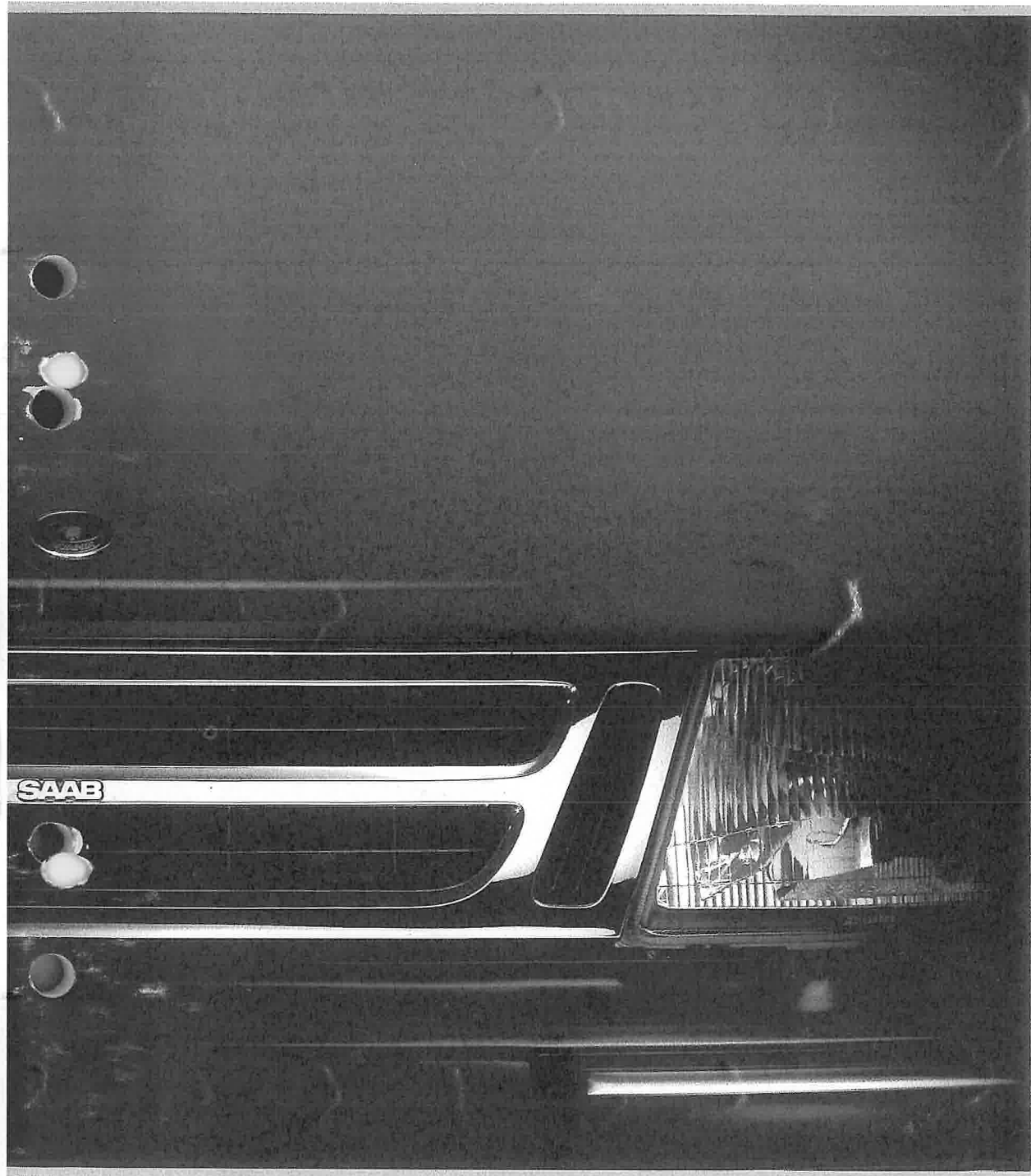


Saab 900

Service Manual



SAAB

6 Front assembly Steering device

M 1979-88-

(GB)



Units

The basic and derived units used throughout the Service Manual are in accordance with the SI system.

For users not familiar with the SI units, some non-Continental units are given in brackets after the respective SI unit.

The following symbols and abbreviations are used:

SI unit	Equivalent unit and symbol
mm	inch (in)
kg	pound (lb)
N	pound-force (lbf)
Nm	pound-force foot (lbf ft)
bar	pound-force per square inch (lbf/in ²) (Also abbreviated: psi)
l (litre)	US liquid quart (liq qt) (Also abbreviated: qts)
	US gallon (USgal)
°C	°F

Conversion factors

1 in = 25.4 mm	1 mm = 0.039 in
1 lbf = 4.45 N	1 N = 0.23 lbf
1 lbf ft = 1.36 Nm	1 Nm = 0.74 lbf ft
1 psi = 0.07 bar	1 bar = 14.5 lbf/in ²
1 liq qt = 0.95 l	1 l = 1.05 liq qt
1 US liq qt = 0.83 UKqt	1 USgal = 0.83 UKgal

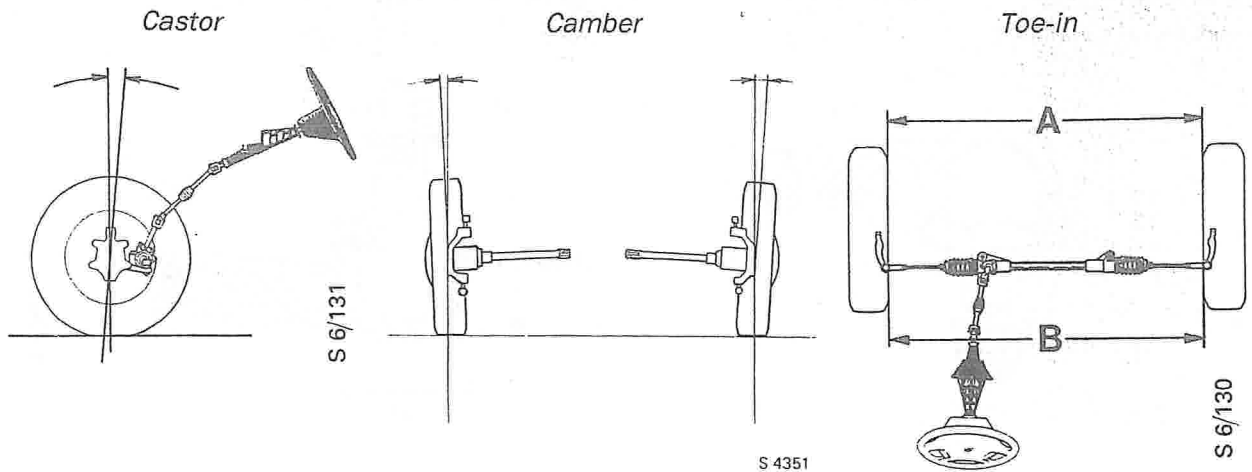
Market codes

The codes refer to market specifications

AT	Austria	FR	France
AU	Australia	GB	Great Britain
BE	Belgium	GR	Greece
CA	Canada	IS	Iceland
CH	Switzerland	IT	Italy
DE	Germany	JP	Japan
DK	Denmark	ME	Middle East
ES	Spain	NL	Netherlands
EU	Europe	NO	Norway
FE	Far East	SE	Sweden
FI	Finland	US	USA

Technical data

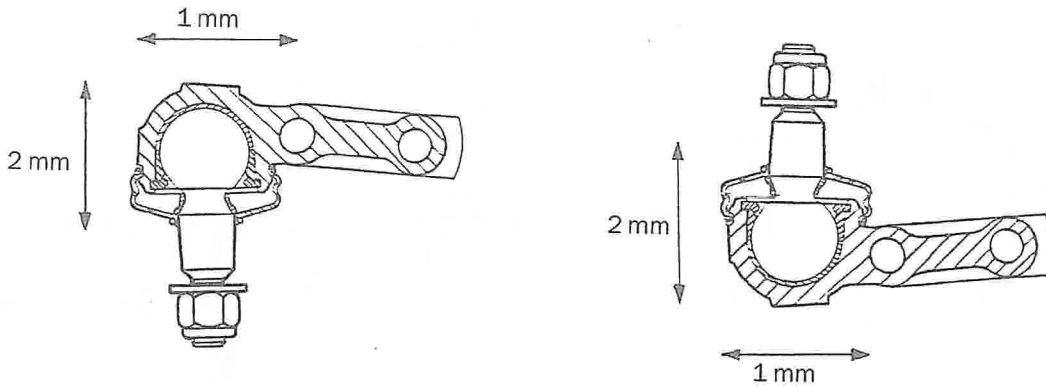
Front wheel alignment (unladen car)



Castor		
Manual steering	degrees (°)	1 ± 0.5
Power-assisted steering	degrees (°)	2 ± 0.5
Cars with sports chassis	degrees (°)	2 ± 0.25
Camber		
Manual steering	degrees (°)	0.5 ± 0.5
Power-assisted steering	degrees (°)	0.5 ± 0.5
Cars with sports chassis	degrees (°)	0.25 ± 0.25
Toe-in, measured between rims(B-A)		
Manual steering	mm (in)	2 ± 1 (0.08 ± 0.04)
Power-assisted steering	mm (in)	2 ± 1 (0.08 ± 0.04)
Cars with sports chassis	mm (in)	1.5 ± 0.5 (0.06 ± 0.02)
Swivel pin (king pin) inclination	degrees (°)	11.5 ± 1
Steering angle		
Outer wheel	degrees (°)	20
Inner wheel	degrees (°)	20.75 ± 0.50

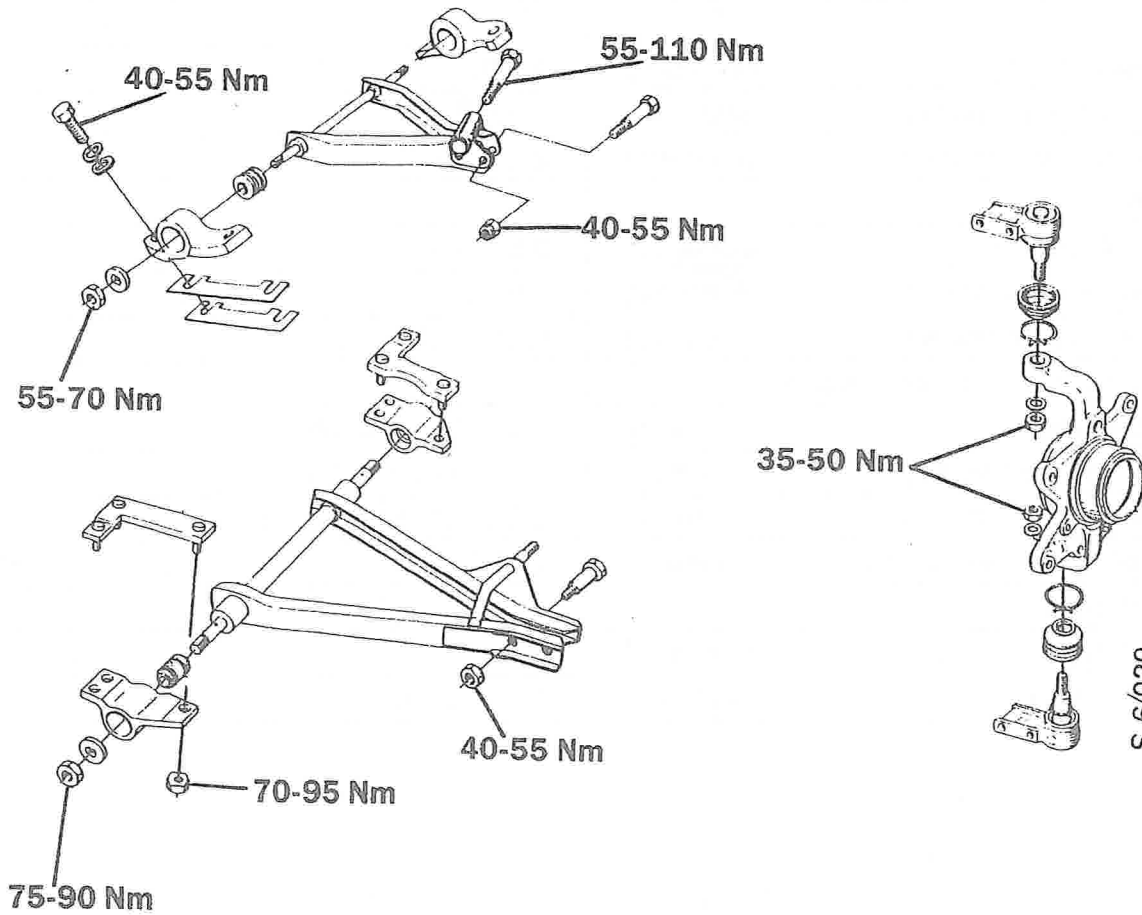
Steering swivel member

Ball-joint wear limits:		
Axial play	mm(in)	2 (0.08)
Radial play	mm(in)	1 (0.04)
Ball-joint lubricant		Molycote Longterm 2E



S 6/281

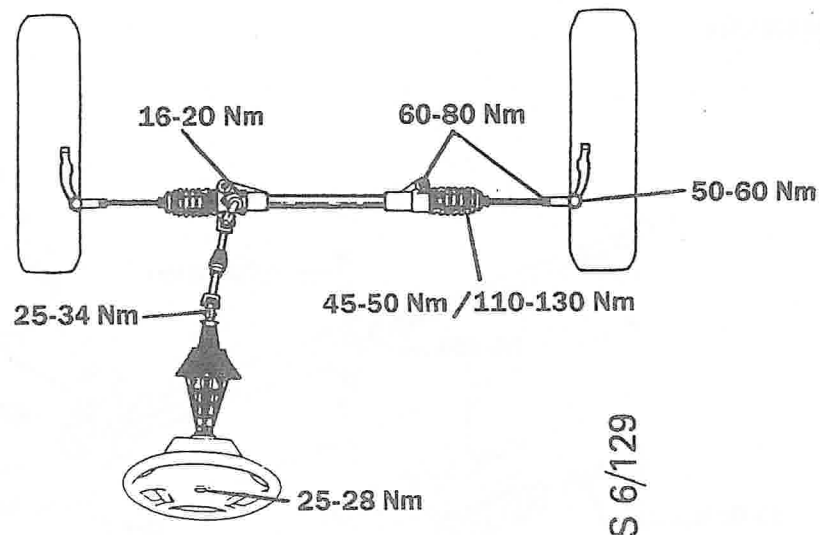
Tightening torques: wishbones and steering swivel members



S 6/029

Manual steering system

Steering wheel turns, lock-to-lock		4.2 (EMS: 3.5)
Damping yoke: clearance to cover plate	mm (in)	0.05 - 0.15 (0.002 - 0.006)
Shim thicknesses	mm (in)	0.13, 0.19 and 0.25 (0.0051, 0.0075 and 0.0098)
Lubricant for rack, pinion and bearings		BP Energrease FGL, Part No. 30 08 703
Tightening torque: rack-and-pinion gear, car raised	Nm (lbf ft)	0.8 - 1.7 (0.59 - 1.25)
Tightening torques:		
Yoke cover plate bolts	Nm (lbf ft)	16 - 20 (12 - 15)
Fixing bolts	Nm (lbf ft)	60 - 80 (44 - 59)
Inner ball joint, adjustable	Nm (lbf ft)	45 - 50 (33 - 37)
nonadjustable	Nm (lbf ft)	110 - 130 (81 - 96)
Track-rod end locknut	Nm (lbf ft)	60 - 80 (44 - 59)
to track arm	Nm (lbf ft)	50 - 60 (37 - 44)

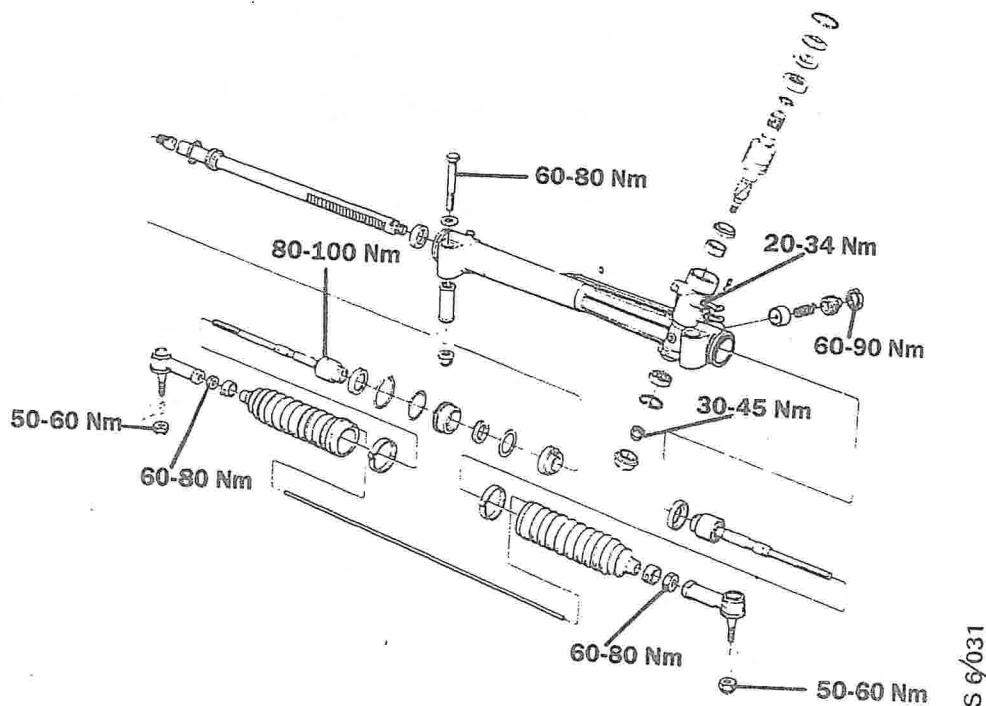
Tightening torques

Steering column assembly

Steering column shaft: length (must not be adjusted)	mm (in)	418 ± 1 (16.46 ± 0.04)
Tightening torques:		
Pinch-bolt in UJ	Nm (lbf ft)	25 - 34 (18.5 - 25.1)
Steering wheel centre-nut	Nm (lbf ft)	25 - 28 (18.5 - 20.7)

Power-assisted steering system

Steering wheel turns, lock-to-lock		3.6
Damping yoke		Screw the yoke fully home and then back off through 40° - 60°. Ensure that the rack does not bind at any point.
Servo fluid	cl (liq qt)	Texaco 4634 Power Steering Fluid 75 (0.8)
Lubricant for damper yoke, pinion and rack		Lithium grease - Shell EP B2 Code 71303, Shell Retinax A or equivalent
Rack-and-pinion gear tightening torque, car raised	Nm (lbf ft)	0.8 - 2.5 (0.59 - 1.85)
Tightening torques:		
Fixing bolts	Nm (lbf ft)	60 - 80 (44 - 59)
Hydraulic hose fittings	Nm (lbf ft)	20 - 34 (14.8 - 25.2)
Pinion locknut	Nm (lbf ft)	30 - 45 (22 - 33)
Damper yoke locknut	Nm (lbf ft)	60 - 90 (44.4 - 66.6)
Inner ball joint	Nm (lbf ft)	80 - 100 (59 - 74)
Track-rod end locknut	Nm (lbf ft)	60 - 80 (44 - 59)
to track arm	Nm (lbf ft)	50 - 60 (37 - 44)

Tightening torques

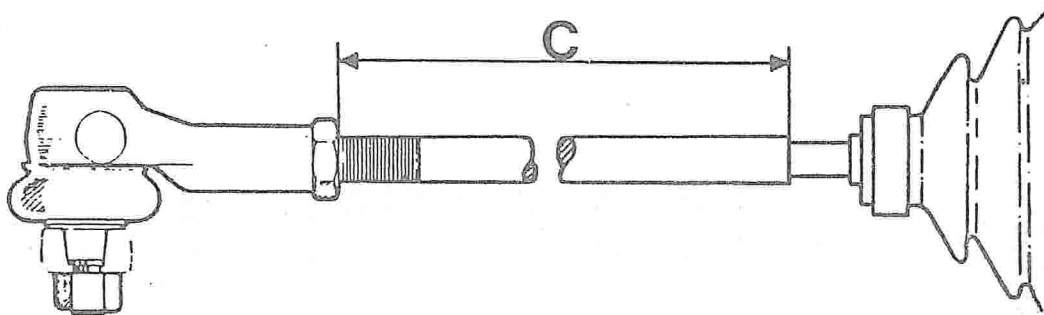


Hydraulic pump belt tension

Minimum	N (lbf)	220 (49.5)
After adjustment	N (lbf)	290 - 330 (65.3 - 74.3)
New belt	N (lbf)	400 - 490 (90 - 110)

Ball joints

Wear check: nonadjustable inner ball joint (All cars with power-assisted steering and M81 cars onwards with manual steering)	Ball joint must move freely to limit of travel in all directions without binding. With the rack horizontal, the track-rod complete with ball joint should remain in any position and not be able to fall under its own weight. If the track rod falls under its own weight, there is excessive play in the ball joint and the track rod assembly should be replaced.
Wear check: adjustable inner ball joint (cars with manual steering, M80 and earlier)	With the track-rod end removed, the rack preload must not exceed 32 N (7.2 lbf). If the specified value cannot be obtained after adjustment, the rack complete with ball caps must be replaced.
Track-rod ends	Nonadjustable - must be replaced before maximum permissible play present.
Maximum play in inner ball joint:	
Axial play	mm (in) 2 (0.08)
Radial play	mm (in) 1 (0.04)
Maximum play in track-rod ends:	
Axial play	mm (in) 2 (0.08)
Radial play	mm (in) 1 (0.04)
Inner ball joint lubrication	Permanently lubricated
Track-rod end lubrication	Molycote Longterm 2E
Maximum value of "C" after adjustment of toe-in:	
Manual system	mm (in) 100 (3.94)
Power-assisted system	mm (in) 125 (4.92)
Maximum difference in value of "C" between LH and RH trackrods	mm (in) 2 (0.079)



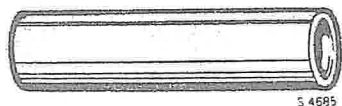
S6/166

C = 100 mm (3.94 in) maximum - manual steering
 C = 125 mm (4.92 in) maximum - power-assisted steering

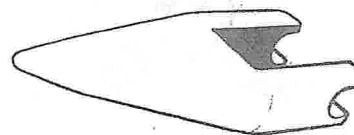
Faint, illegible text or markings in the top right corner, possibly bleed-through from the reverse side of the page.



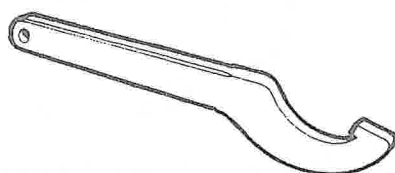
Special tools



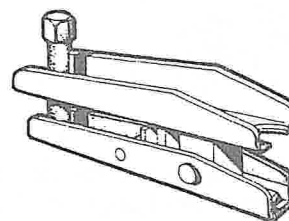
7841067 Sleeve for fitting control valve and end cap over pinion locknut (special tool for section 4)



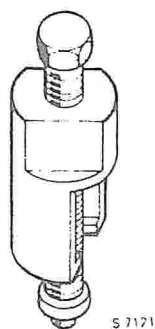
8995813 Tool for fitting gaiter on steering-column shaft



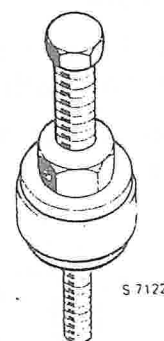
8390197 "C" spanner for removal/fitting of inner ball joint (manual steering)



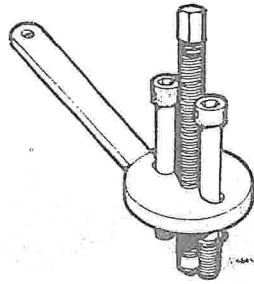
8995409 Ball-joint separator for inner ball joints and track-rod ends



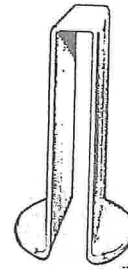
8996423 Puller for servo pump pulley



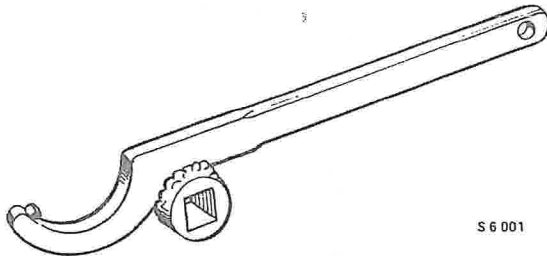
8996415 Tool for fitting servo pump pulley



8996 258 Steering-wheel puller

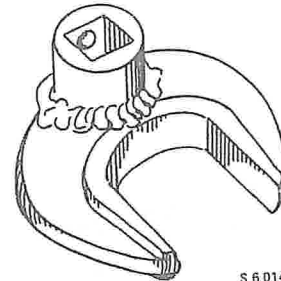


8996 399 Tool for removing inner hydraulic seal from rack-and-pinion gear (power-assisted steering)



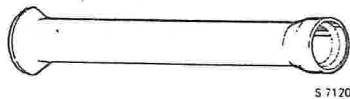
S 6 001

8996 472 "C" spanner for removal/fitting of inner ball joint (manual steering)



S 6 014

8996 480 Tool for removal/refitting inner ball joint on rack-and-pinion gear (power-assisted steering)

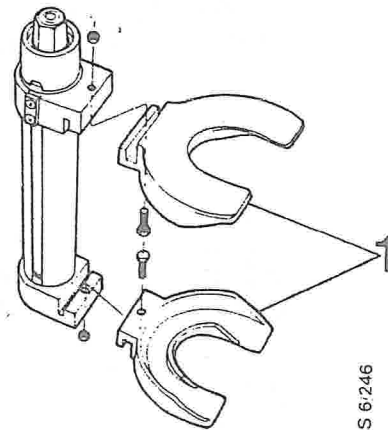


S 7 120

8996 407 Press sleeve

Fitting of sealing ring between control valve and pinion

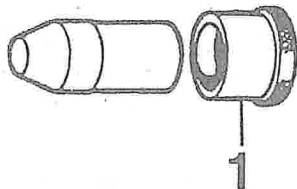
Pressing of seal retainer into servo cylinder



S 6 246

88 18 791 Spring compressor

88 18 809 Jaws (1)



1

8995 938 Seal-fitting tool

8995 946 Seal protector (1)

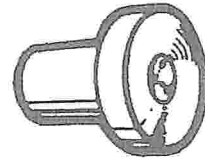


S 6 263

88 19 013 Tracking gauge



83 90 148 Removal sleeve for control valve
(special tool for section 4)

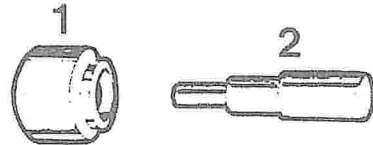


78 41 331 Tool for fitting rubber bush in upper wishbone (1)

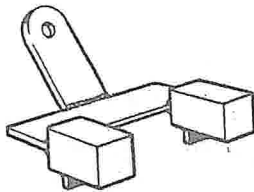
78 41 349 Tool for fitting rubber bush in lower wishbone (2)



87 90 644 Dolly for removal of control valve
(special tool for section 4)



83 91 849 Dolly for press-fitting of steering rack
(special tool for section 2)



83 93 209 Insert

S/6 463

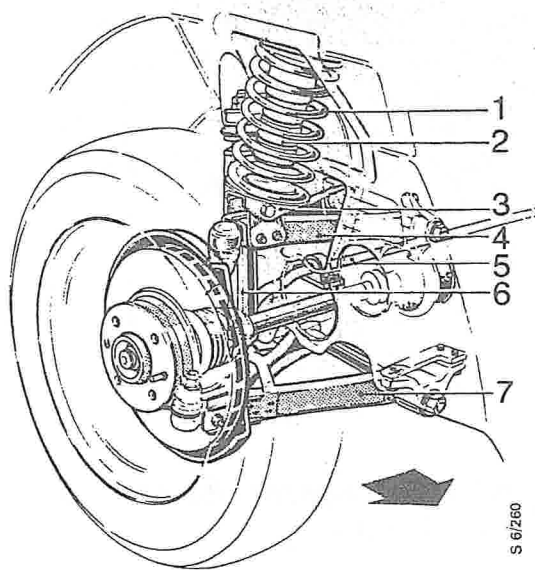


Technical description

Front-wheel suspension	600-1	Track-rod ends	600- 4
Steering swivel member	600-1	Power-assisted steering system	600- 5
Wishbones	600-3	Servo pump	600- 8
Steering column assembly	600-3	Wheel geometry	600-11
Manual steering system	600-4		

Front-wheel suspension

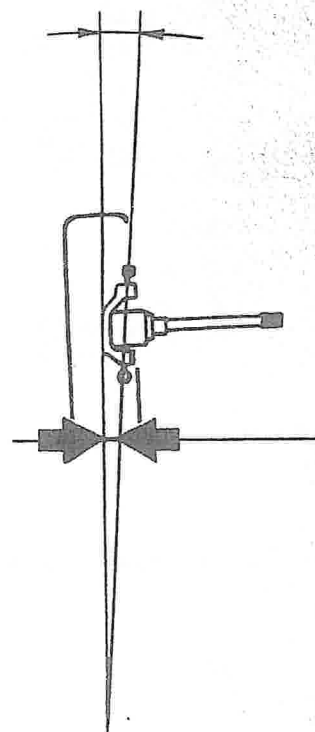
The car has independent front suspension and the hubs and outboard drive shafts are mounted in bearings in the steering swivel member.



Independent front suspension

- 1 Coil spring
- 2 Rubber bump stop
- 3 Bottom spring seat
- 5 Anti-roll bar
- 6 Damper
- 7 Lower wishbone

When the steering wheel is turned, the steering swivel member, hub and wheel swivel around the swivel axis - an imaginary line running through the centres of the top and bottom ball joints. The swivel-axis (swivel-pin) inclination is positive, i.e. the imaginary swivel-axis line intercepts the centre line of the wheel below the ground (positive offset or scrub radius).



*Positive swivel-axis inclination
(Positive offset or scrub radius)*

Steering swivel member

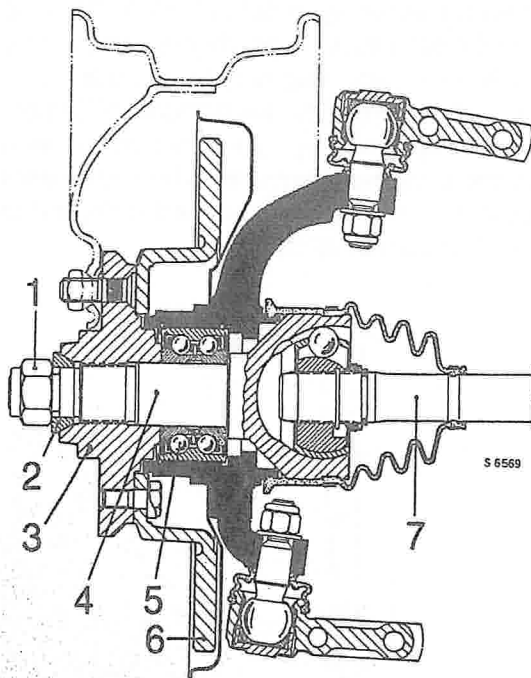
The steering swivel member, which carries the wheel bearings, comprises a bearing housing with two inward-curving arms. The bearing is a double-row, angular contact bearing.

The outboard and inboard drive shafts are coupled through the outboard universal joint (CV joint). A rubber gaiter is fitted over the joint to prevent the ingress of dirt or moisture.

M80 and earlier:

The outboard drive shaft is press-fitted in the bearing and splined and press-fitted in the hub. The bearing is press-fitted in the steering swivel member and retained on the outboard side by means of a circlip. The brake disc, which is of the solid type, is mounted on the inboard side of the hub. The backplate is bolted to the steering swivel member.

Two bolts secure the track arm to the steering swivel member.

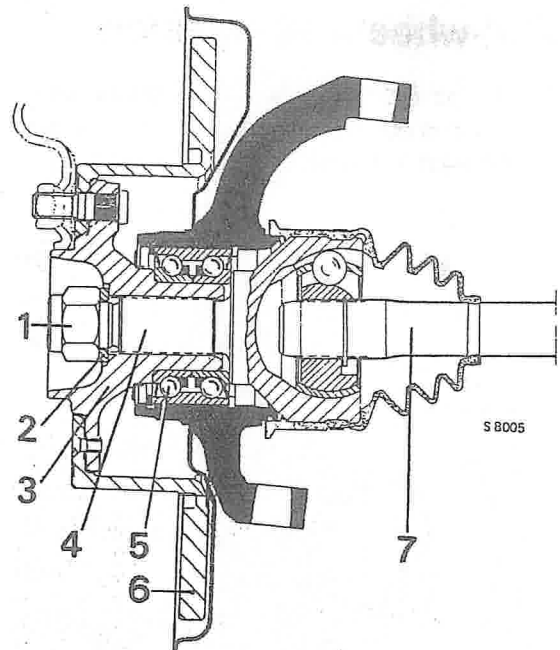


Steering swivel member, M80 and earlier

- 1 Hub centre-nut
- 2 Washer
- 3 Hub
- 4 Outboard drive shaft and CV-joint assembly
- 5 Bearing with seals
- 6 Brake disc
- 7 Inboard drive shaft

M81-87 inclusive:

The bearing is press-fitted in the steering swivel member and secured both inboard and outboard by means of circlips. The outboard drive shaft is splined in the hub which, in turn, is press-fitted in the bearing. The brake disc fitted to the outboard side of the hub may be either solid or ventilated. The track arm is an integral part of the steering swivel member.

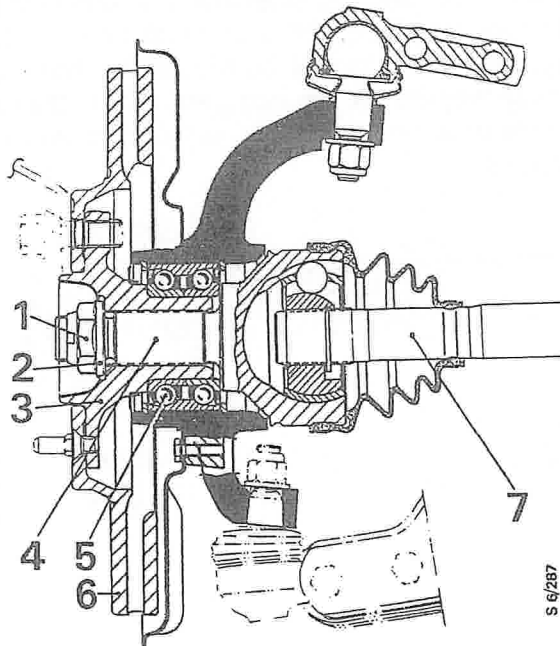


Steering swivel member, M81-87 inclusive:

- 1 Hub centre-nut
- 2 Washer
- 3 Hub
- 4 Outboard drive shaft and CV-joint assembly
- 5 Bearing with seals
- 6 Brake disc
- 7 Inboard drive shaft

M88 onwards:

The bearing is press-fitted in the steering swivel member and secured both inboard and outboard by circlips. The outboard drive shaft is splined in the hub which, in turn, is press-fitted in the bearing. The brake disc is fitted to the outboard side of the hub and is of the ventilated type. The track arm is an integral part of the steering swivel member.



Steering swivel member, M88 onwards

- 1 Hub centre-nut
- 2 Washer
- 3 Hub
- 4 Outboard drive shaft and CV-joint assembly
- 5 Bearing with seals
- 6 Brake disc
- 7 Inboard drive shaft

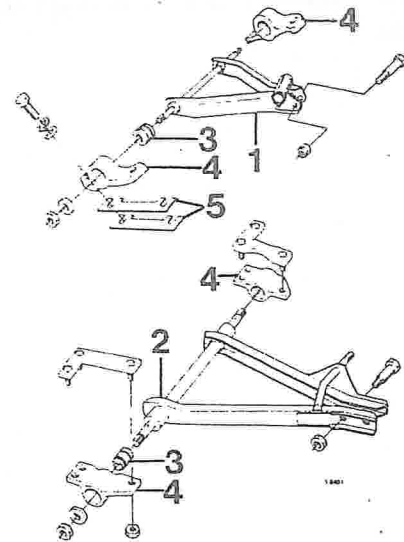
Steering column assembly

The steering column assembly consists of the steering wheel, the steering-column shaft, which is mounted in the steering column bearing support, and an intermediate shaft coupled through universal joints to the steering-column shaft and rack-and-pinion gear.

The steering-column shaft is mounted in two needle bearings which are rubber-bonded inside the steering column. The steering column is bolted to the crossmember under the dash panel which, as well as being part of the frame for the dash, is also the frame for the ventilation system.

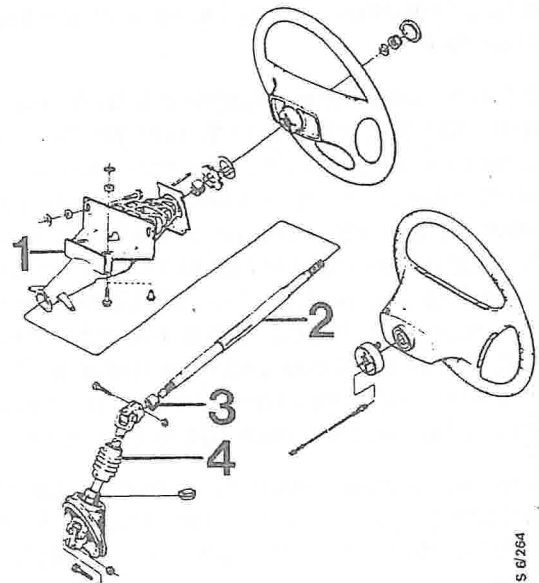
Wishbones

The independent front suspension consists of four wishbones, each of which is pivot-mounted to the frame by two bearing brackets fitted with rubber bushes, and to the steering swivel member by means of ball joints. The upper wishbones incorporate the bottom seats for the coil springs, which also serve as stops for the bump stops.



Wishbones, bearings and bushes

- 1 Upper wishbone
- 2 Lower wishbone
- 3 Rubber bush
- 4 Bearing bracket
- 5 Shims

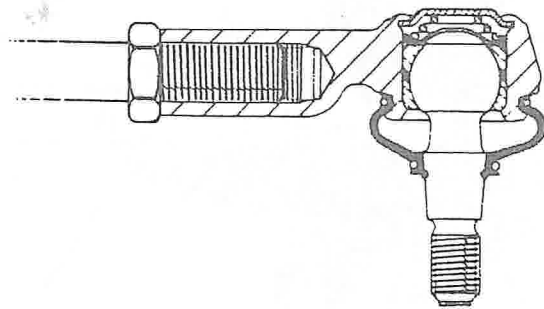


- 1 Steering-column bearing support
- 2 Steering-column shaft
- 3 Needle bearing
- 4 Intermediate shaft with universal joints

The rack-and-pinion gear determines the axial position of the steering column shaft. To protect the driver in the event of a frontal collision, the steering column is designed to collapse under a predetermined load; this is achieved by having a telescopic steering column shaft, an intermediate shaft incorporating sheet steel bellows, and a steering column bearing support in the form of a metal basket. The angles of the universal joints on the intermediate shaft ensure that the steering shaft will be deflected away from the driver in a collision, and the steering wheel itself is padded.

Track-rod ends

The track-rod ends are screwed onto the track rods and locked in position by means of locknuts. For toe-in adjustment, the distance between the inner ball joint and the track-rod end on either side can be altered by undoing the locknut and rotating the track-rod clockwise or anticlockwise to decrease or increase the distance. The track-rod end is attached to the track arm on the steering swivel member by means of a taper ball joint and a self-locking nut. The track-rod ends cannot be dismantled but, because they are self-adjusting and able to take up a moderate amount of wear, will seldom need replacing.



S 6 283

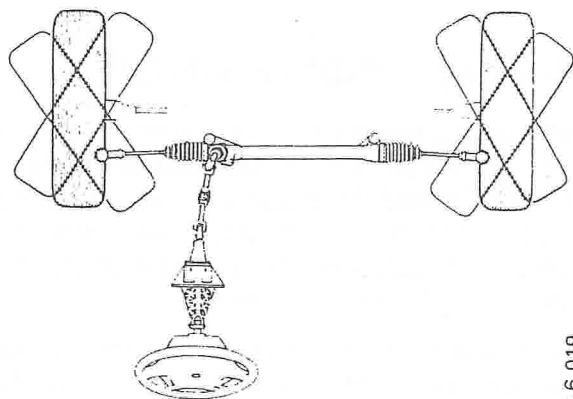
Manual steering

The steering gear is of the rack-and-pinion type, the pinion being a helical spur gear which meshes with teeth on the rack. The rack is carried in a light-alloy casting incorporating a cast-steel tube.

The pinion bearing is equipped with a spring-loaded damping yoke, which presses the rack into mesh with the pinion. The other end of the rack is supported in a bush. Steering-wheel movement is transferred to the pinion via the two-section steering column shaft and two universal joints. The pinion imparts axial movement to the rack and thence to the two track rods, linked to the track-rod ends via the inner ball joints. The track rods then transfer the movement via the track-rod ends to the track arms.

The rack-and-pinion gear is lubricated for life with liquid grease. On fitting, the inner ball joints are lubricated with Molybdenum disulphide grease.

The picture below shows the steering gear for a LHD car, although the steering gear in RHD cars is the same in principle. During the 1981 model year, the adjustable inner ball joints were discontinued in favour of fully enclosed, nonadjustable ball joints.



S 6 019

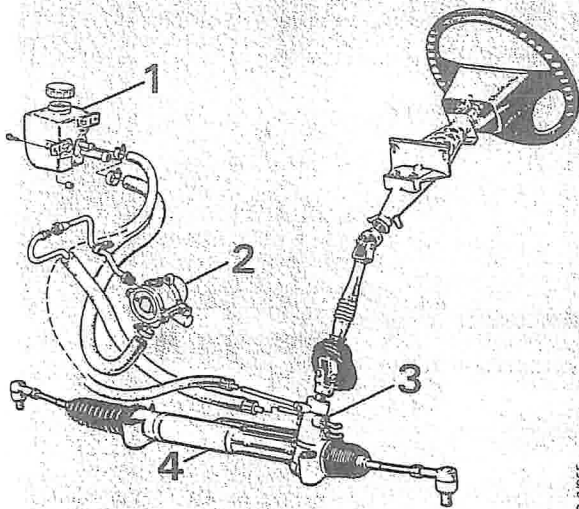
The rack-and-pinion gear assembly is accurately set up at the factory and should not be dismantled unless absolutely necessary. Dismantling and reassembly procedures for the rack-and-pinion gear are detailed in subsection 642.

Power-assisted steering

The power-assisted steering system is of the rack-and-pinion type, the main components of which are a control valve, servo cylinder and hydraulic pump.

The pump supplies fluid under pressure to the control valve which, according to which way the steering wheel is turned, directs the flow to the right or left side of the servo cylinder. The fluid

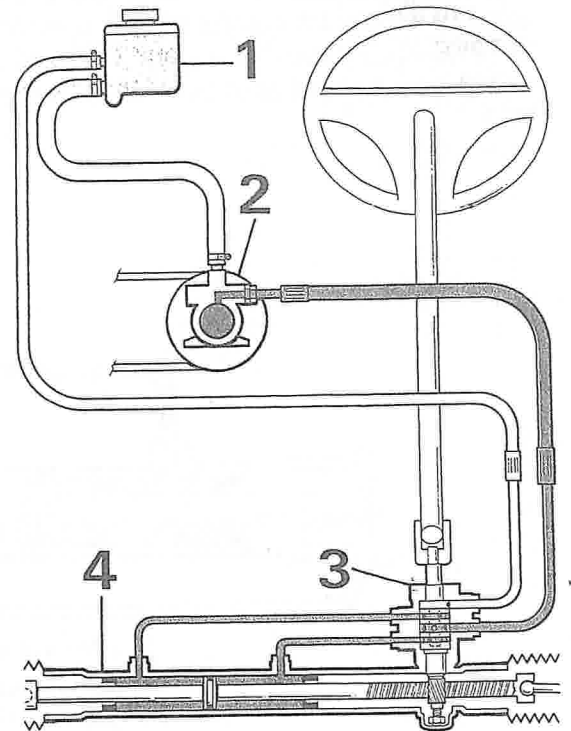
inside the cylinder acts on the rack, thus providing power assistance to the rack-and-pinion gear. The mechanical components of the rack-and-pinion gear are lubricated by a high-viscosity grease and sealed from the hydraulic circuit and other parts of the system by means of seals and rubber gaiters.



S 6255

Power-assisted steering gear

- 1 Power steering fluid reservoir
- 2 Servo pump
- 3 Control valve
- 4 Servo cylinder



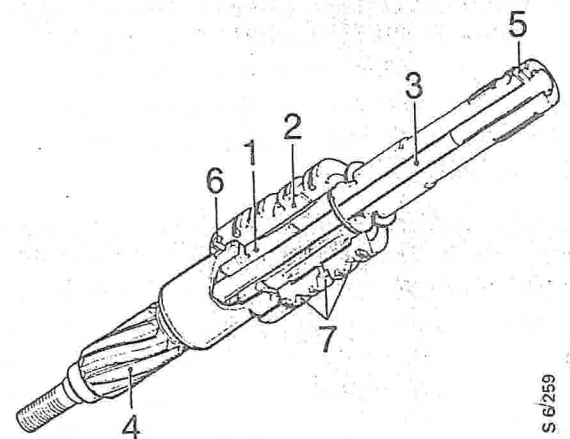
Power-assisted steering system

- 1 Power steering fluid reservoir
- 2 Servo pump
- 3 Control valve
- 4 Servo cylinder

Control valve

The control valve consists of a valve (1), a spool (2), a torsion rod (3) and the pinion (4). The intermediate shaft is splined to the valve and one end of the torsion rod is secured to the splined joint by means of a pin (5).

The other end of the torsion rod is press-fitted in the pinion, to which the spool is secured by means of a pin (6), with the result that the spool follows the rotation of the pinion exactly. There is also an additional splined joint between the valve and the pinion as a fail-safe measure. The top of the pinion is supported in a needle bearing and the bottom in a ball bearing.

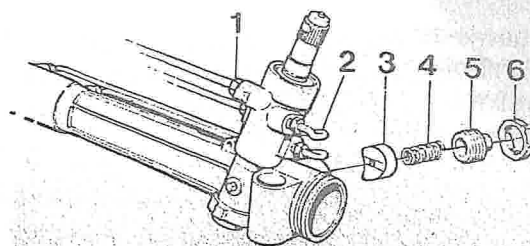


S 6259

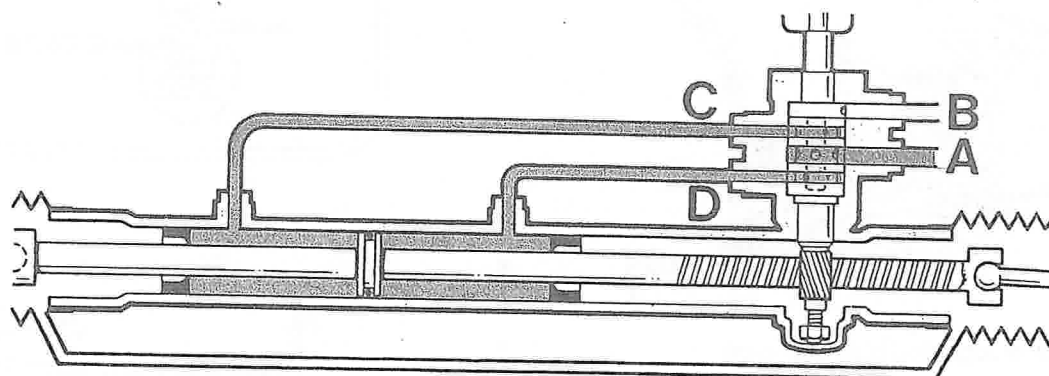
- 1 Valve
- 2 Spool
- 3 Torsion rod
- 4 Pinion
- 5 Pin
- 6 Pin
- 7 Radial grooves

A spring-loaded damper yoke presses the rack into mesh with the pinion and is adjustable to take up any backlash due to wear.

The valve housing, which is part of the rack housing, incorporates four hydraulic connections: two for pump flow and return and two for servo cylinder flow and return. The spool has three radial grooves and the fluid is pumped to the middle one. When the steering wheel is in the straight-ahead position, the control valve is open and the fluid flows up through the valve and back to the pump via the chamber at the top of the spool.



- 1 Flow/return of fluid from/to the pump
- 2 Flow/return of fluid to/from the servo cylinder
- 3 Damper yoke
- 4 Spring
- 5 Adjusting screw
- 6 Locknut



Control valve and servo cylinder

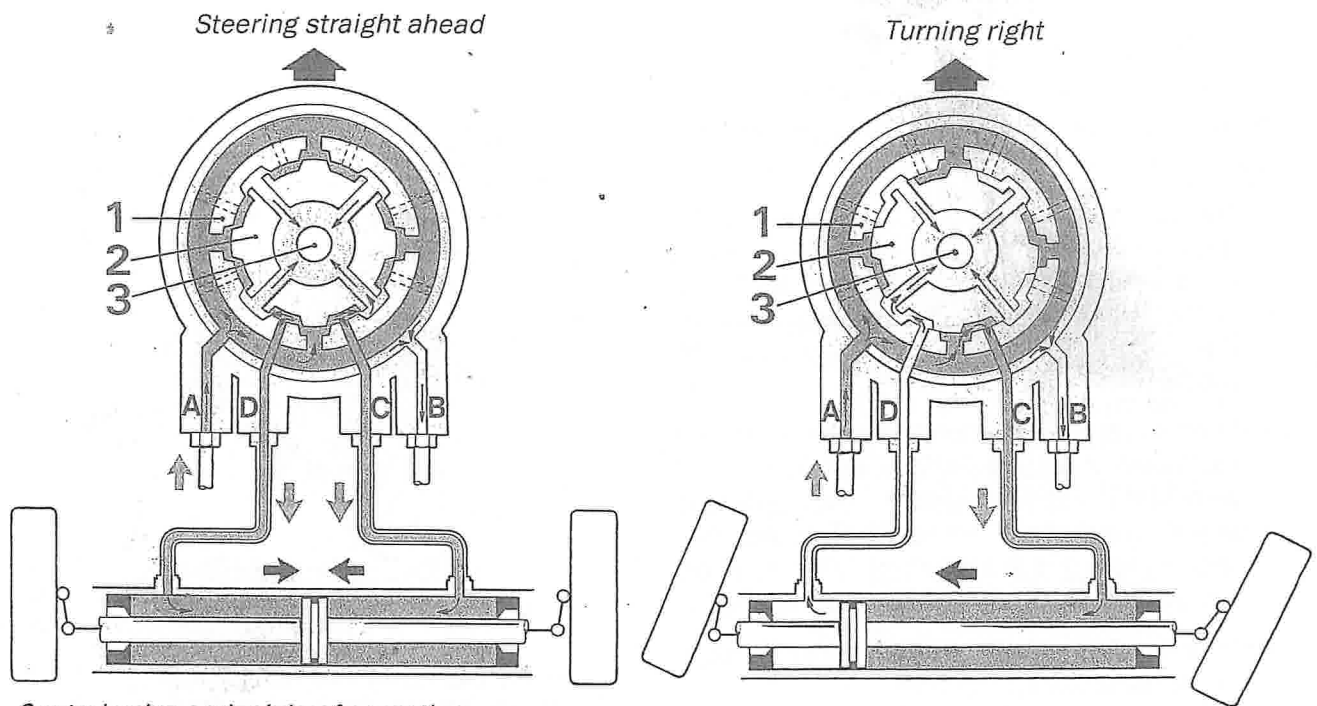
- A Delivery pressure from pump
- B Return to reservoir
- C To servo cylinder for turning right or from servo cylinder for turning left
- D To servo cylinder for turning left or from servo cylinder for turning right

When the steering wheel is turned, the movement is transferred via the torsion rod to the pinion. Because the torsion rod twists slightly, there will be a difference between the degree of rotation of the valve (which follows the rotation of the intermediate shaft) and the spool, which is fixed to the pinion.

The fluid can no longer flow through the control valve back to the reservoir but instead flows through the flow and return passages for the servo cylinder. For a right turn, the fluid is pumped to the right side of the servo cylinder via the top radial groove (C) in the spool. At the same time, fluid is discharged from the left side of the servo cylinder via the bottom radial groove (D) in the spool. The fluid flows up through the valve into the chamber above the spool and is returned to the reservoir (B). For turning left, the opposite circuit is opened.

As long as the torsion rod is twisted, hydraulic pressure will act on the rack to provide power assistance. The amount of twist in the torsion rod will be reduced when the hydraulic fluid acts on the rack, reinforcing the action of the pinion. The moment the torsion rod is no longer under torsion, the return passage through the valve is opened again, allowing fluid to flow back to the reservoir direct.

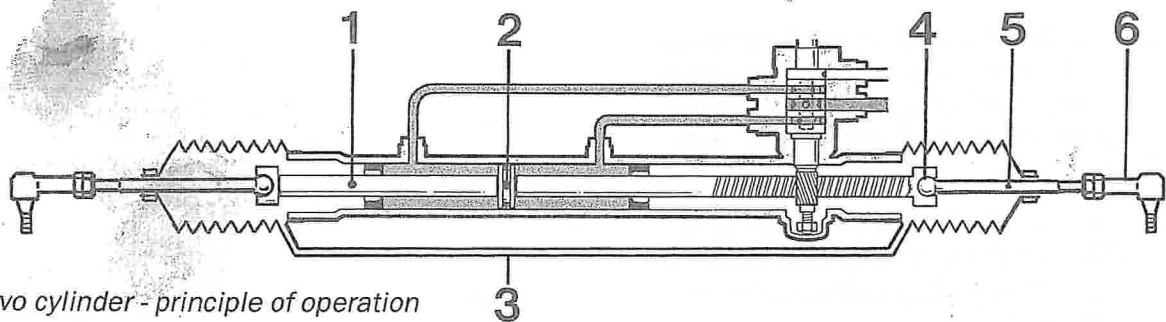
There is always some flow of fluid through the valve, apart from when the steering wheel is at full lock. This is necessary for the control valve in the pump to operate and also helps to cool the fluid.



Control valve - principle of operation

- 1 Spool
- 2 Valve
- 3° Torsion rod

- A Delivery pressure from pump
- B Return to reservoir
- C To servo cylinder on right turn; from servo cylinder on left turn
- D To servo cylinder on left turn; from servo cylinder on right turn



Servo cylinder - principle of operation

- 1 Rack
- 2 Piston
- 3 Pressure-equalizing capillary tube
- 4 Inner ball joint
- 5 Track rod
- 6 Track-rod end

Servo cylinder

The cylinder is part of the rack housing. The rack (1) is equipped with a piston (2) complete with seals. For flow between the cylinder and the control valve there are two pipes, connected one on either side of the piston. For turning right, fluid is pumped to the right side of the cylinder, forcing the piston and rack towards the left, whereupon fluid is discharged from the left section of the servo cylinder. Simultaneously, the gaiter on the LH side is distended and that on the right com-

pressed, causing air to flow through a capillary tube (3) between the gaiters, thus keeping the air pressure constant. Movement of the rack is transferred via the inner ball joints (4), track rod (5) and track-rod ends (6) to the track arms on the steering swivel members.

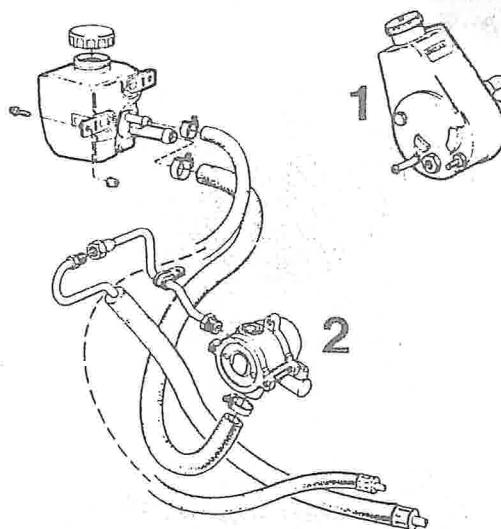
Both the inner ball joints and the track-rod ends are lubricated for life and self-adjusting, with no further lubrication or adjustment required.

Servo pump

The hydraulic servo pump is driven by a vee belt from the crankshaft pulley. Two pump variants are in use:

- Pumps incorporated in the fluid reservoir are fitted to cars with B201 engines with rubber engine mountings. The top of the reservoir is in the form of a filler neck and has a screw-on filler cap incorporating a dipstick for checking the fluid level.
- Pumps with separate fluid reservoirs are fitted to all cars with B202 engines and also to cars with B201 engines equipped with hydraulic engine mountings. The reservoir is transparent, enabling the fluid level to be read off against marks on the outside of the reservoir.

Both pumps incorporate a control valve for regulation of the pressure and flow.



- 1 Servo pump incorporated in fluid reservoir
- 2 Servo pump with separate fluid reservoir

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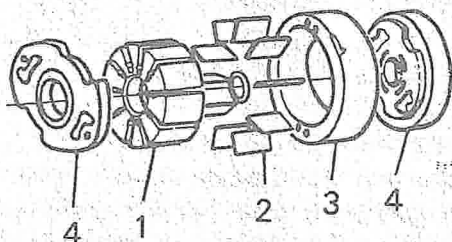
Caution

To avoid damage to the pump, the following points must be observed:

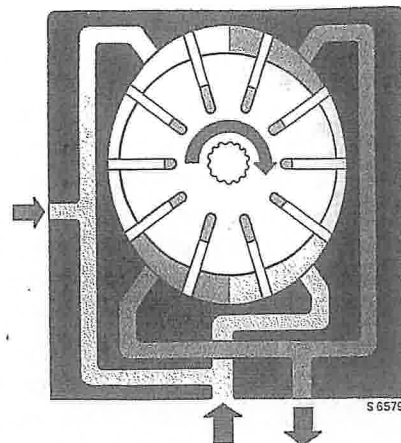
- 1 Never forcibly hold the steering wheel at full lock for any length of time with the engine running, as this may cause the pump to overheat and be damaged.
- 2 Take care never to allow any particles of dirt to get into the hydraulic system, e.g. when checking or topping up the fluid level.
- 3 Never allow the pump to run dry, with no fluid in the system.

Principle of operation

The pump comprises a slotted or aperture rotor (1), a vane (2) for each slot in the rotor, a pump casing (3) and two end plates (4) with inlet and outlet ports.



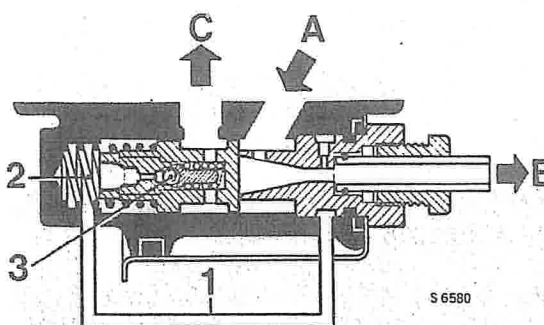
Because of the oval shape of the pump casing, the volume between the vanes increases and decreases twice during each revolution of the rotor. The inlet port leads to the areas in which the volume increases and the outlet ports from those in which the volume decreases, thereby producing the pumping effect. As well as being forced outwards by the centrifugal force, the vanes are also pressed outwards against the pump casing by the pressure of the fluid flowing through the slots at the bottom of the vanes.



Control of pressure and flow

The function of the control valve in the pump is to regulate the pressure and flow to the level required by the rack-and-pinion gear.

One side of the control valve is in direct communication with the delivery pressure (A) from the pump. The pump outlet (B) incorporates a restriction which is connected by a passage (1) to the other, spring-loaded side of the valve (2). In the rest position, the valve is pressed towards the discharge side.



Inside the control valve is a relief valve (3) which, once the pressure exceeds a certain limit, is actuated by the pressure on the spring-loaded side of the control valve.

- 1 Connecting passage
- 2 Spring
- 3 Relief valve

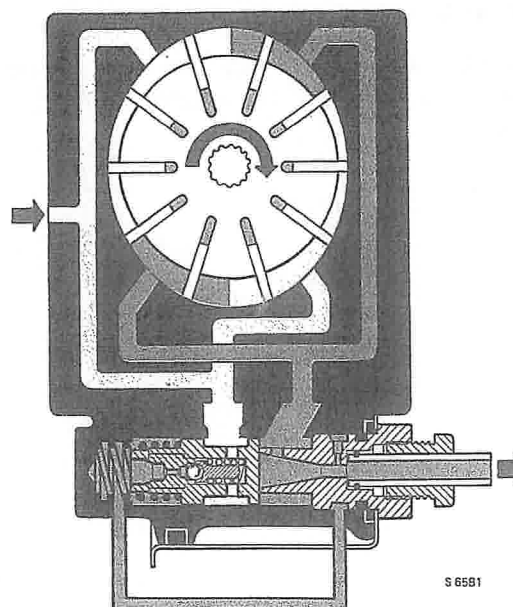
For the valve to operate, some fluid must circulate continuously through the valve, apart from when the steering wheel is at full lock.

- A = From delivery side of pump
- B = To rack-and-pinion gear
- C = To intake side of the pump

The pump delivers a maximum pressure of approx. 75 bar (1088 psi) and a maximum flow of 8.5 litres (9 liq qt) a minute.

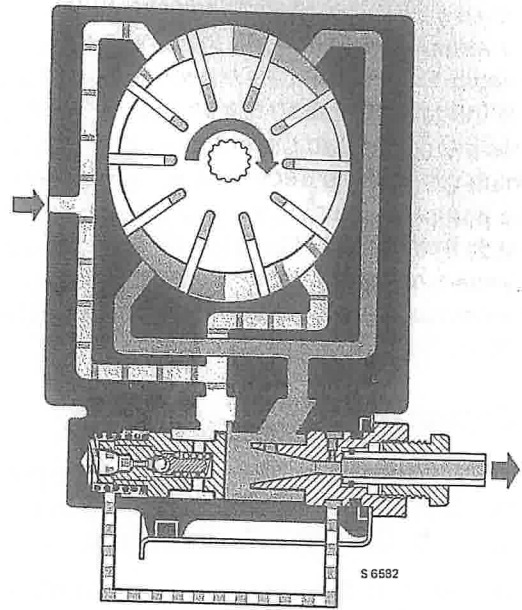
Regulation at low rpm

The pressure raised by the pump (shown in red) is reduced slightly by the restriction in the pump outlet. This drop in pressure is also communicated to the spring-loaded side of the control valve, creating a small pressure difference across the valve. Because of the low speed of the pump, the pressure is insufficient to overcome the force of the spring and actuate the valve.



Regulation at high rpm

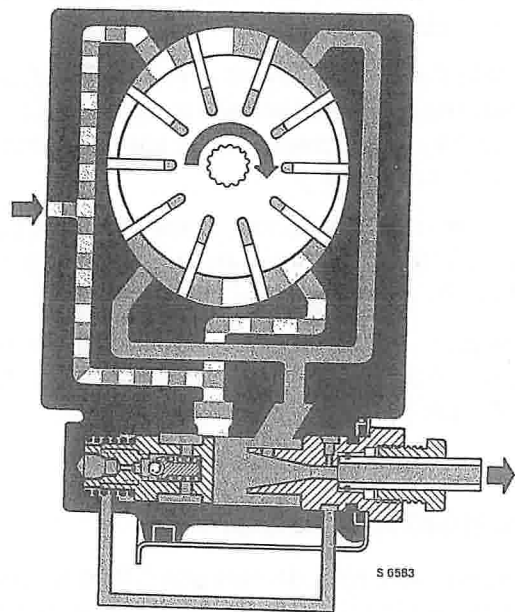
The hydraulic flow increases with increasing engine speed and because of the restriction in the pump outlet the flow velocity is also increased. This causes a fall in pressure in the communication passage, and the pressure on the spring-loaded side of the control valve will now be lower than that acting on the outlet side of the valve. The valve now overcomes the force of the spring, opening a port to the inlet side of the pump and allowing internal recirculation of the fluid. Because of the recirculation of the fluid inside the pump and the higher pressure created on the inlet side of the pump, a supercharging effect is obtained, making it possible for a fairly heavy flow at high pressure to be generated when required.



High torque applied to steering wheel or wheel turned to full lock

When a load is applied to the rack-and-pinion gear and the delivery pressure from the pump increases, there is a corresponding increase in pressure on the spring-loaded side of the control valve. This causes the relief valve inside the control valve to open, whereupon the pressure behind the control valve falls, enabling the relief valve to operate, opening a relief circuit. This produces a drop in pressure on the spring-loaded side of the control valve, causing the control valve to move to the left in the picture, opening further the port for internal recirculation.

The supercharging effect that this produces in the pump provides the required pressure and flow.

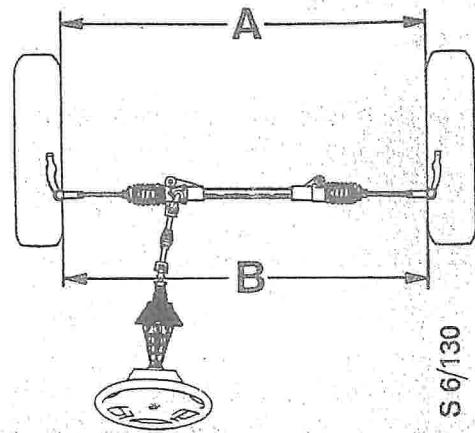


Wheel geometry

Toe-in

Toe-in is the difference between A and B. If the wheels are exactly parallel, with the two dimensions equal, the toe-in will be zero.

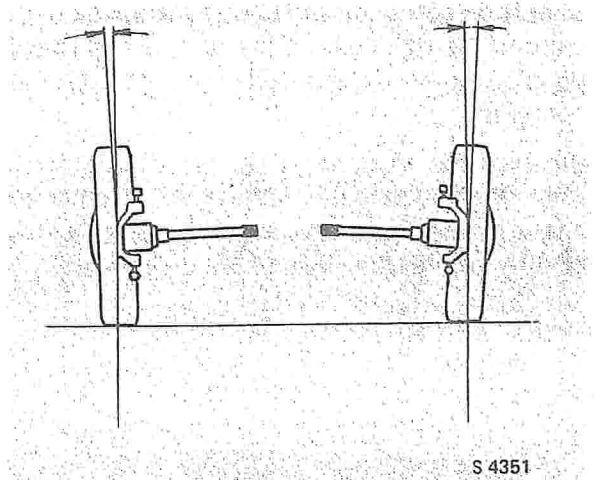
The toe-in value must always be positive, i.e. dimension B must be greater than dimension A.
 $B - A = \text{Positive value}$



Toe-in

Camber

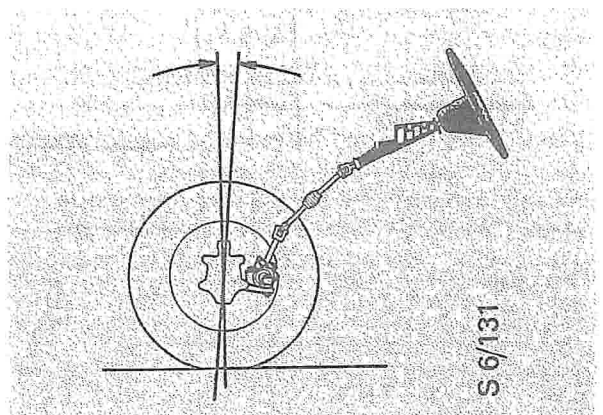
Camber refers to the angle formed between the wheel and the vertical. If the wheel tilts outwards, the camber angle is said to be positive; if it tilts inwards, the angle is said to be negative. The camber on the Saab 900 is positive.



Camber

Castor

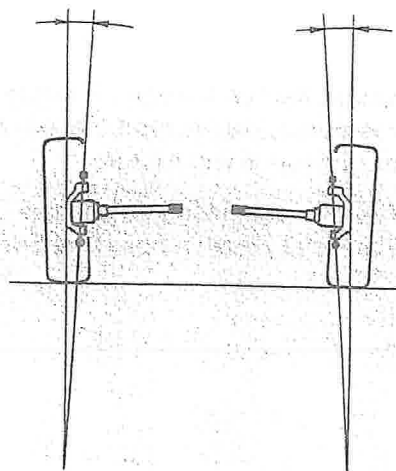
Castor is the angle at which the swivel pin (king pin) deviates from the vertical when viewed from the side. When the swivel axis is inclined backwards as shown, the castor is said to be positive; when inclined forwards, the castor is said to be negative. The Saab 900 has positive castor.



Castor

Swivel-pin inclination (KPI)

Swivel-pin inclination is the angle between the swivel axis (the imaginary line running through the centres of the top and bottom ball joints) and the vertical.



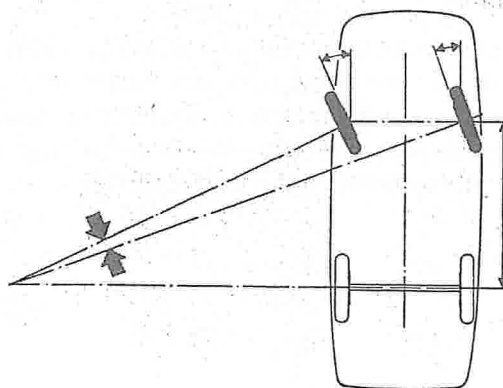
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Swivel-pin inclination

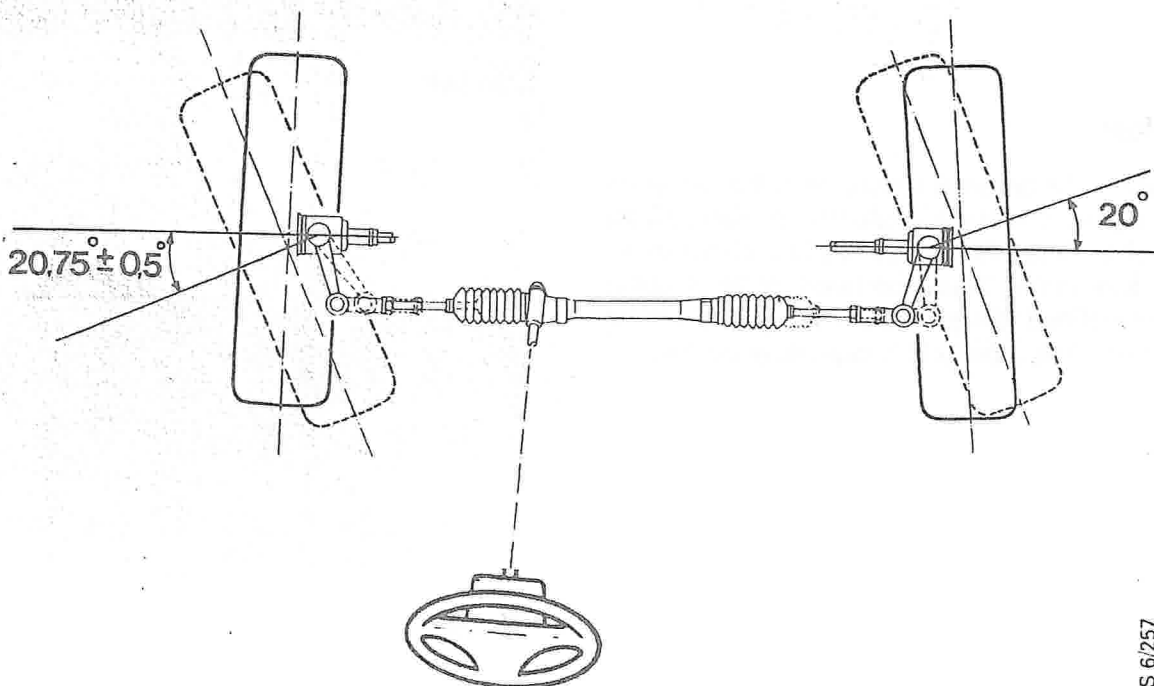
Steering angles

The ideal steering angle for perfect rolling of the wheels on cornering varies with the speed of the car and the tightness of the turn, owing to suspension movement and deflection of the tyres on cornering.

Because the track arms are turned slightly inwards in relation to the path taken by the car, the angle of the inner wheel on cornering will be slightly greater than that of the outer wheel.



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Steering angle

Wheel alignment

Checking and adjusting	601-1	Swivel-pin inclination	601-4
Toe-in	601-1	Checking the steering angles	601-4
Checking the track-rod length	601-2	Reference table for adjusting camber and castor	601-6
Camber	601-3		
Castor	601-3		

Checking and adjusting

If there is reason to believe that the front-wheel alignment is incorrect (e.g. because of abnormal tyre wear, impaired steering or roadholding properties, etc.) the following procedure should be followed:

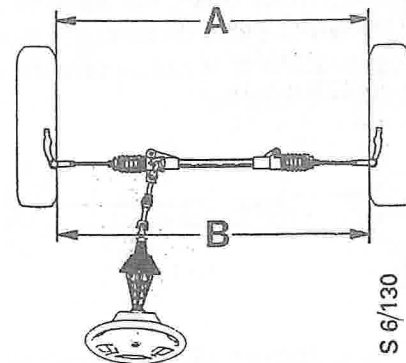
- 1 Check the tyre pressures.
- 2 Check the front-wheel bearings, wishbone mountings and ball joints, and the inner ball joints and track-rod ends. Adjust or replace any defective parts as necessary, to eliminate any symptoms caused by such defects.
- 3 Inspect the dampers and replace any that are defective, together with any worn rubber bushes.
- 4 If the car has been involved in a collision, has run off the road or the like, repair any damage before starting wheel-alignment checks.
- 5 To prevent distorted readings being obtained, rock the car firmly a few times to allow the suspension to settle before starting any checks.

For checking of wheel alignment and steering angles, the car must be unladen, with nobody inside it, but with a full tank of fuel and on a perfectly level surface. Adjustment by means of shims must only be attempted within reasonable limits; shims must not be used to correct major discrepancies.

Toe-in

Adjusting using a tracking gauge

- 1 With the car on a perfectly level surface, roll it straight ahead and allow it to come to a stop by itself.



- 2 Using the tracking gauge, measure dimension A between the rims, at axle height.

Mark the measuring points with chalk. Roll the car forward until the chalk marks are at axle height again and then measure dimension B.

In this method, the tracking gauge remains in the same position on the floor for both measurements, thereby preventing any unevenness in the surface of the floor from influencing the measurements.

- 3 If adjustment is necessary, do this by adjusting the length of the track rod. Slacken the locknut at the track-rod end and the clip securing the gaiter on the steering rack.
- 4 Gripping the track rod with a suitable tool, turn it clockwise or anticlockwise the number of turns shown in the table on page 601-2 until the correct toe-in is obtained. Make sure that the gaiter does not turn with the track rod.



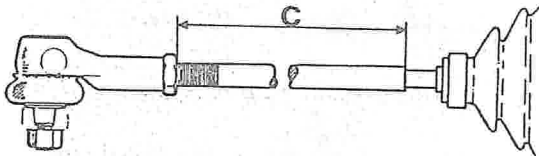
Tracking gauge

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Checking the track-rod length

- 1 Adjust the toe-in.
- 2 Slacken the clip for the rack gaiter.
- 3 Slide the rubber gaiter towards the rack-and-pinion housing to expose the groove in which it seals.
- 4 Measure dimension C.

Dimension C, the distance between the locknut and the edge of the groove for the gaiter, must never be allowed to exceed 100 mm (3.94 in) on cars with manual steering, or 125 mm (4.92 in) on cars with power-assisted steering.



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C = max. 100 mm (3.94 in) - manual steering
 C = max. 125 mm (4.92 in) - power-assisted steering

- 5 Repeat steps 2 - 4 on the other side of the car.
- 6 Compare the two values of dimension C. The difference between the two sides of the car must not exceed 2 mm (0.079 in).

 The two main reasons that dimension C on either side of the car must not vary more than 2 mm are:
 - To avoid undesirable oversteer on cornering;
 - To avoid exceeding the maximum permissible working angle of the CV joints.
- 7 If the track-rod length has been adjusted, recheck the toe-in.
- 8 Slide the gaiter back into the groove.
- 9 Refit the clip.
- 10 Repeat steps 8 & 9 on the other side of the car.
- 11 Check the position of the steering wheel.

Toe-in adjustment table

Use the table as shown in the following example:

- 1 Assume that the tracking gauge gives a value of 0.5 toe-out.
- 2 Find this value in the "Toe-out" section of the first column and follow the line across to the second column, which gives the number of required turns: "0.5 out". This means that together the two track rods must be turned through 0.5 turns, i.e. each track rod should be rotated 0.25 turns outwards or anti-clockwise.

Measured toe setting	Number of track-rod turns required; in = clockwise, out = anticlockwise		
	Standard chassis	Sports chassis	
Toe-out mm	6	1.6 out	1.5 out
	5.5	1.5 out	1.4 out
	5	1.4 out	1.3 out
	4.5	1.3 out	1.2 out
	4	1.2 out	1.1 out
	3.5	1.1 out	1.0 out
	3	1.0 out	0.9 out
	2.5	0.9 out	0.8 out
	2	0.8 out	0.7 out
	1.5	0.7 out	0.6 out
	1	0.6 out	0.5 out
Toe-in, mm	0.5	0.5 out	0.4 out
	0	0.4 out	0.3 out
	0.5	0.3 out	0.2 out
	1	0.2 out	0.1 out
	1.5	0.1 out	Correct value
	2	Correct value	0.1 in
	2.5	0.1 in	0.2 in
	3	0.2 in	0.3 in
	3.5	0.3 in	0.4 in
	4	0.4 in	0.5 in
	4.5	0.5 in	0.6 in
5	0.6 in	0.7 in	
5.5	0.7 in	0.8 in	
6	0.8 in	0.9 in	
6.5	0.9 in	1.0 in	
7	1.0 in	1.1 in	
7.5	1.1 in	1.2 in	
8	1.2 in	1.3 in	
8.5	1.3 in	1.4 in	
9	1.4 in	1.5 in	
9.5	1.5 in	1.6 in	
10	1.6 in	1.7 in	

Locknut tightening torque:
 60 - 80 Nm (44.4 - 59.2 lbf ft)

Camber

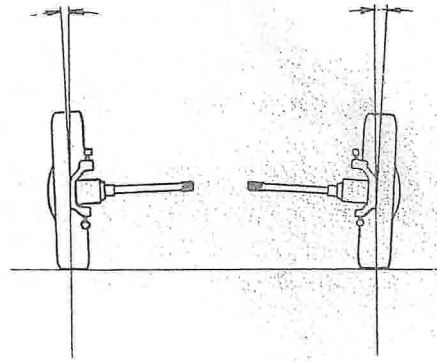
Camber can be adjusted by fitting suitable shims under both bearing brackets for the top wishbone.

When increasing or decreasing the camber angle, always fit identical shims under both bearing brackets. Reducing the shim thickness will increase the positive camber and increasing the shim thickness will reduce the positive camber. After measuring the camber, refer to the table on page 601-6.

Shims are available in thicknesses 0.5, 1.0 and 2.0 mm. See the "Technical Data" section for the camber specification.

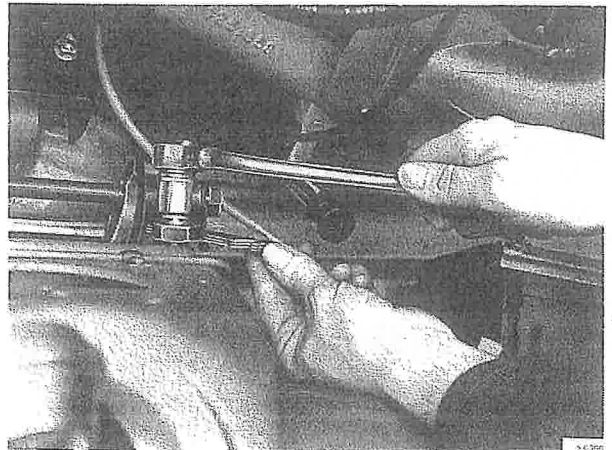
N.B.

The wishbone bearing nearer the back of the car is available in a thinner variant which allows a wider adjustment range. See the Parts Catalogue.



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Camber



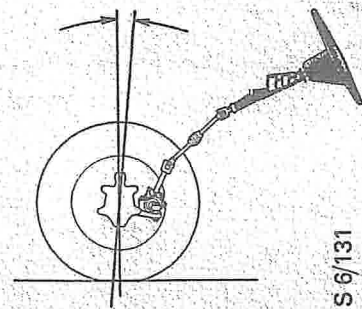
Location of shims

Castor

The castor can be adjusted by fitting shims under the bearing brackets for the top wishbone.

Moving shims from the forward bearing bracket and fitting them under the rear bracket on the wishbone will increase the castor and vice versa. When a shim of a given thickness is removed from under one bearing bracket, a shim of the same thickness must be fitted under the other to avoid the camber being altered. After measuring the castor, refer to the table on page 601-6.

Shims are available in thicknesses 0.5, 1.0 and 2.0 mm. Refer to the "Technical Data" section for the specified castor.



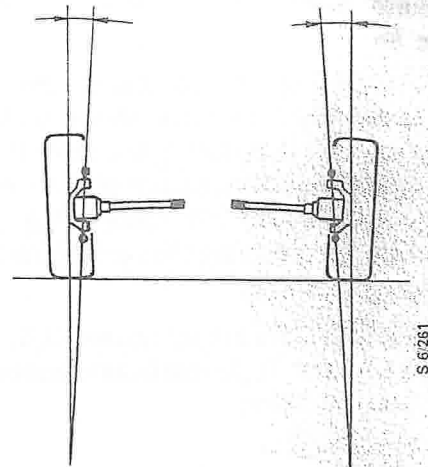
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Castor

Swivel-axis inclination (KPI)

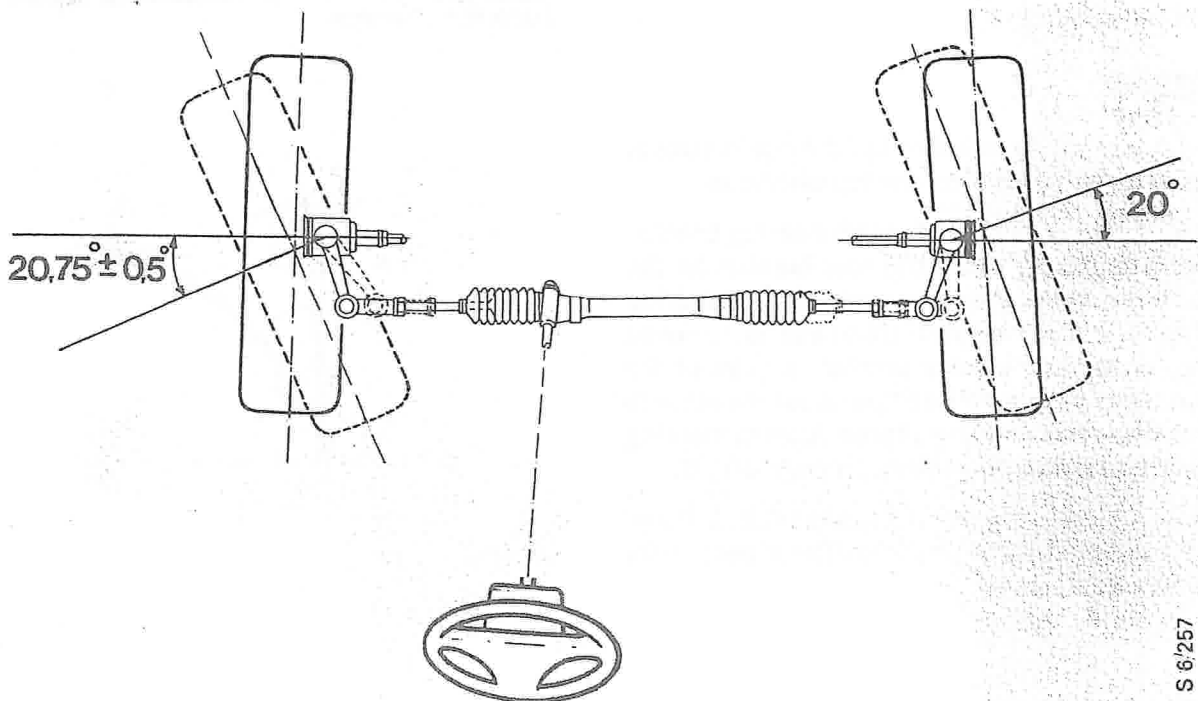
Altering of the camber will also alter the swivel-pin inclination by the same amount. Because the basic swivel-pin inclination is determined by the design of the steering swivel member, it cannot be adjusted.

If the swivel-pin inclination is wrong after the camber has been set correctly, the fault must lie with the steering swivel member, which must therefore be replaced.



Swivel-pin inclination

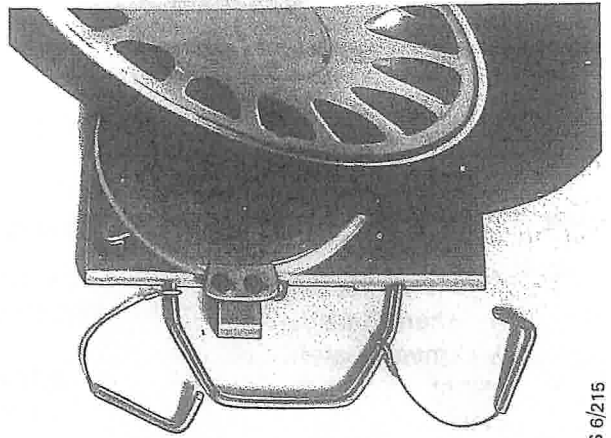
Checking the steering angles



Steering angles

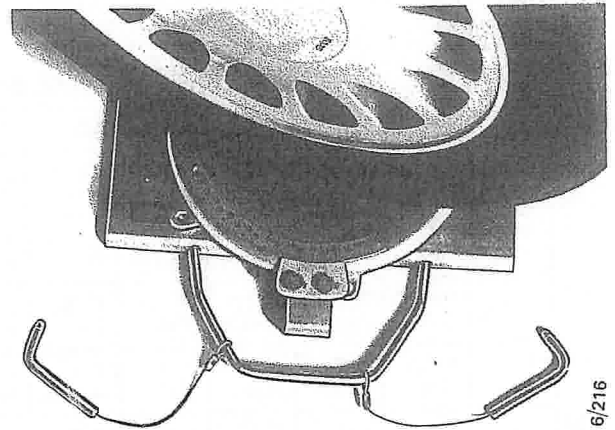
Before the steering angles of the wheels can be adjusted, the toe-in setting must be correctly adjusted. The wheel angles are measured using two turntables, each one centred underneath the respective wheel.

Make sure the turntables are set to zero then turn the outside wheel through 20° . If the steering angle is correct, the angle of the inner wheel will be $20.75^\circ \pm 0.5^\circ$. If the turning angle is incorrect, then one or both track arms is distorted, and must be replaced (bending of track arms is not permissible). As from M81, the track arms are an integral part of the steering swivel member, which means if a track arm is distorted, the entire steering swivel member must be replaced.



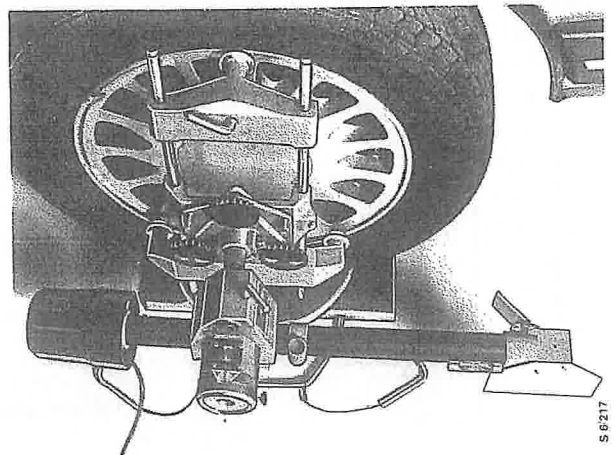
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Outer wheel: 20°



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Inner wheel: $20.75^\circ \pm 0.5^\circ$



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Optical measuring equipment

Camber/castor adjustment table

The table below should be referred to for the adjustment of camber/castor.

Use the table as shown in the following example:

- 1 Assume that the following values are obtained when checking the front wheels on a car with manual steering:

camber 1 1/4°
 castor 1 1/2°

- 2 From the box at which the two values coincide in the table we get:

F + 5

B + 3

which tells us that the front (F) wishbone bearing bracket requires 5 mm additional (+) shimming and the back (B) bearing bracket an additional (+) 3 mm.

- 3 After the required shims have been fitted, both the camber and castor will be set correctly.

		Castor, deg., Manual steering												
		-1/2	-1/4	0	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2
Camber, deg.	1 3/4	F+3 R+7,5	F+3 R+7	F+3,5 R+6,5	F+4 R+6,5	F+4,5 R+6	F+5 R+6	F+6 R+6	F+6,5 R+5,5	F+7 R+5,5	F+7 R+5	F+7,5 R+5	F+8 R+4,5	F+8 R+4
	1 1/2	F+2 R+6,5	F+2 R+6	F+2,5 R+5,5	F+3 R+5,5	F+3,5 R+5	F+4 R+5	F+5 R+5	F+5,5 R+4,5	F+6 R+4	F+6 R+3,5	F+6,5 R+3,5	F+7 R+3	F+7 R+2,5
	1 1/4	F+1 R+5	F+1,5 R+5	F+1,5 R+4,5	F+2 R+4,5	F+2,5 R+4	F+3 R+4	F+4 R+4	F+4,5 R+3,5	F+5 R+3	F+5 R+2,5	F+5,5 R+2,5	F+6 R+2	F+6 R+1,5
	1	F-0,5 R+4	F±0 R+4	F+0,5 R+3	F+1 R+3	F+1 R+2,5	F+1,5 R+2,5	F+2 R+2	F+3 R+2	F+3,5 R+2	F+4 R+1,5	F+4,5 R+1,5	F+4,5 R+1	F+5 R+0,5
	3/4	F-1,5 R+3	F-1 R+2,5	F-1 R+2	F-0,5 R+2	F±0 R+1,5	F+0,5 R+1,5	F+1 R+1	F+1,5 R+1	F+2 R+0,5	F+2,5 R+0,5	F+3 R±0	F+3,5 R-0,5	F+4 R-1
	1/2	F-3 R+2,5	F-3 R+2	F-2,5 R+1,5	F-2 R+1	F-1 R+0,5	F-0,5 R+0,5	Corr. value	F+0,5 R-0,5	F+1 R-0,5	F+2 R-1	F+2,5 R-1,5	F+3 R-2	F+3 R-2,5
	1/4	F-4 R+1	F-3,5 R+0,5	F-3 R±0	F-2,5 R-0,5	F-2 R-0,5	F-1,5 R-1	F-1 R-1	F-0,5 R-1,5	F±0 R-1,5	F+0,5 R-2	F+1 R-2	F+1 R-2,5	F+1,5 R-3
	0	F-5 R-0,5	F-4,5 R-1	F-4,5 R-1,5	F-4 R-1,5	F-3,5 R-2	F-3 R-2	F-2 R-2	F-1,5 R-2,5	F-1 R-2,5	F-1 R-3	F-0,5 R-3	F±0 R-4	F+0,5 R-4
	-1/4	F-6 R-1,5	F-6 R-2	F-5,5 R-2,5	F-5 R-2,5	F-5 R-3	F-4,5 R-3,5	F-4 R-4	F-3 R-4	F-2,5 R-4	F-2 R-4,5	F-1,5 R-4,5	F-1,5 R-5	F-1 R-5
	-1/2	F-7 R-2,5	F-7 R-3	F-6,5 R-3,5	F-6 R-3,5	F-6 R-4	F-5,5 R-4,5	F-5 R-5	F-4 R-5	F-3,5 R-5	F-3 R-5,5	F-2,5 R-5,5	F-2 R-6	F-2 R-6,5
-3/4	F-8 R-4	F-8 R-4,5	F-7,5 R-5	F-7 R-5	F-7 R-5,5	F-6,5 R-5,5	F-6 R-6	F-5 R-6	F-4,5 R-6	F-4 R-6,5	F-3,5 R-6,5	F-3 R-7	F-3 R-7,5	
		1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2
		Castor, deg., Power-assisted steering												

The values given in the outlined boxes fall within the permitted tolerances and no adjustment is therefore necessary.

(Note that a decimal comma instead of a decimal point is used in the table.)

Steering swivel member

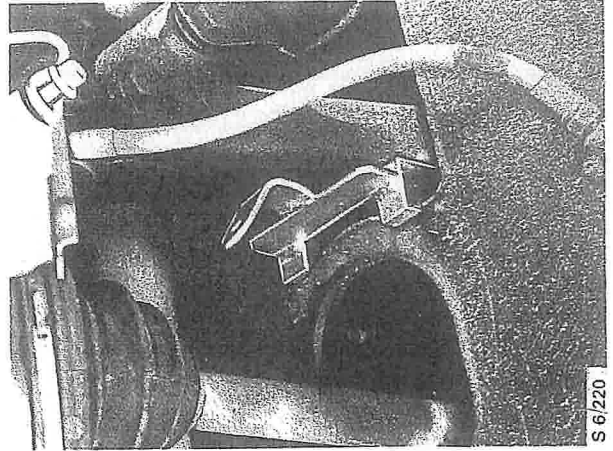
Checking ball-joint play 631-1
 Replacing a ball joint 631-2

Replacing ball-joint seals 631-3

Checking ball-joint play

For any ball-joint play to be detected, the wishbones must be relieved of the tension imposed by the coil spring and damper.

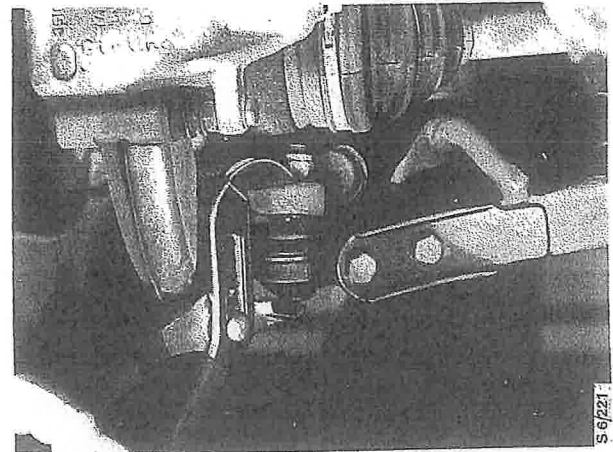
- 1 Fit insert 83 93 209 under the top wishbone.



- 2 Check the axial play in the top and bottom ball joints:

Use a pair of water pump pliers to compress the ball joint.

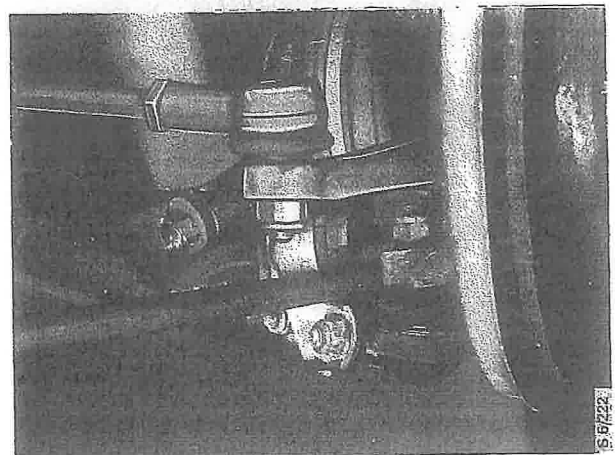
Maximum axial play: 2 mm.



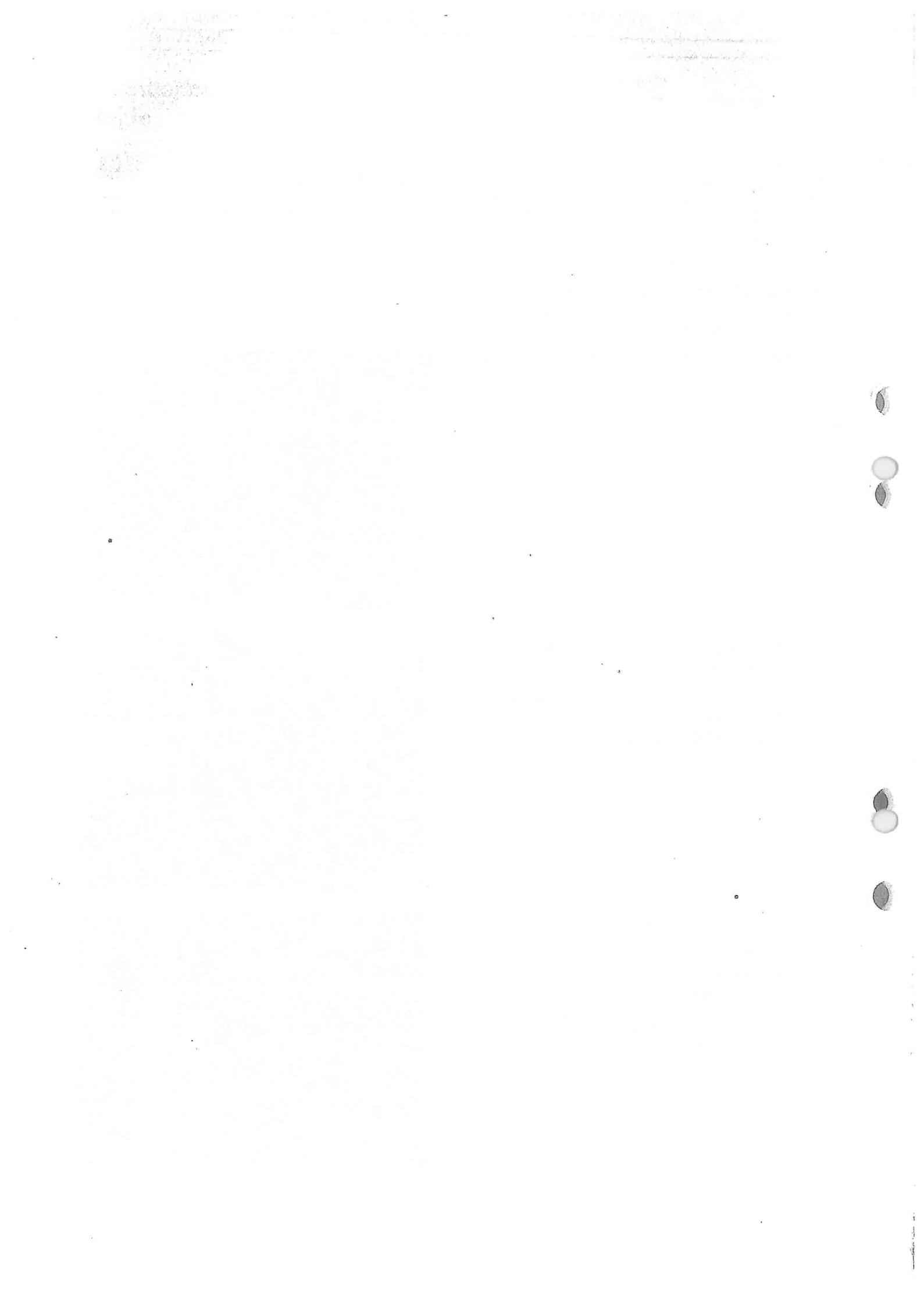
- 3 Check the radial play in the top and bottom ball joints:

Insert a lever between the wishbone and the steering swivel member. Take care not to pinch and damage the rubber seal!

Maximum radial play: 1 mm.



- 4 Inspect the rubber seals for damage and replace any that are defective.



Wishbones

Upper wishbone 632-1

Lower wishbone 632-12

Upper wishbone

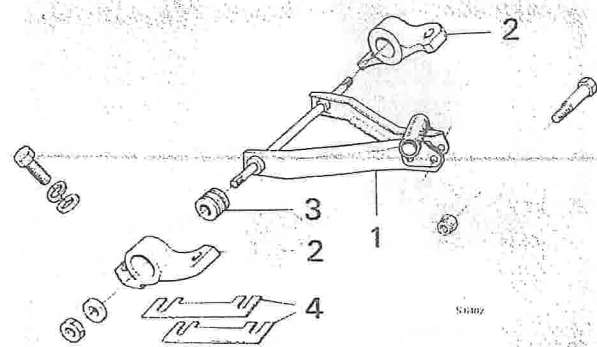
If the wishbones have been subjected to violent stresses as the result of a collision or the like, they must be carefully inspected for signs of failure or distortion. If found to be defective in any way, they must be replaced.

To remove

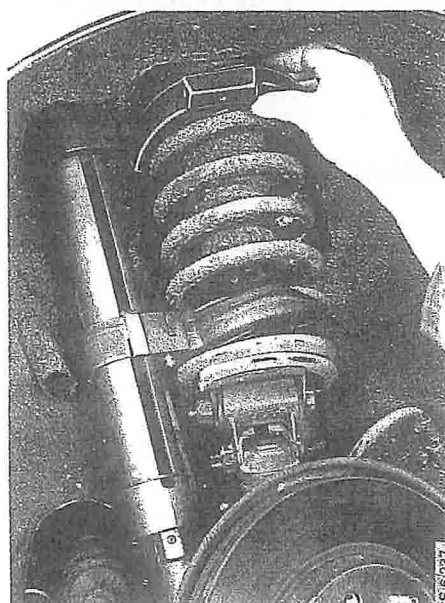
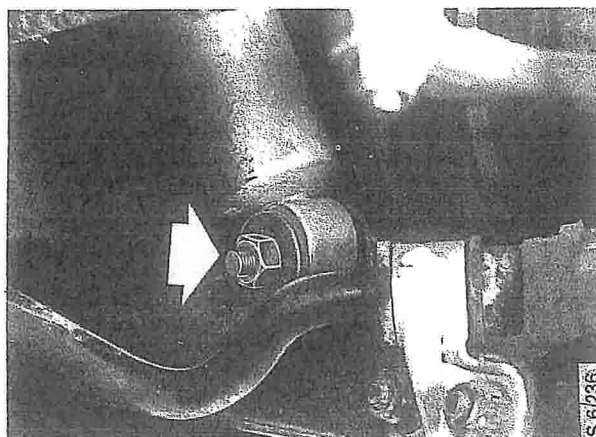
N.B.

Before the upper wishbone on the left-hand side can be removed, the engine will first have to be removed. See section 2, subsection 201, of the Manual

- 1 Raise and support the car.
- 2 Remove the road wheel.
- 3 Relieve the load on the damper by applying a jack under the outer end of the lower wishbone. Undo the bottom damper mounting and remove the jack.
- 4 Fit spring compressor 88 18 791 complete with jaws 88 18 809, bottom jaw first.



- 1 Wishbone
- 2 Bearing bracket
- 3 Bush
- 4 Shims

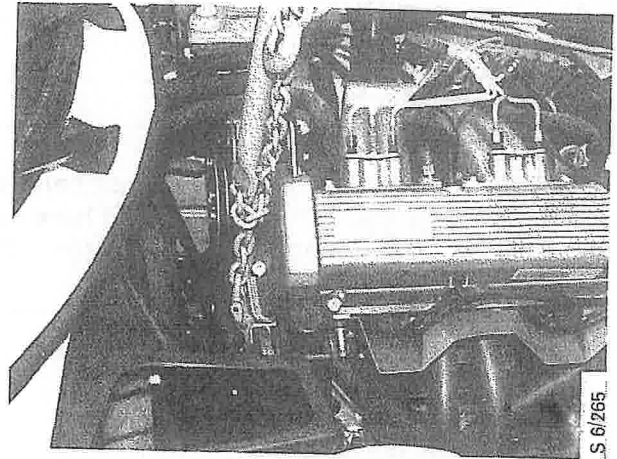


Cars not fitted with hydraulic engine mountings:

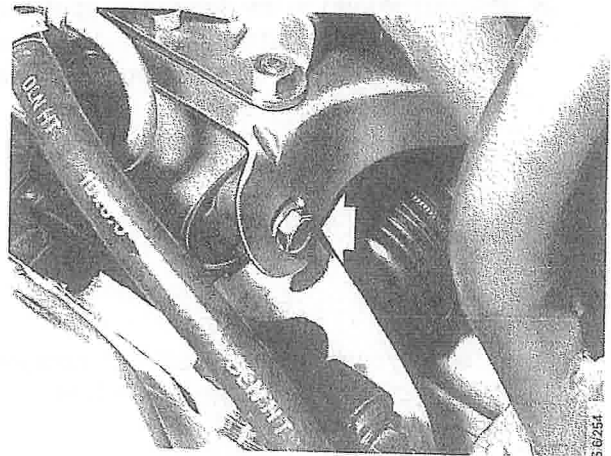
- Remove the two bottom bolts in the mounting rubber.



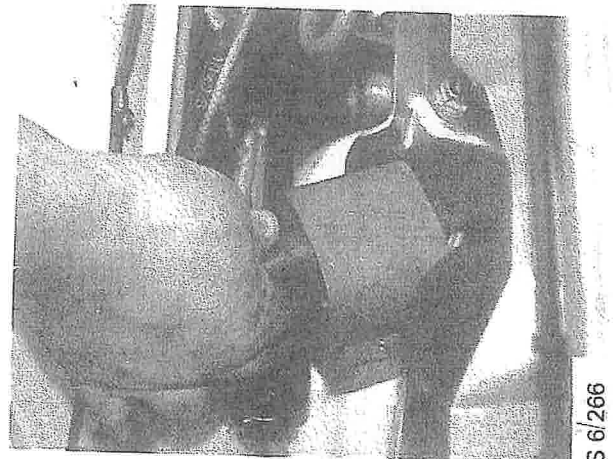
- Take the weight of the engine off the mounting by means of a hoist or jack.
If using a hoist, attach it to the engine steady bar.



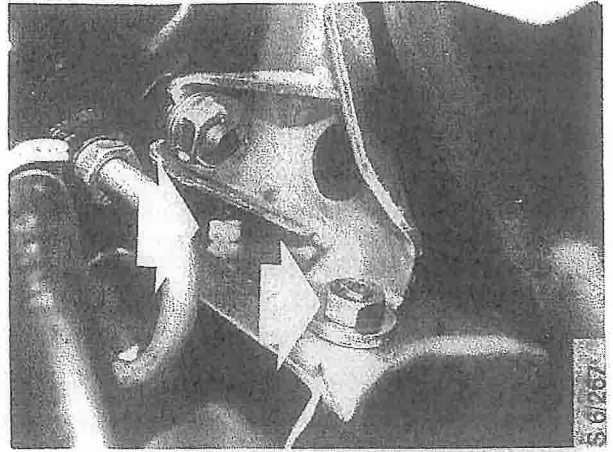
- Remove the bolt securing the mounting rubber to the mounting.



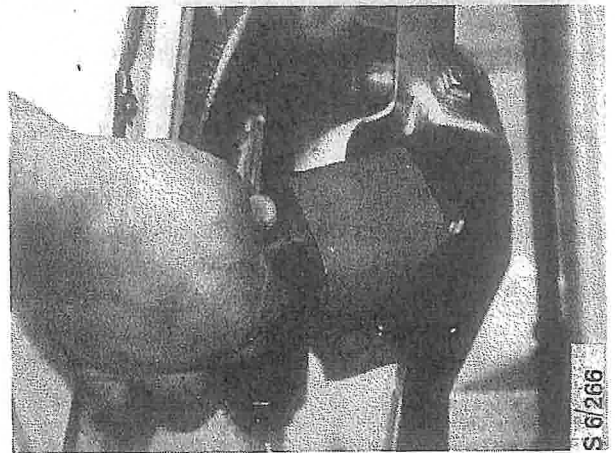
- Lift out the mounting rubber.



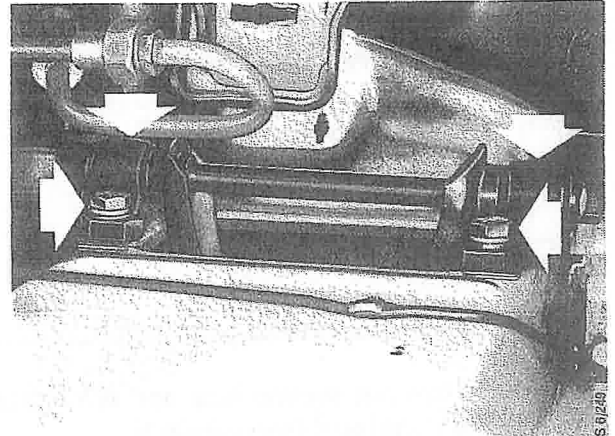
- Remove the two nuts securing the engine mounting to the steady bar.



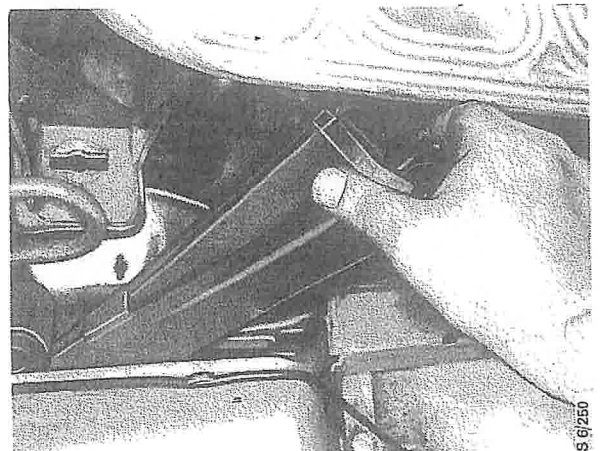
- Remove the two nuts securing the engine mounting to the block.
- Lift out the mounting taking care not to damage the gaiter on the drive shaft.



- 9 Remove the four bolts securing the wishbone bearing brackets to the body. Note the number of shims fitted under each bracket and save them.



- 10 Swing up the wishbone complete with bearings.
- 11 Remove the nut from each bearing, followed by the bearing brackets complete with bushes.



632-6 Wishbones

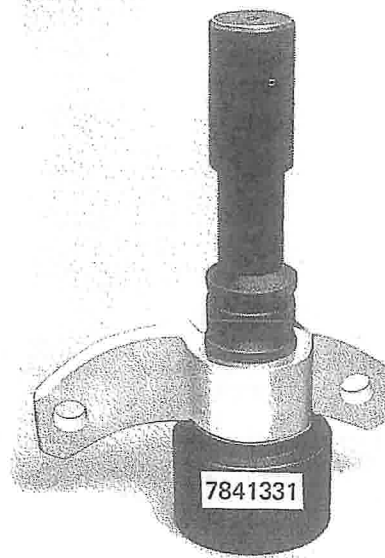
To refit

Thoroughly clean all parts before refitting and replace any that are worn or damaged.

- 1 Fit the rubber bushes: apply soapy water to the bushes and press them into the bearing brackets using tool 78 41 331.

N.B.

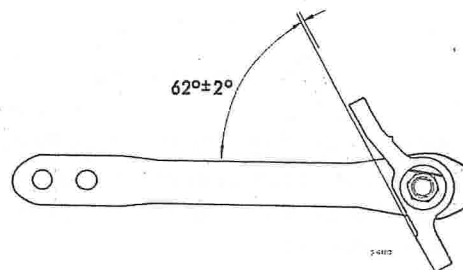
Oil or grease must not be allowed to come into contact with the rubber bushes. Use only soapy water.



- 2 Fit the bearings onto the wishbone. When the two nuts have been tightened, the angle between the wishbone and bearing bracket should be $62^\circ \pm 2^\circ$.

Tightening torque:

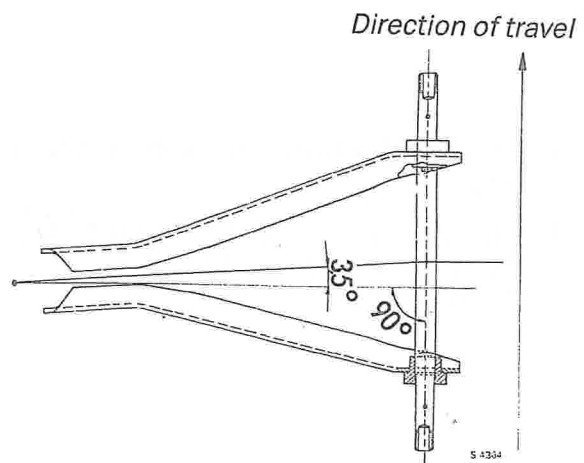
55 - 70 Nm (40.7 - 51.8 lbf ft)



Angle between upper wishbone and bearing bracket.

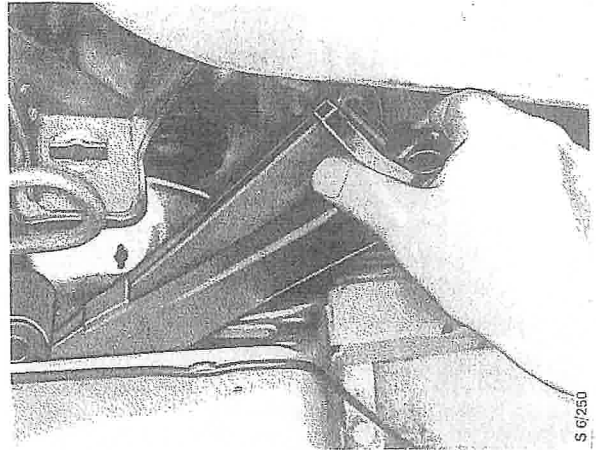
N.B.

Wishbones are not symmetrical and are either left-hand or right-hand (see drawing).

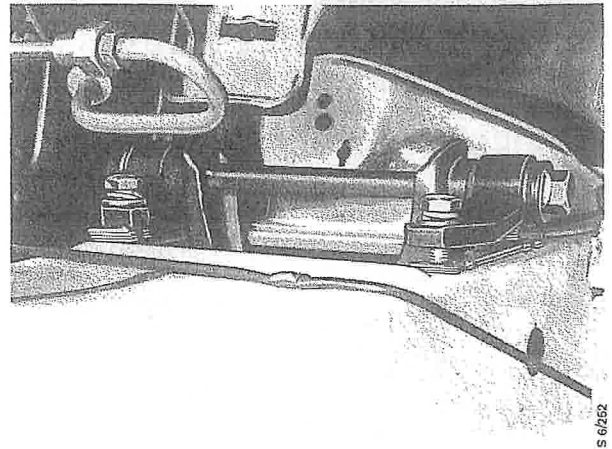


Asymmetric wishbone

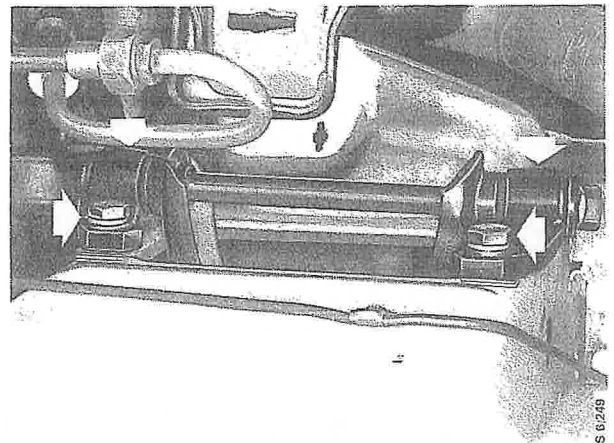
- 3 Position the wishbone complete with bearings ready for fixing to the body.



- 4 Insert the four bolts securing the wishbone bearings to the body and refit the shims exactly as before.



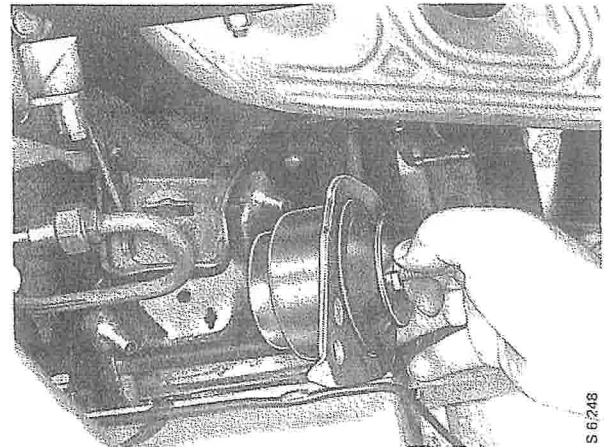
- 5 Tighten the bolts.



- 6 Refit the engine mountings as follows:

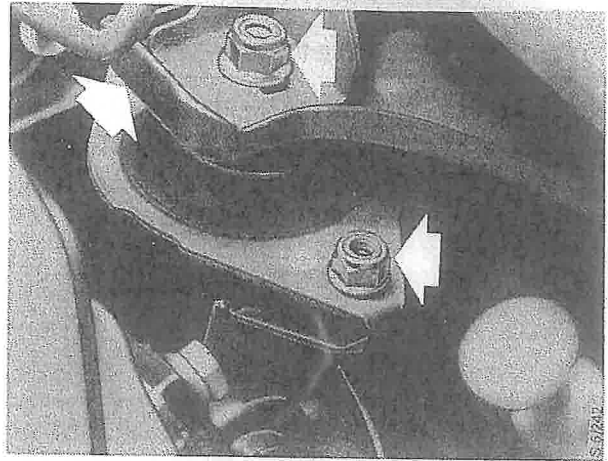
Cars fitted with hydraulic engine mountings:

- Place the engine mounting and rubber in position.
Insert the two bottom bolts through the holes in the body.

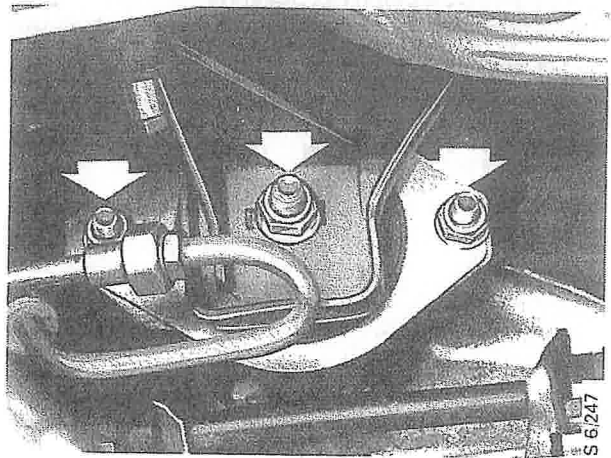


632-8 Wishbones

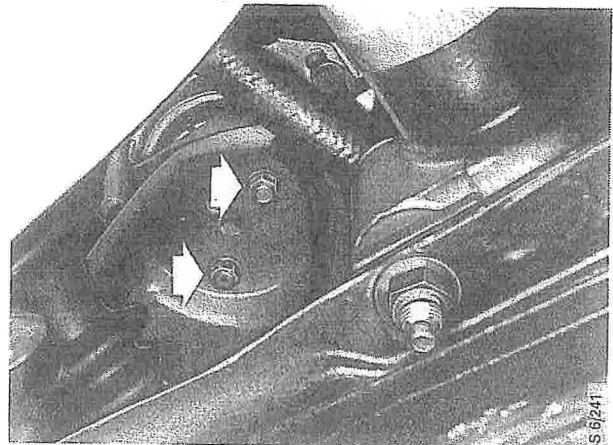
- Screw on the three nuts at the top, leaving them slack. Refit the bump stop (where applicable).
- Lower the engine.



- Tighten the three nuts at the top.



- Fit and tighten the two nuts in the bottom.

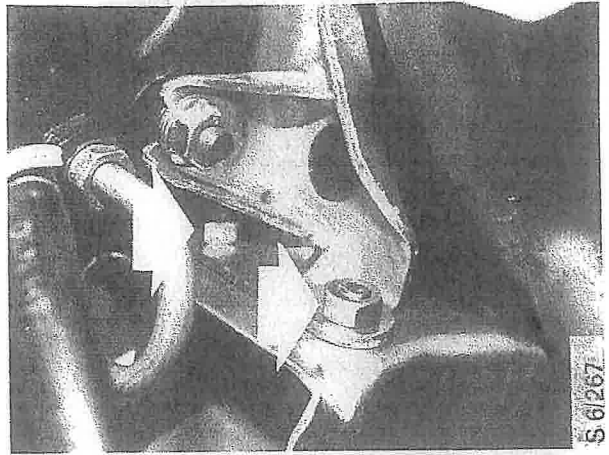


Cars not fitted with hydraulic mountings:

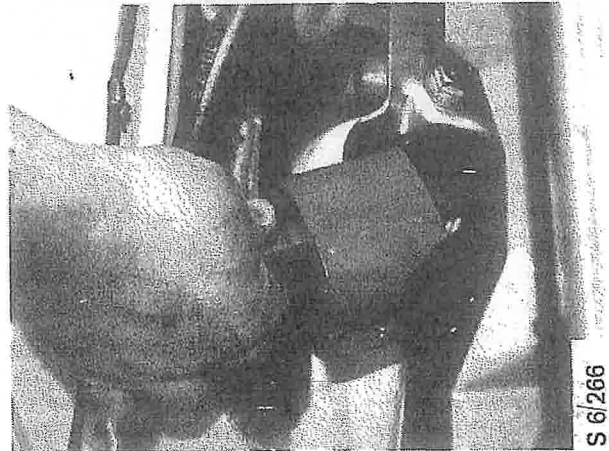
- Put the engine mounting in position.



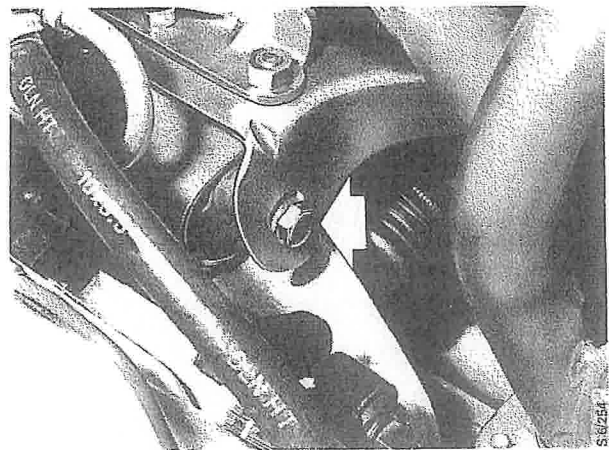
- Tighten the two bolts securing the engine mounting to the block.
- Tighten the two bolts securing the engine mounting to the steady bar.



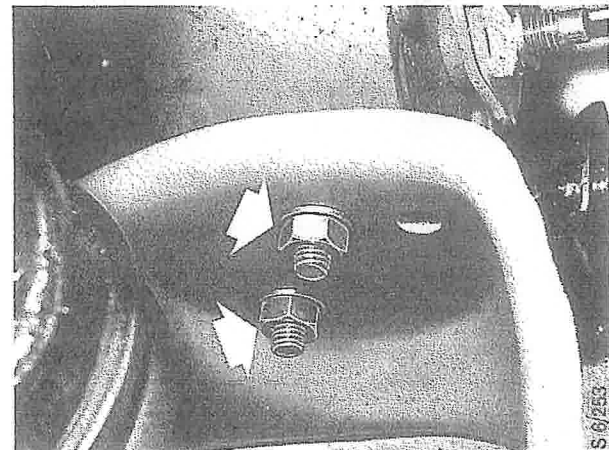
- Put the mounting rubber in position and insert the two bottom bolts through the holes in the body.



- Lower the engine.
- Tighten the bolts securing the mounting rubber to the mounting.

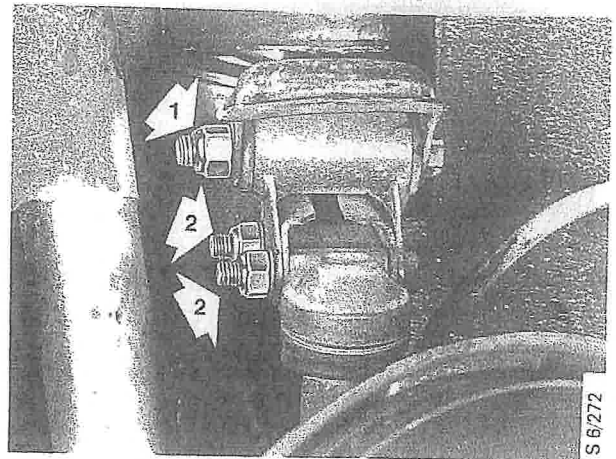


- Tighten the two bottom bolts.

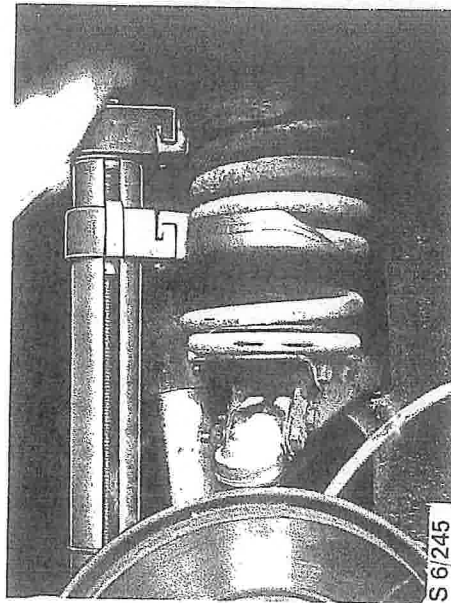


632-10 Wishbones

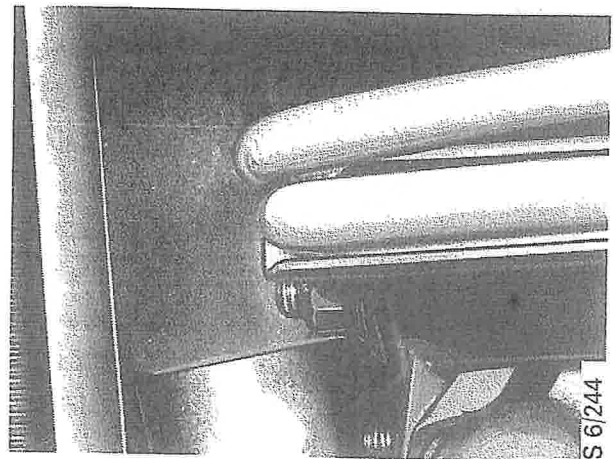
- 7 Fit and tighten the bolt securing the spring seat (1) to the wishbone and the two bolts (2) for the ball joint.



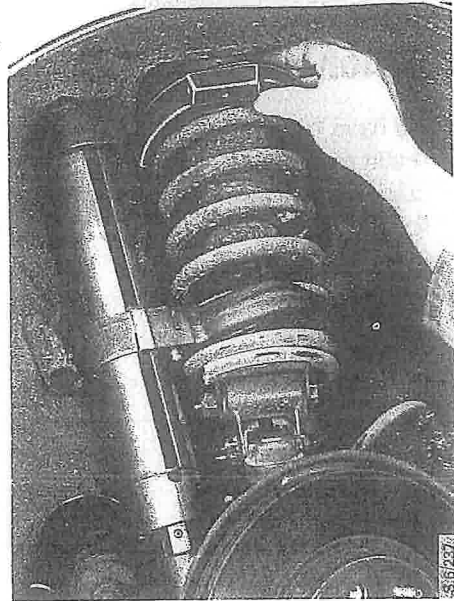
- 8 Fit the coil spring.



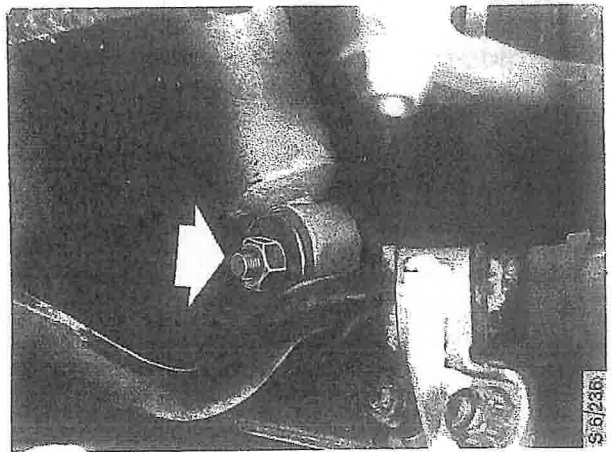
Make sure that the spring is against the stop on the spring seat.



9 Remove the spring compressor with jaws.



10 Apply a jack under the lower wishbone and secure the bottom of the damper.



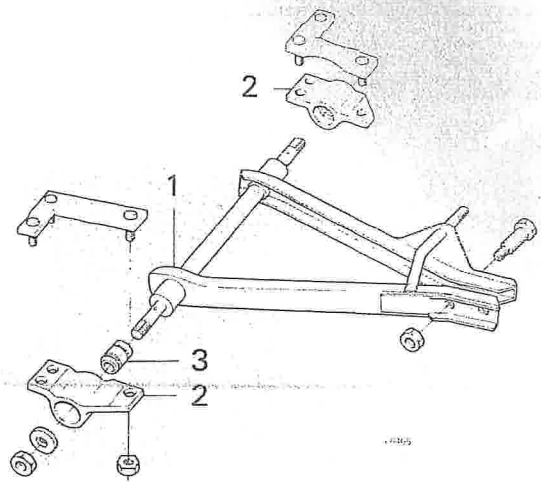
11 Fit the wheel.

12 Check the wheel alignment (see subsection 601).

13 Test drive the car.

Lower wishbone

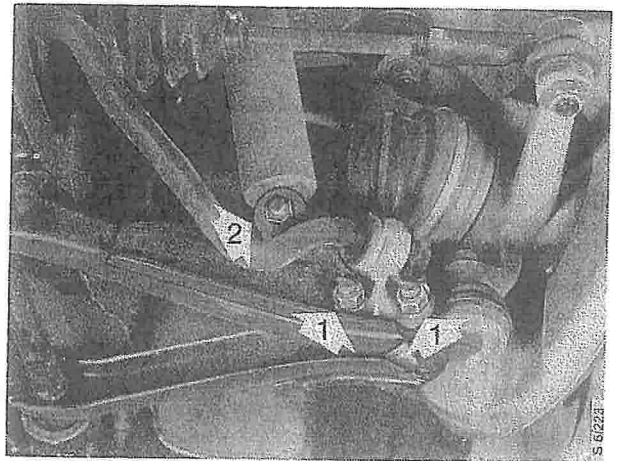
If the wishbones have been subjected to violent stresses as a result of a collision or the like, they must be carefully inspected for signs of failure or distortion. If found to be defective in any way, they must be replaced.



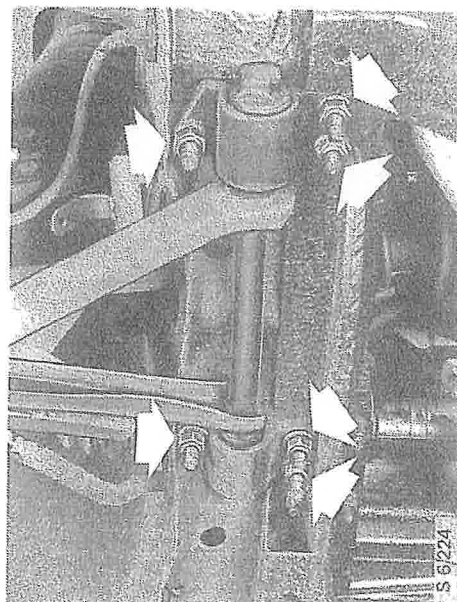
- 1 Wishbone
- 2 Bearing bracket
- 3 Bush

To remove

- 1 Raise and support the car and remove the road wheel.
- 2 Undo the two bolts (1) securing the wishbone to the ball joint. If an anti-roll bar is fitted, move it out of the way.
- 3 Undo the securing bolt at the bottom of the damper (2). If necessary, apply a jack under the outer end of the wishbone to relieve the damper.



- 4 Remove the six fixing bolts for the wishbone.



- 5 Lower the wishbone.
- 6 Remove the nuts from the bearings and remove the bearing brackets.

To refit

Thoroughly clean all parts before refitting and replace any that are worn or damaged.

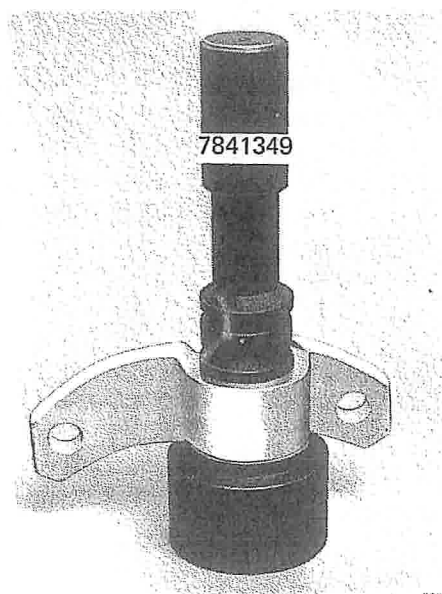
N.B.

Oil or grease must not be allowed to come into contact with the rubber bushes. Use only soapy water.

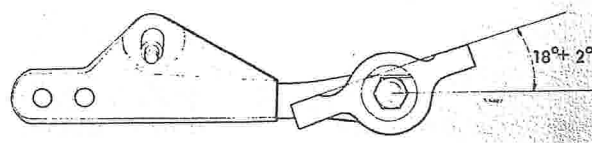
- 1 Fit the rubber bushes. Apply soapy water to the bushes and press them into the bearings using tool 78 41 349. After the two nuts have been tightened, the angle between the wishbone and the bearing bracket should be $18^{\circ} \pm 2^{\circ}$.

Tightening torque:

75 - 90 Nm (55.5 - 66.6 lbf ft)



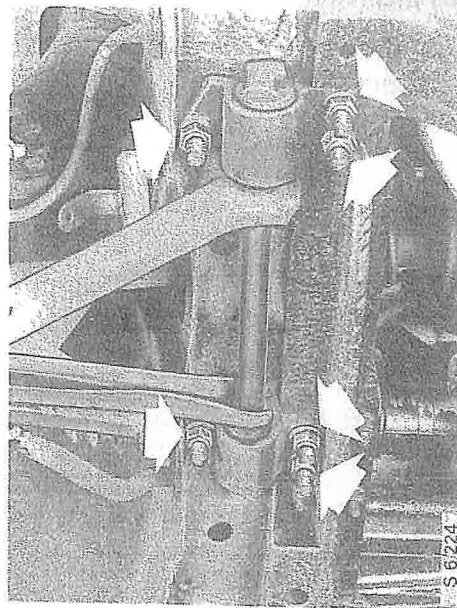
Tool 78 41 349



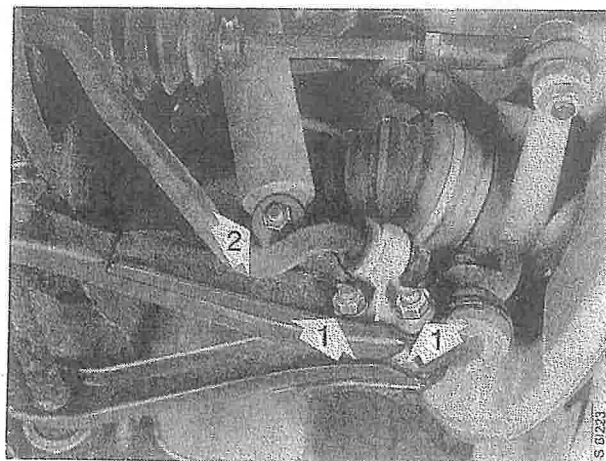
Angle between lower wishbone and bearing bracket

632-14 Wishbones

- 2 Raise the wishbone.
- 3 Tighten the six fixing bolts.



- 4 If the car is equipped with an anti-roll bar, refit it. Tighten the two bolts (1) securing the wishbone to the ball joint and also the bolt for the bottom of the damper (2). If necessary, apply a jack underneath the outer end of the lower wishbone.



- 5 Fit the wheel.
- 6 Check the wheel alignment and adjust as necessary (subsection 601).
- 7 Test drive the car.

Steering column assembly

Steering wheel	641- 1	Replacing the rubber gaiter on the intermediate shaft	641-11
Steering column assembly	641- 4		

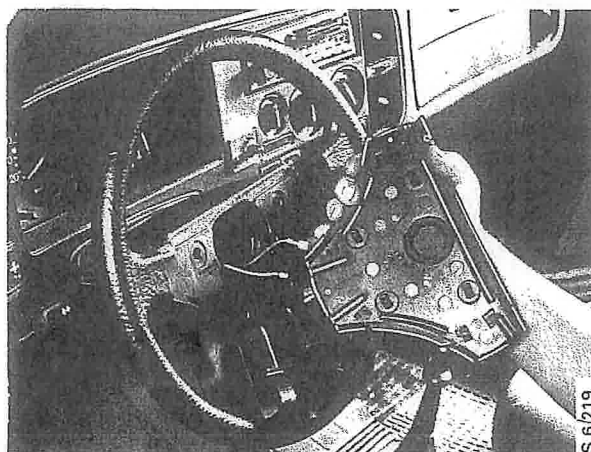
Steering wheel

Caution

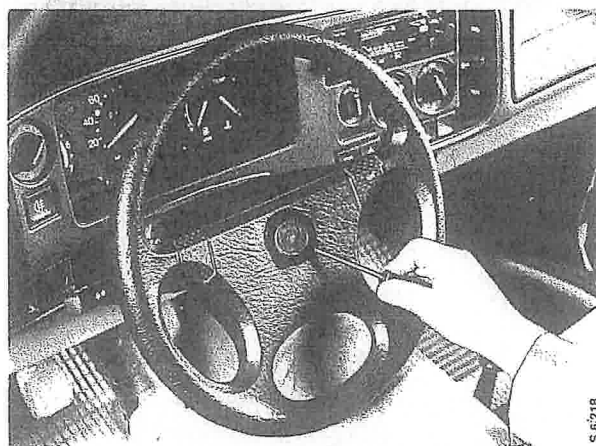
Never hammer or use any form of impact tool to remove or refit the steering wheel.

To remove

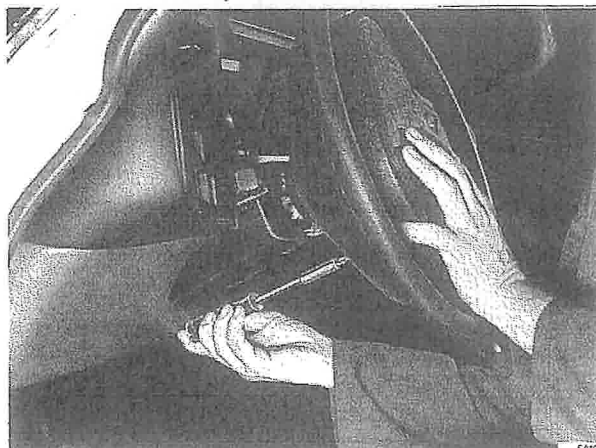
- 1 Remove the steering-wheel padding:
On three-spoke wheels, unhook the rubber flanges on the padding from the spokes.



On four-spoke wheels, remove the badge.

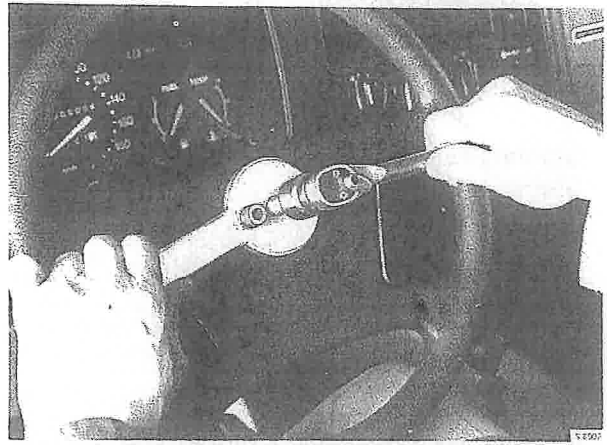


On M79 and M80 cars, the padding is held by four screws, accessible from behind the wheel.

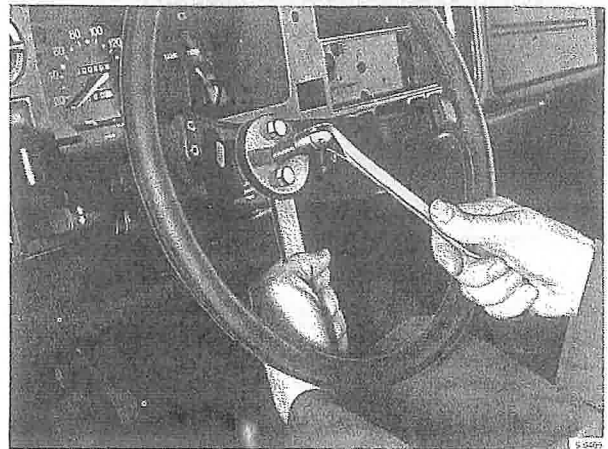


641-2 Steering column assembly

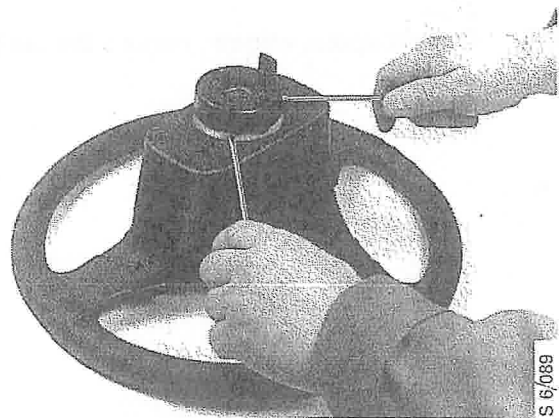
- 2 Undo the centre-nut and pull the steering wheel off the shaft using puller 89 96 258, which screws into the two holes in the steering-wheel hub.



The puller is suitable for use on all steering-wheel variants.



- 3 Using two screwdrivers, prise off the actuator for the cancelling mechanism for the direction indicators. (N/A to M79 or M80 cars.)



To fit

- 1 Fit the steering wheel onto the shaft. The road wheels must be pointing straight ahead and the steering wheel must be fitted with the spokes symmetrical. Fine-tuning of the position of the steering wheel should be done on the road. If the steering wheel cannot be fitted with the spokes level (e.g. top spoke lined up with instrument panel), adjustment can be made by screwing the track rods in or out by the same amount on both sides (see subsection 601). Tighten the centre-nut to the correct torque.

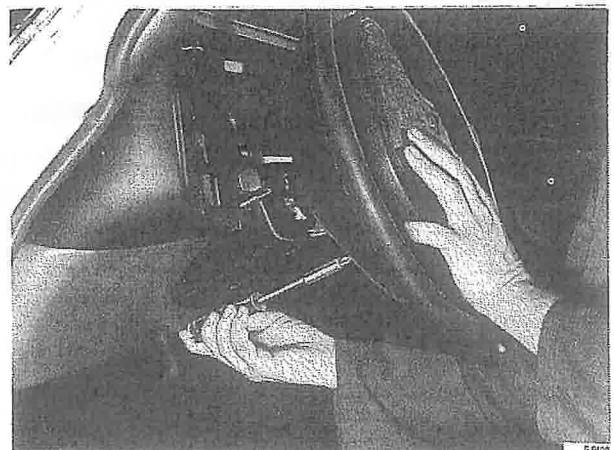
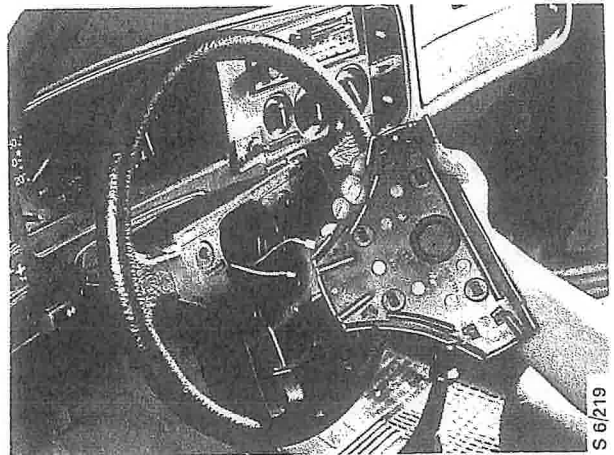
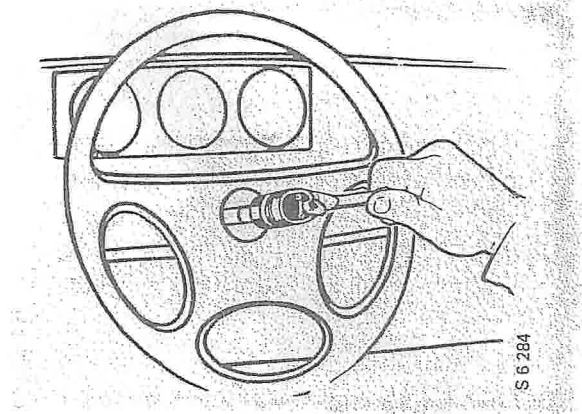
Tightening torque:**25 - 28 Nm (18.5 - 20.7 lbf ft)**

- 2 Refit the padding.

Three-spoke wheel: hook the rubber flanges of the padding onto the spokes.

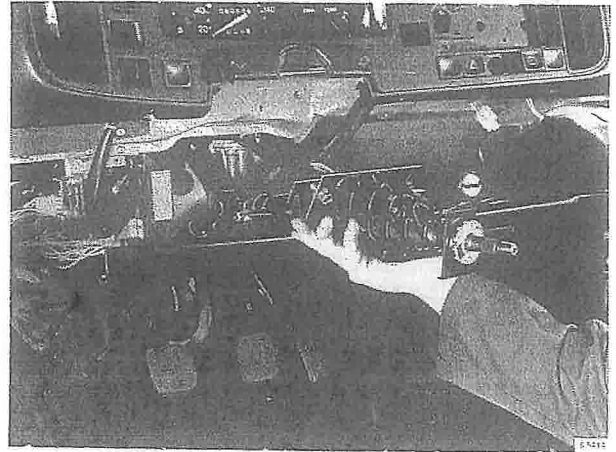
Four-spoke wheels: fit the badge.

On M79 and M80 cars, secure the padding by tightening the four screws in the back of the steering wheel.



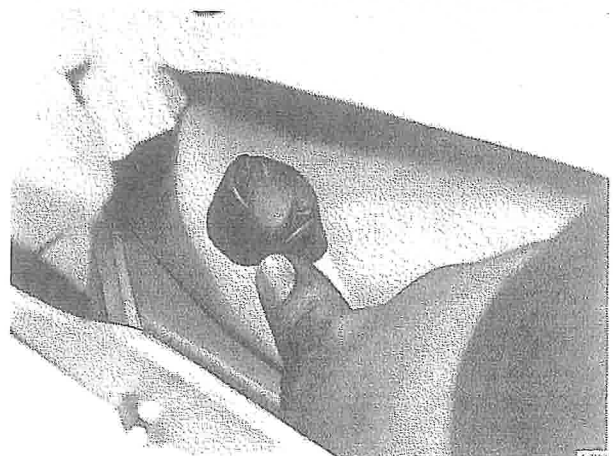
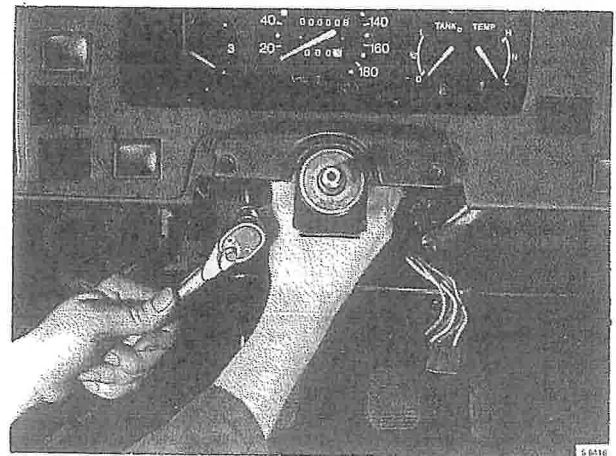
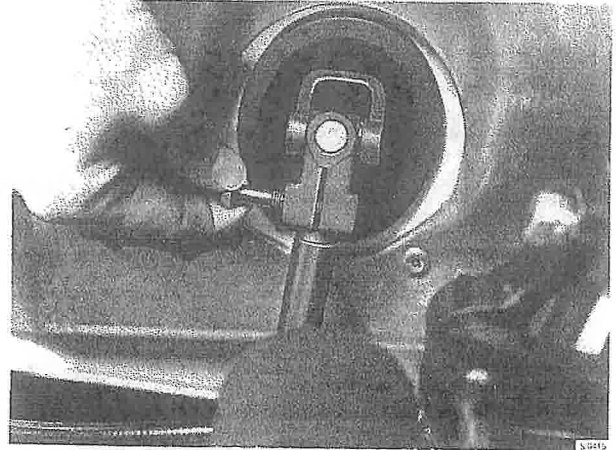
641-6 Steering column assembly

- 5 Detach the rubber gaiter from the bulkhead.
- 6 Remove the four securing bolts for the steering-column bearing bracket and remove the steering column assembly complete.



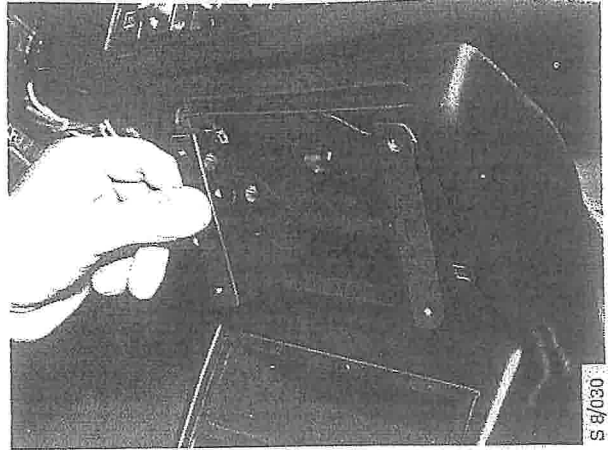
To refit

- 1 Fit the bottom UJ joint onto the pinion shaft and fit the pinch-bolt. Make sure that the pinch-bolt properly engages the groove in the shaft.
- 2 Fit the steering column bearing bracket, leaving the securing bolts slack. Line up the holes in the bearing bracket with those in the dash panel and then tighten the securing bolts.
- 3 Fit the rubber gaiter to the bulkhead.
Apply sealant to the groove in the gaiter.
- 4 Refit the stalk switch unit, followed by the lower dash panel section and the cowling for the steering column bearing.
- 5 Refit the lower section of the dash panel and seal the fixing holes with plastic sealant.



6 Refit the radio console (where applicable):

- Put back the two console sections and tighten the securing screws.
- Put back the ashtray housing, reconnect the electrical leads and fit the bulb. Tighten the screws securing the housing to the dash crossmember. Tighten the four screws securing the ashtray housing to the console and fit the ashtray.



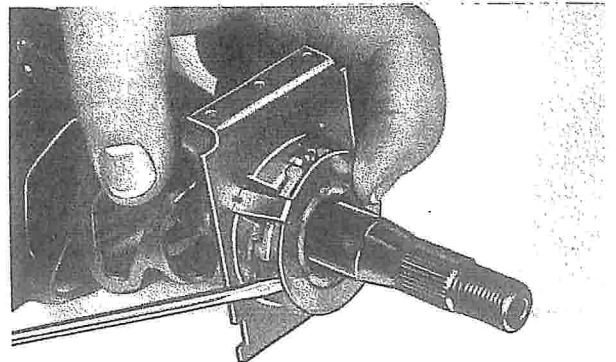
- Press the rubber gaiter back into place.



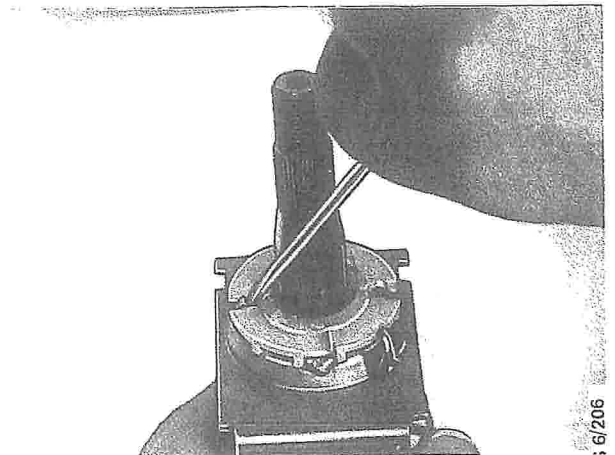
7 If necessary, adjust the position of the steering wheel.

To dismantle

- 1 Remove the circular contact.

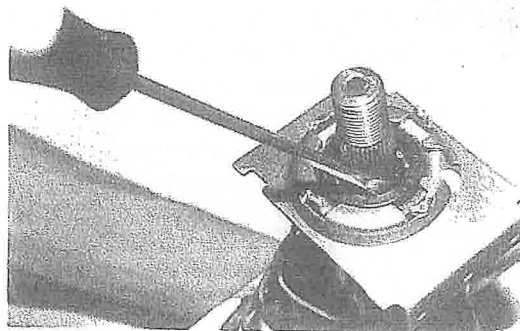


- 2 Prise out the catch and remove the plastic retainer.



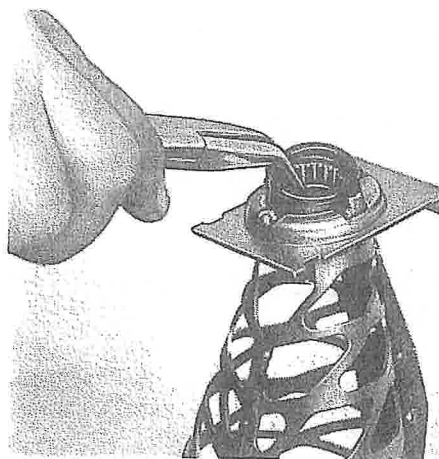
641-8 Steering column assembly

- 3 Remove the top needle bearing: carefully press in the steering-column shaft until it touches the basket section of the column and then tap down the needle bearing underneath the rubber seal.



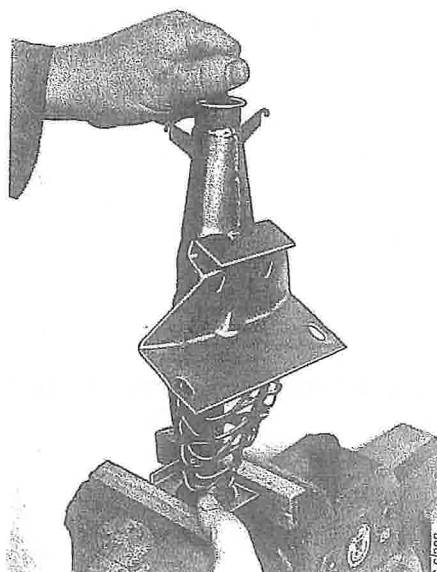
S 6/269

- 4 Remove the seal and needle bearing.



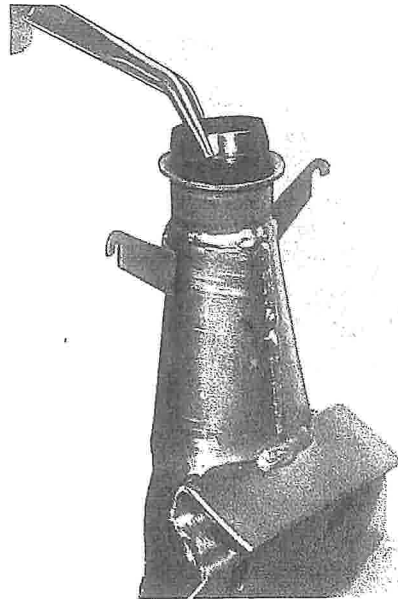
S 6/207

- 5 Withdraw the steering-column shaft.



S 6/208

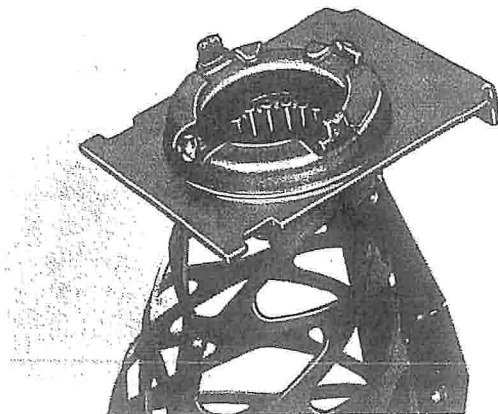
6 Remove the lower needle bearing.



S 6/209

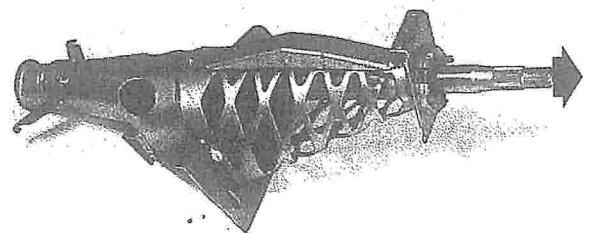
To assemble

1 Press in the top needle bearing.



S 6/210

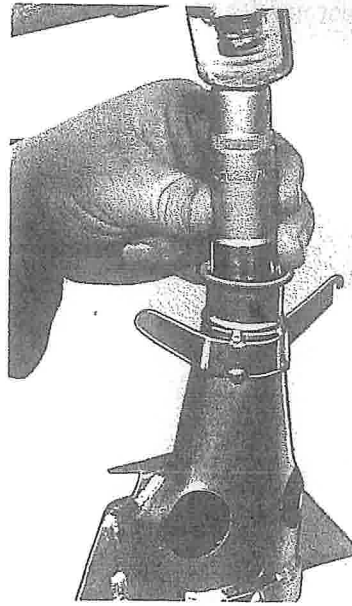
2 Slide the steering-column shaft into position from below as far as it will go.



S 6/232

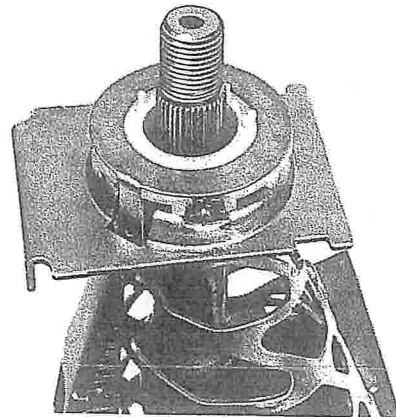
641-10 Steering column assembly

- 3 Carefully tap the lower needle bearing into place.



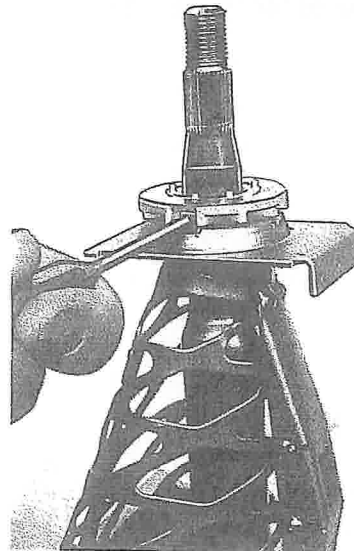
S 6/211

- 4 Push back the shaft to its correct position.
- 5 Fit a new plastic retainer and refit the circular contact.



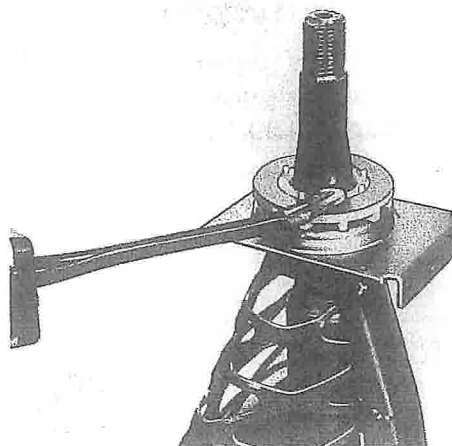
S 6/233

- 6 Tap the catch into engagement.



S 6/212

- 7 "Weld" the plastic pegs onto the circular contact.

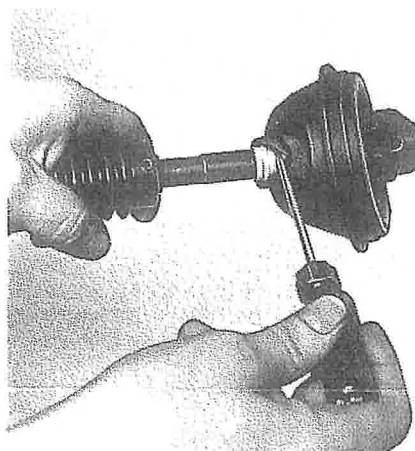


S 6/213

Replacing the rubber gaiter on the intermediate shaft

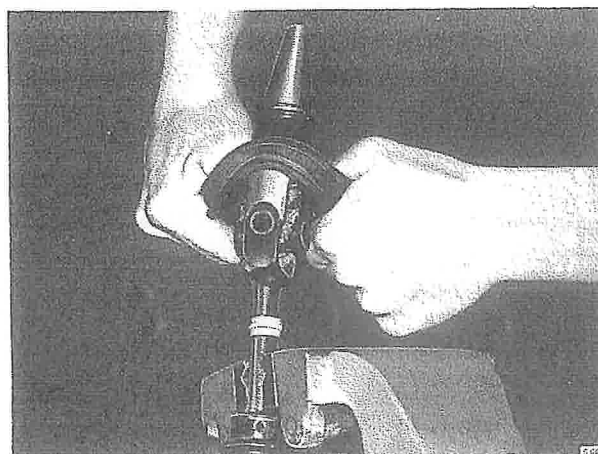
To replace the rubber gaiter on the intermediate steering shaft, the intermediate shaft must first be removed by undoing the pinch-bolts in the two universal joints (on the pinion shaft and the steering-column shaft).

- 1 Remove the gaiter by levering the bush towards the intermediate shaft and then cutting away the gaiter.

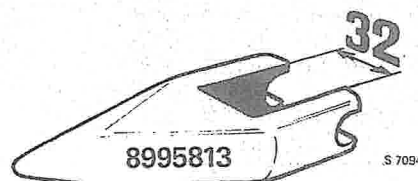


S 6417

- 2 To fit the new gaiter, fit the tapered guide 8995813 on the joint, and then slide the gaiter over the tool and joint. It helps to lubricate the tool with Vaseline or soapy water.



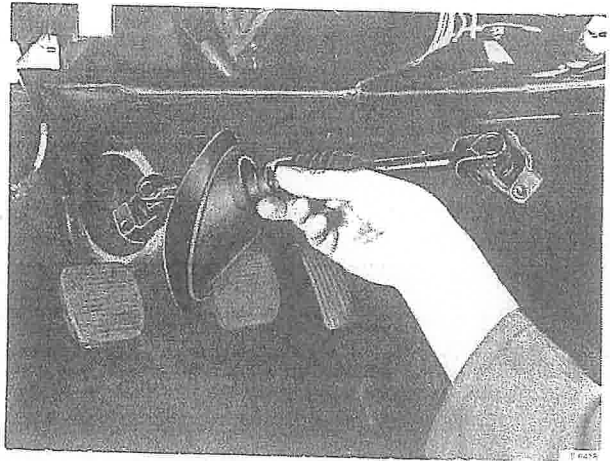
Early variants of tool 89 95 813 can be modified for use on 900 models by increasing the width of the slot to 32 mm.



641-12 Steering column assembly

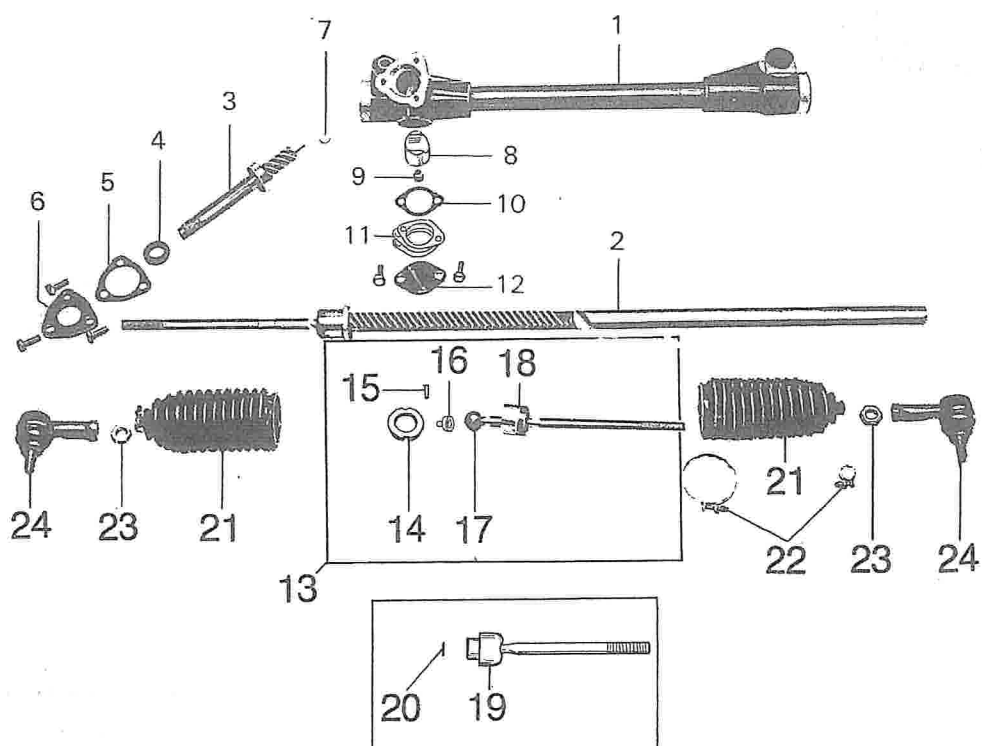
- 3 Fit the bush in the hole in the gaiter.

Before refitting the intermediate shaft, apply sealant to the groove in the gaiter where it seals against the bulkhead.



Manual steering system

Removal	642-2	Replacing the rack gaiters	642-11
Refitting	642-3	Adjusting the rack-and-pinion gear	642-11
Dismantling	642-4		
Assembly	642-6		

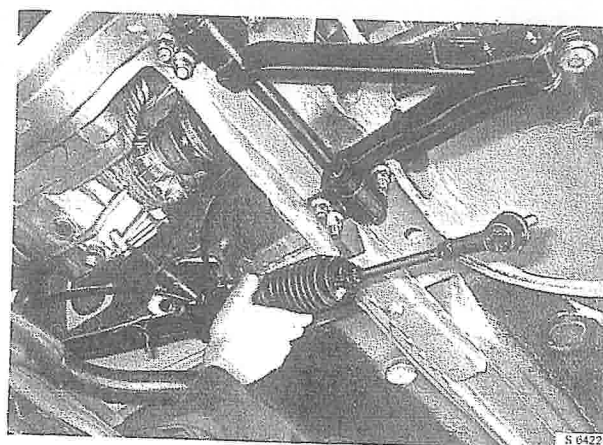
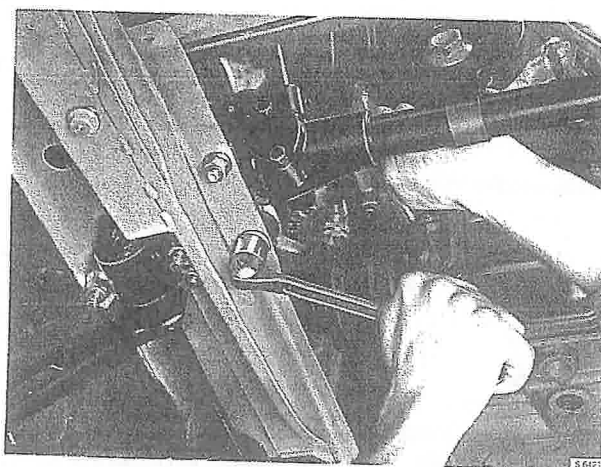
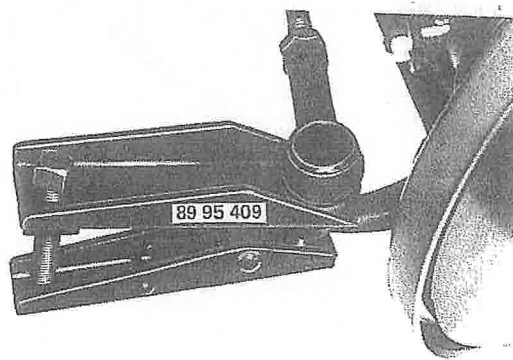
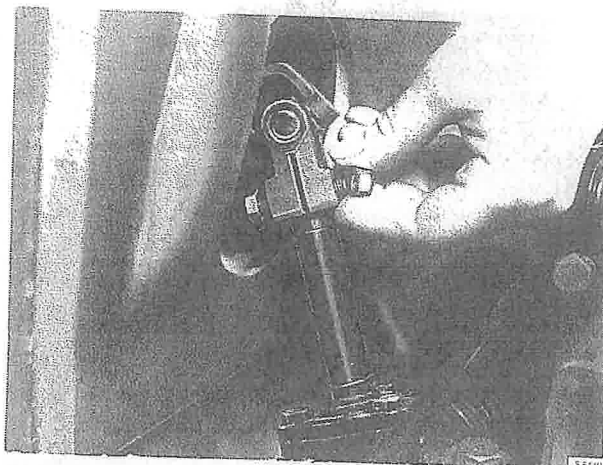


Rack-and-pinion gear

- | | |
|--------------------------------------|--|
| 1 Rack housing | 13 Adjustable inner ball joint (M81 and earlier) |
| 2 Rack | 14 Locknut |
| 3 Pinion shaft complete with bearing | 15 Locking pin |
| 4 Seal | 16 Inner bearing cap |
| 5 Gasket | 17 Track rod |
| 6 Cover plate | 18 Outer bearing cap |
| 7 Needle bearing | 19 Nonadjustable inner ball joint (M82 onwards) |
| 8 Damping yoke | 20 Spacer |
| 9 Spring | 21 Gaiter |
| 10 Gasket | 22 Clips |
| 11 Shims | 23 Locknut |
| 12 Cover plate | 24 Track-rod ends |

To remove

- 1 Raise the car and remove the front road wheels.
- 2 Remove the pinch-bolt from the universal joint between the intermediate shaft and the pinion shaft.
- 3 Remove the nuts from the track-rod ends and disconnect the track-rod ends from the track arms using ball-joint separator 89 95 409.
- 4 Remove the securing bolts for the rack assembly.
- 5 Separate the universal joint on the steering-column shaft from the pinion shaft, move the rack assembly to the side and withdraw it through the aperture in the engine-bay floor.

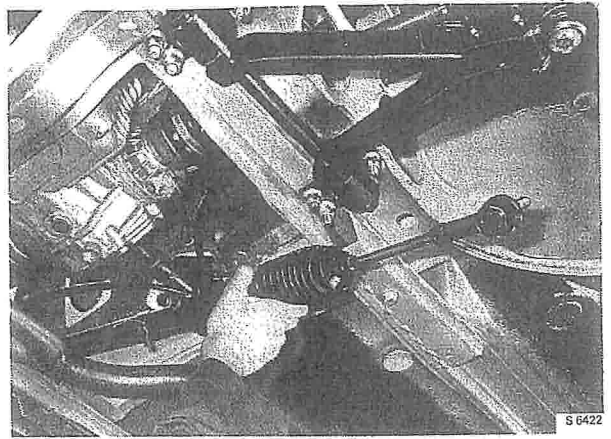


N.B.

Take care to avoid damaging the gaiters against sharp edges.

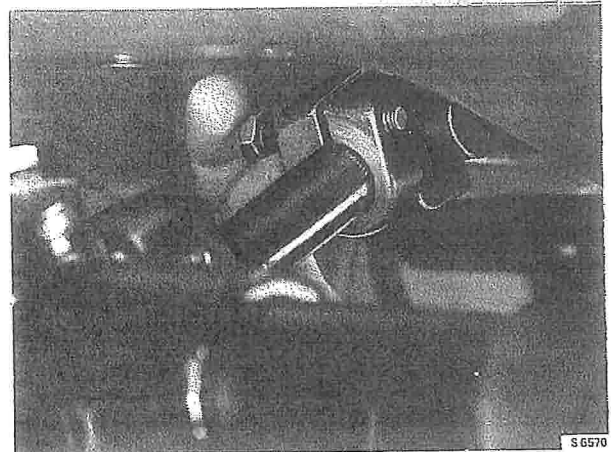
To refit

- 1 Lift the rack assembly into position through the aperture in the engine-bay floor.



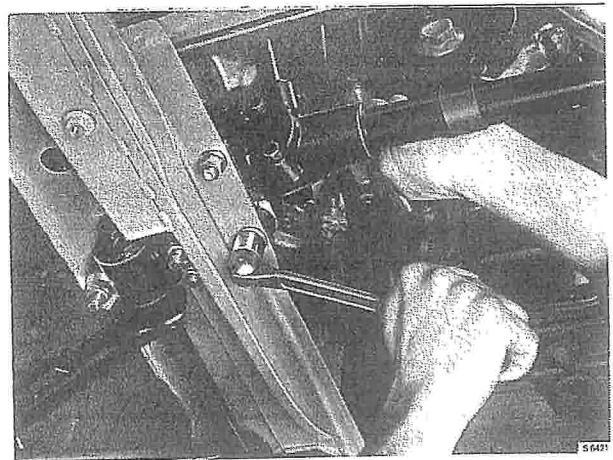
- 2 Reconnect the universal joint on the intermediate shaft to the pinion shaft. Ensure that the pinch-bolt is located in the groove in the pinion shaft.

Pinch-bolt tightening torque:
25 - 34 Nm (18.5 - 25.2 lbf ft)



- 3 Refit and tighten the two bolts securing the rack assembly to the body.

Tightening torque:
60 - 80 Nm (44.4 - 59.2 lbf ft)



- 4 Reconnect the track-rod ends to the track arms.

Tightening torque:
50 - 60 Nm (37.0 - 44.4 lbf ft)

- 5 Check the toe-in and steering-wheel position and adjust as necessary (see subsection 601). Tighten the locknuts on the track rods.

Tightening torque:
60 - 80 Nm (44.4 - 59.2 lbf ft)

Caution

The collapsible steering column must be handled with care. If it is knocked or treated roughly the preset length of the telescopic section can be altered and the energy-absorbing properties of the column impaired.

When fitting the steering column, make doubly certain that the splined joint is slid fully home on the pinion shaft, so that the groove in the shaft lines up with the pinch-bolt. The joint should slide easily onto the shaft; should the splines bind, never tap or hammer the top of the column.

Similarly, never hammer or use any form of impact tool to remove or refit the steering wheel.

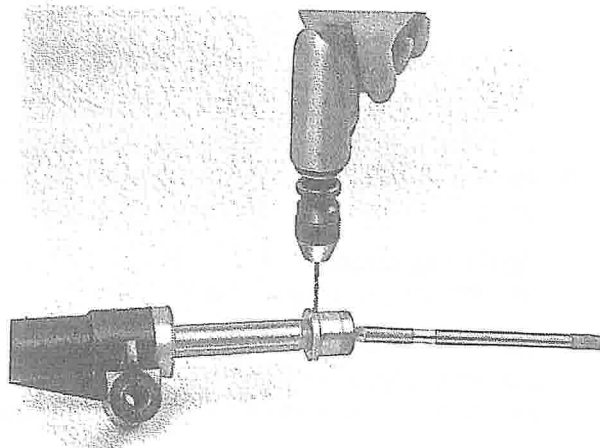
When the front wheels are off the ground, never forcibly swivel a front wheel, causing the steering to spin to full lock. **This can very easily result in serious damage to the steering system.** Operating the rack-and-pinion gear by swivelling a road wheel will cause the steering wheel to spin at high torque, exerting a powerful torsional stress on the steering column when the rotation is arrested by the stop in the rack-and-pinion gear.

To dismantle

- 1 Undo the locknuts and unscrew the track-rod ends.
- 2 Slacken the clips and remove the rack gaiters.
- 3 Separating adjustable inner ball joints:
 - Drill out the pins in the inner ball joint
Drill diameter: 4 mm; length of pin: 9.4 mm.

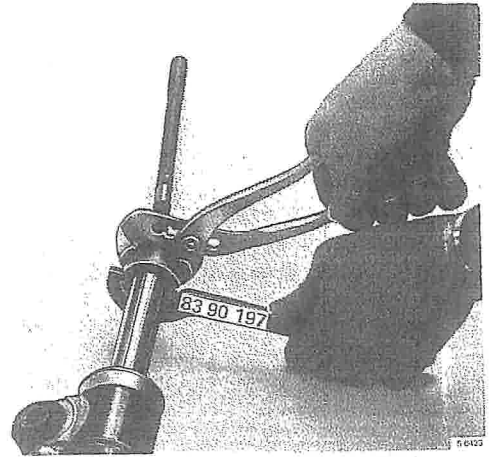
Caution

Do not drill too deep.



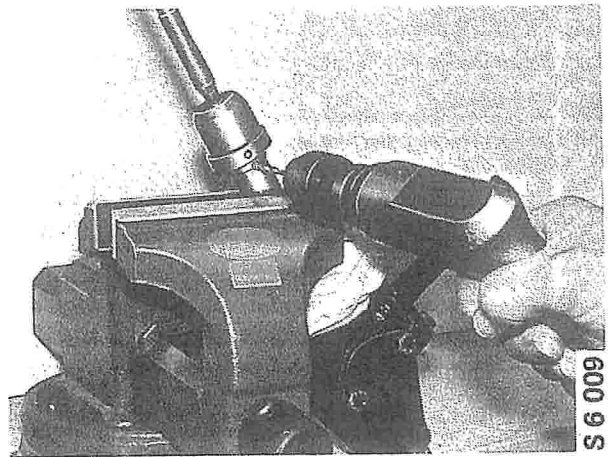
S.0591

- Remove the outer bearing caps and locknuts using 'C' spanner 83 90 197 and water pump pliers.

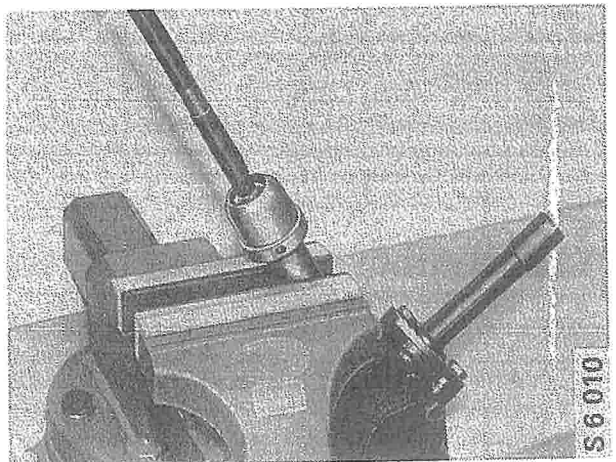


4 Separating nonadjustable inner ball joints:

- Place suitable protection around the rack and then drill out the tab in the locking groove. Drill diameter: 4 mm.



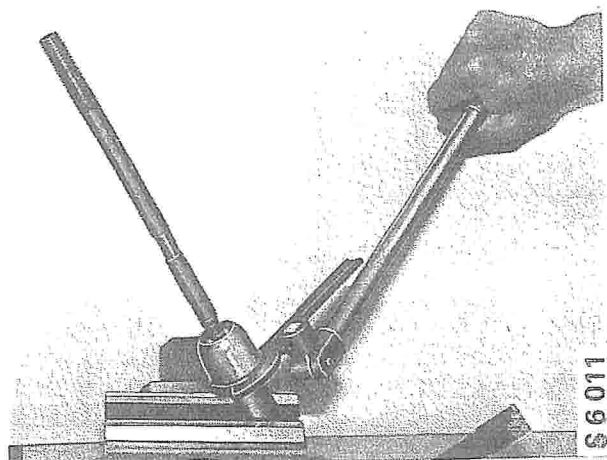
- Clamp the rack, pinion end down, in a soft-jaw vice.



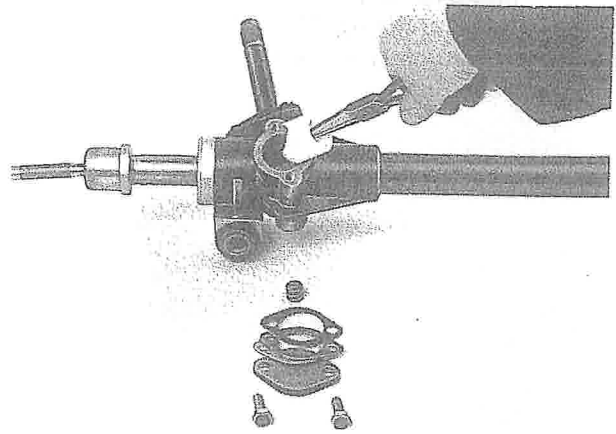
Caution

Under no circumstances must force be applied to the pinion when undoing or tightening the ball joint.

- Undo the inner ball joint using 'C' spanner 89 96 472.

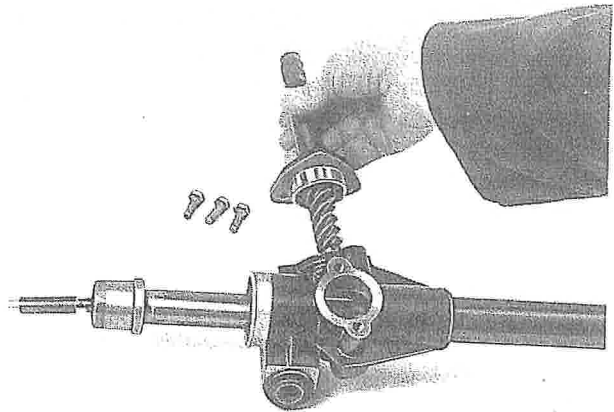


- 5 Undo the bolts and remove the cover plate, shims, spring and damper yoke for radial adjustment of the rack.



- 6 Undo the bolts securing the pinion and remove the pinion complete with bearing, cover plate and seal.

The bearing is factory-fitted on the pinion shaft and cannot be replaced separately. Only complete bearing and pinion shaft units are available.



- 7 Withdraw the rack.
- 8 If necessary, remove the needle bearing.
- 9 If necessary, remove the bush from the end of the housing.

To assemble

Before assembly, thoroughly clean all parts.

Lubrication: Lubricate the moving parts of the assembly and pack the gear housing with 1.5 dl (0.16 liq qt) of BP Energrease FGL.

- 1 Refit the bush in the end of the gear housing.
- 2 Using a drift, refit the needle bearing in the gear housing.

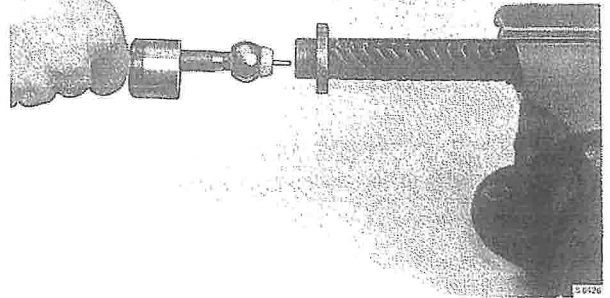
Cars with adjustable inner ball joints:
Carry out steps 3 - 11 inclusive, and then omit step 12.

Cars with nonadjustable ball joints:
Go direct to step 12.

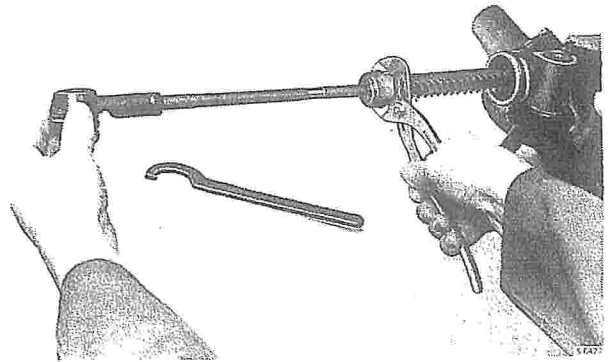
- 3 Fit the inner ball joint onto the toothed end of the rack as follows:

- Screw the locknut onto the rack.

Lubrication: apply Molybdenum paste to the ball and bearing caps.



- Insert the plastic cap and spring into the end of the rack, fit the track rod and screw on the outer bearing cap.



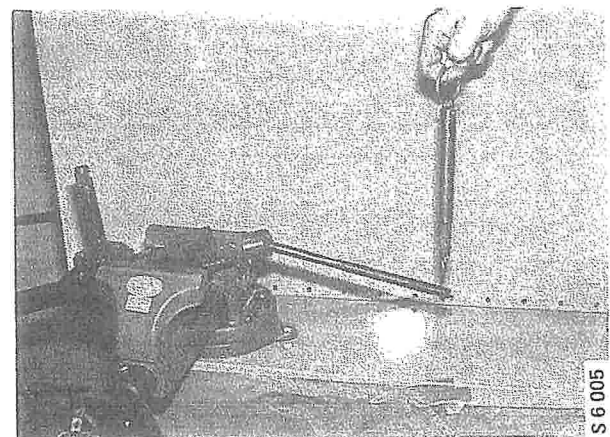
- 4 Adjust the preload on the joint as specified below. Thereafter, tighten the locknut to the specified torque using a 'C' spanner and holding the outer ball cup with water pump pliers.

Tightening torque:
45 - 50 Nm (33.3 - 37.0 lbf ft)
Ball-joint preload:
7.3 - 32.0 N (1.7 - 5.4 lbf)

Caution

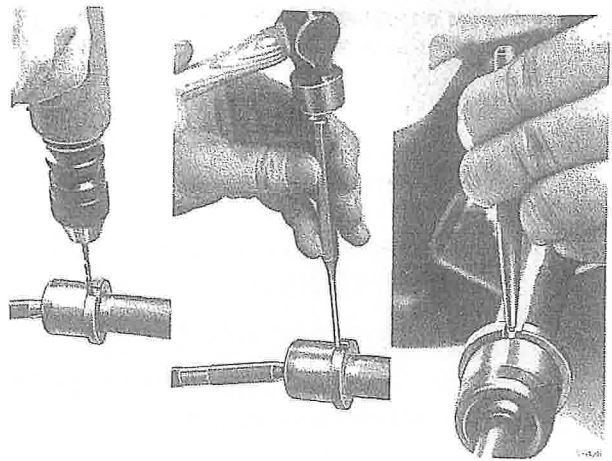
The maximum preload value of 32.0 N must not be exceeded in any direction of the track rod. If the amount of preload cannot be brought within the specified range by adjustment, the track rod and ball caps must be replaced.

To measure the ball-joint preload, use a spring balance attached to the end of the track rod.



642-8 Manual steering system

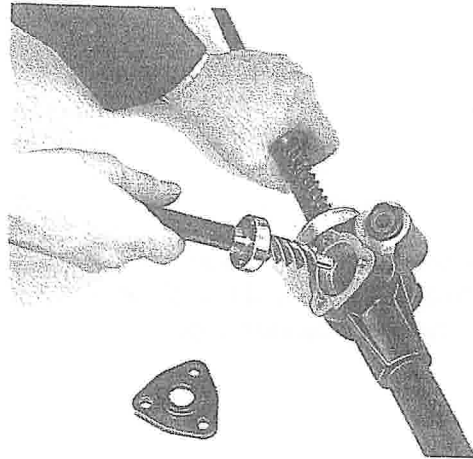
- 5 Recheck the ball-joint preload. Drill a new hole for the pin (3.9 mm diameter; 9.4 mm deep) and fit a new pin. Secure the pin by using a drift to upset the edge of the hole in four places. Make absolutely certain that no swarf gets into the steering gear.



- 6 Insert the rack in the housing. Fit the pinion (complete with bearing), gasket, seal and cover plate.

Lubricant: BP Energrease FGL.

Apply thread sealant to the through-bolt.

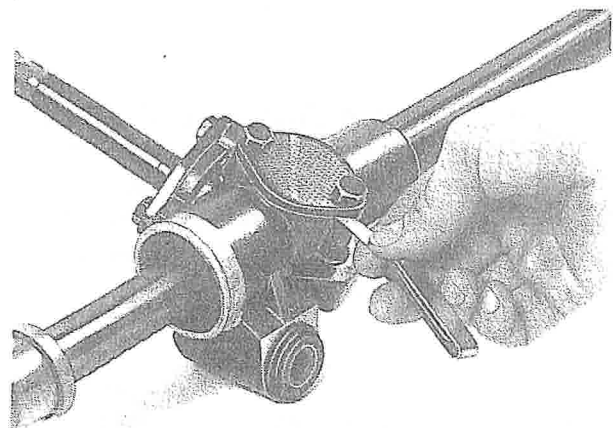
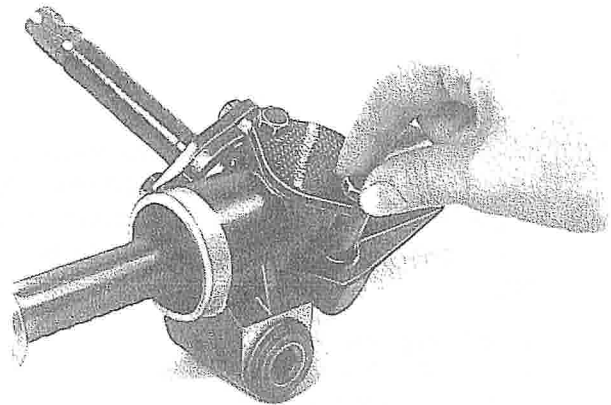


- 7 Adjust the damper yoke for the rack as follows:

- Fit the damper yoke without the spring. Fit the cover plate (without gasket), leaving the screws finger tight only, to bring it into contact with the damper yoke. (Overtightening the cover plate will distort it.)

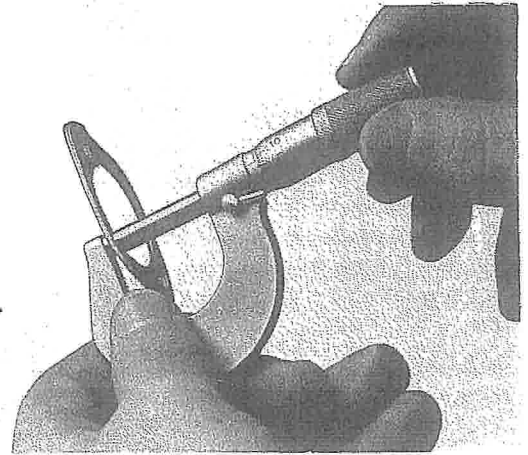
It is also possible to make the adjustment with the rack-and-pinion gear fitted to the car.

- Measure the clearance by inserting a feeler gauge between the cover plate and the housing.

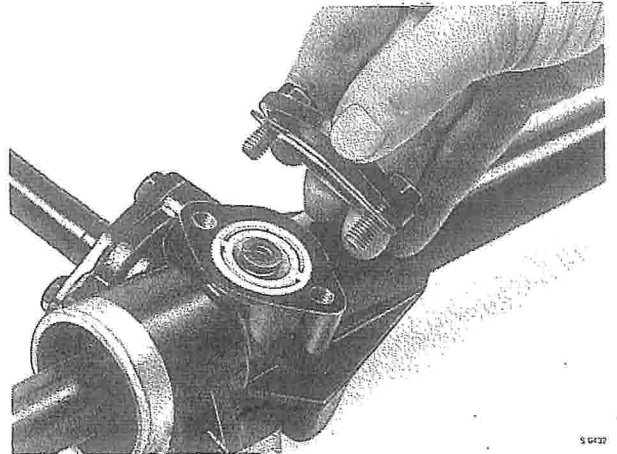


- Note the value and add 0.05 - 0.15 mm to allow for the clearance required between the damper yoke and the cover plate after fitting. For instance: assume that the feeler gauge indicates a clearance of 0.55 mm; therefore, the total thickness of gasket and shims required will be 0.60 - 0.70 mm. Use a micrometer to measure the thickness of the gasket and shims (as shown).

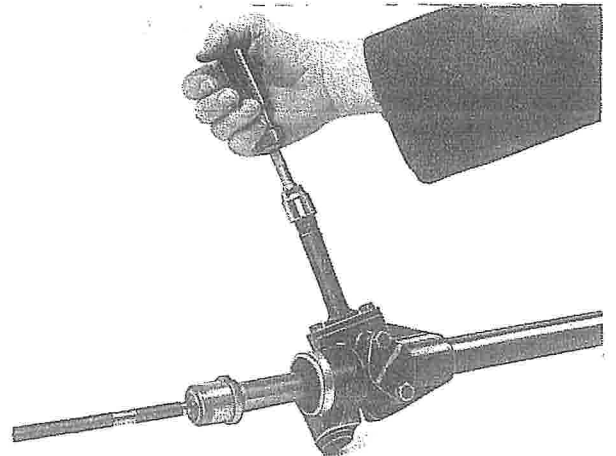
Shims are available in thicknesses 0.13, 0.19 and 0.25 mm.



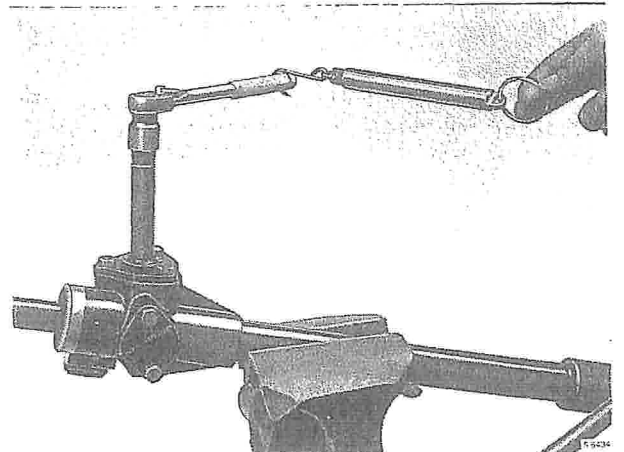
- 8 Refit the damper yoke, spring, shims, gasket and cover plate.



- 9 Fit an 18-mm bihexagon socket onto the splines of the pinion shaft, and rotate the pinion to check that the rack slides freely and does not bind.



- 10 With the rack-and-pinion gear correctly adjusted, the torque loading on the pinion should be 0.8 - 1.7 Nm (0.59 - 1.26 lbf ft). To check this, measure the moment of force required to rotate the pinion by means of a spring balance, 18-mm bihexagon socket and a suitable socket handle. If the length of the handle (lever) is approx. 15 cm, the reading on the spring balance should be between 5 and 11 N (1.15 - 2.53 lbf).

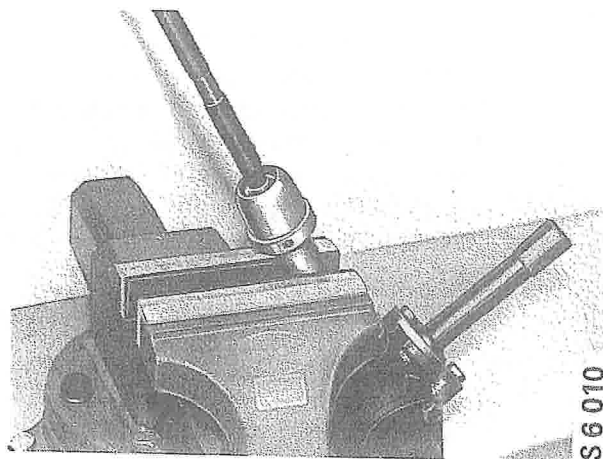


642-10 Manual steering system

- 11 Fit the other ball joint and adjust the preload in the same way as before.
- 12 Refitting of nonadjustable inner ball joints:
 - Clamp the toothed end of the rack in a soft-jaw vice.

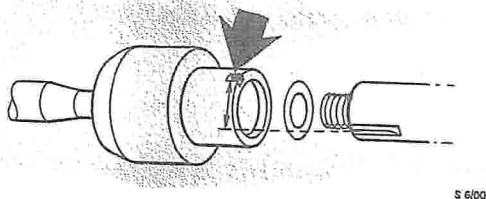
Caution

Under no circumstances must force be applied to the pinion when undoing or tightening the ball joint.



- Screw on the inner ball joint.

If the existing ball joint is to be refitted, the old peening mark must be offset by at least 90°. This is achieved by fitting spacer 8946360 between the rack and the inner ball joint.

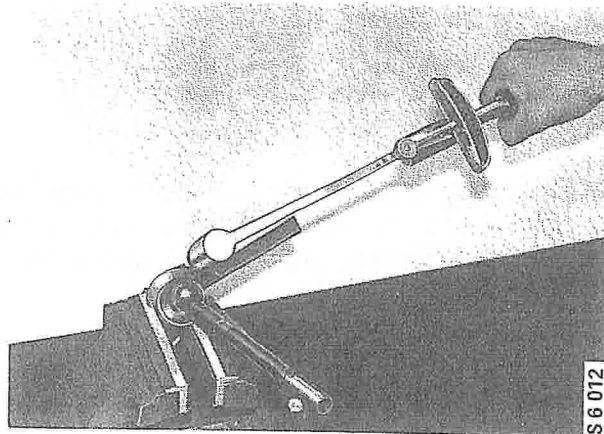


Old peening mark offset by 90°

- Tighten the ball joint to the specified torque using 'C' spanner 8996472 and a torque wrench.

Tightening torque:

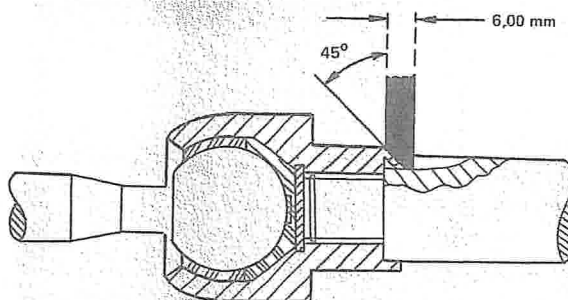
110 - 130 Nm (81.4 - 96.2 lbf ft)



- Lock the inner ball joint to the rack by up-setting the flange in the groove.

N.B.

The rack must be removed from the vice before the flupset.



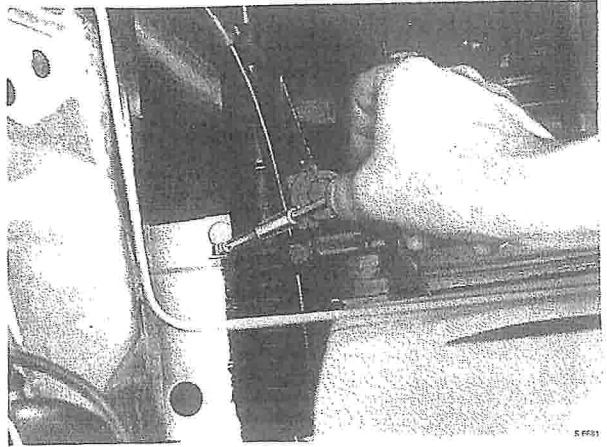
S 6 003

13 Refit the rack gaiters.

Lubrication: Apply silicone grease to the contact surfaces between the rubber gaiters and the track rods. Before fitting the gaiter on the rack end, pack it with 1.5 dl of BP Energrease FGL.

Fit rubber caps over the screws on the clips.

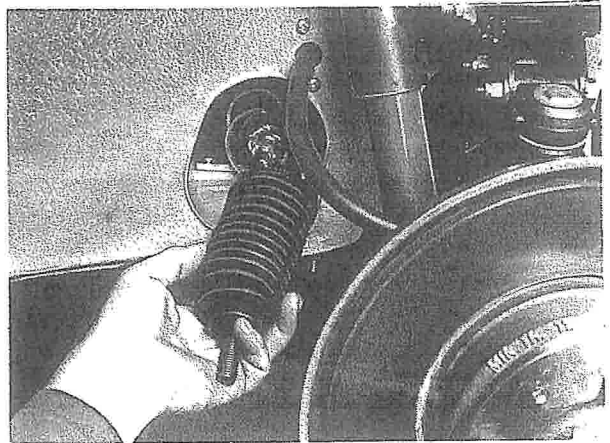
14 Screw on the locknuts and fit the track-rod ends onto the track rods.



Replacing the rack gaiters

If either of the rubber gaiters needs replacing, this can be carried out with the steering gear in the car but with the track-rod end and locknut removed. Clean the area around the gaiter thoroughly before removing it.

Lubrication: Pack about 0.5 dl of BP Energrease FGL inside either end of the new gaiter.

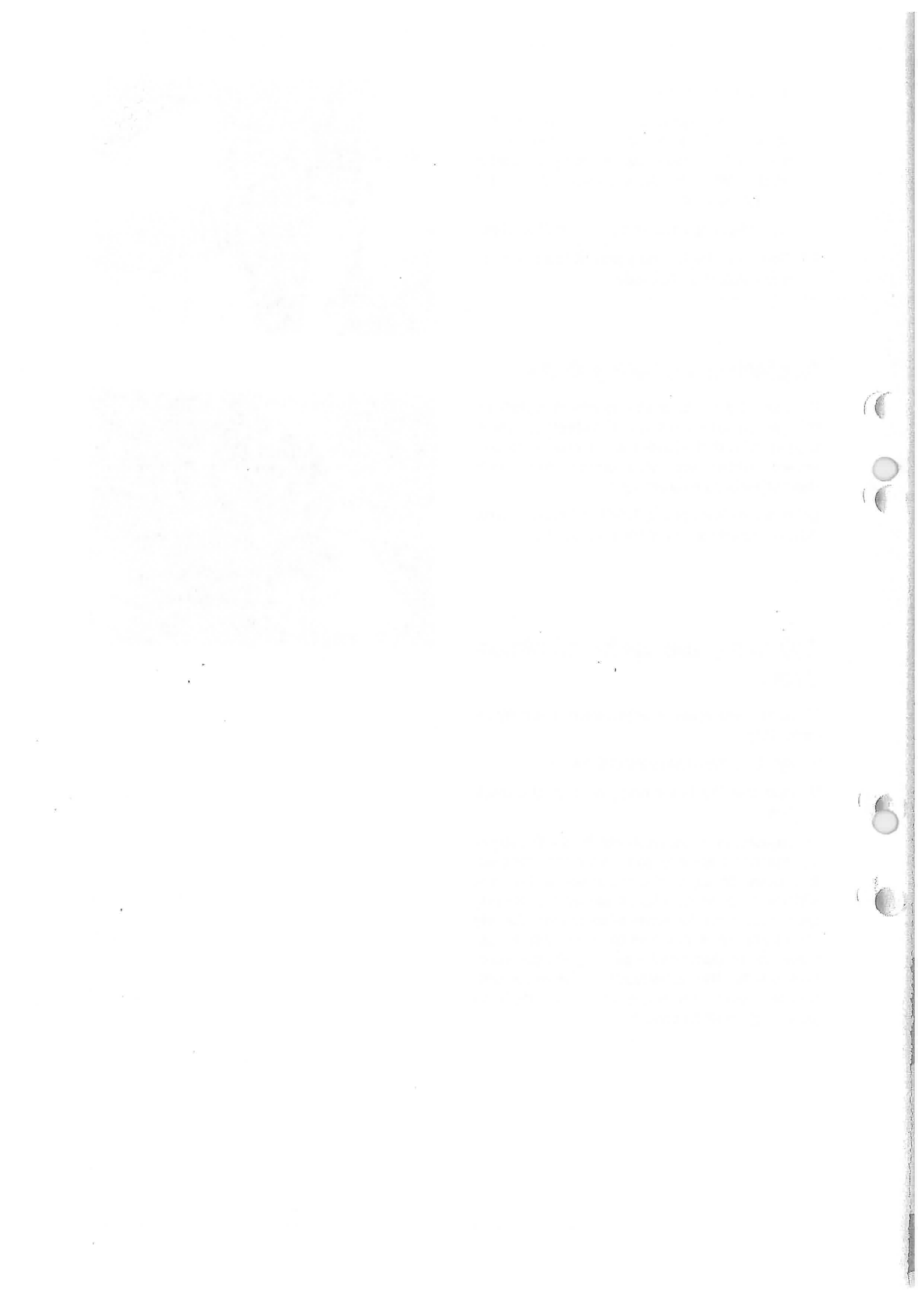


Adjusting the rack-and-pinion gear.

There are two types of adjustment that may be necessary:

- A Adjusting the radial play in the rack
- B Adjusting the inner ball joints on the track rods.

For adjustment of the inner ball joints, the steering gear must be removed from the car. However, it is easier to adjust the radial play in the rack with the steering gear fitted, unless the steering gear is removed for some other reason. As very little wear takes place in the inner ball joints, these will seldom need adjusting. For details of how to make the adjustments, refer to the section on how to assemble the rack-and-pinion gear (page 642-6 et seq.).



Track-rod ends

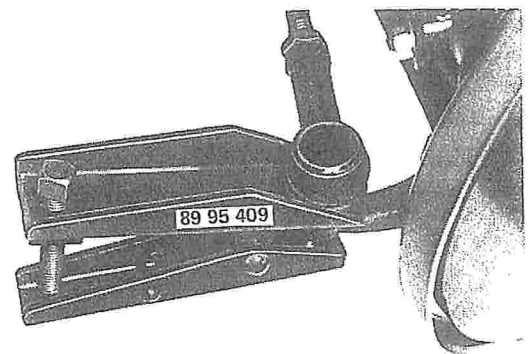
Replacing track-rod ends 643-1

Replacing ball-joint seals 643-2

Replacing track-rod ends

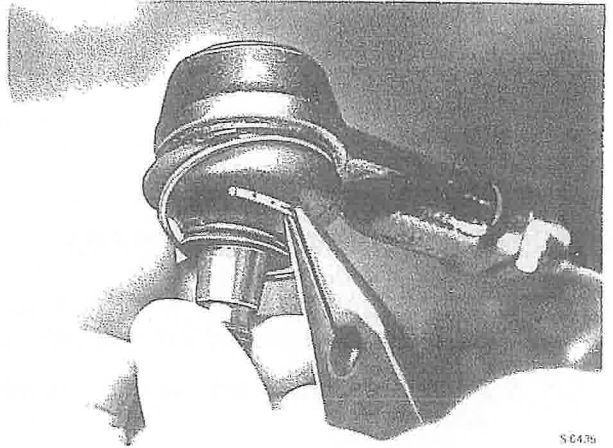
The track-rod ends cannot be dismantled and must therefore be replaced if play is present.

- 1 Raise the front of the car and remove the road wheel.
- 2 Remove the nut securing the track-rod end to the steering swivel member.
- 3 Undo the nut securing the track-rod end to the track rod.
- 4 Separate the track-rod end from the track arm using ball-joint separator 89 95 409, as shown. Never hammer the track-rod end as this is liable to damage the parts.
- 5 Unscrew the track-rod end from the track rod, counting and noting the number of turns.
- 6 Screw the new track-rod end onto the track rod using the same number of turns as required to remove the old one and leave the locknut slack.
- 7 Fit the track-rod end to the track arm and fit the nut, tightening it to the specified torque.
Tightening torque:
50 - 60 Nm (37.0 - 44.4 lbf ft)
- 8 Tighten the nut securing the track-rod end to the track rod.
Tightening torque:
60 - 80 Nm (44.4 - 59.9 lbf ft).
- 9 Refit the wheel and lower the car.
- 10 Measure and adjust the toe-in (see subsection 601).
- 11 Test drive the car.



Replacing ball-joint seals

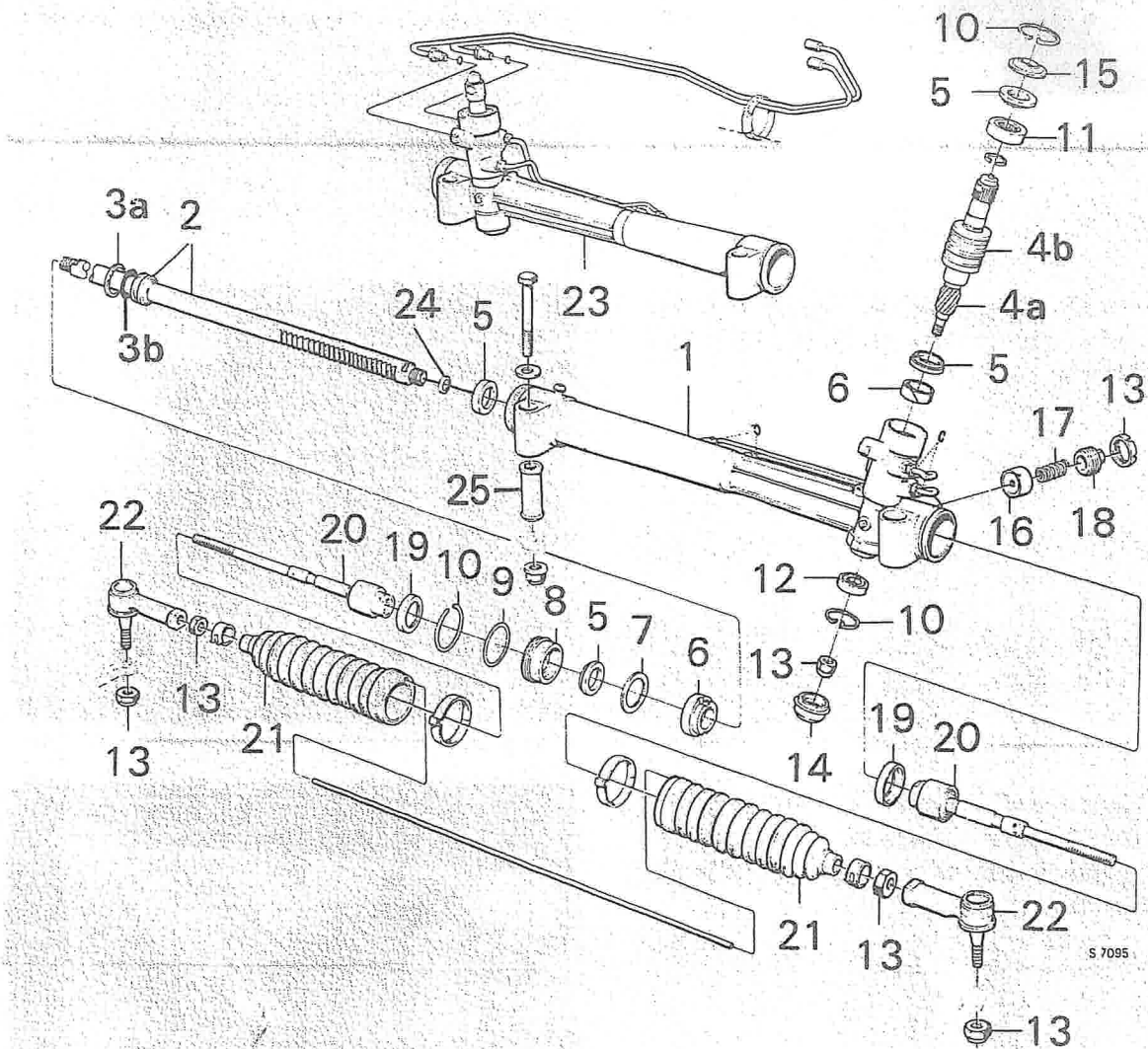
Each ball joint is protected by a rubber seal. If the seal is damaged, it will no longer be able to keep dirt and moisture out of the joint and must therefore be replaced. To change the rubber seal, disconnect the track-rod end from the track arm.



S643b

Power-assisted steering system

Removal	644-2	Assembly	644-15
Refitting	644-6	Servo pump	644-23
Dismantling	644-9		



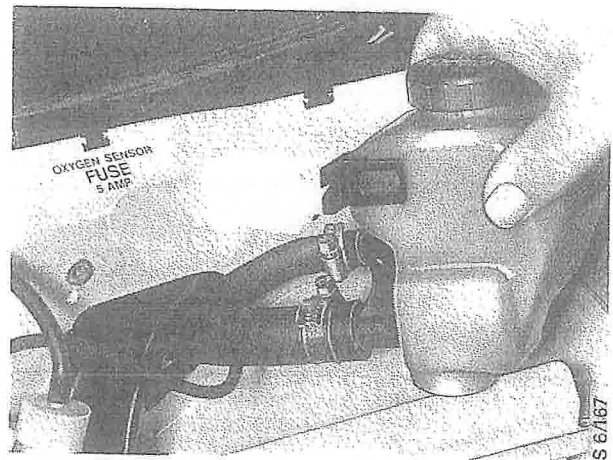
Power-assisted steering system

- | | | |
|----------------------|----------------------------|--|
| 1 Rack housing | 8 Seal retainer | 17 Spring |
| 2 Rack with piston | 9 "O" ring | 18 Adjusting screw |
| 3a Piston ring | 10 Circlip | 19 Thrust washer (end stop) |
| 3b "O" ring | 11 Needle bearing and race | 20 Inner ball joint and track rod assembly |
| 4a Pinion | 12 Ball bearing | 21 Rubber gaiter |
| 4b Control valve | 13 Locknut | 22 Track-rod end |
| 5 Hydraulic seal | 14 End cap | 23 RHD variant |
| 6 Bush | 15 Dust cap | 24 Shim (on reassembly) |
| 7 Wave spring washer | 16 Damper yoke | 25 Rubber bush |

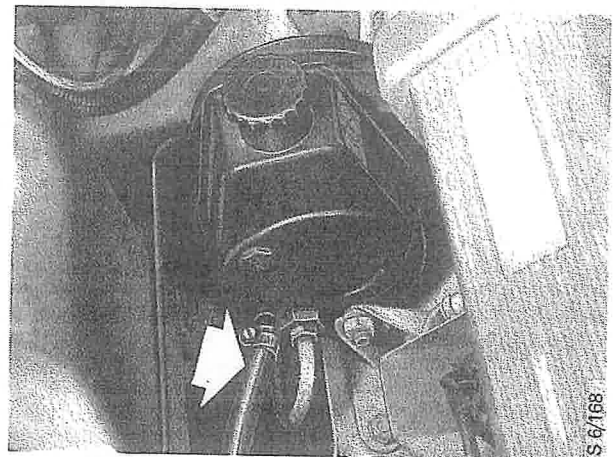
To remove

1 Drain the fluid from the system as follows:

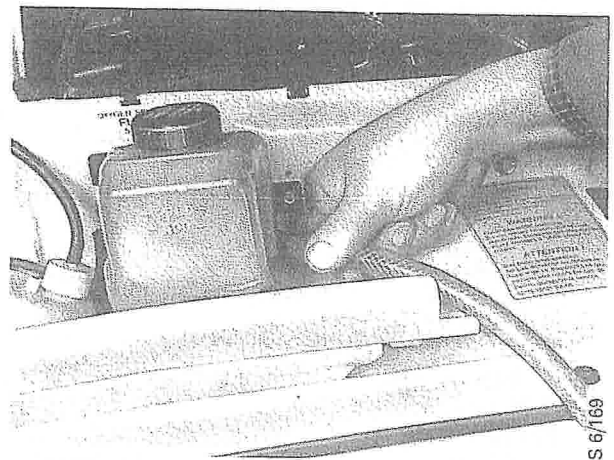
- Cars with B202 engine: Undo the fixings for the fluid reservoir and disconnect the return hose. Plug the opening in the reservoir.



Cars with B201 engine: Disconnect the return hose from the pump and plug the opening.



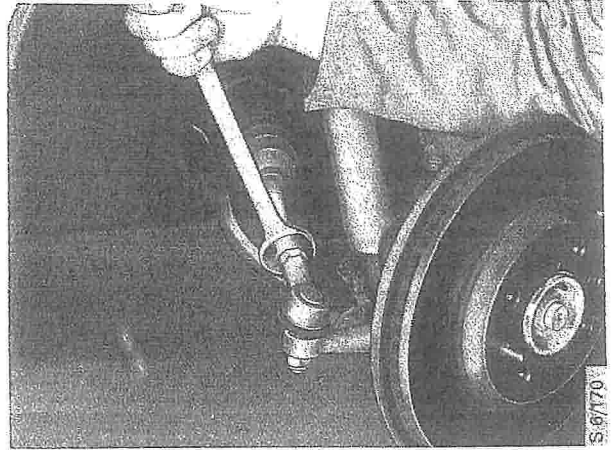
- Connect a length of hose or tubing to the return hose and place the other end in a receptacle having a capacity of at least one litre.



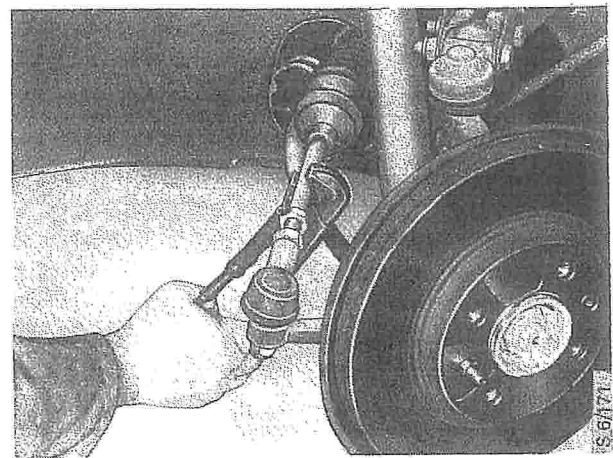
- Start the engine and allow the fluid to be pumped out of the system. Turn the steering wheel twice from lock to lock to drain the system completely.
- Cars with B202 engine: Reconnect the return hose to the fluid reservoir and secure the reservoir.

Cars with B201 engine: Reconnect the return hose to the pump.

- 2 Remove the front wheels.
- 3 Slacken the locknuts on the track rods but then return them loosely to their original position to minimize toe-in adjustment after the steering gear has been refitted.

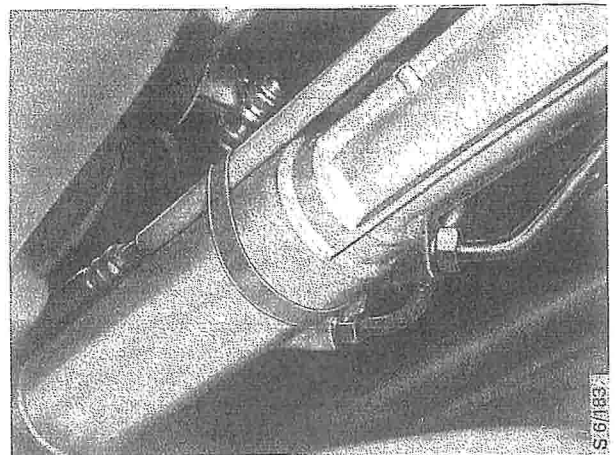


- 4 Unscrew the track rod from the track-rod end, ensuring that the rubber gaiter does not turn with the rod. Measure the distance between the locknut and the end of the track rod; this measurement will assist in setting the correct toe-in after refitting the steering gear.

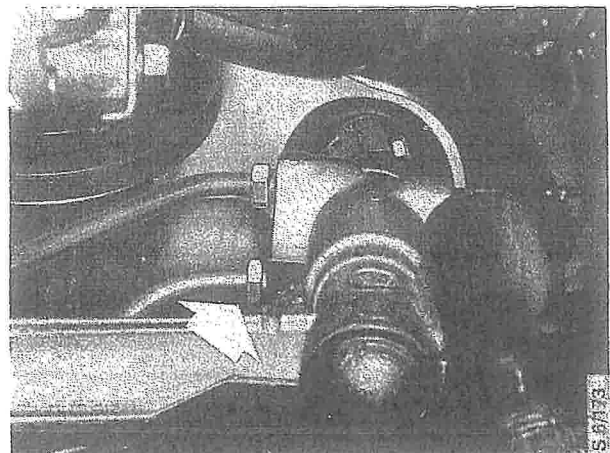


- 5 Remove the strap holding the return pipe to the rack housing and snip through the tie securing the flow hose to the pipe between the control valve and the servo cylinder.

Cars with B201 engine, M87 and earlier:
Snip off the tie round the handbrake cables and rack housing.

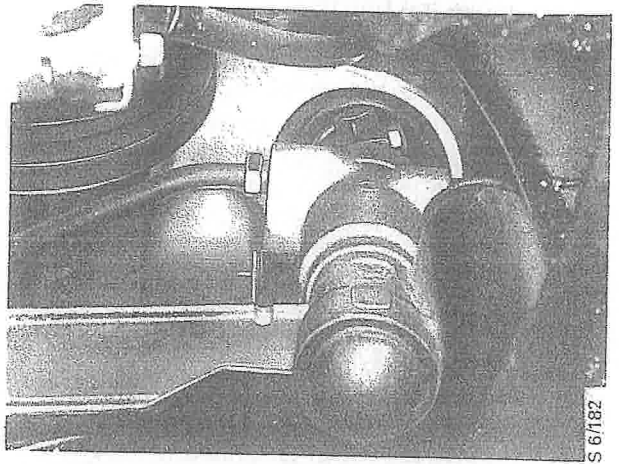


- 6 Disconnect the flow pipe from the control valve (18-mm spanner). Fit some absorbent paper to the end of the pipe to prevent spillage and rest the hose on the exhaust pipe.



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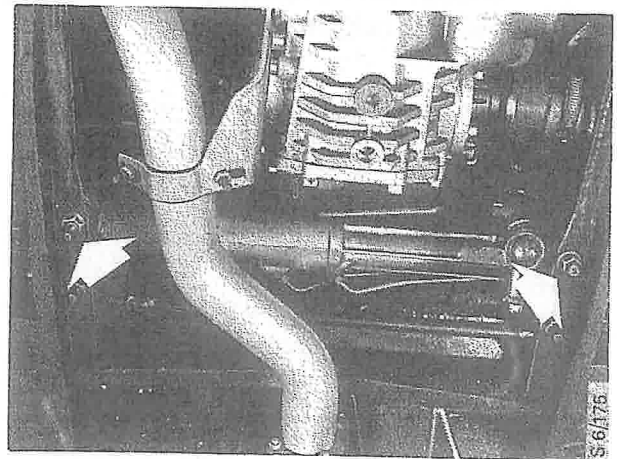
- 7 Disconnect the return pipe from the control valve (16-mm spanner). Tie the return pipe to the speedometer cable.
- 8 Plug the openings in the control valve.



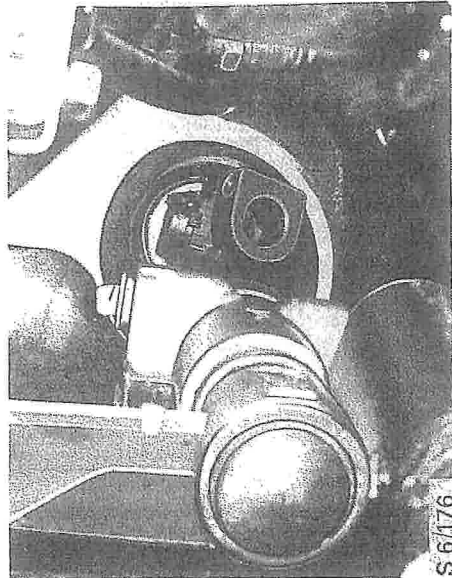
- 9 Remove the pinch-bolt from the universal joint between the pinion shaft and the intermediate shaft.



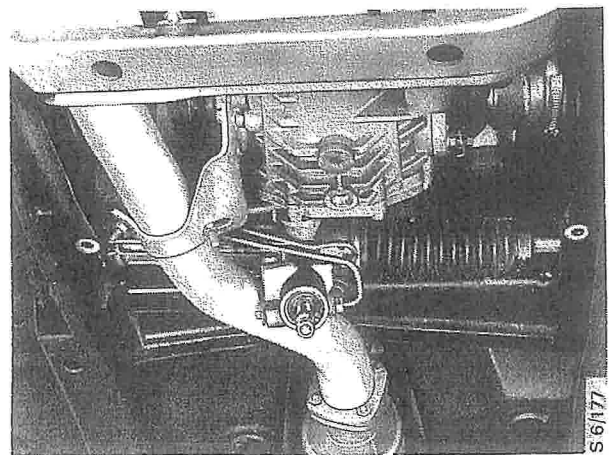
- 10 Remove the securing bolts for the rack-and-pinion gear assembly.



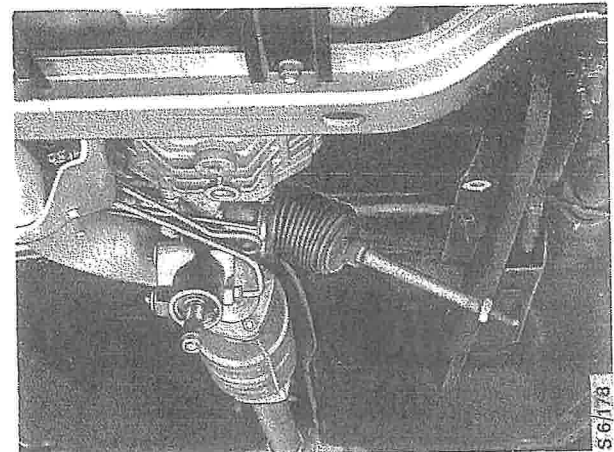
- 11 Separate the pinion shaft from the intermediate shaft.



- 12 Turn the rack-and-pinion gear assembly towards the front, so that the pinion shaft points downwards, and then move the assembly as far as it will go to the right (looking towards the front of the car).



- 13 Rotate the pinion shaft until the rack is at the RH end of its travel.
- 14 Position the LH track rod underneath the subframe member.



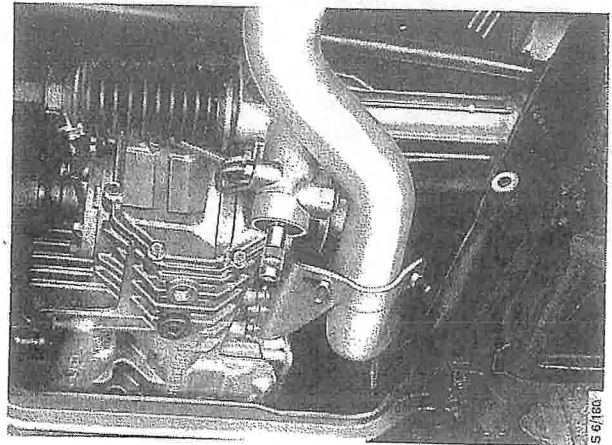
- 15 Move the rack to the LH end of its travel and lower the assembly out of the car.

To refit

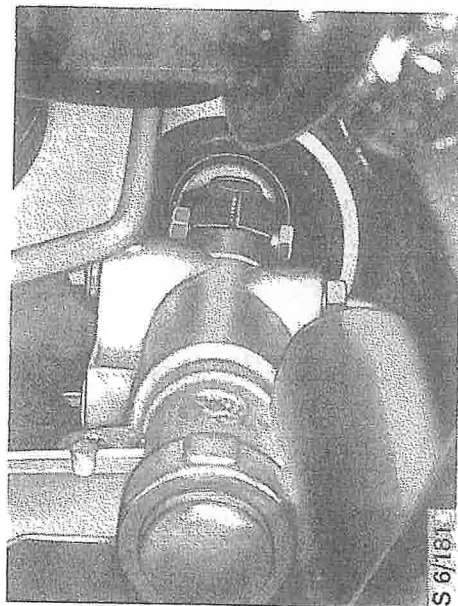
- 1 Move the rack to the LH end of its travel (pinion end), hold the assembly with the pinion shaft pointing downwards and lift the assembly into position.



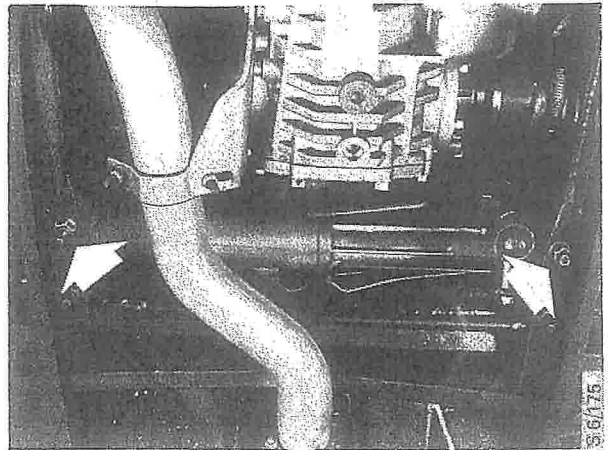
- 2 Move the rack to the RH end of its travel.
- 3 Lift the LH track rod over the subframe member.
- 4 Return the rack to the centre position. The slot for the pinch-bolt in the pinion shaft should be towards the rear of the car when the pinion shaft is pointing downwards.



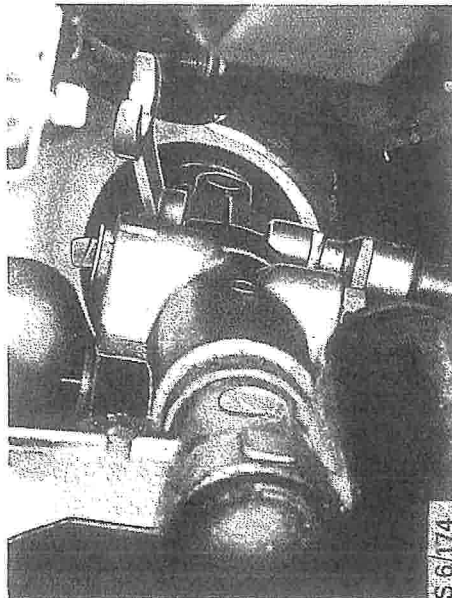
- 5 Rotate the entire assembly forwards to bring the pinion shaft to the top.
- 6 Connect the pinion shaft to the intermediate shaft and refit the pinch-bolt and nut, leaving them slack.



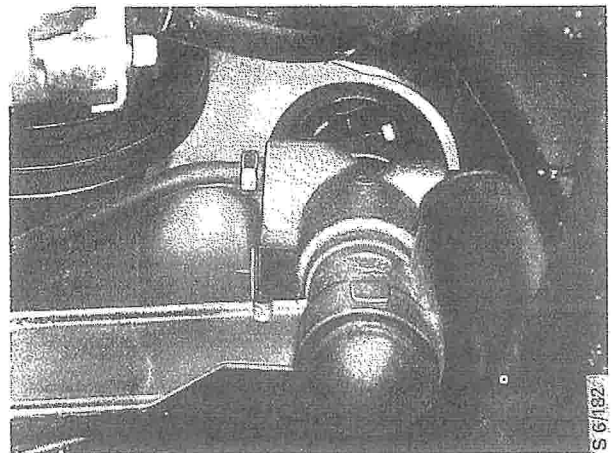
7 Tighten the fixing bolts.



8 Tighten the pinch-bolt in the universal joint between the pinion shaft and intermediate shaft.

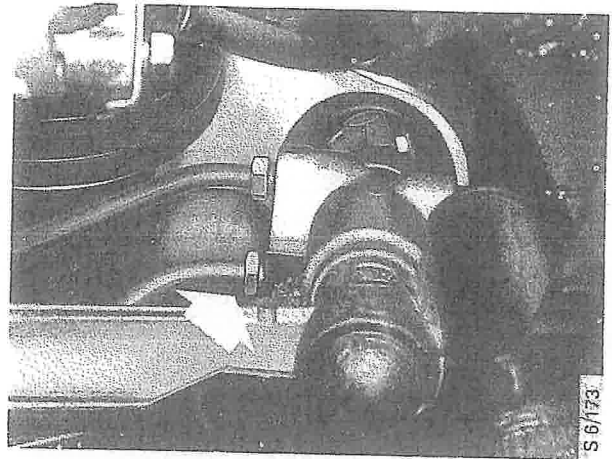


9 Check the condition of the "O" ring on the return pipe and then reconnect the return pipe to the pinion housing (16-mm spanner).



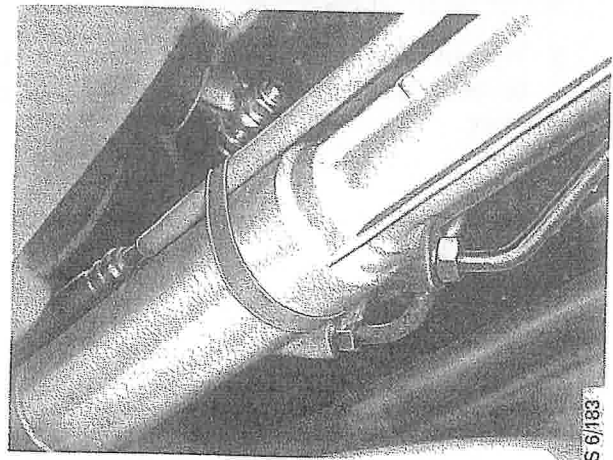
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- 10 Check the condition of the "O" ring on the flow line and reconnect the flow pipe to the pinion housing (18-mm spanner).

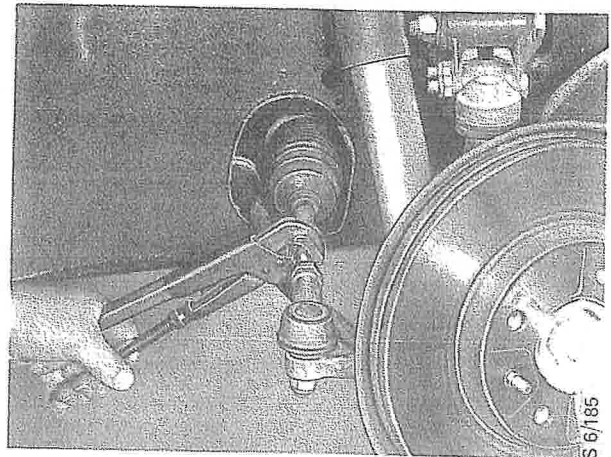


- 11 Fit a strap around the return pipe and rack housing and use a cable tie to hold the pipe to one of the flow pipes between the control valve and servo cylinder.
Note that the pressure-equalizing capillary tube between the rubber gaiters **must not be clipped or tied in any way.**

Cars with B201 engine, M87 and earlier: Fit a cable tie around the handbrake cables and rack housing.



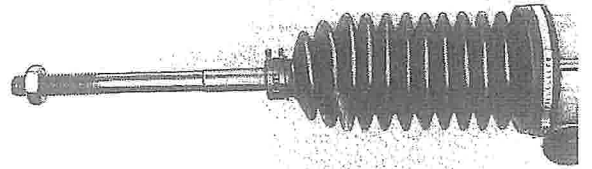
- 12 Screw the track rods onto the track-rod ends until they make contact with the locknuts. Leave the locknuts slack until after the toe-in has been checked.



- 13 Refit the wheels.
- 14 Fill the system with 75 cl (0.8 liqqt) of Texaco 4634 power steering fluid.
- 15 Bleed the system as follows: with the engine switched off and the front wheels off the ground, turn the steering wheel from lock to lock three or four times.
- 16 Lower the car, start the engine and turn the steering wheel lock to lock twice more to check that the system is working properly. Check the fluid level.
- 17 Measure the toe-in and adjust as necessary.
- 18 Tighten the locknuts on the track rods.

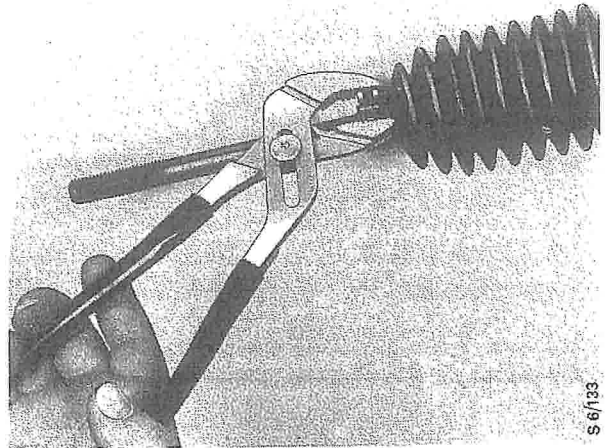
To dismantle

- 1 Measure and note the distance between the locknut and the end of the track rod (on both sides) to minimize adjustment of toe-in on refitting, and then remove the nut.



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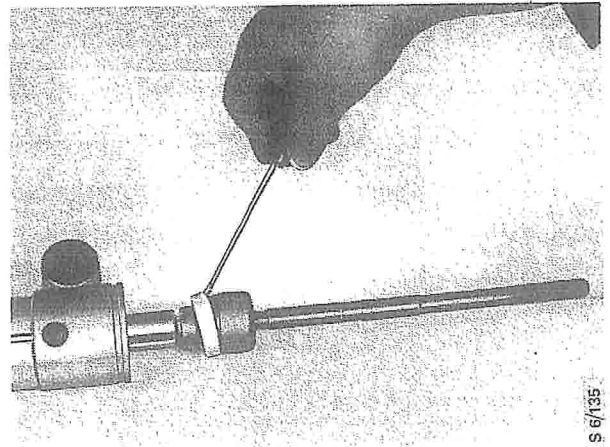
- 2 Remove the rubber gaiters and pressure-equalizing capillary tube.



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- 3 Remove the inner ball joint at the greater distance from the pinion as follows:

- Undo and slide back the end stop.

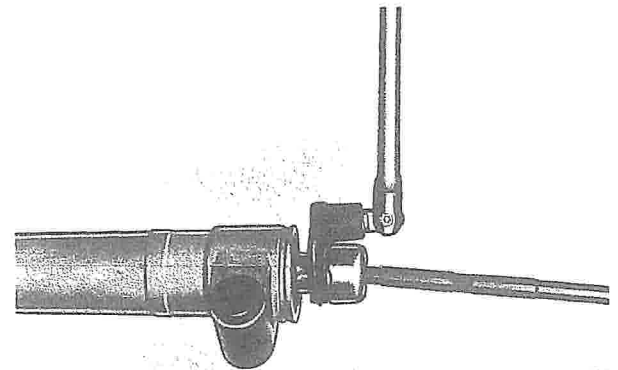


S 6/135

- Clamp the rack in a soft-jaw vice and undo the inner ball joint using tool 89 96 480.

N.B.

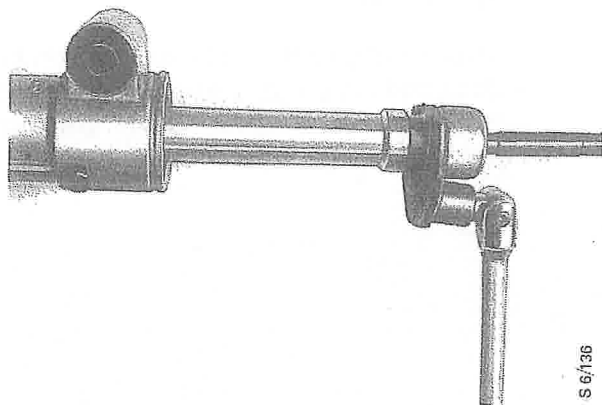
Under no circumstances hold the pinion when undoing or tightening the ball joint.



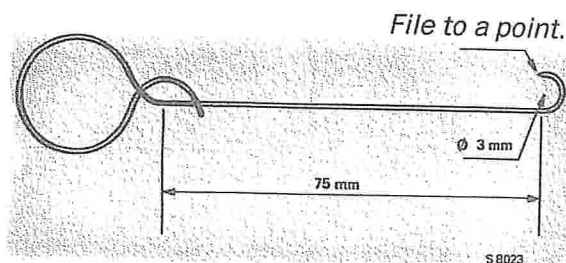
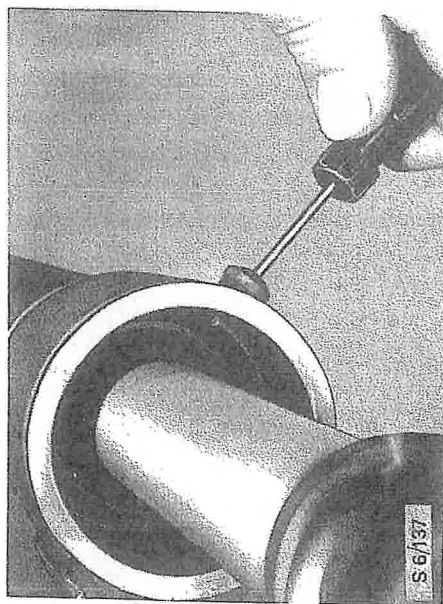
S 6/142

4 Remove the circlip from inside the end of the rack housing as follows:

- Move the rack to the end of its travel at the opposite end of the rack housing to the pinion. Clamp the rack in a soft-jaw vice and slide sleeve 89 96 407 over the rack.
- Push in the spring-loaded seal retainer by screwing on the inner ball joint.

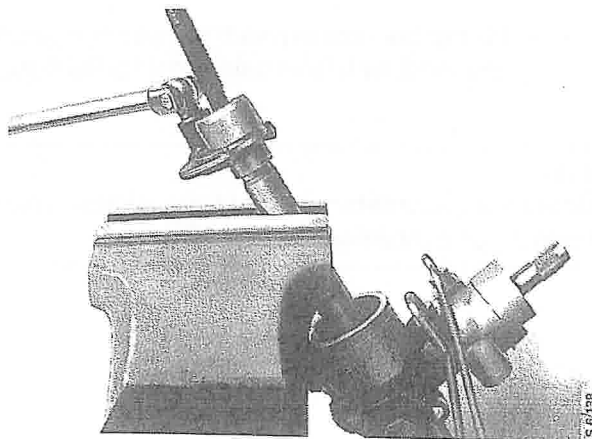


- Remove the rubber cap from the narrow-bore hole in the end of the rack housing and push in the end of the circlip by means of a sawn-off electrical screwdriver (3 x 15 mm). Bend back and withdraw the circlip using a hook made from a piece of 1-mm piano wire (see drawing).

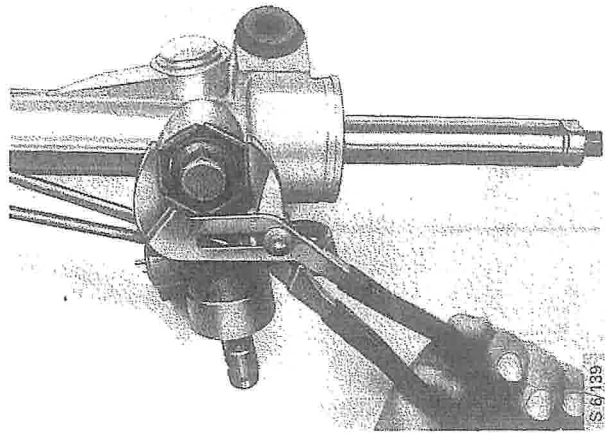


5 Remove the ball joint and sleeve.

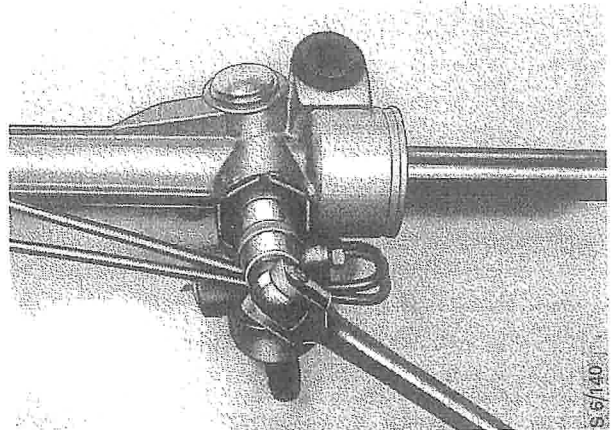
6 Clamp the rack housing in a soft-jaw vice and unscrew the inner ball joint from the pinion end of the rack housing using tool 89 96 480.



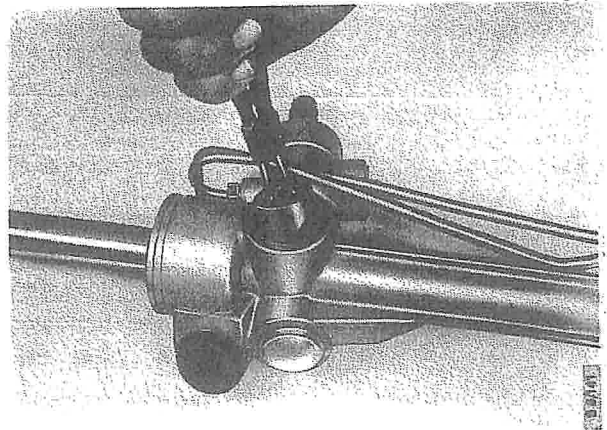
7 Remove the locknut for the damper yoke.



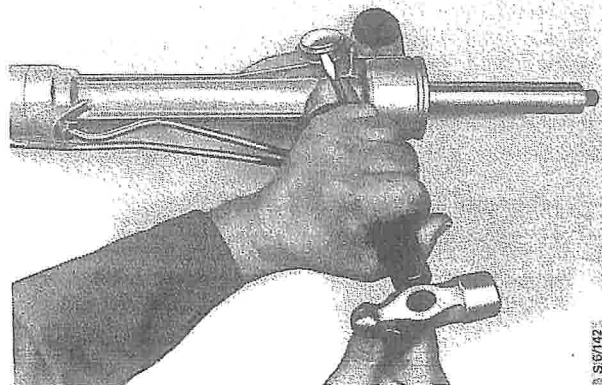
8 Remove the adjusting screw and spring.



9 Lift out the damper yoke. If it proves obstinate, tap the housing gently on the workbench.

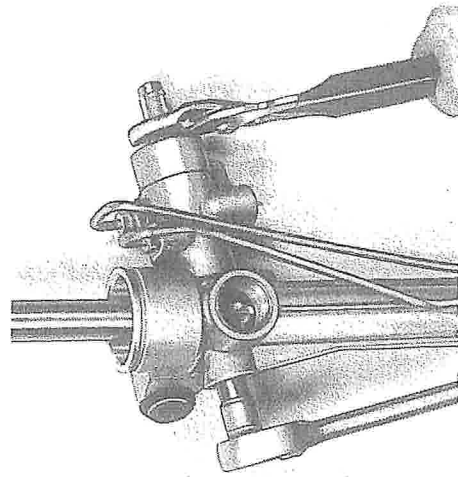


10 Tap off the end cap on the bottom of the pinion housing.



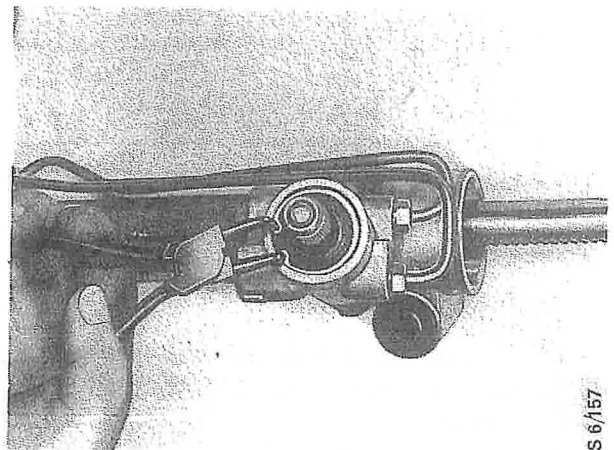
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- 11 Undo the locknut. Use a pair of water pump pliers to hold the pinion shaft, taking care not to damage the splines.



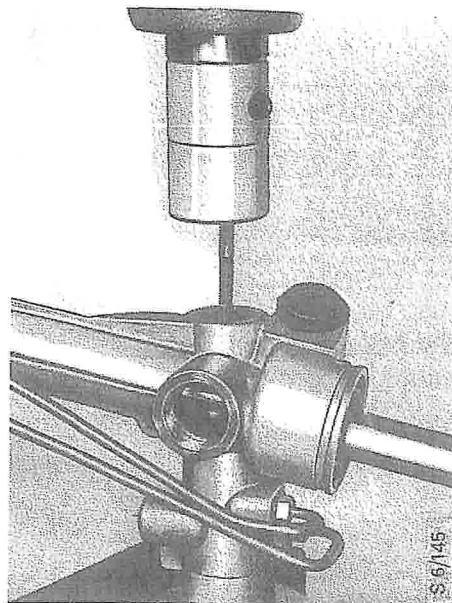
S 6/143

- 12 Remove the circlip from the top of the valve.



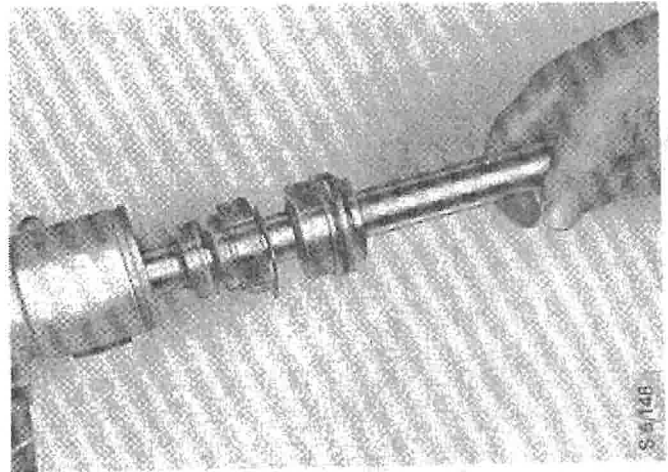
S 6/157

- 13 Press out the pinion and valve complete with needle bearing, bearing race, hydraulic seal and dust cap. Start by using tool 83 91 849 (special tool for section 2 - engine) followed by an M8 bolt, if necessary. Use ring 87 90 644 (special tool for section 4 - gear-box) as a support.

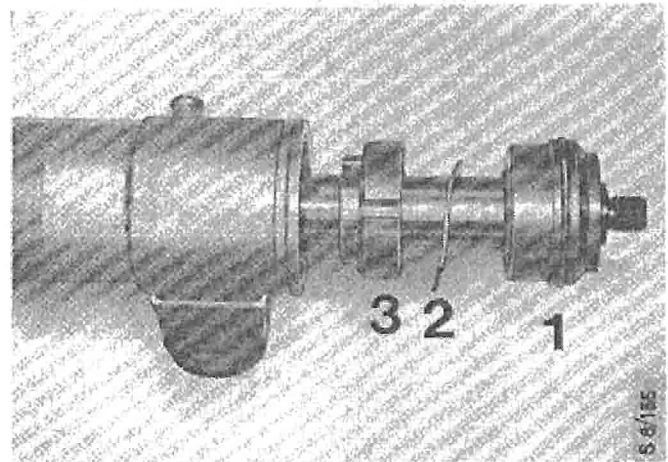


S 6/145

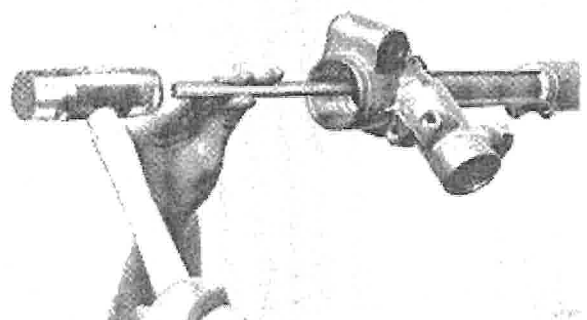
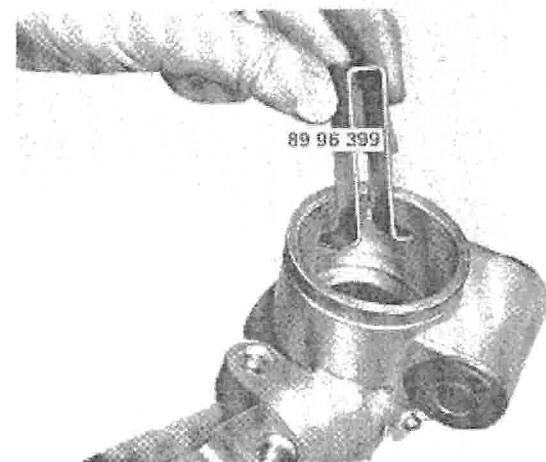
14 Withdraw the rack.



15 Remove the outer hydraulic seal (1), the wave spring washer (2) and the bush (3).

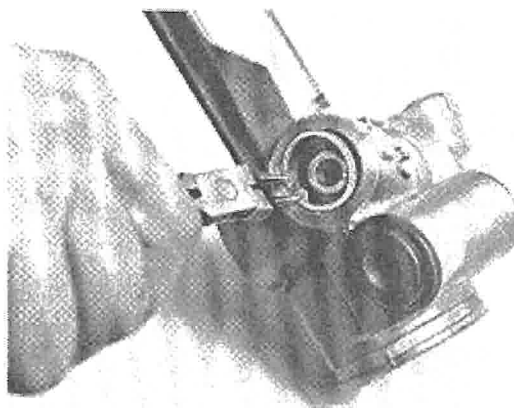


16 Remove the inner seal using tool 89 96 399 and a long drift.

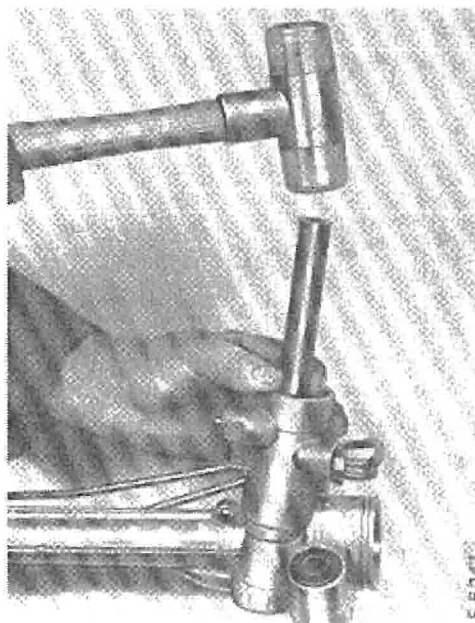


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17 Remove the circlip from inside the pinion housing.

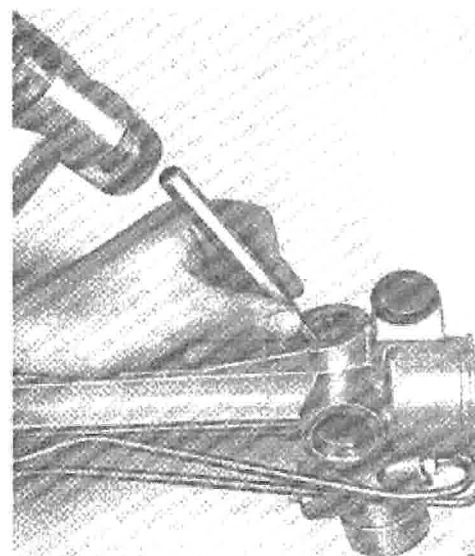


18 Tap out the lower pinion bearing.



S.6.147

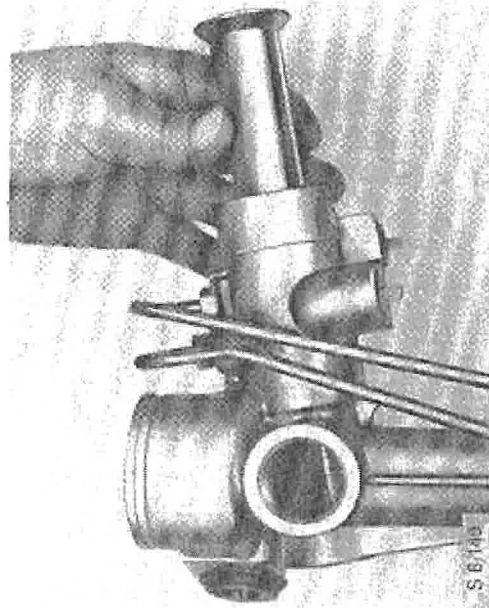
19 Tap out the bush and seal using a drift.



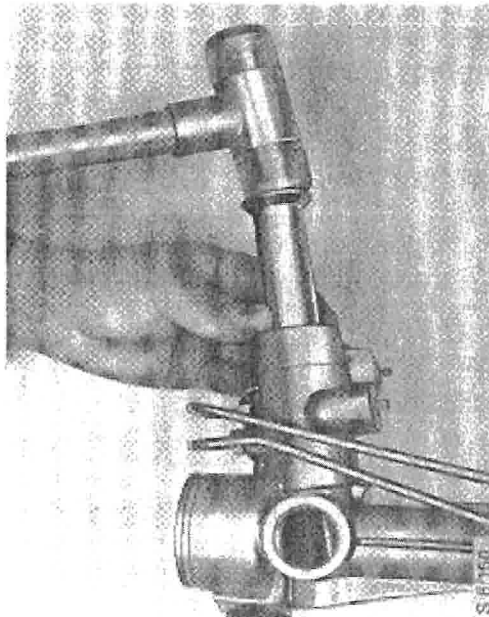
S.6.148

To assemble

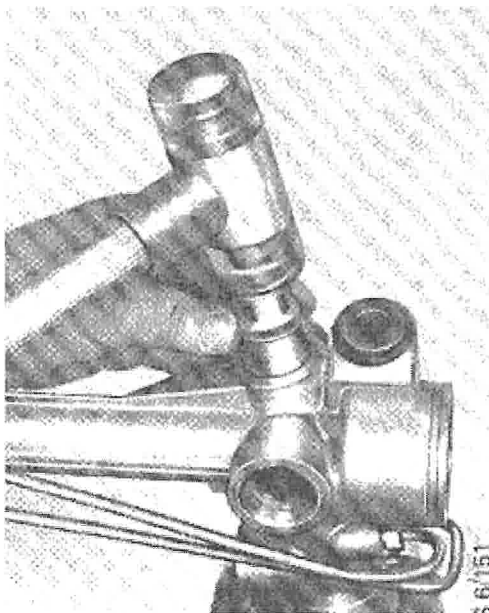
- 1 Fit the bush with the aid of tool 89 96 407.



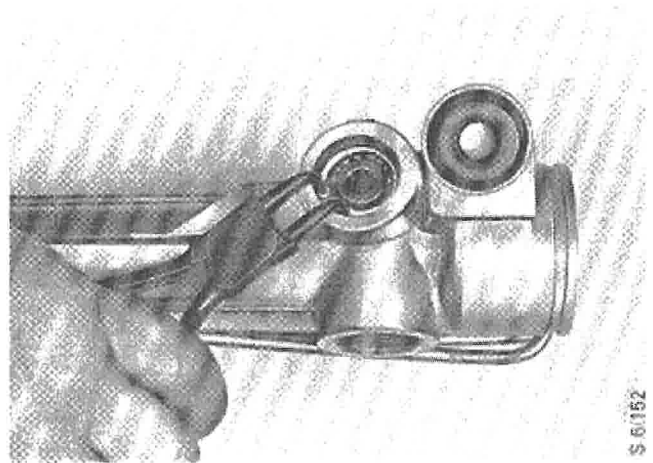
- 2 Tap in the seal, with the chamfered side uppermost.



- 3 Tap in the lower pinion bearing using a suitable socket (e.g. 19 mm) as a drift.



4 Fit the circlip.



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5 Inspect the condition of the piston ring on the rack.

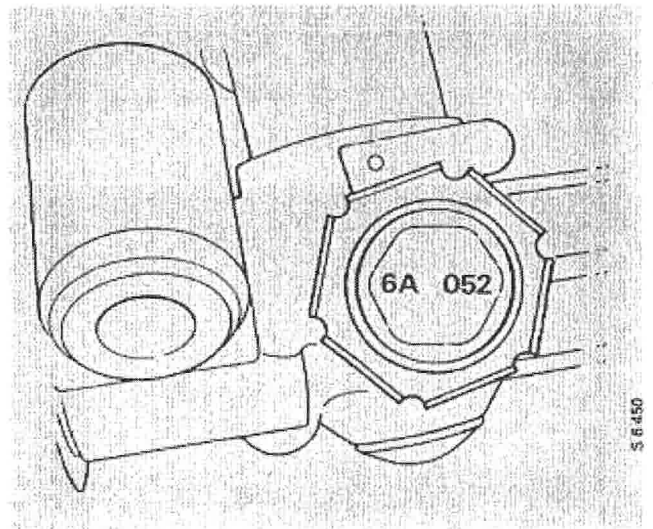
N.B.

Two piston variants are in use: one fitted with piston ring 89 37 070 alone; and the other with both a piston ring (89 70 873) and an "O" ring (89 70 865).

As from date code 6A052 on the steering gear, the piston must be fitted with both a piston ring (89 70 873) and an "O" ring (89 70 865). The date code is stamped on the damping yoke adjusting screw; the first digit denotes the year of manufacture, and the last three digits the day of manufacture.

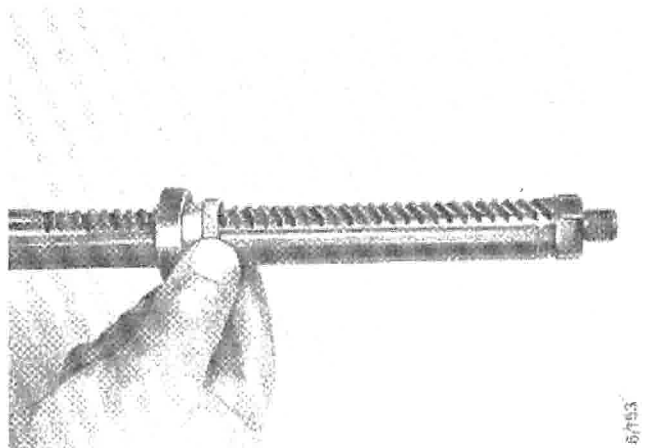
Pistons requiring both a piston ring and an "O" ring also carry a groove adjacent to the groove for the piston ring.

Neither the piston rings nor the "O" ring are interchangeable.



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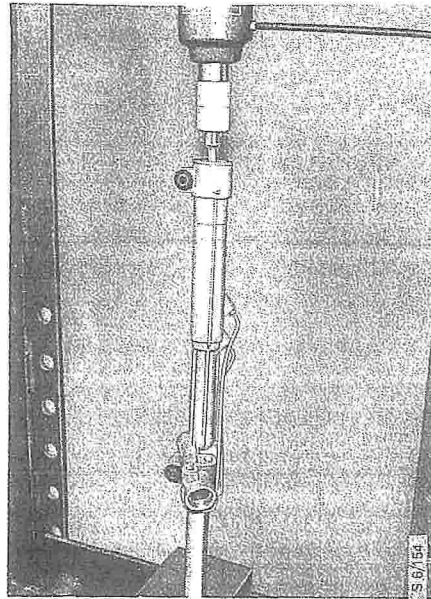
6 Slide the inner hydraulic seal onto the rack followed by the plastic end stop. Use tool 89 95 946 to prevent the rubber seal being damaged by the teeth on the rack.



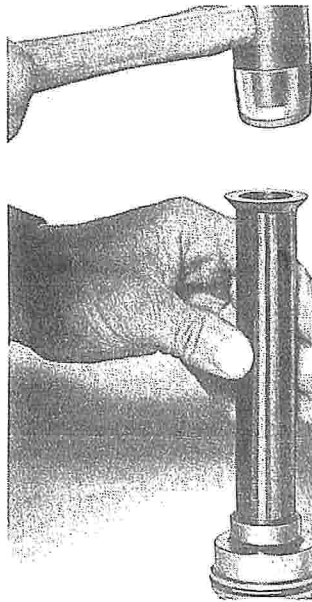
S 6/153

- 7 Press the rack into the housing, using a 17-mm socket and a short extension piece between the press and the rack, and tool 83 90 148 (special tool for section 4 - gear-box) as a support.

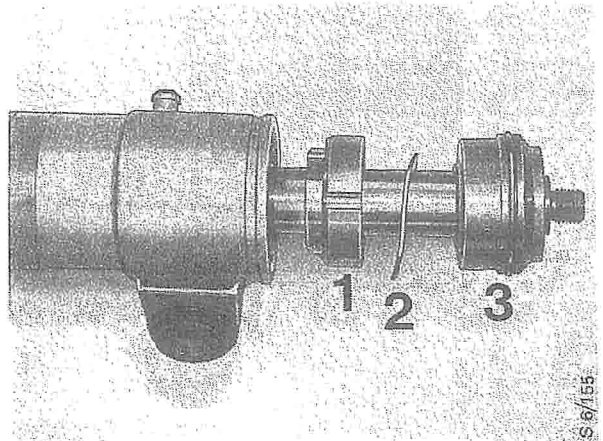
**Maximum pressing force:
2,200 N (506 lbf)**



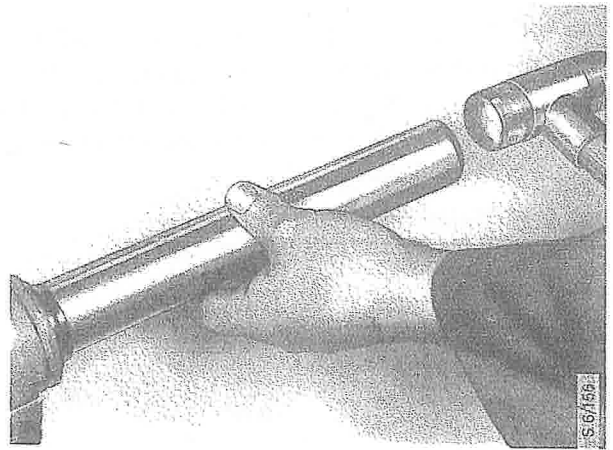
- 8 Fit a new "O" ring onto the outer seal retainer. Inspect the seal itself; if it is in good condition it can be refitted. If a new seal is required, use tool 89 96 407 to fit it.



- 9 Fit the bush (1) on the rack, with the narrower end inwards.
- 10 Slide the wave spring washer (2) up to the bush and then fit the hydraulic seal (3). Take care not to damage the sealing lip.



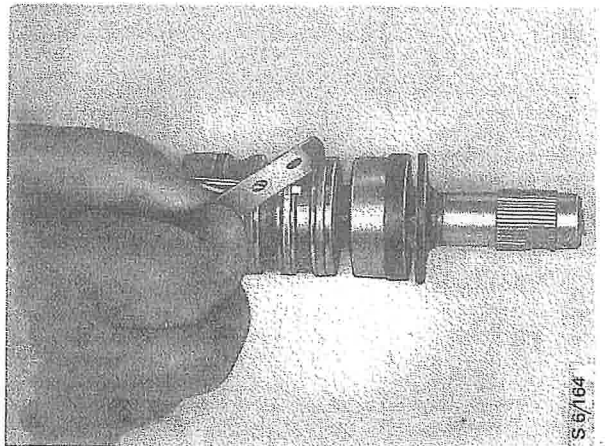
- 11 Carefully drive in the seal retainer using tool 8390 148 (special tool for section 4 - gearbox).
- 12 Centre the rack and rotate it to enable it to mesh with the pinion.



- 13 Fit new seals on the valve. Remove any burrs on the splines as these can damage the dust seal. *2 seals from J. M. ...*

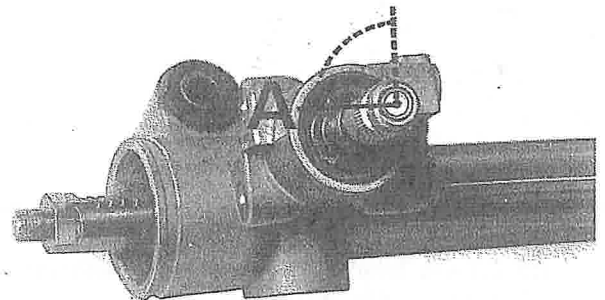
Inspect the four PTFE rings on the valve to see whether they are split. If not, use a razor blade to make a 5-7-mm long slit through each ring. Cut the slits by applying pressure - do not saw. *reg. ...*

The slits serve to compensate for the loss of power assistance that can occur immediately after starting at low ambient temperatures. *... ...*



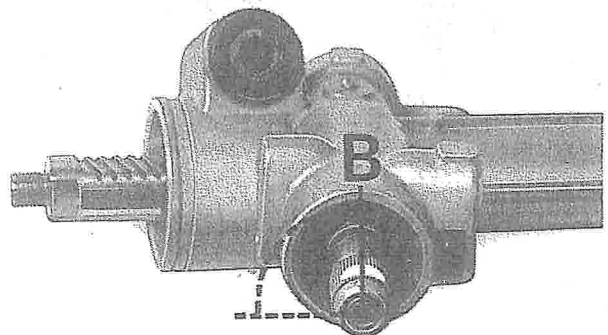
- 14 Fit the servo valve and pinion unit as follows:

- Hold the valve body with the slot in the end of the shaft pointing to the left (at 9 o'clock looking towards the front of the car - see "A" in picture) as the teeth are enmeshed.



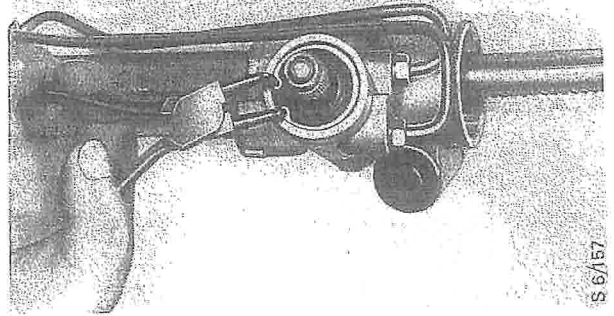
S 7110

- Slide the valve unit in as far as it will go and then tap it home using sleeve 7841067 (special tool for section 4 - gearbox). The pinion should now be rotated so that the slot in the end of the shaft will be in the 12 o'clock position (B in picture) when the rack is centred.



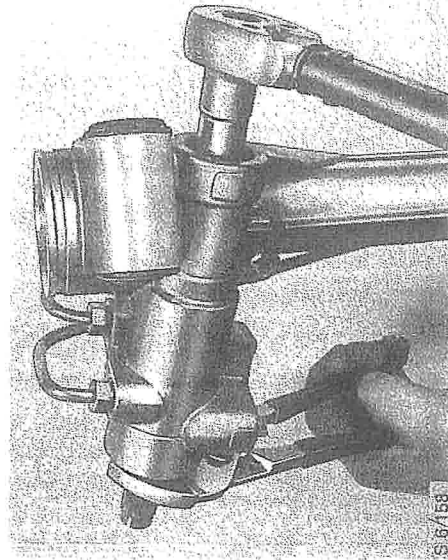
S 7109

- Fit the circlip.



- 15 Fit and tighten the locknut on the pinion shaft, using water pump pliers to grip the other end of the shaft.

Tightening torque:
30 - 45 Nm (22.2 - 33.3 lbf ft)



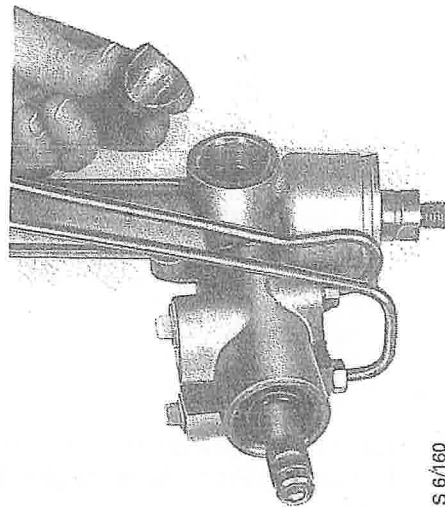
- 16 Fit the bottom end cap by tapping it home using sleeve 78 41 067 (special tool for section 4 - gearbox).



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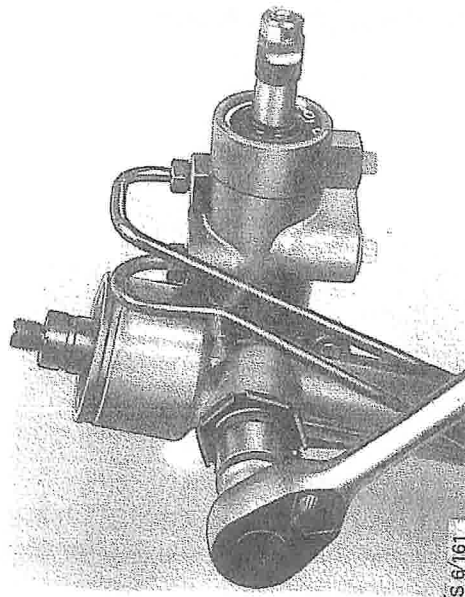
- 17 Apply grease to the damper yoke and then fit the yoke, followed by the spring, adjusting screw and locknut.

Lubricant: Shell EP B2 lithium grease (code 71303), Shell Retinax A or the equivalent.



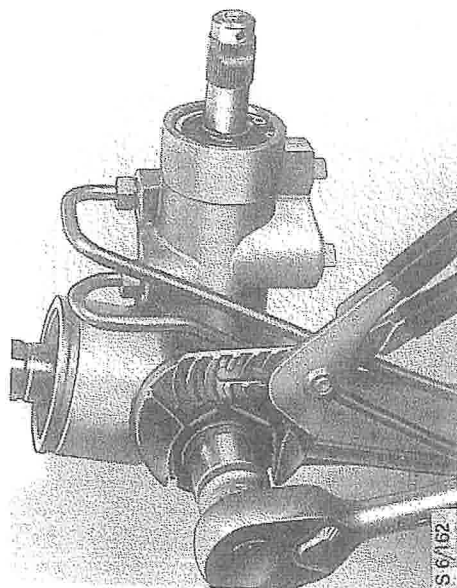
Adjust the radial pressure on the rack as follows:

- Screw the adjusting screw right home.
- Back off the adjusting screw by between 40° and 60°.



- Tighten the locknut.

Tightening torque:
60 - 90 Nm (44.4 - 66.6 lbf ft)

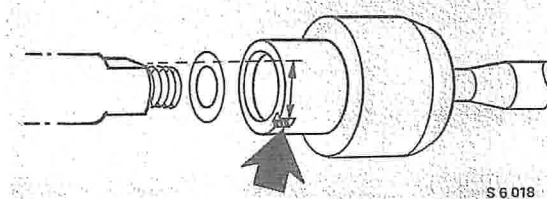
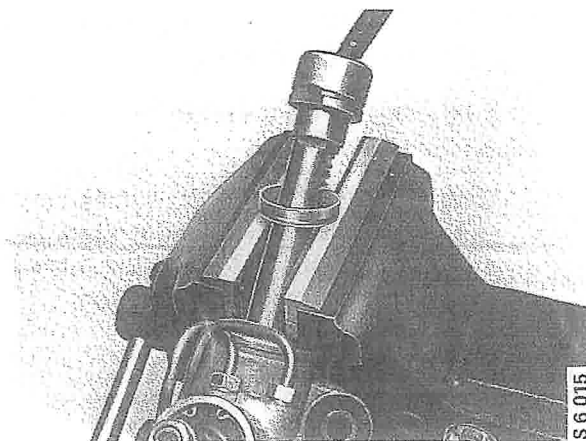


- 18 Fit the inner ball joint complete with end stop onto the pinion end of the rack. Mount the rack housing in a soft-jaw vice.

N.B.

Under no circumstances hold the pinion when undoing or tightening the ball joint.

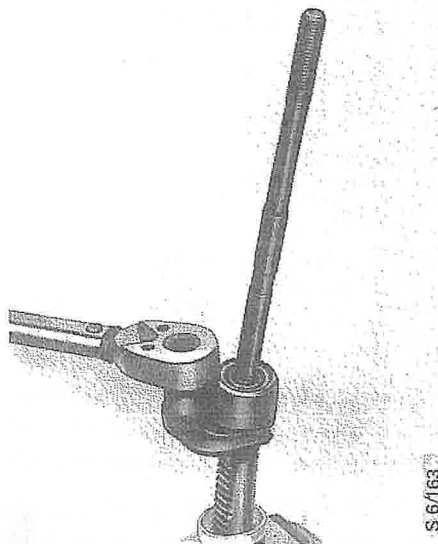
- When refitting the old ball joint, a special spacer, part no. 89 46 360, must be fitted to offset the old peening marks by 90°.



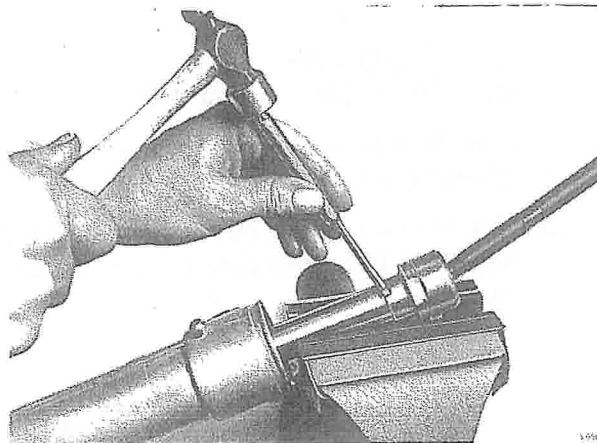
Old peening mark offset by 90°

- 19 Tighten the ball joint using tool 89 96 480 and a torque wrench.

Tightening torque:
80 - 100 Nm (59.2 - 74.0 lbf ft)

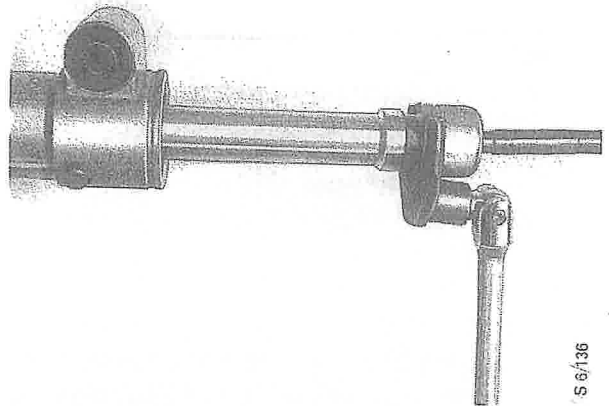


Lock the ball joint to the rack by driving the tab into the groove in the rack.



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- 20 Move the rack to the end of its travel at the opposite end to the pinion.
- 21 Fit the circlip inside the end of the rack housing as follows:
 - Mount the rack housing in a soft-jaw vice. Slide sleeve 89 96 407 onto the rack and press in the spring-loaded seal retainer by screwing on the inner ball joint.

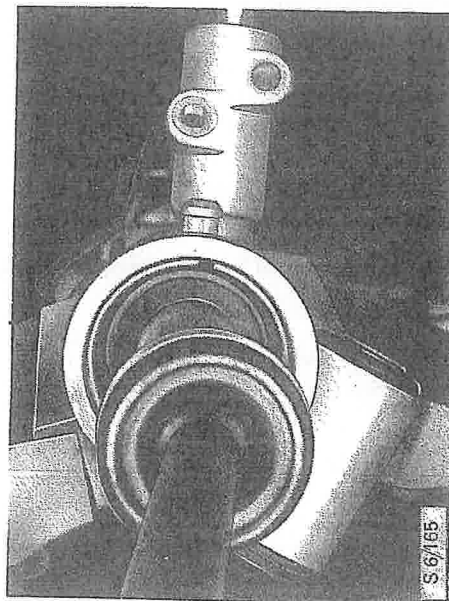


- Fit the circlip.

N.B.

To enable the circlip to be removed again in the future, one end of the circlip must be directly in line with the hole in the rack housing.

- Remove sleeve 89 96 407.



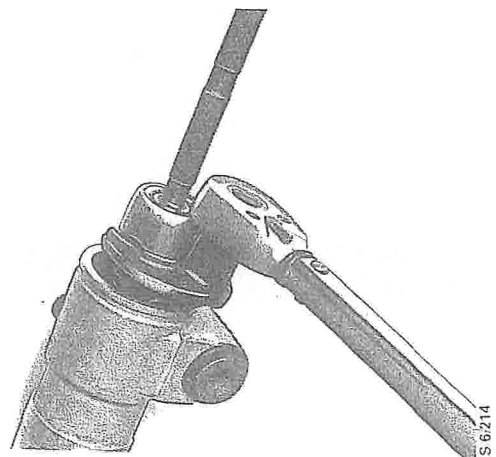
- 22 With the rack again mounted in a soft-jaw vice, fit the inner ball joint and end stop using tool 89 96 480 and a torque wrench.
 - When refitting the old ball joint, a special spacer, part no. 89 46 360, must be fitted to offset the old peening marks by 90°.

Tightening torque:

80 - 100 Nm (59.2 - 74.0 lbf ft)

Lock the ball joint to the rack by driving the tab into the groove in the rack.

- 23 Refit the rubber gaiters complete with pressure-equalizing capillary tube and secure the clips.



Servo pump

Caution

To avoid damage to the pump, the following points must be observed:

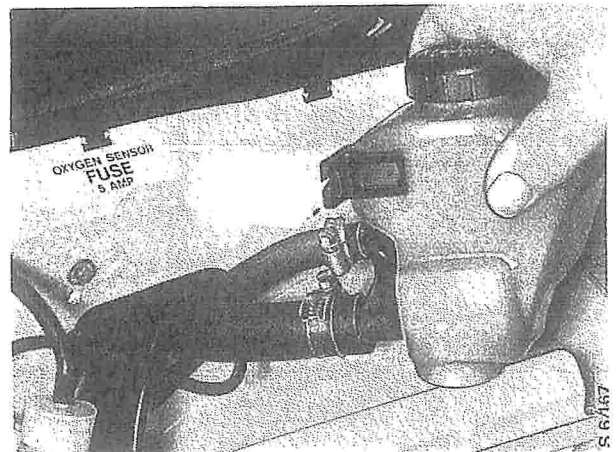
- 1 Never forcibly hold the steering wheel at full lock for any length of time with the engine running, as this may cause the pump to overheat and be damaged.
- 2 Take care never to allow any particles of dirt to get into the hydraulic system, e.g. when checking or topping up the fluid level.
- 3 Never allow the pump to run dry, with no fluid in the system.

Pump with separate reservoir

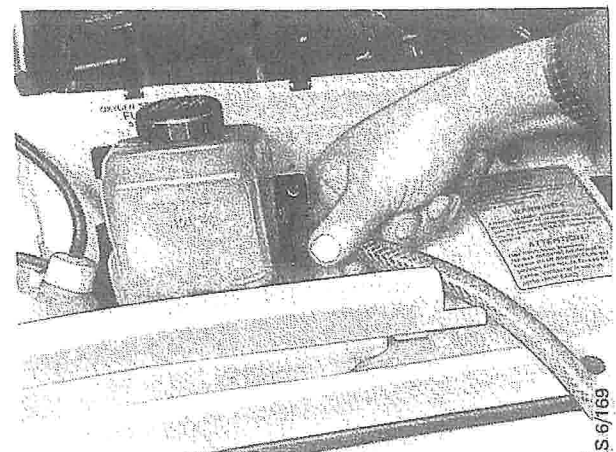
To remove

- 1 Drain the fluid from the system as follows:

- Undo the fixings for the fluid reservoir and disconnect the return hose. Plug the opening in the reservoir.

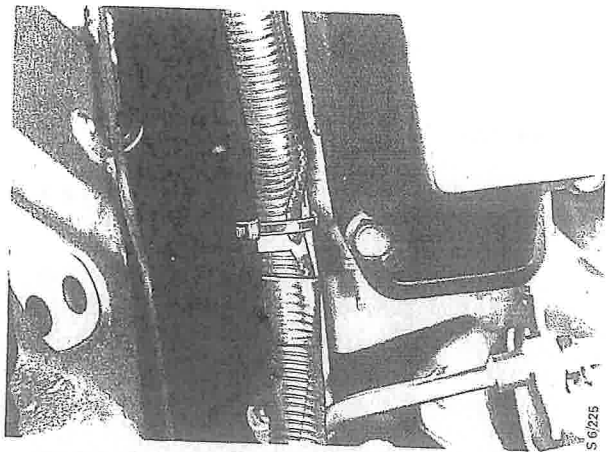


- Connect a length of hose or tubing to the return hose and place the other end in a receptacle having a capacity of at least one litre.
- Start the engine and allow the fluid to be pumped out of the system. Turn the steering wheel twice from lock to lock to drain the system completely.
- Remove the feed hose.



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- 2 Snip off the lower cable tie holding the leads to the wiring loom for the engine. Rest the leads on top of the engine.

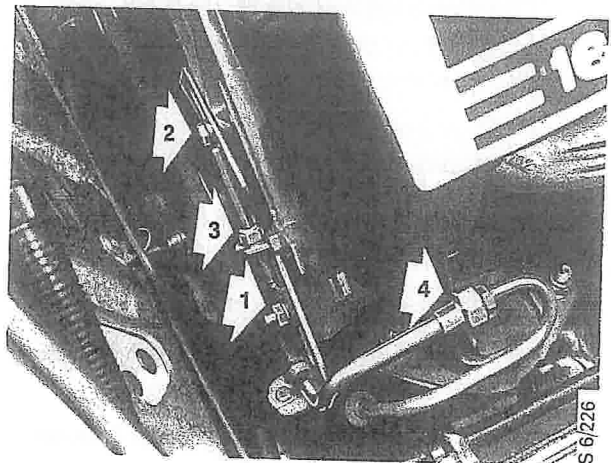


- 3 Slacken but do not remove the pump bracket nut (1) and the top fixing bolt (2).

- 4 Remove the adjusting screw (3).

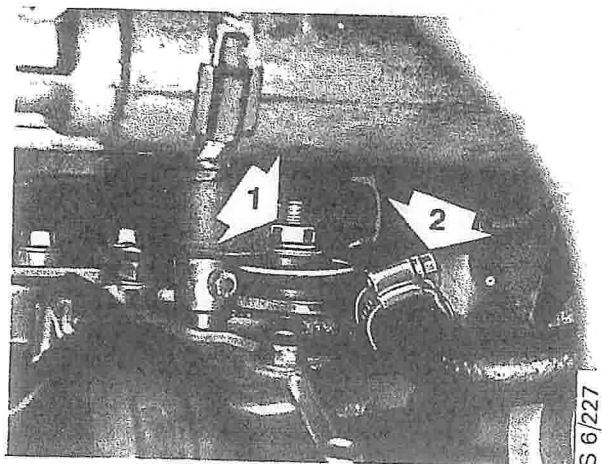
- 5 Remove the drive belt.

- 6 Disconnect the connecting pipe from the feed pipe (4). Blank off the open ends.



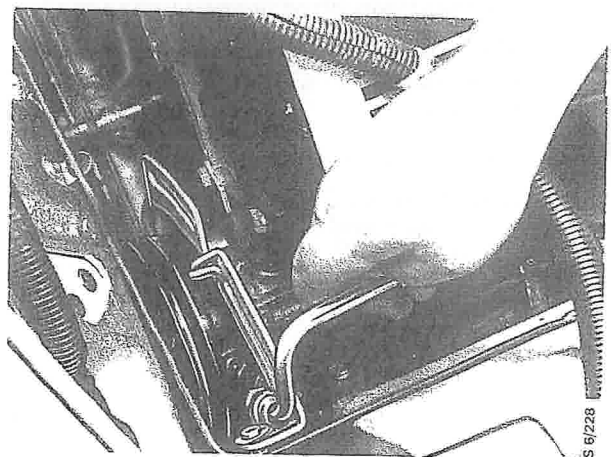
- 7 From underneath, remove the bottom fixing bolt (1) for the pump bracket, saving the rubber bushes, the distance piece and the washer.

- 8 Disconnect the inlet hose (2) from the pump.

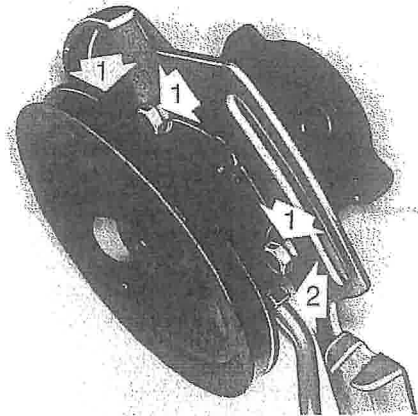


- 9 From above, remove the pump bracket fixing nut and top fixing bolt.

- 10 Swivel the pump towards the wheel arch and lift it out of the car.



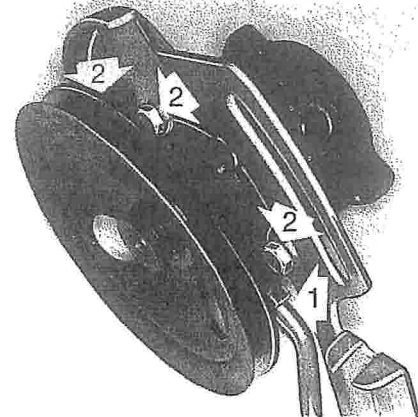
- 11 Remove the three bolts (1) securing the pump to the bracket.
- 12 Disconnect the connecting pipe (2) from the pump.



S 6229

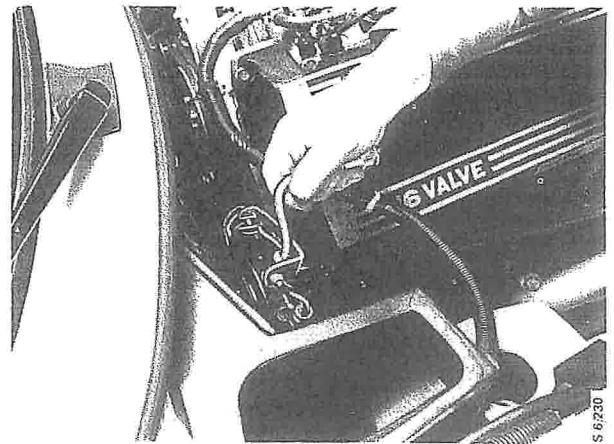
To refit

- 1 Reconnect the connecting pipe (1) to the pump.
- 2 Refit the bracket to the pump and tighten the three bolts (2).



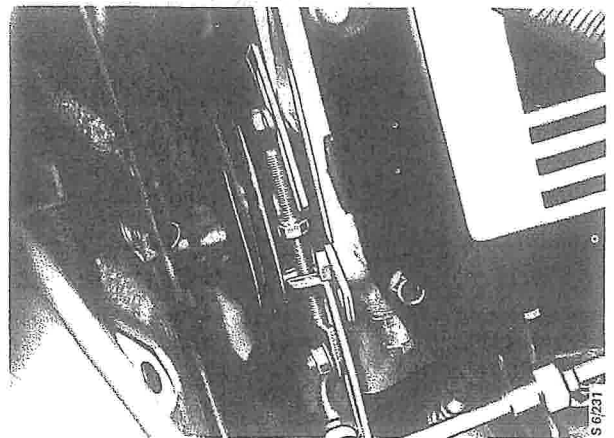
S 6275

- 3 Lower the pump via the space adjacent to the fresh air intake.



S 6230

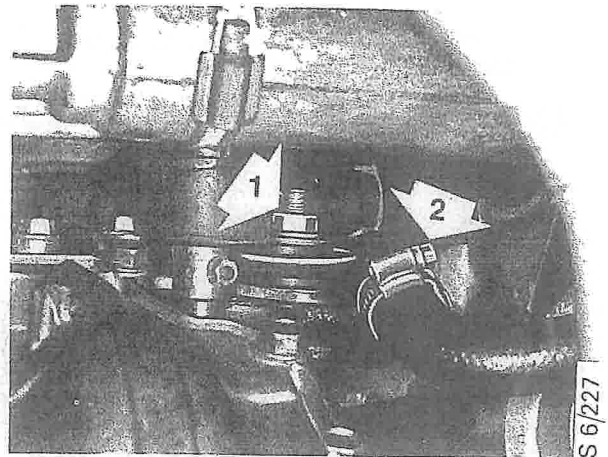
- 4 Loosely fit the pump bracket nut, the top fixing bolt and the adjusting screw. Ensure that the bracket is in position on the bottom fixing bolt.



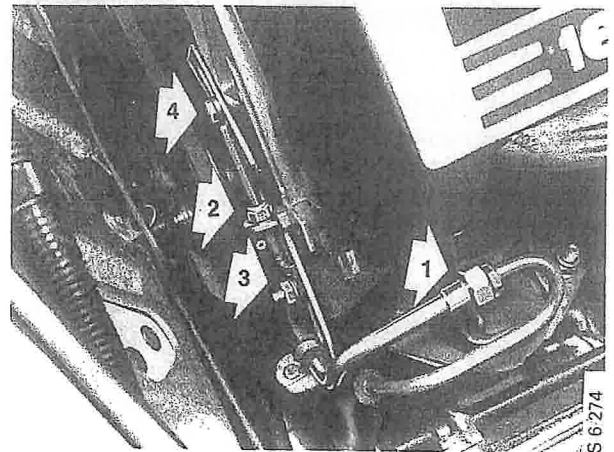
S 6231

644-26 Power-assisted steering system

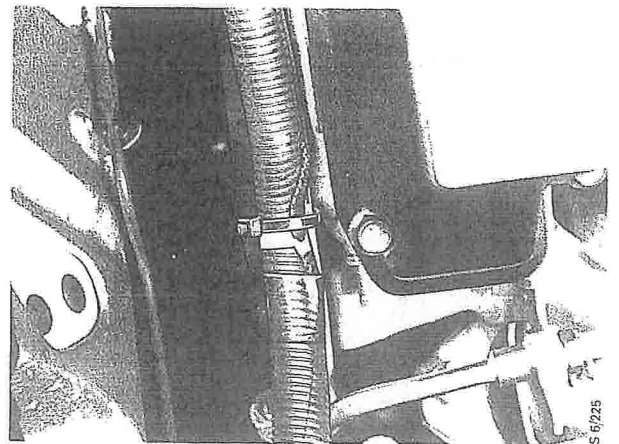
- 5 From underneath, fit the rubber bushes, washer and distance piece for the pump bracket bottom fixing bolt. Ensure that the distance piece protrudes through the washer so that the nut will apply pressure to the distance piece. Tighten the nut (1).
- 6 Reconnect the inlet hose (2) to the pump.



- 7 From above, connect the connecting pipe to the feed pipe (1).
- 8 Fit the drive belt.
- 9 Adjust the belt tension by means of the adjusting screw (2).
- 10 Tighten the nut (3) and the top fixing bolt (4).



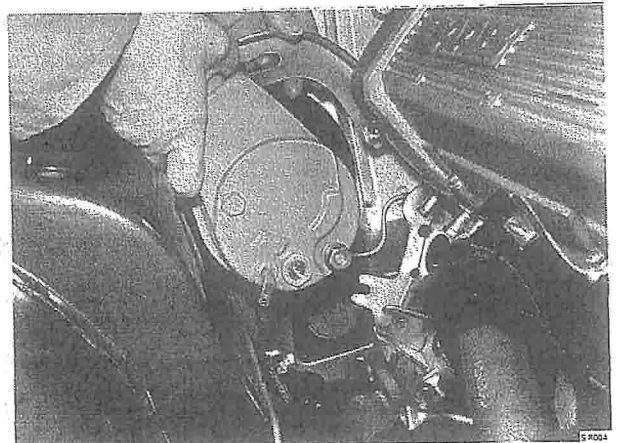
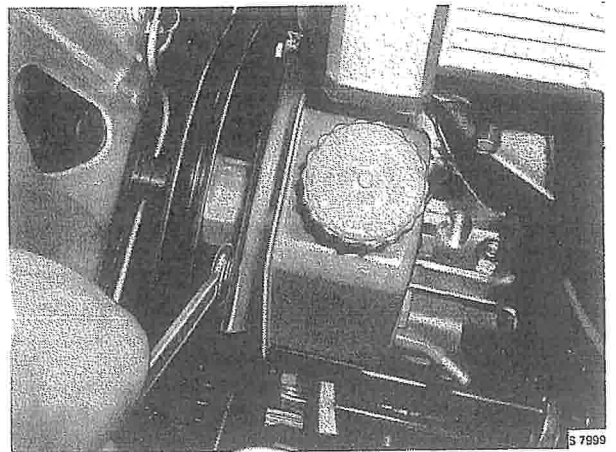
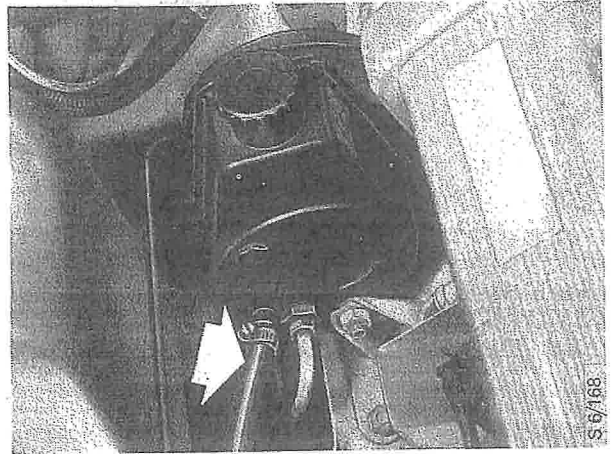
- 11 Clip the electrical leads to the engine wiring loom by means of a cable tie.
- 12 Fill the system with 75 cl (0.8 liq qt) of Texaco 4634 power steering fluid.
- 13 Bleed the system as follows: With the engine switched off and the front wheels off the ground, turn the steering wheel from lock to lock three or four times.
- 14 Lower the car, start the engine and turn the steering wheel lock to lock twice more to check that the system is working properly. Check the fluid level.



Pump with separate reservoir

To remove

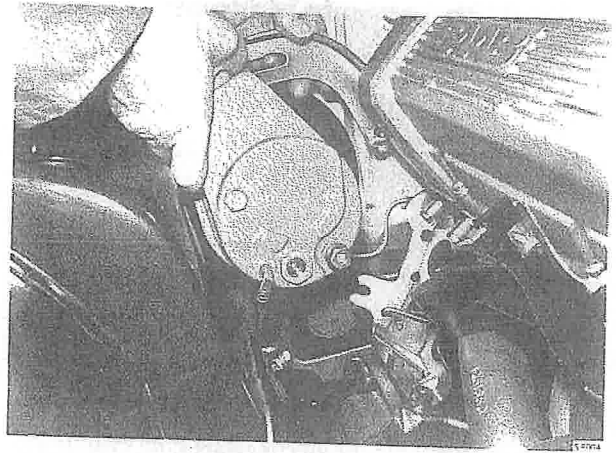
- 1 Drain the fluid from the system as follows:
 - Disconnect the return hose from the pump. Plug the opening in the pump.
 - Connect a length of hose or tubing to the return hose and place the other end in a receptacle having a capacity of at least one litre.
 - Start the engine and allow the fluid to be pumped out of the system. Turn the steering wheel twice from lock to lock to drain the system completely.
 - Remove the feed pipe.
- 2 Slacken the nut and bolt securing the pump to the bracket. Slacken the bolt in the slotted adjusting strap and remove the drive belt.
- 3 Swivel the pump to the side and remove the bolt in the adjusting strap.
- 4 Lift out the pump complete with adjusting strap.



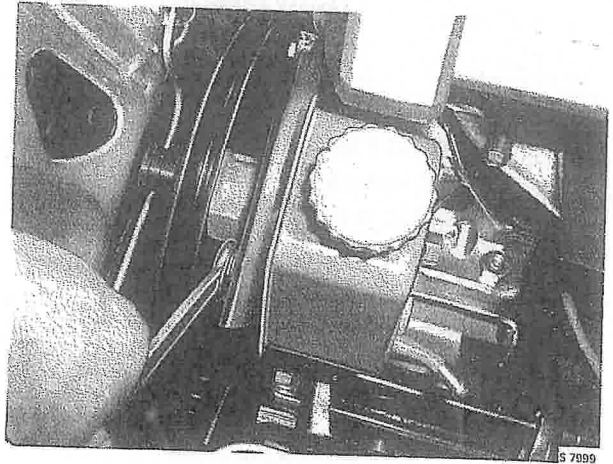
644-28 Power-assisted steering system

To fit

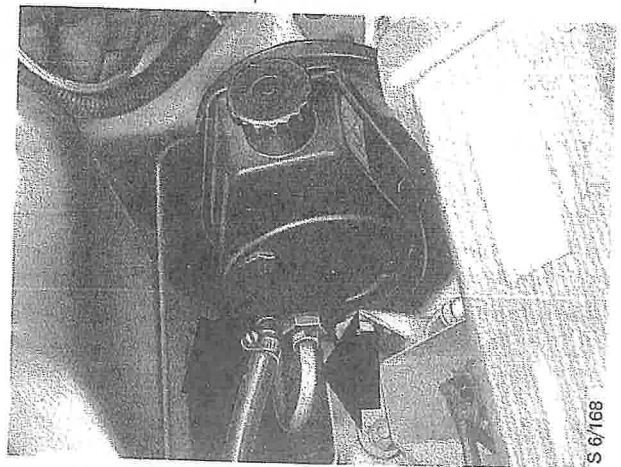
- 1 Lift the pump complete with adjusting strap into position.



- 2 Fit the nut and bolt in the pump bracket, leaving them slack. Fit the drive belt and tighten the bolt in the adjusting strap. Thereafter, tighten the nut and bolt in the bracket.



- 3 Reconnect the feed pipe and return hose to the pump.
- 4 Fill the system with 75 cl (0.8 liq qt) of Texaco 4634 power steering fluid.
- 5 Bleed the system as follows: With the engine switched off and the front wheels off the ground, turn the steering wheel from lock to lock three or four times.
- 6 Lower the car, start the engine and turn the steering wheel lock to lock twice more to check that the system is working properly. Check the fluid level.



Servo pump
B20 engines, M80 and earlier

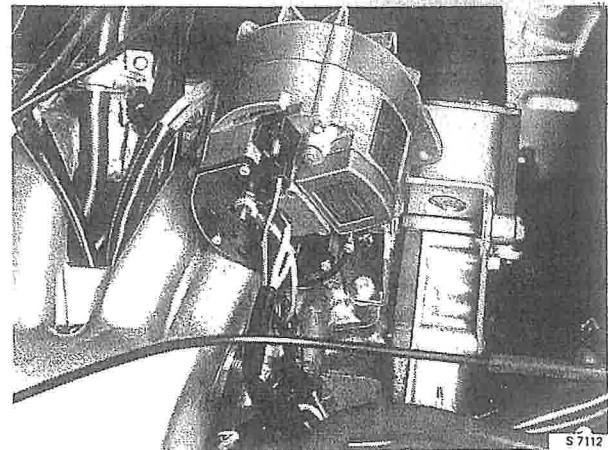
To remove

1 Drain the fluid from the steering system as detailed in the first three paragraphs of step 1 on page 644-2. Disconnect the discharge pipe.



S 7113

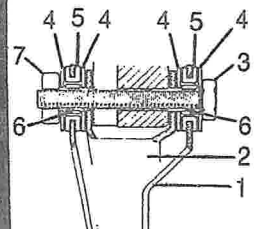
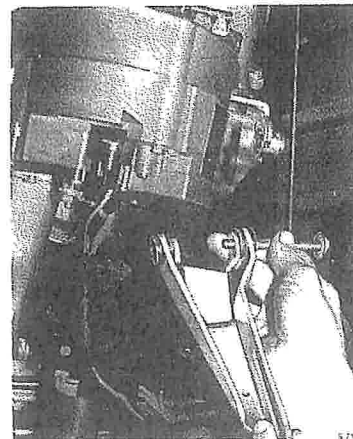
2 Disconnect the negative (-) battery lead and cover the terminal pole on the battery. Undo the fixings for the alternator and move it out of the way.



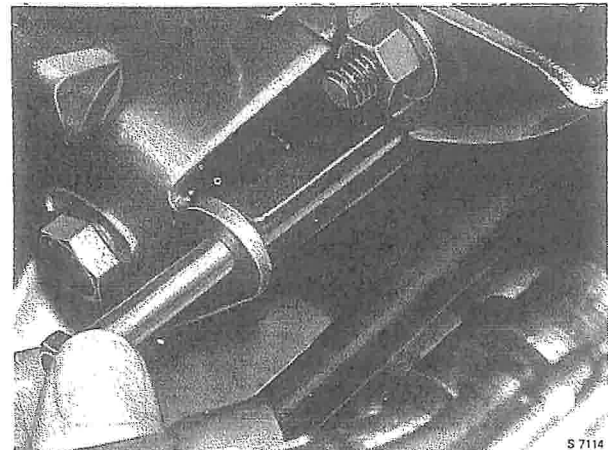
S 7112

3 Remove the alternator and servo pump adjusting straps.

- 1 Alternator adjusting strap
- 2 Servo pump adjusting strap
- 3 Through-bolt
- 4 Plain washer (4)
- 5 Rubber bush (2)
- 6 Distance piece (2)
- 7 Nut

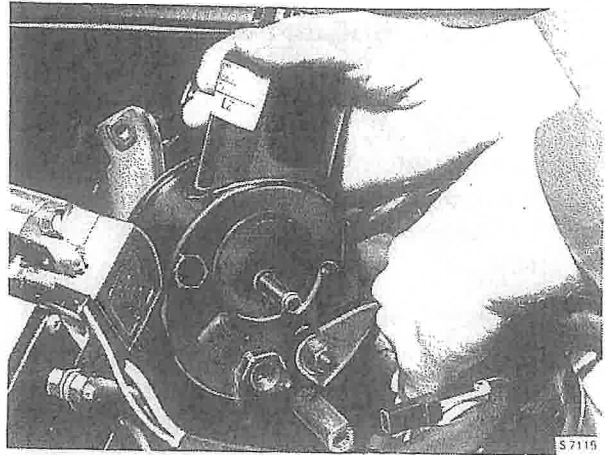


4 Remove the pump through-bolt.



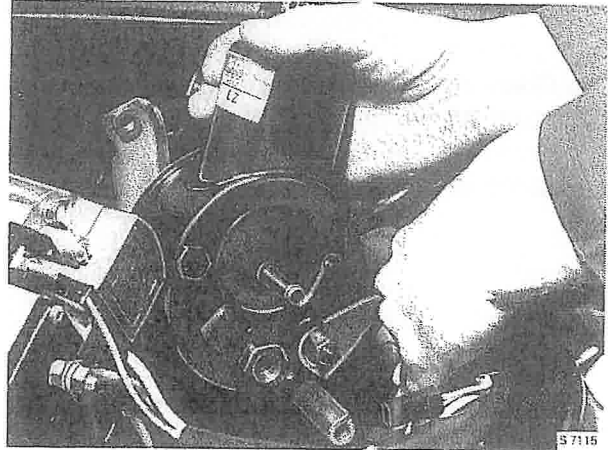
S 7114

5 Lift out the pump.

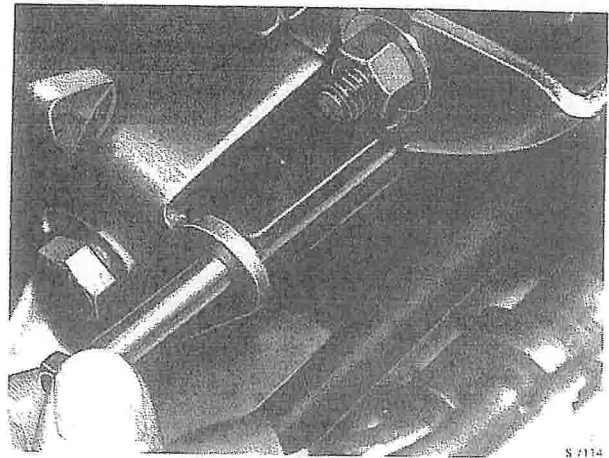


To fit

1 Lift the pump into position.

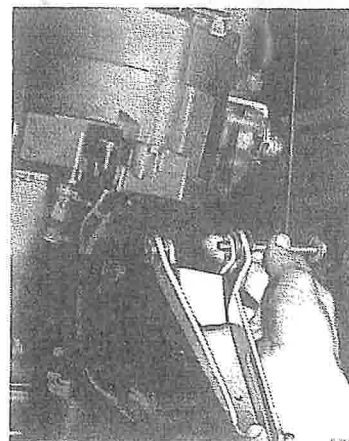


2 Fit the pump through-bolt.

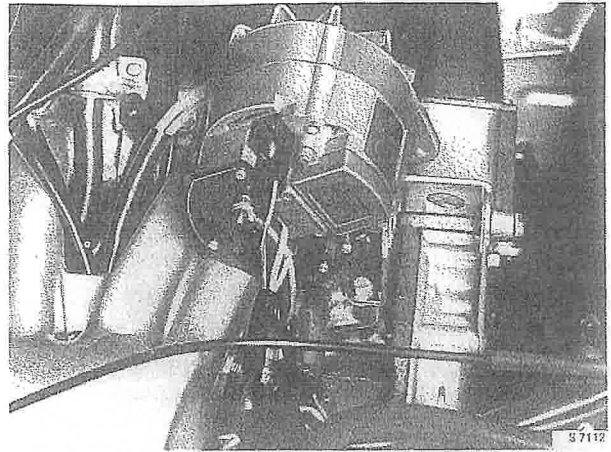


3 Refit the adjusting straps for the alternator and pump.

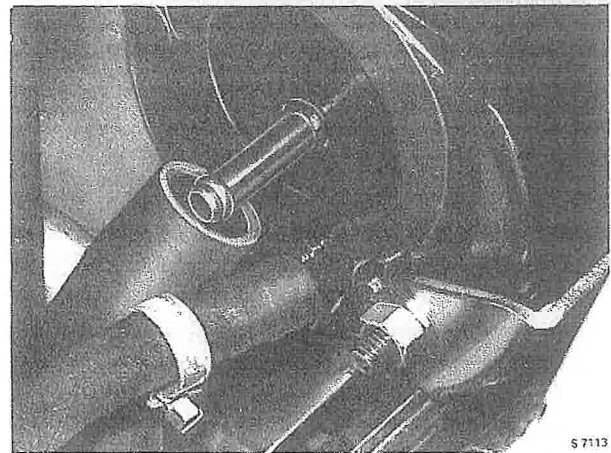
- 1 Alternator adjusting strap
- 2 Servo pump adjusting strap
- 3 Through-bolt
- 4 Plain washer (4)
- 5 Rubber bush (2)
- 6 Distance piece (2)
- 7 Nut



- 4 Refit the alternator and reconnect the battery.



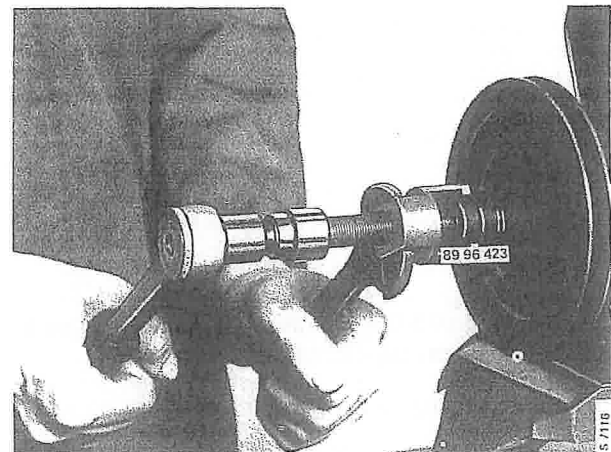
- 5 Reconnect the return hose and discharge pipe to the pump.
- 6 Fill up the system with power steering fluid as detailed in steps 14 - 16 inclusive on page 644-8.



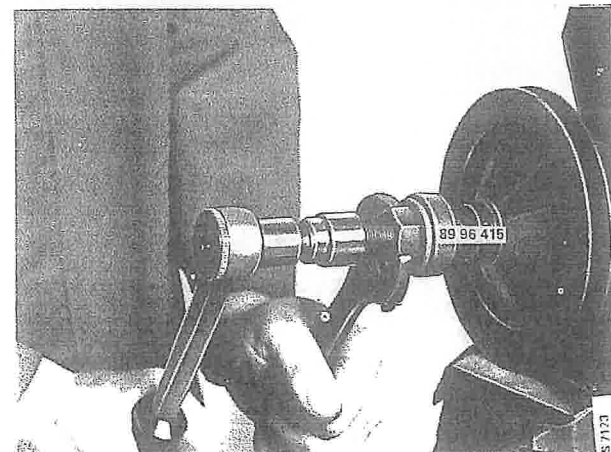
Removal/refitting of servo pump pulley

The procedure is the same for all pump variants.

- 1 Remove the pulley from the pump shaft using puller 89 96 423.



- 2 Refit the pulley onto the pump shaft using tool 89 96 415.



M80 and earlier:

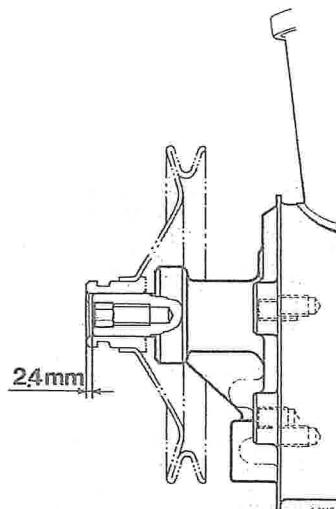
The outside edge of the pulley hub should be 2.4 mm from the end of the shaft.

M81 onwards:

The outside edge of the pulley hub should be flush with the end of the shaft.

Caution

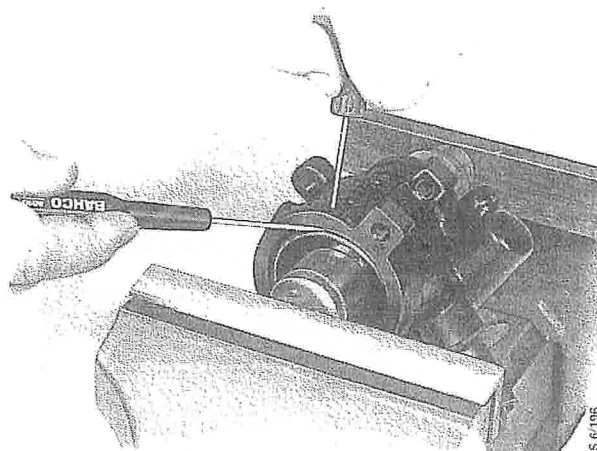
Never apply any force to the pump shaft during removal/refitting of the pulley.



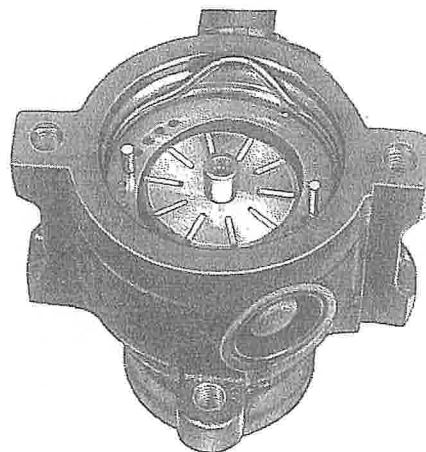
Pump with separate reservoir

To dismantle

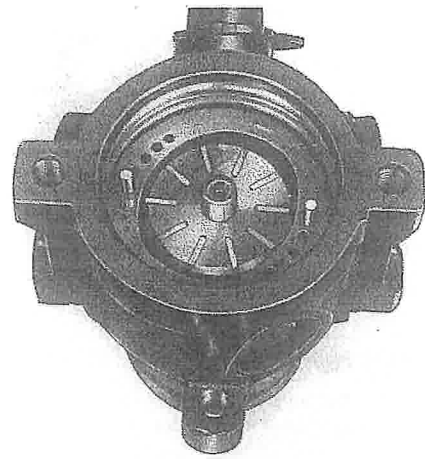
- 1 Press in the end cover and prise the retaining ring out of the groove by inserting a screwdriver through the hole in the pump casing.



- 2 Remove the end cover by tapping the pump casing against the workbench.
- 3 Remove the "O" ring.

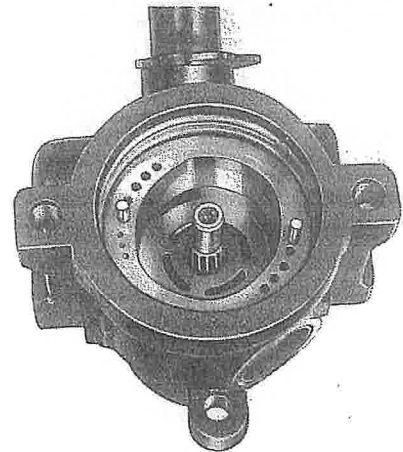


4 Remove the rotor complete with vanes.



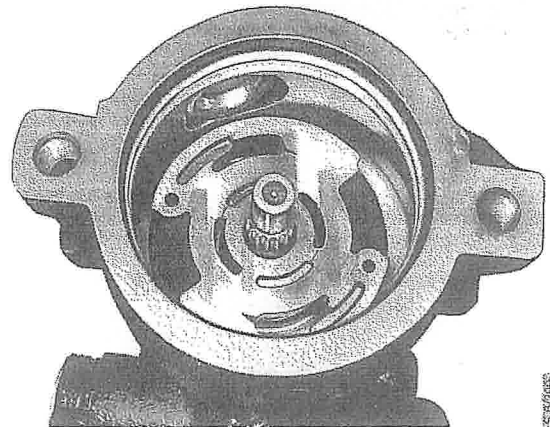
S 6/198

5 Remove the pump ring and the two dowel pins.



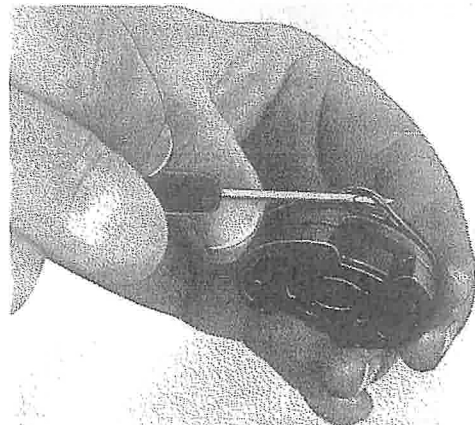
S 6/199

6 Remove the end plate.



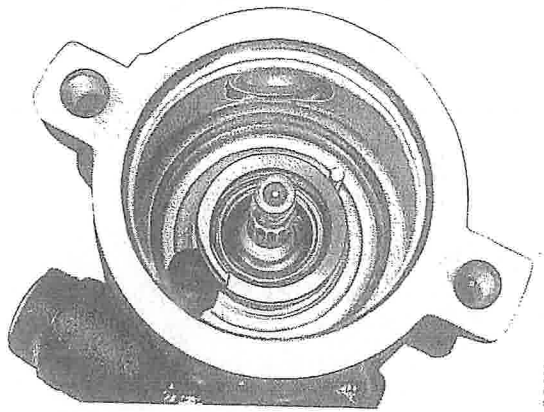
S 6/200

7 Remove the "O" ring from the end plate.



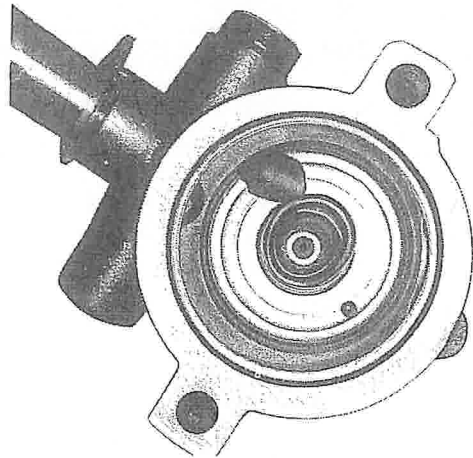
S 6/201

8 Remove the spring and pin.



S 6/202

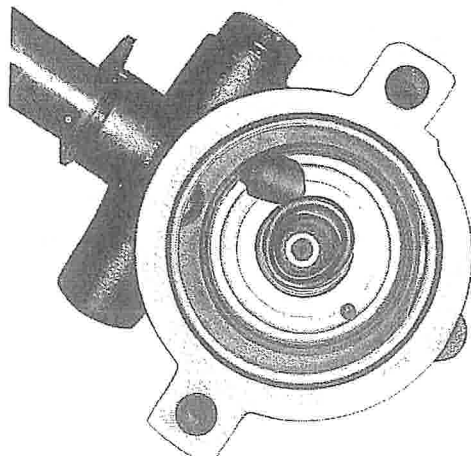
9 Remove the "O" ring.



S 6/203

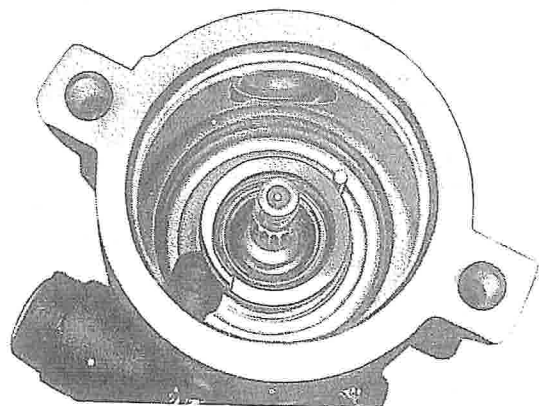
To assemble

1 Fit the "O" ring.



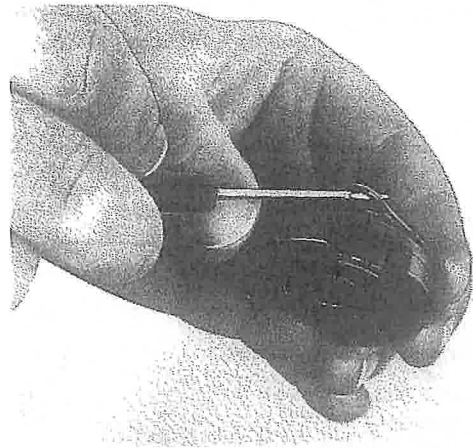
S 6/203

2 Fit the pin inside the casing and insert the spring.



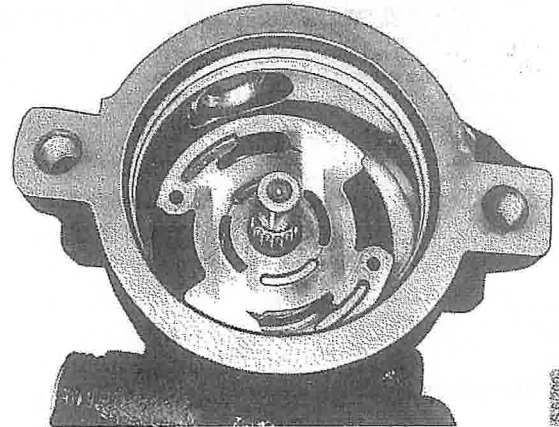
S 6/202

3 Fit the "O" ring onto the end plate.



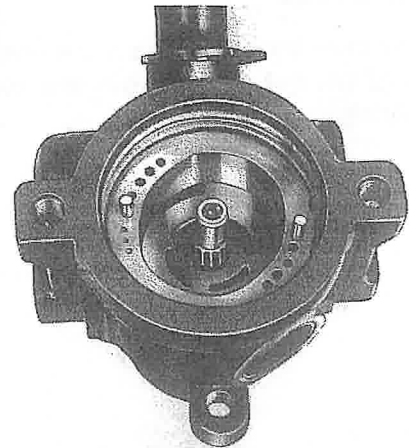
S 6/201

4 Fit the end plate over the pin.



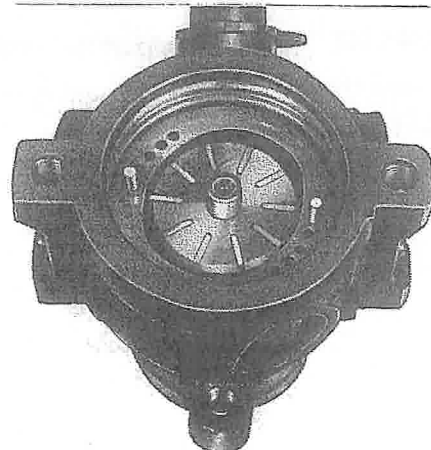
S 6/201

5 Fit the two dowel pins into the holes in the end plate and fit the pump ring on the dowel pins.



S 6/199

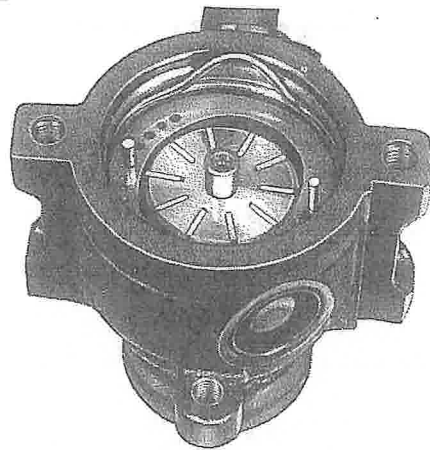
6 Fit the rotor and vanes.



S 6/198

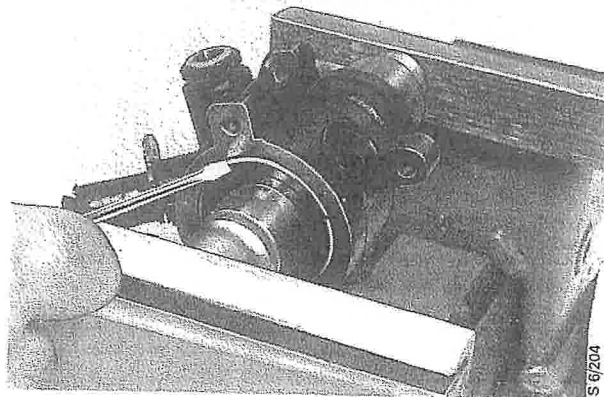
644-36 Power-assisted steering system

- 7 Fit the "O" ring.



S 6/197

- 8 Fit the end cover over the dowel pins, press it in and fit the retaining ring.

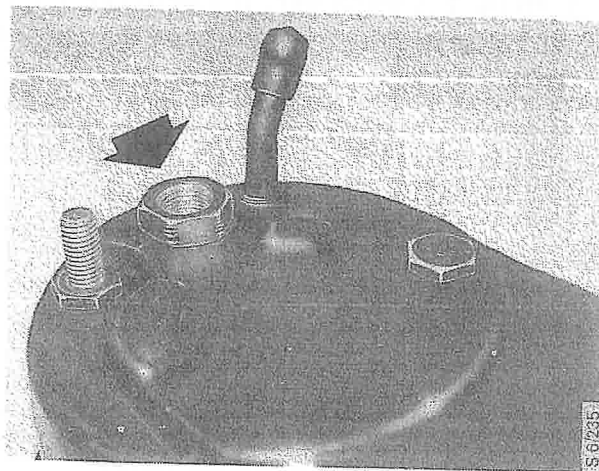


S 6/204

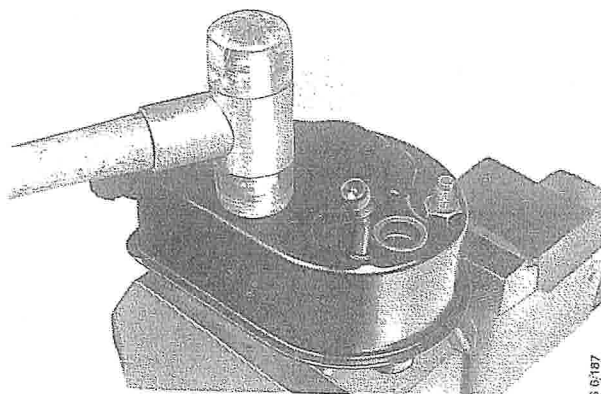
Pump with integral reservoir

To dismantle

- 1 Unscrew the fitting from the reservoir casing. Lift out the control-valve plunger and spring.
- 2 Slacken but do not remove the nut and bolt.
- 3 Remove the pump from the casing by tapping lightly on the nut and bolt.
- 4 Remove the nut and bolt, followed by the casing.

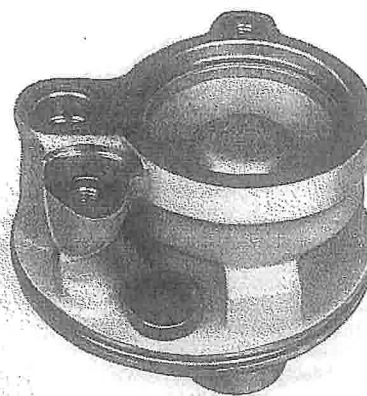


S 6/235



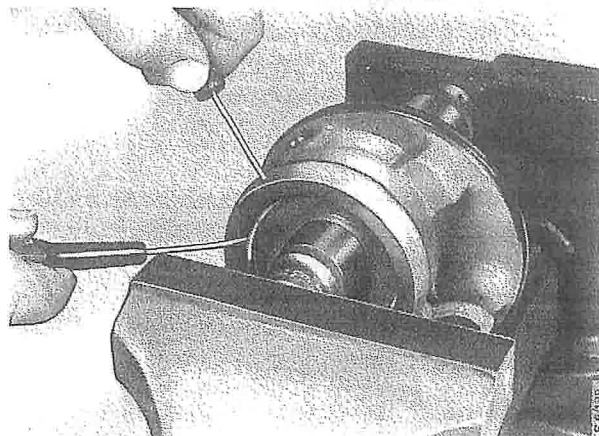
S 6/187

- 5 Remove the three rubber seals, the "O" ring and the magnet.



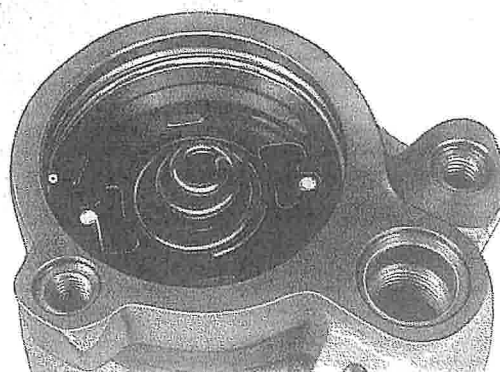
S 67188

- 6 Press in the end cover and remove the retaining ring.
7 Remove the end cover by tapping the pump gently against the workbench.



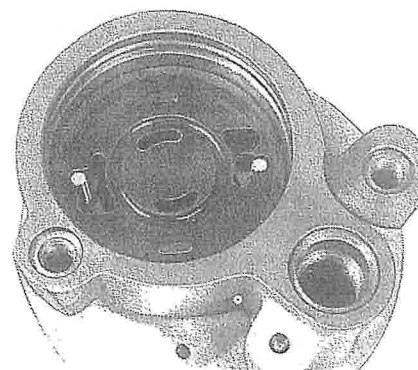
S 67188

- 8 Remove the spring and "O" ring.



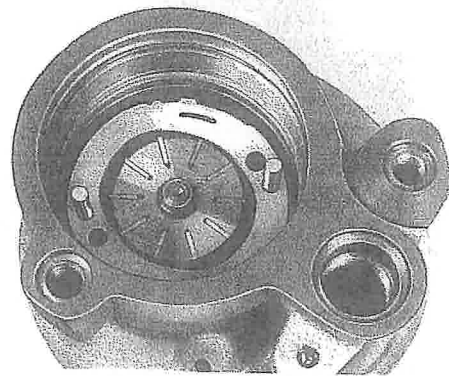
S 67189

- 9 Remove the end plate.



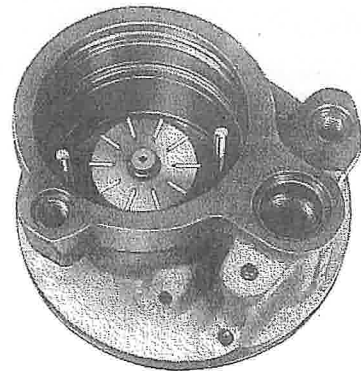
S 67191

10 Remove the pump ring.



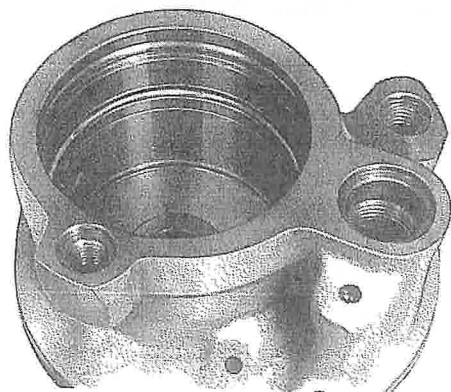
S 6192

11 Lift out the rotor with vanes, the thrust plate complete with two dowel pins and the shaft.



S 6193

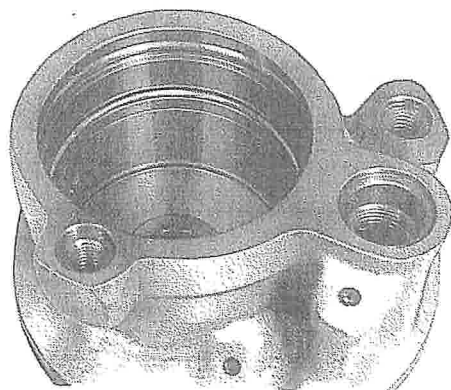
12 Remove the "O" ring from inside the pump casing.



S 6194

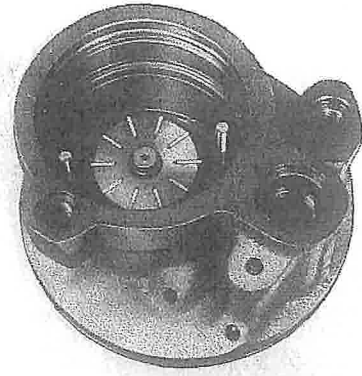
To assemble

1 Fit the "O" ring inside the pump casing.



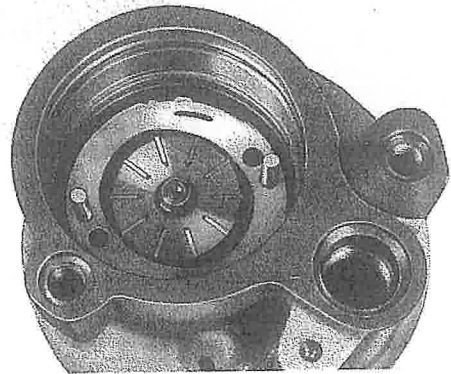
S 6194

- 2 Fit the shaft, rotor with vanes, and the thrust plate complete with two dowel pins.



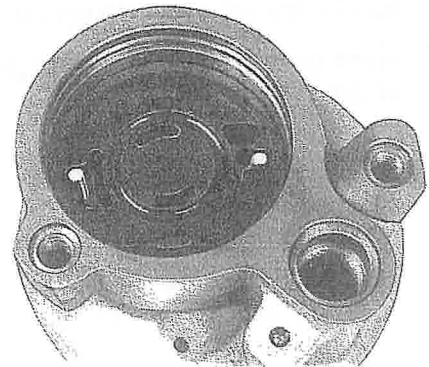
S 6/193

- 3 Fit the pump ring.



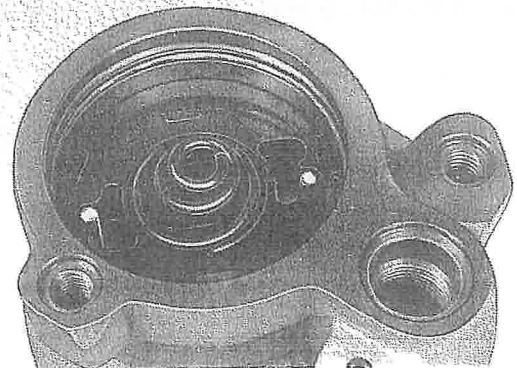
S 6/192

- 4 Fit the end plate.



S 6/191

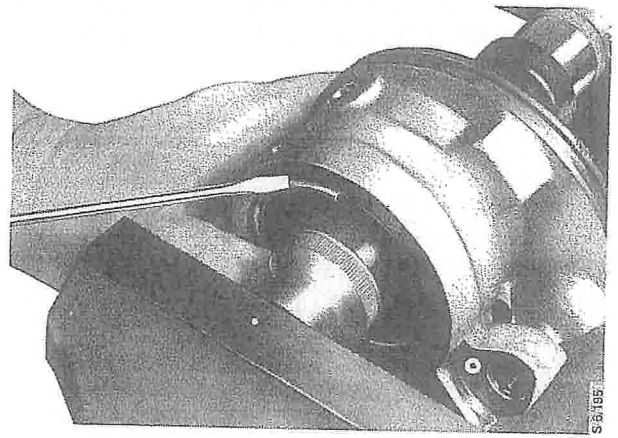
- 5 Insert the spring and fit the "O" ring.



S 6/190

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- 6 Press in the end cover and fit the retaining ring.

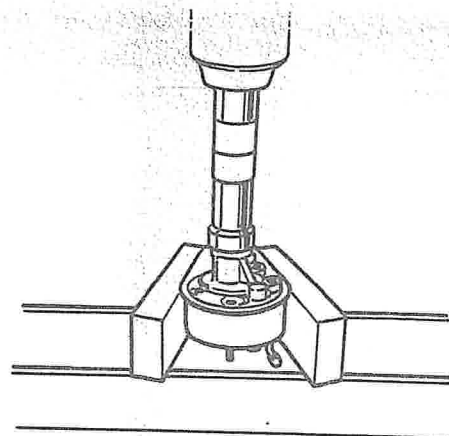


- 7 Fit the "O" ring, the three rubber seals and the magnet.

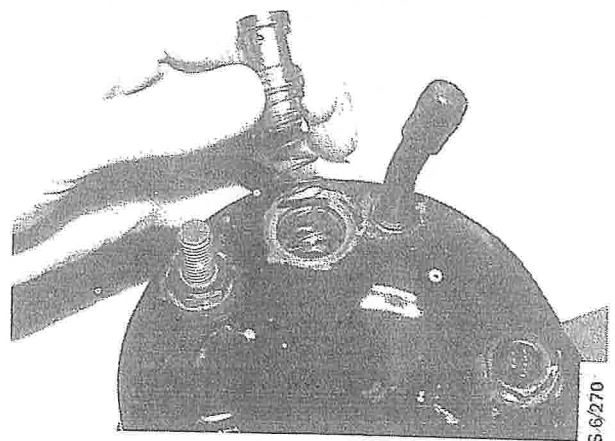


- 8 Lubricate the "O" ring and press on the reservoir casing using sleeve 87 91 311 (special tool for section 4, 9000 gearbox).

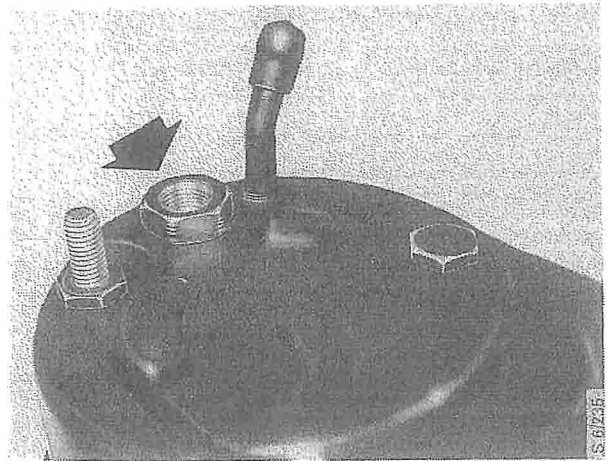
Press carefully to avoid damaging the edge of the casing.

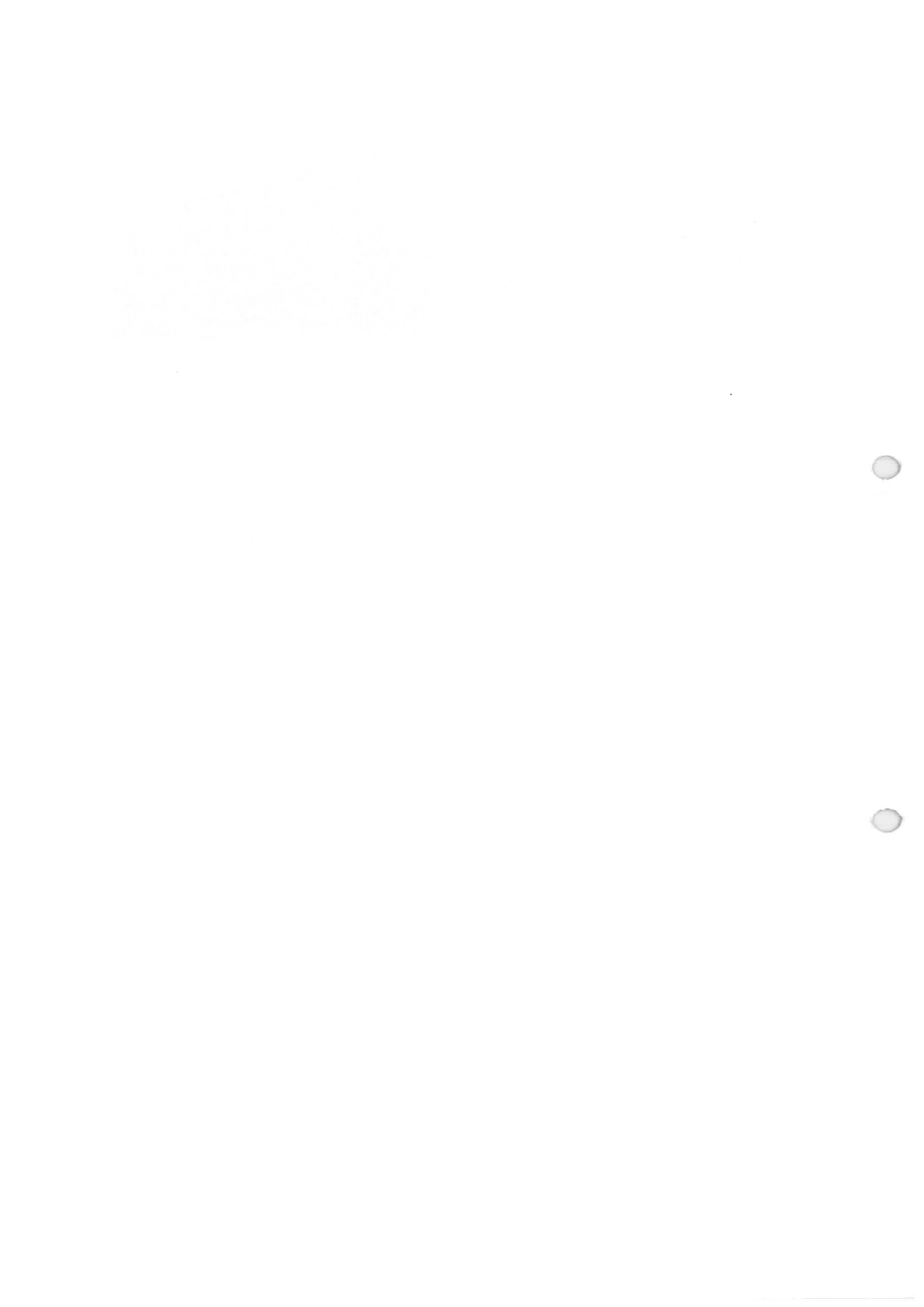


- 9 Tighten the nut and the bolt.
10 Fit the spring and control-valve plunger.



- 11 Inspect the "O" ring and then tighten the fitting.







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