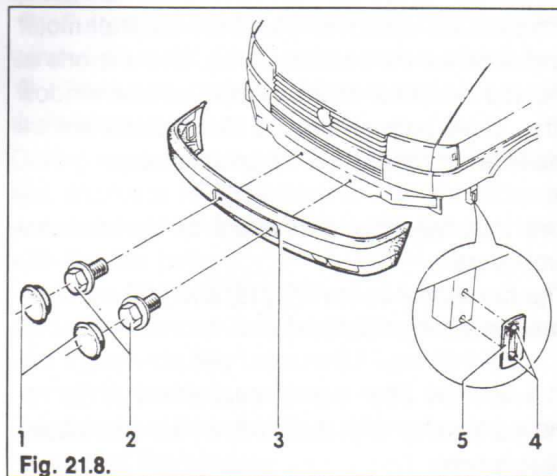
Fig. 21.7 shows the parts fitted to the inside of the tailgate. Replacing any of the parts is fairly straight forward and need no further explanation, except for the following:

- The cross-headed screw (2) is tightened to 2.0 kgm (14.5 ft.lb.).
- The spacer plate (5) must not drop into the roof member, when the hinge (3) is removed.
- The nuts (6) are tightened to 3.0 kgm (22 ft.lb.).
- The guide pin (12) is made for the L.H. and R.H. side and must not be interchanged.

### 21.3. Front Bumper

The parts of the front bumper are shown in Fig. 21.8. The bumper is attached at the centre with the two bolts (2). The two caps (1) must be removed to reach the bolts. To remove the bumper, knock the pins (4) out of their location and pull the bumper straight out of the guides (5).

During installation push the bumper straight into the guides (5) and knock the pins (4) into position until flush. Tighten the two bolts (2) to 1.0 kgm (7.2 ft.lb.) and fit the caps (1).

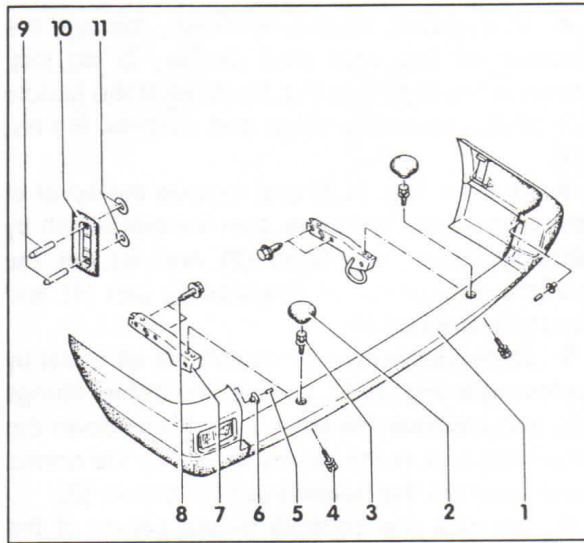


**Fig. 21.8. (R.H. side)**  
Attachment of the front bumper. The numbers are referred to in the text.



### 21.4. Rear Bumper

Fig. 21.9 shows the fitting details of the rear bumper. Note the following details.



- 1 Rear bumper
- 2 Cover cap
- 3 Bolt with washer. Tighten to 1.5 kgm (10 ft.lb.).
- 4 Bolt with washer. Tighten to 1.5 kgm
- 5 Pin. Replacement part consists of items 5 and 6.
- 6 Spreader clip. Replacement part consists of items 5 and 6.
- 7 Bracket
- 8 Combi-bolt, 11 kgm (80 ft.lb.)
- 9 Pin
- 10 Guide. When removing and installing bumper. pull out or push in straight on L.H. and R.H. sides.
- 11 Washer

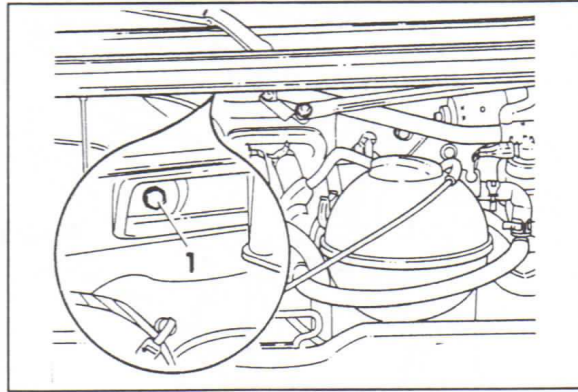


Fig. 21.10.

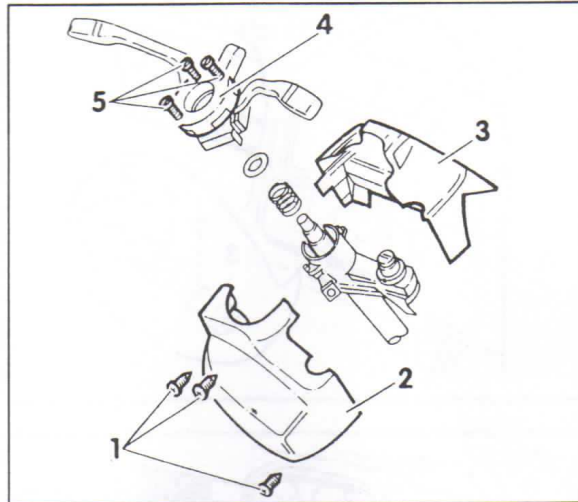


Fig. 21.11.

### 21.5. Instrument Panel

#### 21.5.1. REMOVAL OF COMPLETE INSTRUMENT PANEL

- Disconnect the battery earth cable.
- Unscrew the bolt (1) in Fig. 21.10 from the air duct and cross panel.
- Remove the steering wheel. To do this, remove the cap in the centre and then unscrew the steering wheel nut. The nut is tightened to 7.0 kgm (50.5 ft.lb.).
- Refer to Fig. 21.11 to remove the steering wheel column switch and the switch covers. Remove the screws (1) and take off the lower cover (2). Pull the connectors off the steering column switch (4), unscrew the slotted screw (5) and remove the steering column switch (4). Finally remove the upper cover (3).
- Remove the instrument trim. Refer to Fig. 21.12 and unscrew the self-tapping screws (1). Pull the instrument trim (2) out of the spring clips (3).
- Remove the L.H. heater and fresh air outlet.

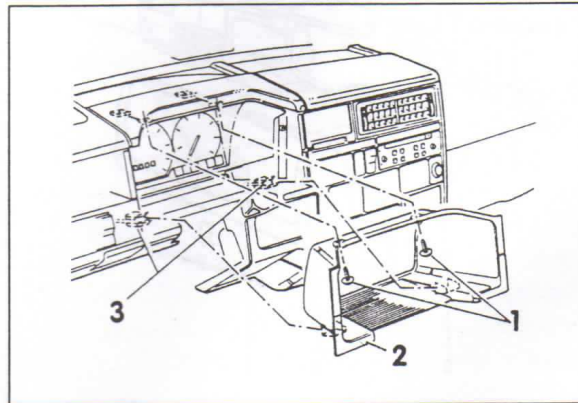


Fig. 21.12.

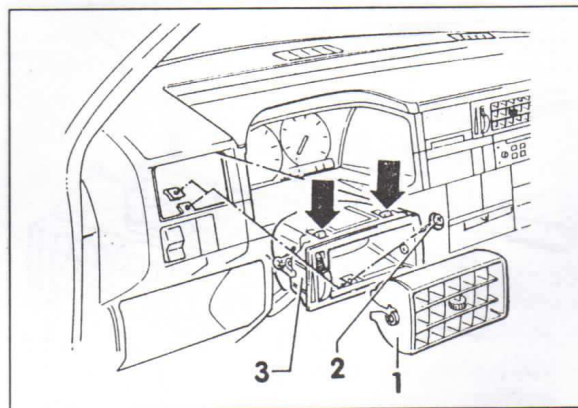


Fig. 21.13.

- Unscrew the swivel fitting (1) and unscrew the cross-headed screw (2). Press down the retaining lugs (points indicated by the arrows) and



## 21 Bodywork

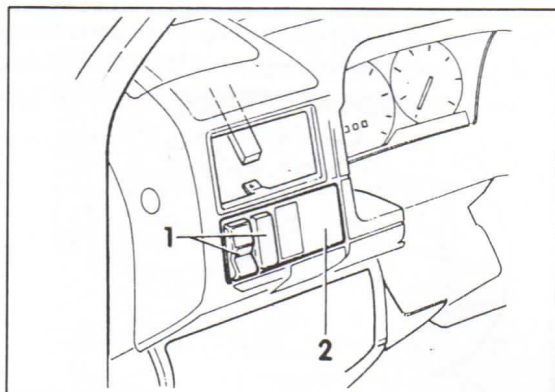


Fig. 21.14.

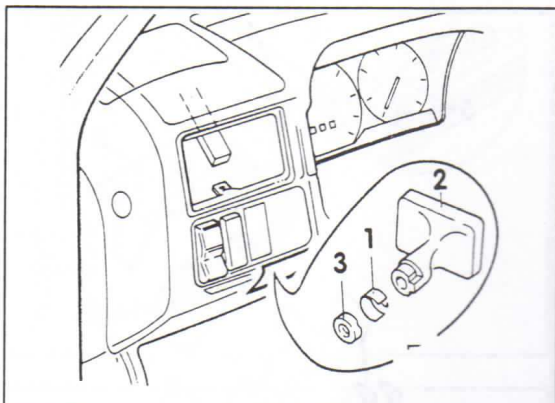


Fig. 21.15.

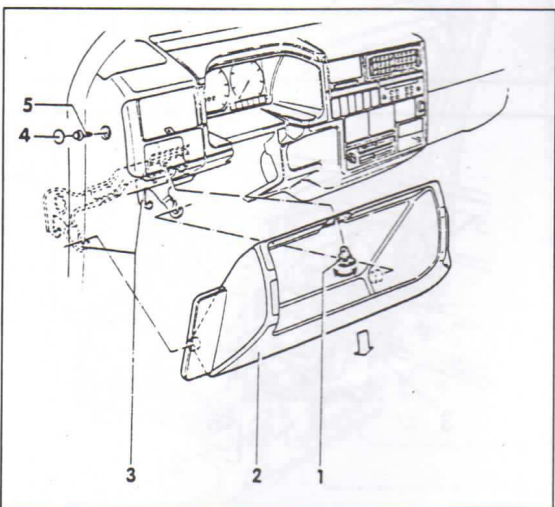


Fig. 21.16.

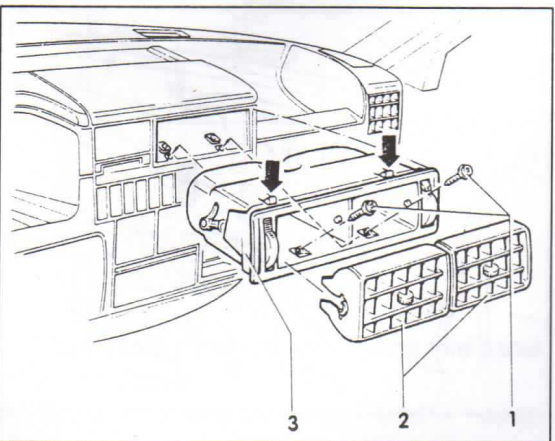


Fig. 21.17.

lever out the heater/fresh air outlet (3). The numbers refer to Fig. 21.13.

- Remove the L.H. switch console by referring to Fig. 21.14. Lever out the light switch (1), separate the connector plug and unclip the trim (2). Separate the connector plug for the L.H. speaker (if fitted).

- If a diesel engine is fitted, remove the handle for the cold start device. To do this, remove the clip (1) in Fig. 21.15, twist the handle (2) off the operating cable and unscrew the nut (3).

- Refer to Fig. 21.16 and remove the cover of the relay plate. To do this, turn the quick-latch by 90°, flip down the cover (2) and lift out the mounts (3). Lever off the closing cap (4) and unscrew the bolt (5).

- Remove the centre heater/fresh air outlet by referring to Fig. 21.17. Unclip the swivel fittings (2) and unscrew the screws (1). Press down the retaining lugs at the points shown by the arrows and lever out the heater/fresh air outlets (3).

- Remove the controls in the centre of the instrument panel by referring to Fig. 21.18. Pull

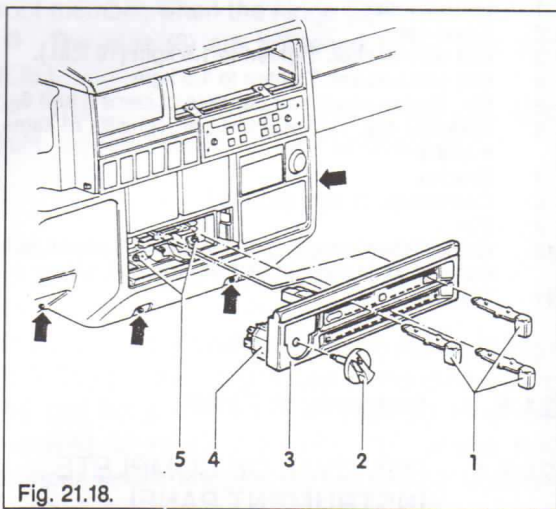


Fig. 21.18.

off the lever (1) and the knob (2). Unclip the trim plate (3) and separate the connector plug at the blower switch (4). Unscrew the cross-head screws (5). The radio must be removed if one is fitted. Separate the aerial and collectrical connectors. Unplug all switches in the centre section of the instrument panel, cigarette lighter, etc. Unscrew the securing screws shown by the arrows to free the instrument panel.

- The next item to be removed is the glove-box. Details are shown in Fig. 21.19 on the next page. First pull out the inside light (arrow), if a glovebox with lockable lid is fitted and unplug the electrical connector. Unscrew the seven cross-head screws and take out the glove box.

- Remove the R.H. heater/fresh air outlet (Fig. 21.20). Unclip the swivel fitting (1). Then proceed as described on the previous page (bottom right).

- Take out the instrument panel.



## 21 Bodywork

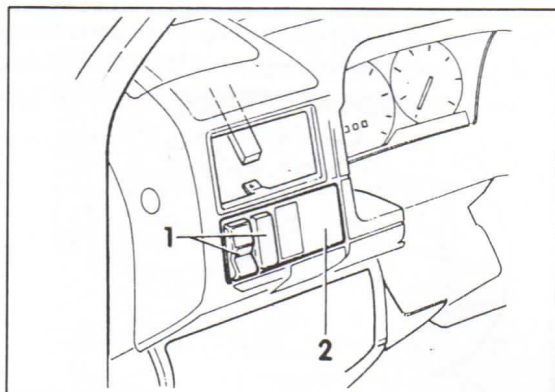


Fig. 21.14.

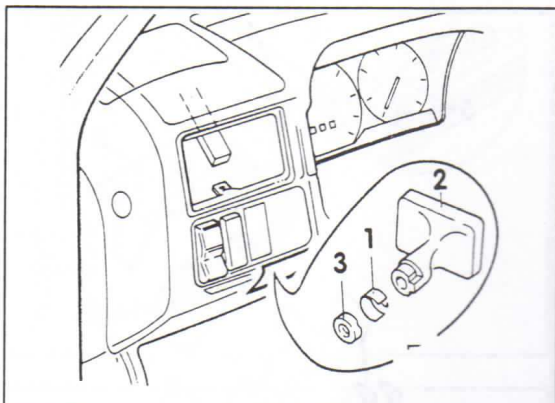


Fig. 21.15.

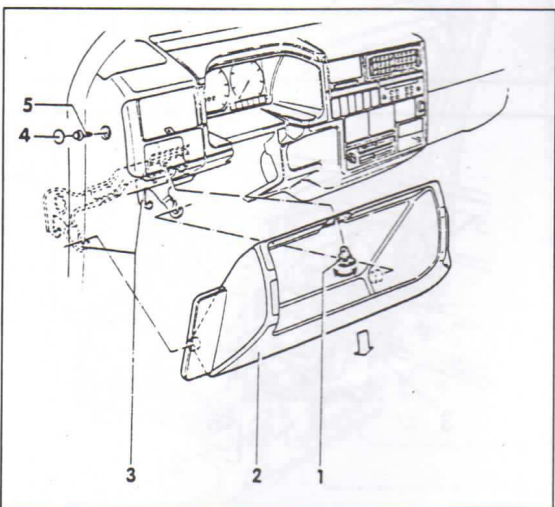


Fig. 21.16.

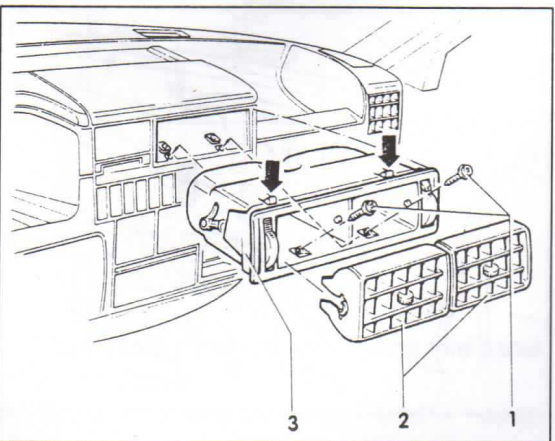


Fig. 21.17.

lever out the heater/fresh air outlet (3). The numbers refer to Fig. 21.13.

- Remove the L.H. switch console by referring to Fig. 21.14. Lever out the light switch (1), separate the connector plug and unclip the trim (2). Separate the connector plug for the L.H. speaker (if fitted).

- If a diesel engine is fitted, remove the handle for the cold start device. To do this, remove the clip (1) in Fig. 21.15, twist the handle (2) off the operating cable and unscrew the nut (3).

- Refer to Fig. 21.16 and remove the cover of the relay plate. To do this, turn the quick-latch by 90°, flip down the cover (2) and lift out the mounts (3). Lever off the closing cap (4) and unscrew the bolt (5).

- Remove the centre heater/fresh air outlet by referring to Fig. 21.17. Unclip the swivel fittings (2) and unscrew the screws (1). Press down the retaining lugs at the points shown by the arrows and lever out the heater/fresh air outlets (3).

- Remove the controls in the centre of the instrument panel by referring to Fig. 21.18. Pull

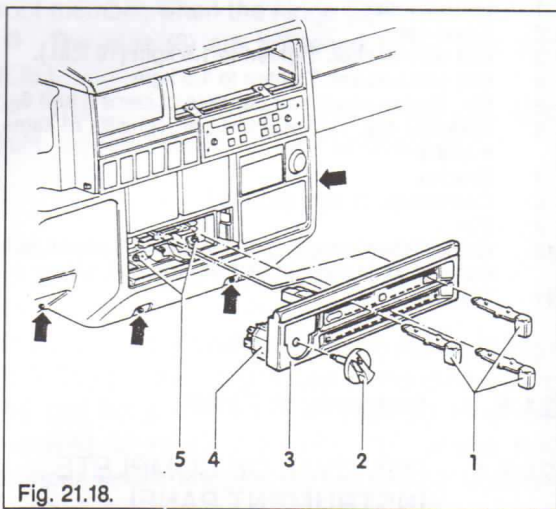


Fig. 21.18.

off the lever (1) and the knob (2). Unclip the trim plate (3) and separate the connector plug at the blower switch (4). Unscrew the cross-head screws (5). The radio must be removed if one is fitted. Separate the aerial and collectrical connectors. Unplug all switches in the centre section of the instrument panel, cigarette lighter, etc. Unscrew the securing screws shown by the arrows to free the instrument panel.

- The next item to be removed is the glove-box. Details are shown in Fig. 21.19 on the next page. First pull out the inside light (arrow), if a glovebox with lockable lid is fitted and unplug the electrical connector. Unscrew the seven cross-head screws and take out the glove box.

- Remove the R.H. heater/fresh air outlet (Fig. 21.20). Unclip the swivel fitting (1). Then proceed as described on the previous page (bottom right).

- Take out the instrument panel.



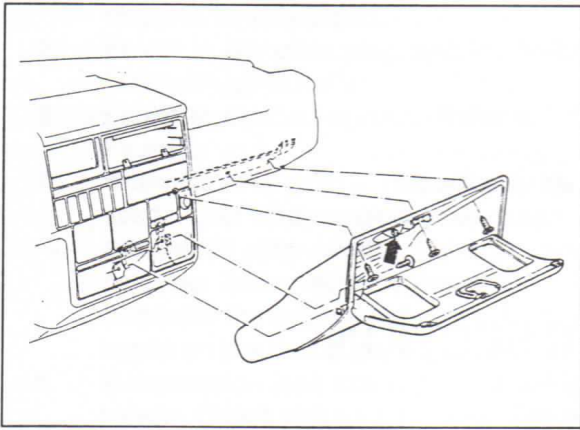


Fig. 21.19.

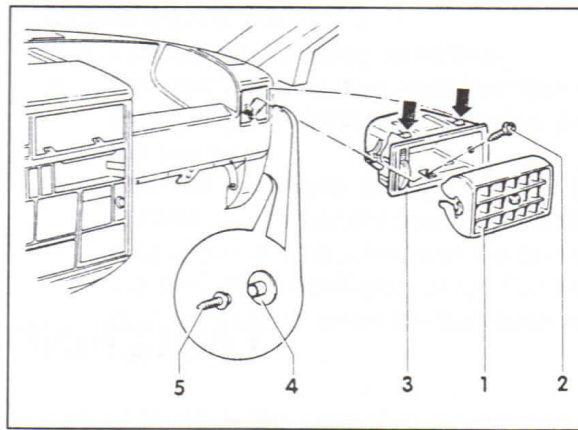


Fig. 21.20.



Transporter with Diesel Engines Pages - 216 to 217

Transporter with Diesel Engines Pages - 216 to 217

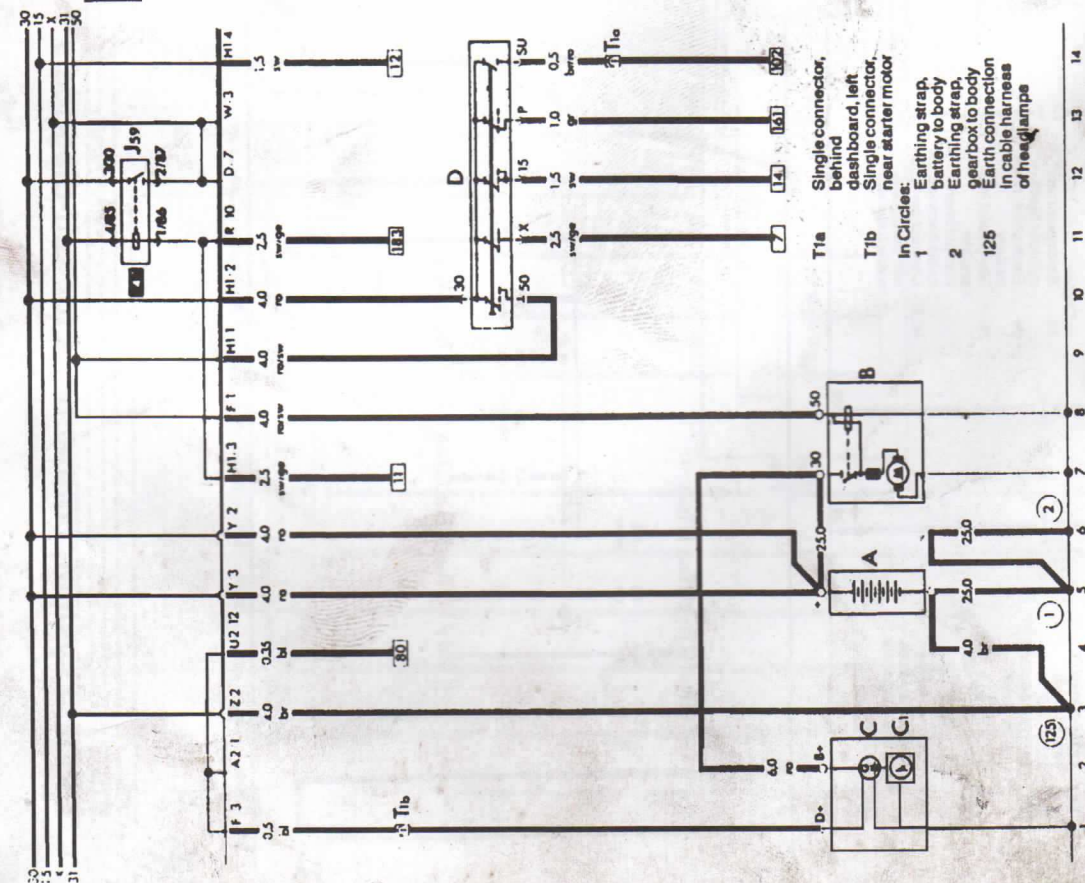
**Cable Colour Code**

|    |          |
|----|----------|
| ge | = yellow |
| ws | = white  |
| ro | = red    |
| li | = lilac  |
| bl | = blue   |
| gr | = grey   |
| gn | = green  |
| br | = brown  |
| sw | = black  |

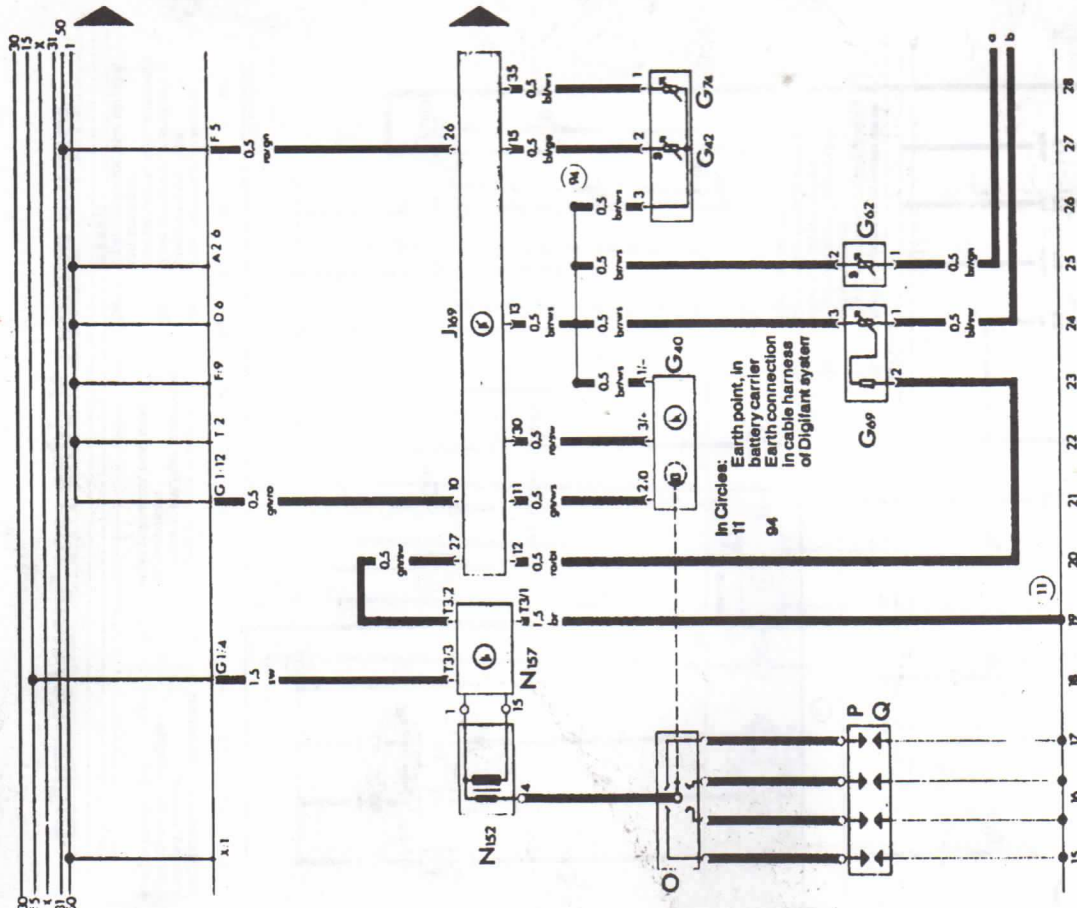
Earth connections are shown in circles.

**Connections**  
commencing with "T"  
indicate connectors.  
The number behind  
indicates the number of  
pins the connector has.



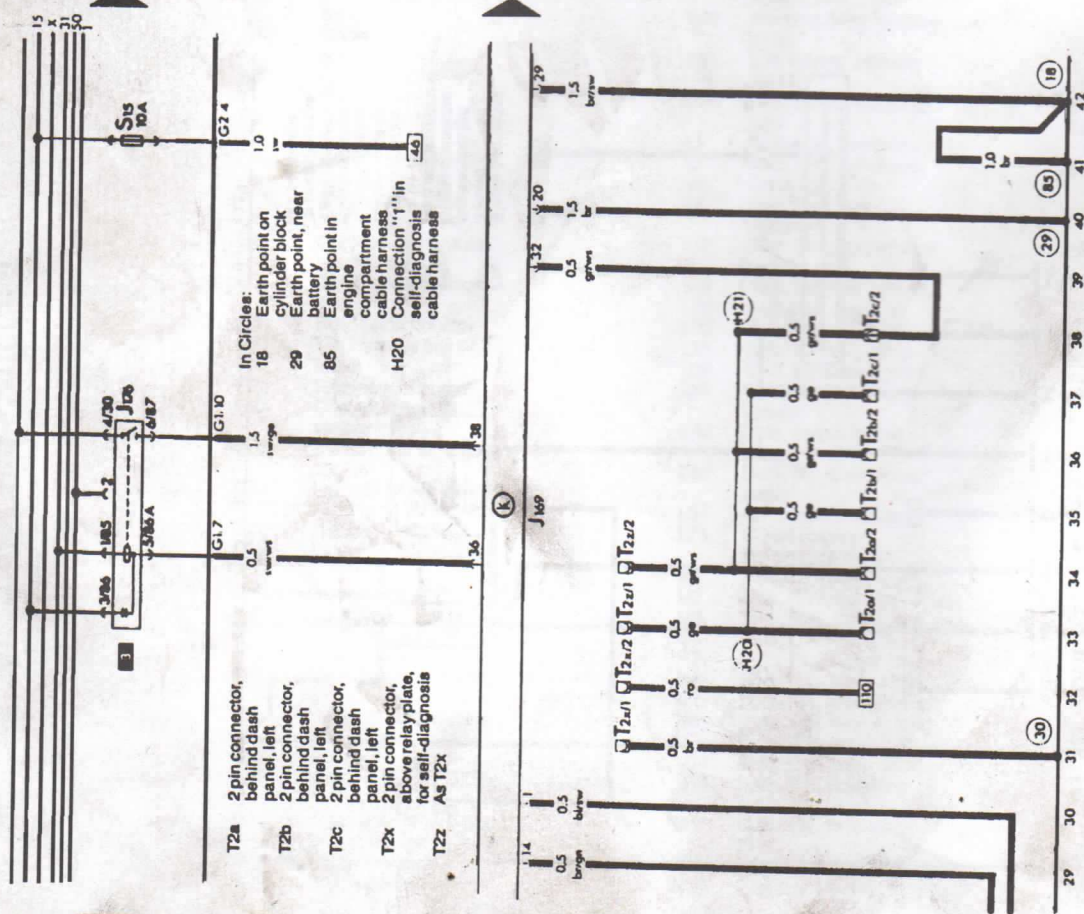


Alternator and starter motor

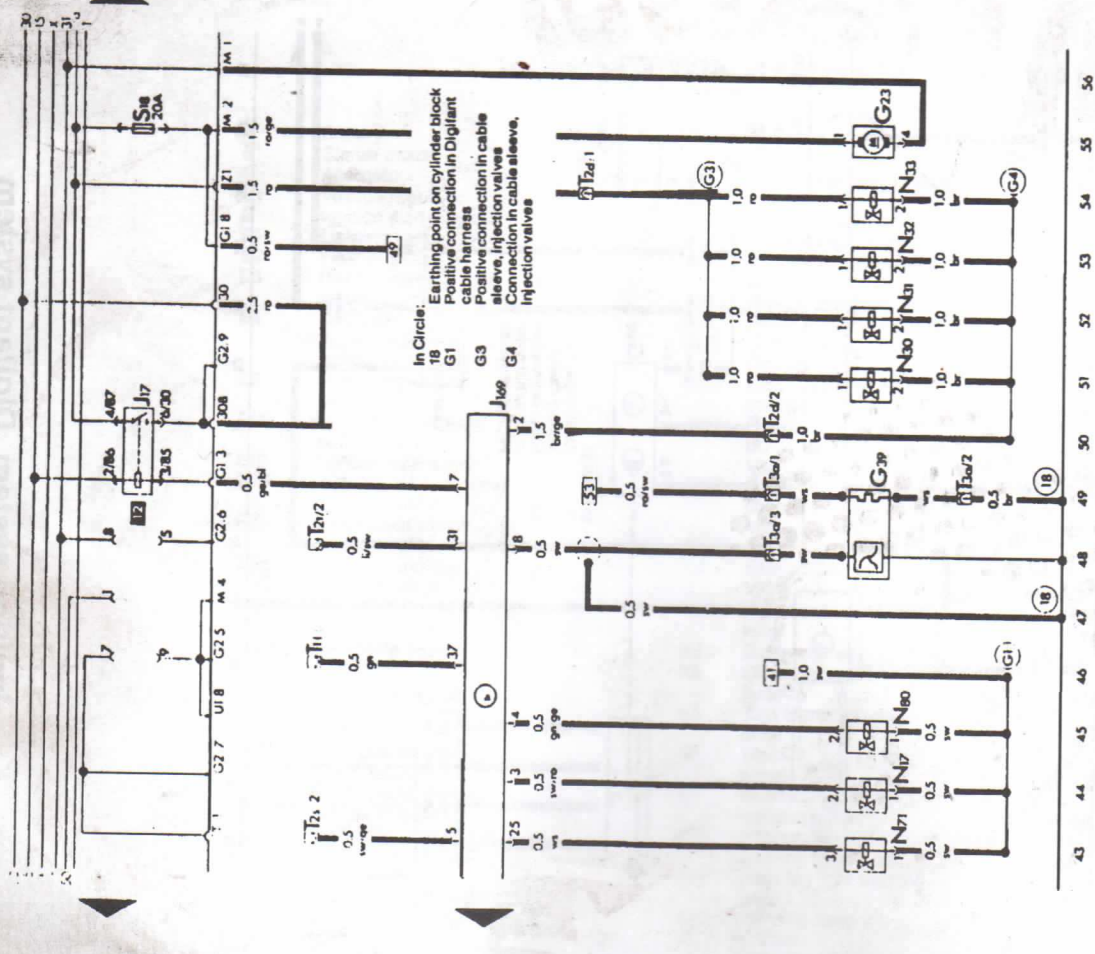


Ignition system, Digifant system





## Digifant system, connections for self-diagnosis

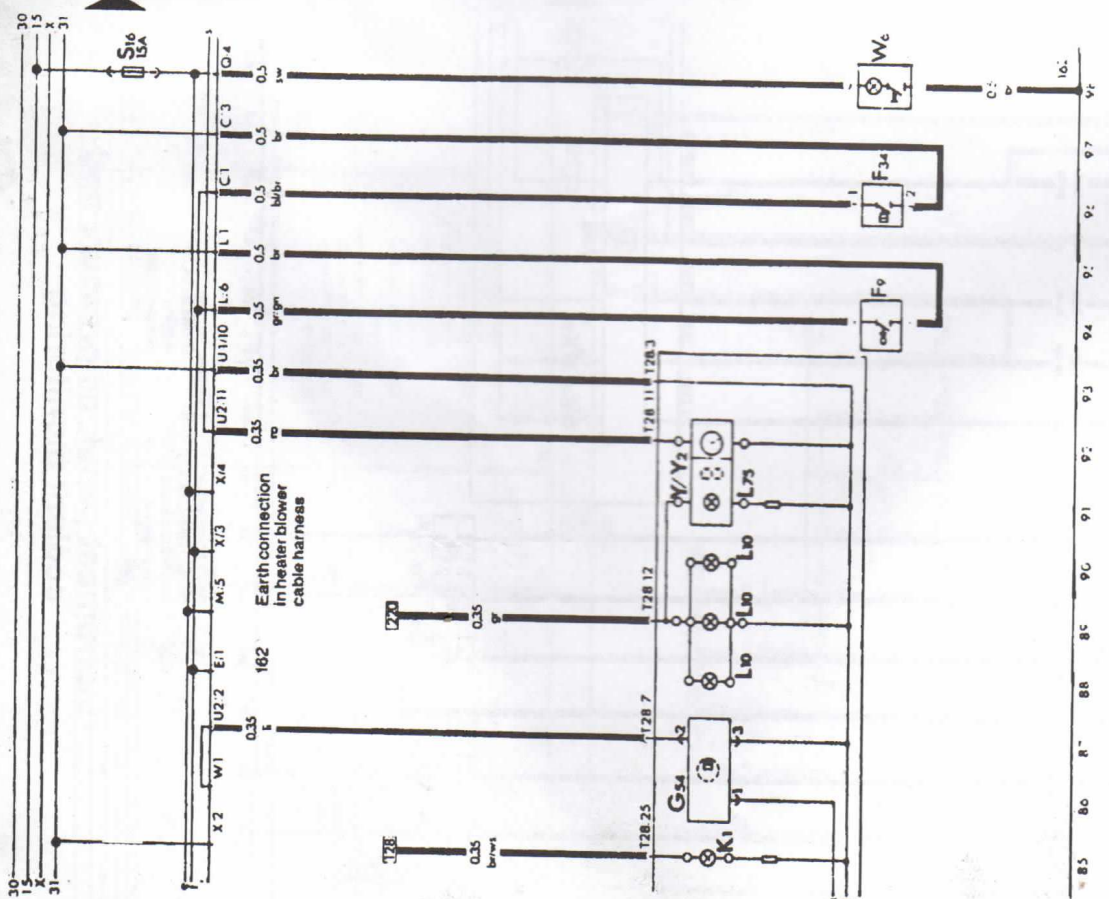


**Digifant system, fuel supply, Lambda control**

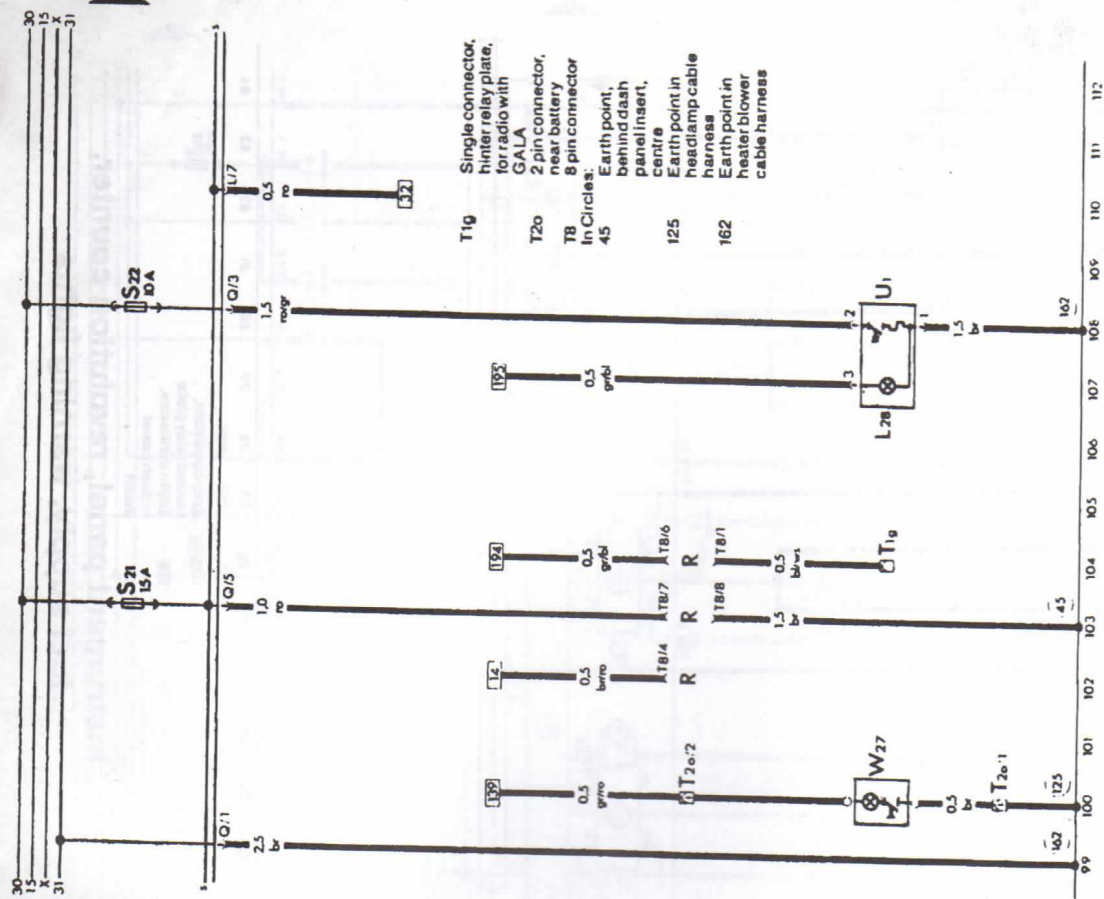






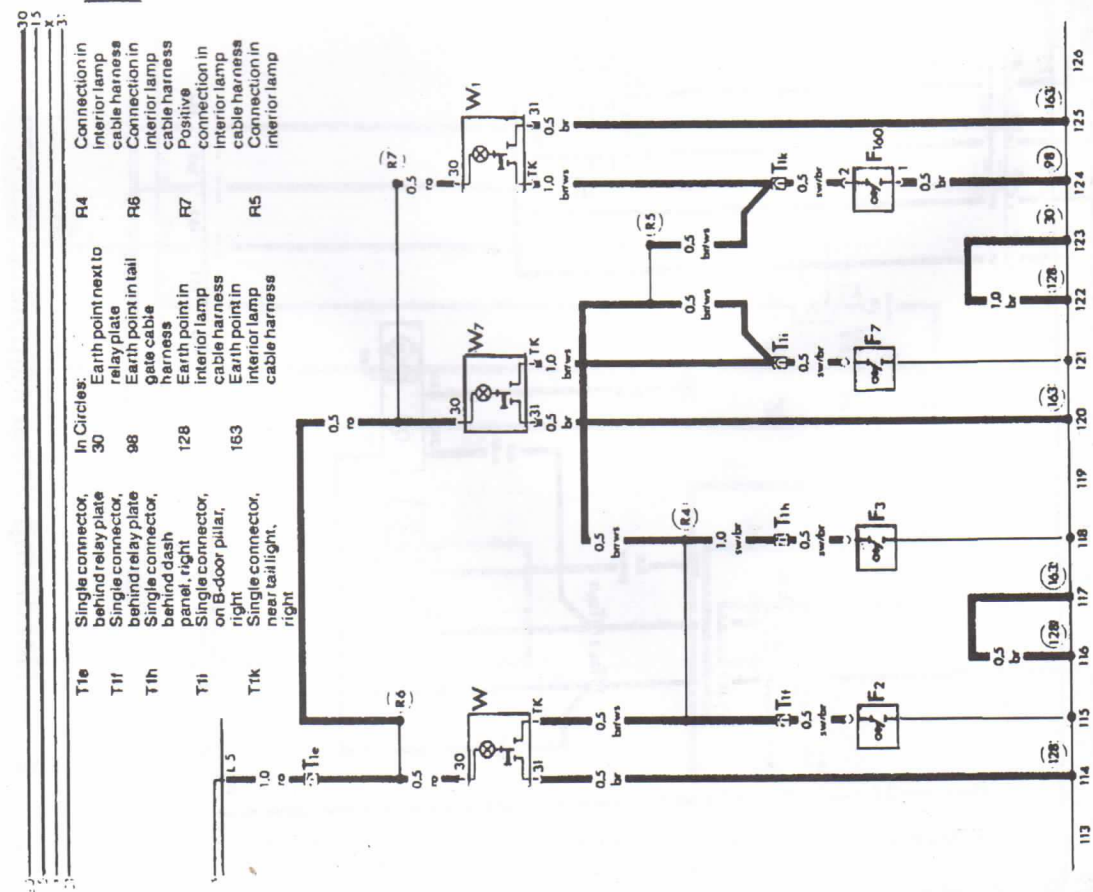


Instrument panel, speed sensor, time clock

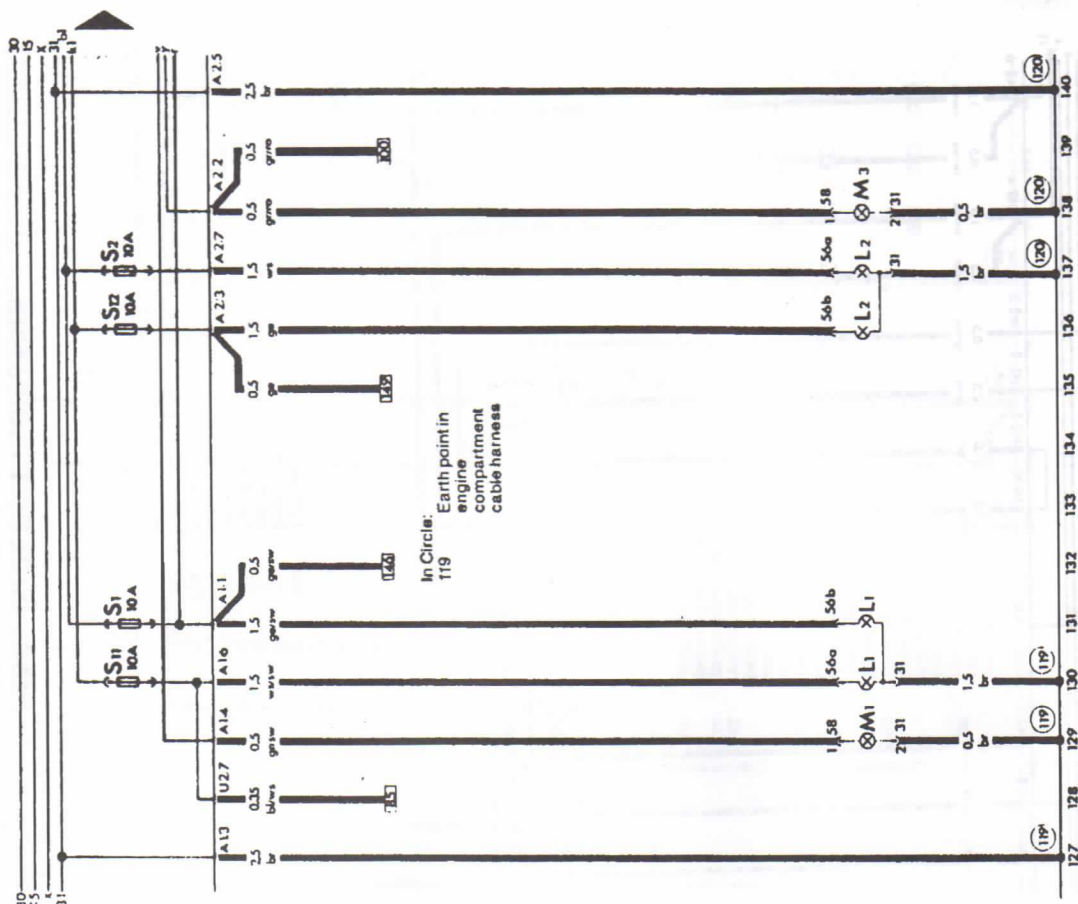


Radio, cigar lighter, engine compartment lamp



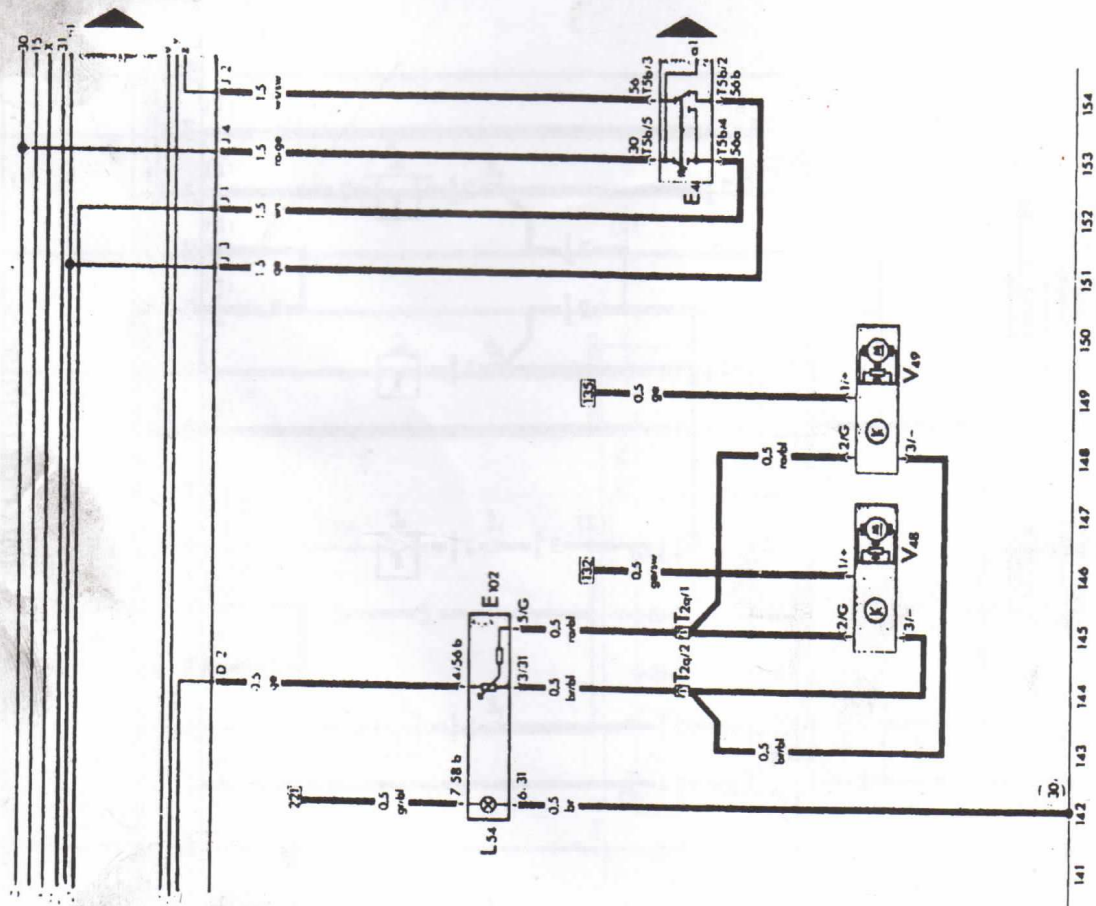


Interior lights



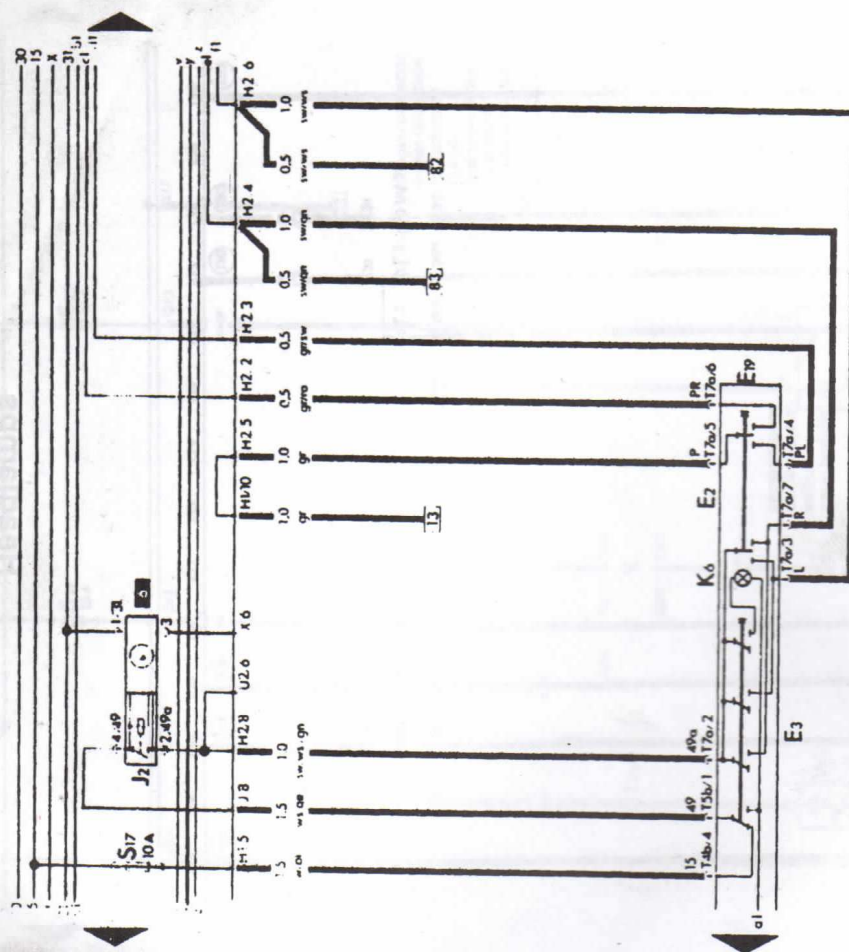
Headlamps





30 Earth point, next to relay plate

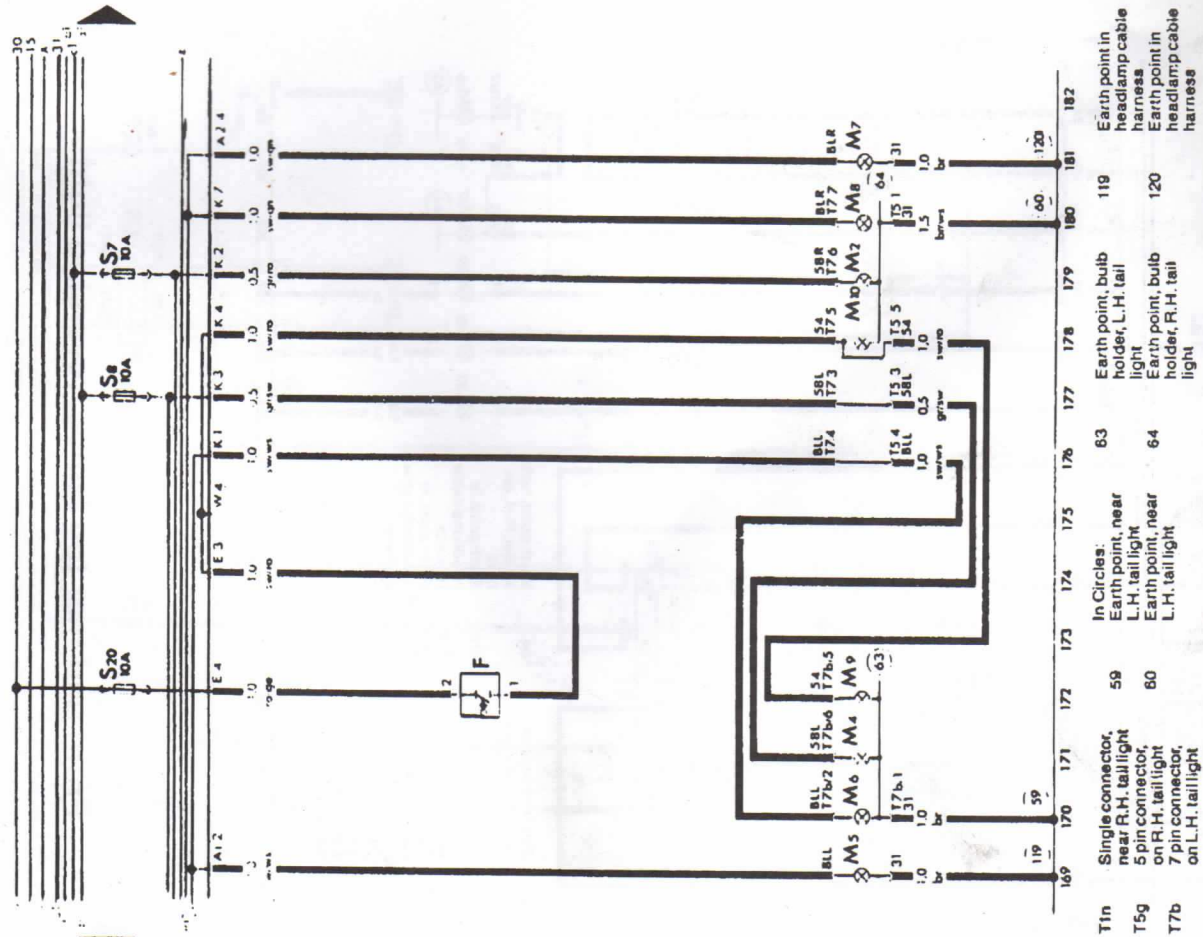
**Headlamp beam adjusters  
dipped beams, headlamp flasher**



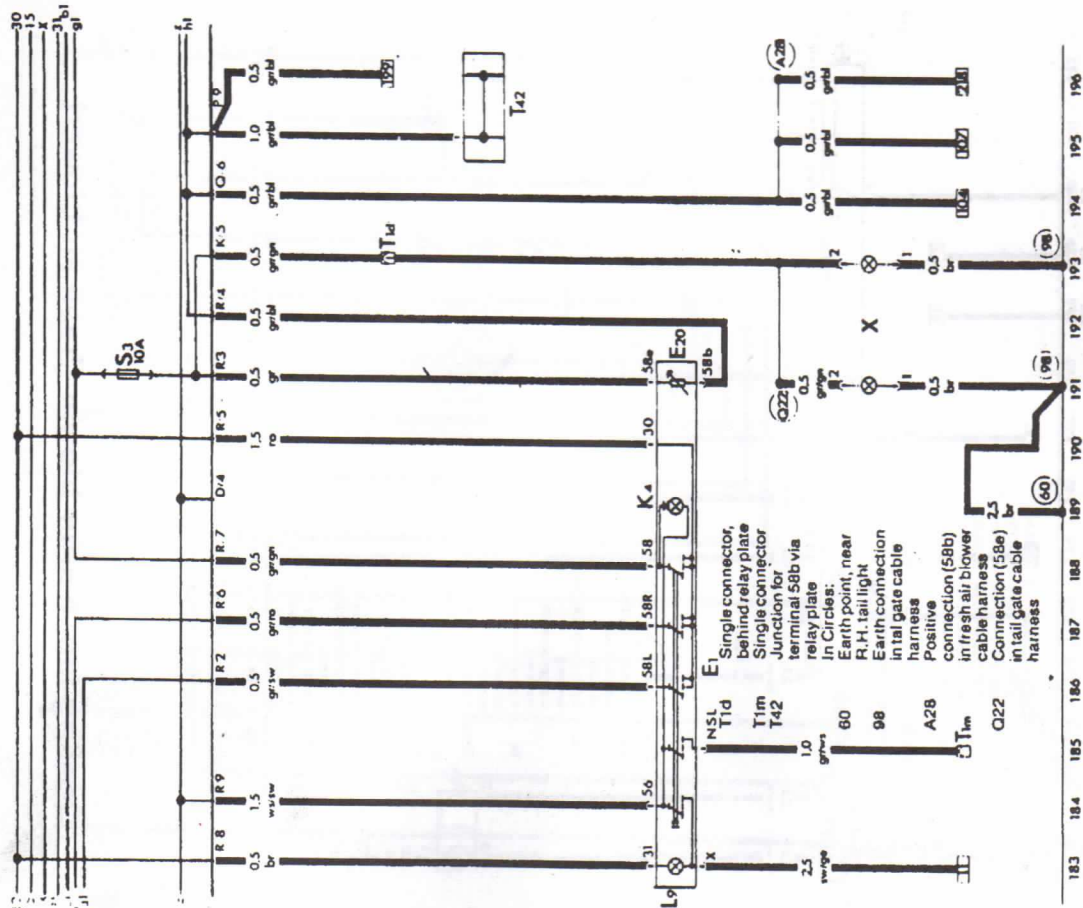
|     |                                                      |
|-----|------------------------------------------------------|
| T4b | 4 pin connector,<br>behind steering<br>column covers |
| T5b | 5 pin connector,<br>behind steering<br>column covers |
| T7a | 7 pin connector,<br>behind steering<br>column covers |

**Front direction indicators,  
hazard warning system, parking lights**





Rear direction indicators, brake and tail lights



Light switch, number plate lights (tail gate)

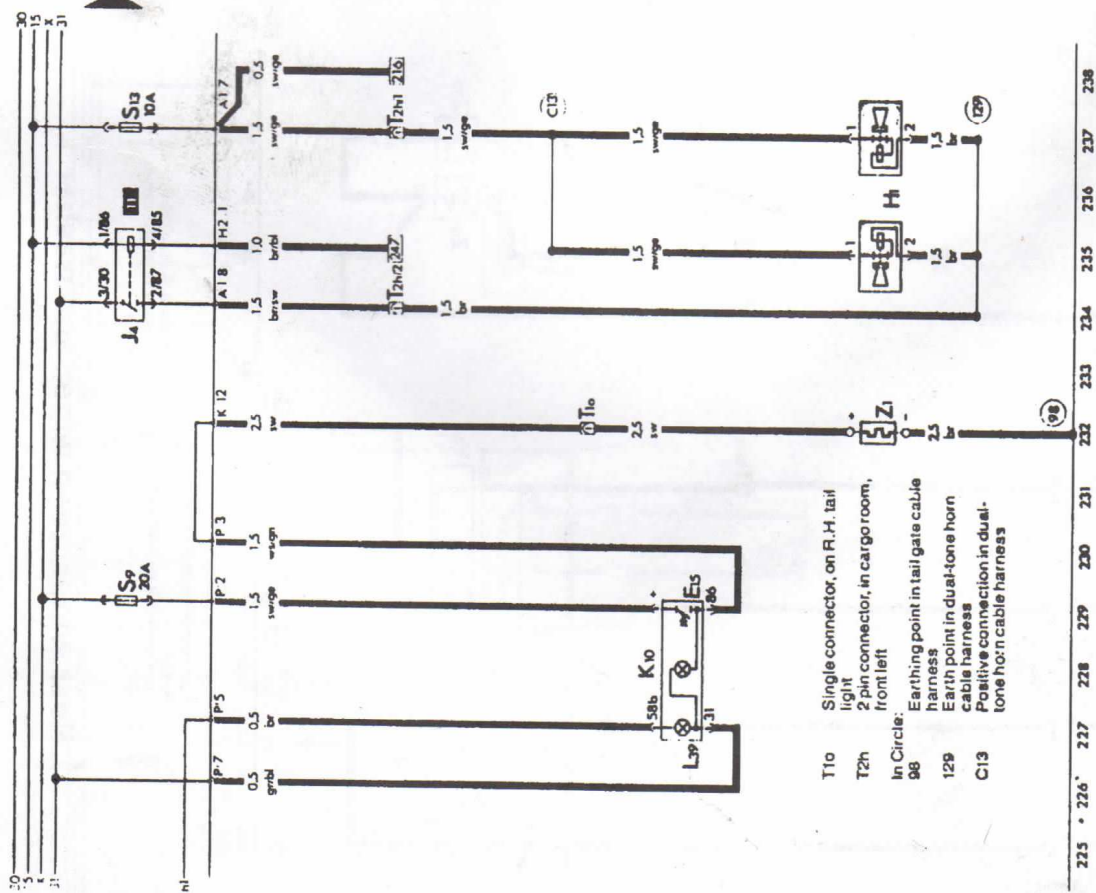


The diagram illustrates the electrical wiring for a vehicle, showing the connection between various components and a central power distribution block. The components and their connections are as follows:

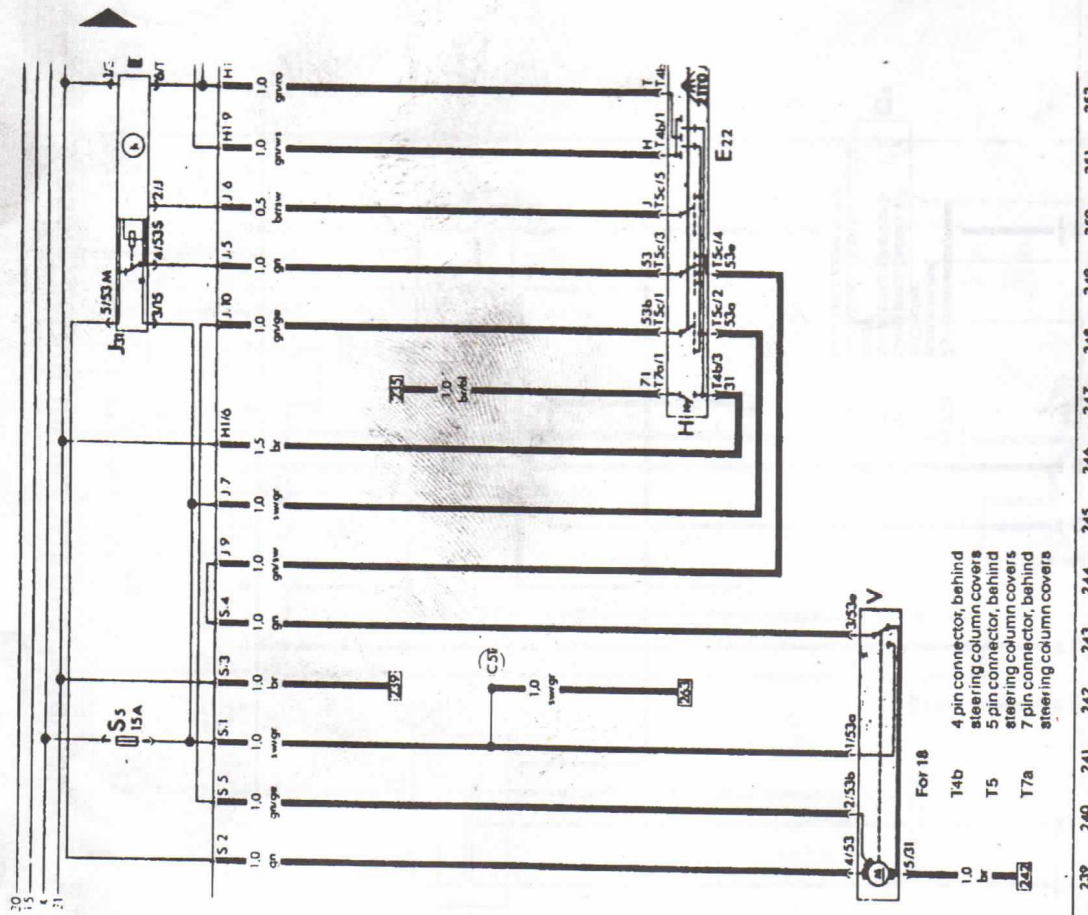
- Power Sources:**
  - Battery (E9):** Connected to the main power distribution block.
  - Fuses (S10, S19, S20):** Located at the top of the diagram, connected to the main power lines.
- Relays and Switches:**
  - Relay V1:** Connected to the main power line and the ground (N1).
  - Relay V2:** Connected to the main power line and the ground (N1).
  - Switch T2:** A 2-pin connector, on fresh air blower.
  - Switch T3b:** A 3-pin connector, in engine compartment, front left.
  - Switch T4:** A 4-pin connector, on switch for fresh air blower.
  - Switch T24a:** A 4-pin connector, on series resistor.
- Grounding and Connections:**
  - Ground (N1):** The common ground for all components.
  - Connections:** Various wires connect the components to the main power distribution block, including wires labeled T2, T3b, T4, T24a, and T24b.
- Legend:**
  - T2:** 2 pin connector, on fresh air blower
  - T3b:** 3 pin connector, in engine compartment, front left
  - T4:** 4 pin connector, on switch for fresh air blower
  - T24a:** 4 pin connector, on series resistor
  - In Circles:**
    - 45: Earth point, behind dash
    - 125: Earth point, centre panel insert
    - 162: Earth point, in headlamp cable harness

Cooling fan, heater blower (fresh air blower)





Heated rear screen, dual-tone horn



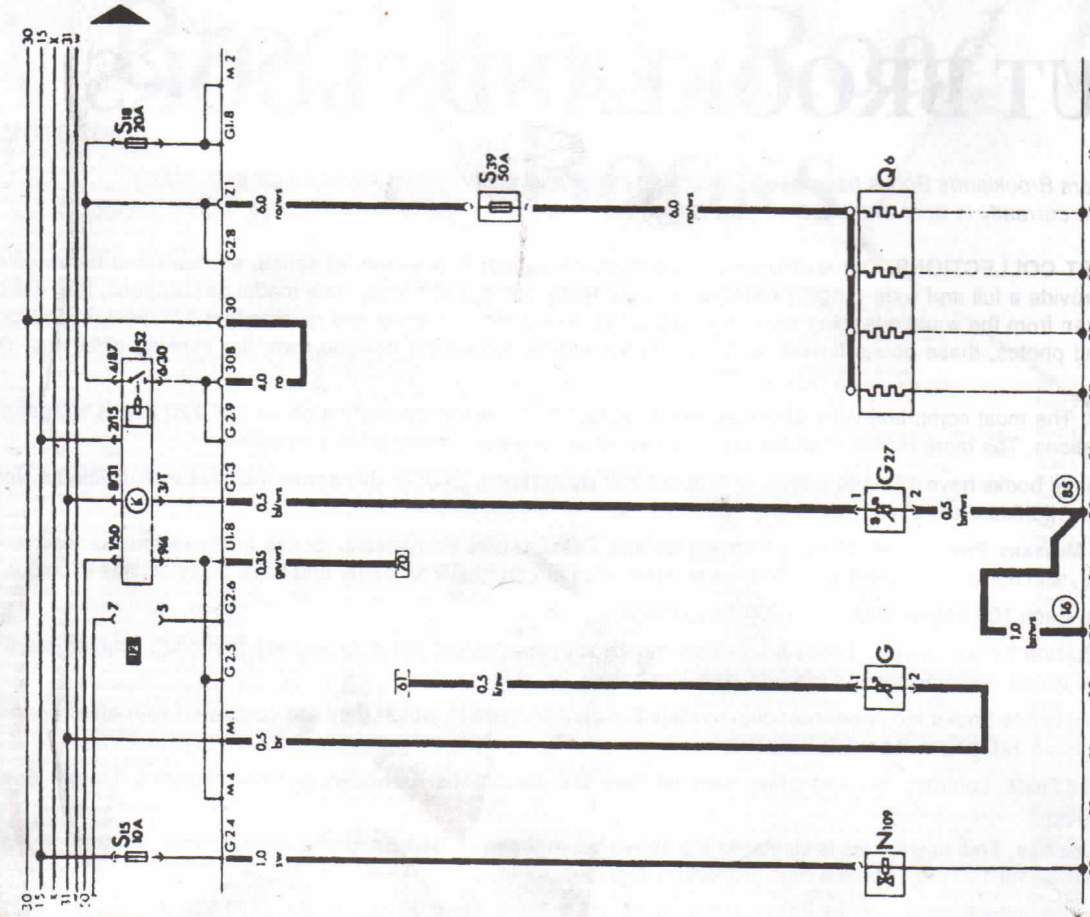
Front windscreen wipers and washers





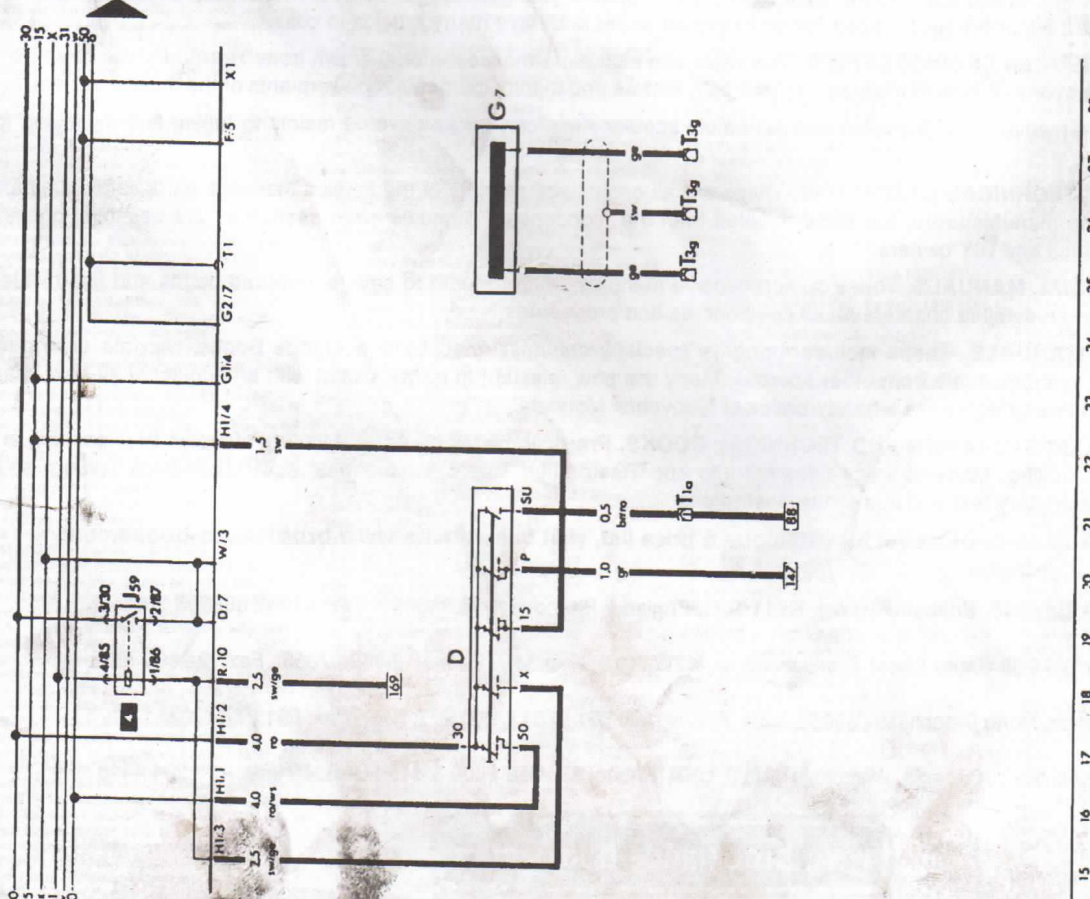
**Rear windscreen wiper and washer**





18 Earth point on cylinder head  
85 Earth point in engine compartment cable harness

# Ignition/starter motor switch (diesel)



T1.1 Single connector, behind dash panel, left  
T3.9 3 pin connector, in engine compartment, left

PORTFOLIO' SERIES  
Portfolio 1979-2002  
Roadster Port. 1996-02  
Portfolio 1993-2002  
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Portfolio 1992-2002  
Portfolio 1995-02  
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Portfolio 1984-03  
1994  
1997