

# **Workshop Manual**

# **928**

**DR. ING. h. c. F. PORSCHE Aktiengesellschaft**

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TECHNICAL DATA

## F r o n t   A x l e

Suspension                      Independent suspension, double  
control arm with coil spring and internal  
damper.

Springs                          1 coil spring per wheel

Dampers                          Double-action hydraulic dampers  
Make/installation              See page 40 - 51

## Stabilizers

until end of model year 79      dia. 26 mm

80 models onward                dia. 28 mm x 4 (tubular stabilizer)

86 models onward                dia. 28 mm x 4 (tubular stabilizer)  
with modified knuckle

## TIGHTENING TORQUES FOR FRONT AXLE

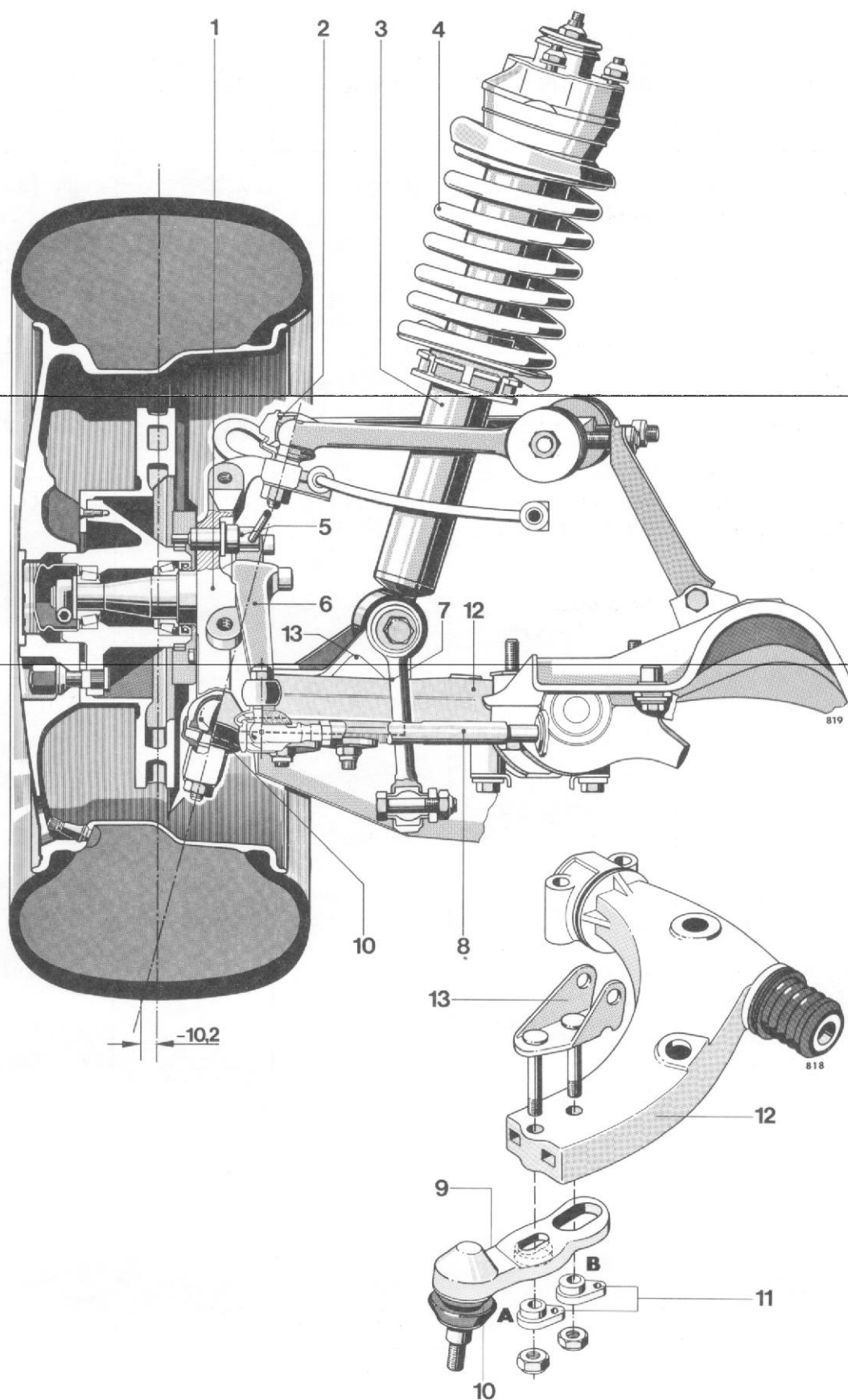
Location	Description	Thread	Material	Torque Nm (ftlb)
Upper control arm to body	Self-locking hex nut	VM 14x1.5	8	140 (103)
Lower control arm to body, rear	Hex bolt	M 12x1.5	10.9	120 (88)
Lower control arm to body, front	Hex bolt	M 12x1.5	8.8	85 (62)
Guard to longitudinal member	Self-locking hex nut	VM 10	8	46 (33)
Spring strut to body	Self-locking hex nut	VM 10	8	46 (33)
Spring strut and stabilizer linkage to lower control arm	Self-locking hex nut	VM 12x1.5	8	85 (62)
Stabilizer clamp to longitudinal member	Hex bolt	M 10	8.8	46 (33)
Stabilizer linkage to stabilizer	Self-locking hex nut	VM 12x1.5	8	85 (62)
Upper and lower control arms to steering knuckle	Flange locknut	M 12x1.5	8	65 (47)
Guard to steering knuckle	Hex bolt	M 7	8.8	15 (11)
Cable holder to steering knuckle	Hex bolt	M 7	8.8	15 (11)



Location	Description	Thread	Material	Torque Nm (ftlb)
Brake caliper to steering knuckle	Hex bolt Panhead bolt	M 12x1.5	8.8	85 (62)
Brake disk to wheel hub	Countersunk bolt	M 6	8.8	10 (7)
Panhead bolt to clamping nut	Panhead bolt	M 7	10.9	15 (11)
Wheel to wheel hub	Wheel nut	M 14x1.5	A1	130 (95)
Steering track rod to steering arm	Hex nut, self-locking	VM 12x1.5	8	65 (47)
Rubber bushing of piston rod of spring strut	Hex nut, self-locking	VM 12x1.5	8	60 (44)
Ball joint, (mounting) to lower control arm	Hex nut, self-locking	VM 12x1.5	10	120 (88)
Support plate on steering axle (upper control arm)	Hex nut, self-locking	VM 12x1.5	8	85 (62)
Roadspeed sensor to steering knuckle	Panhead bolt	M 6	8.8	10 (7)

## NOTES ON FRONT AXLE, 86 MODELS ONWARD

## New front wheel suspension

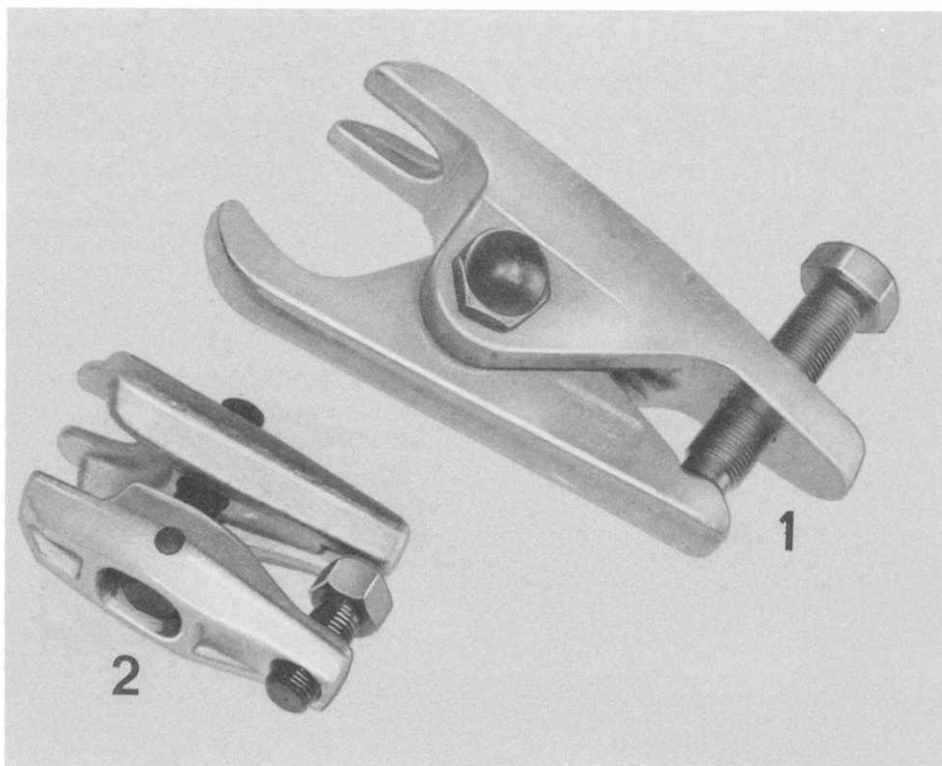


# Front Axle Modifications, 86 Models Onward

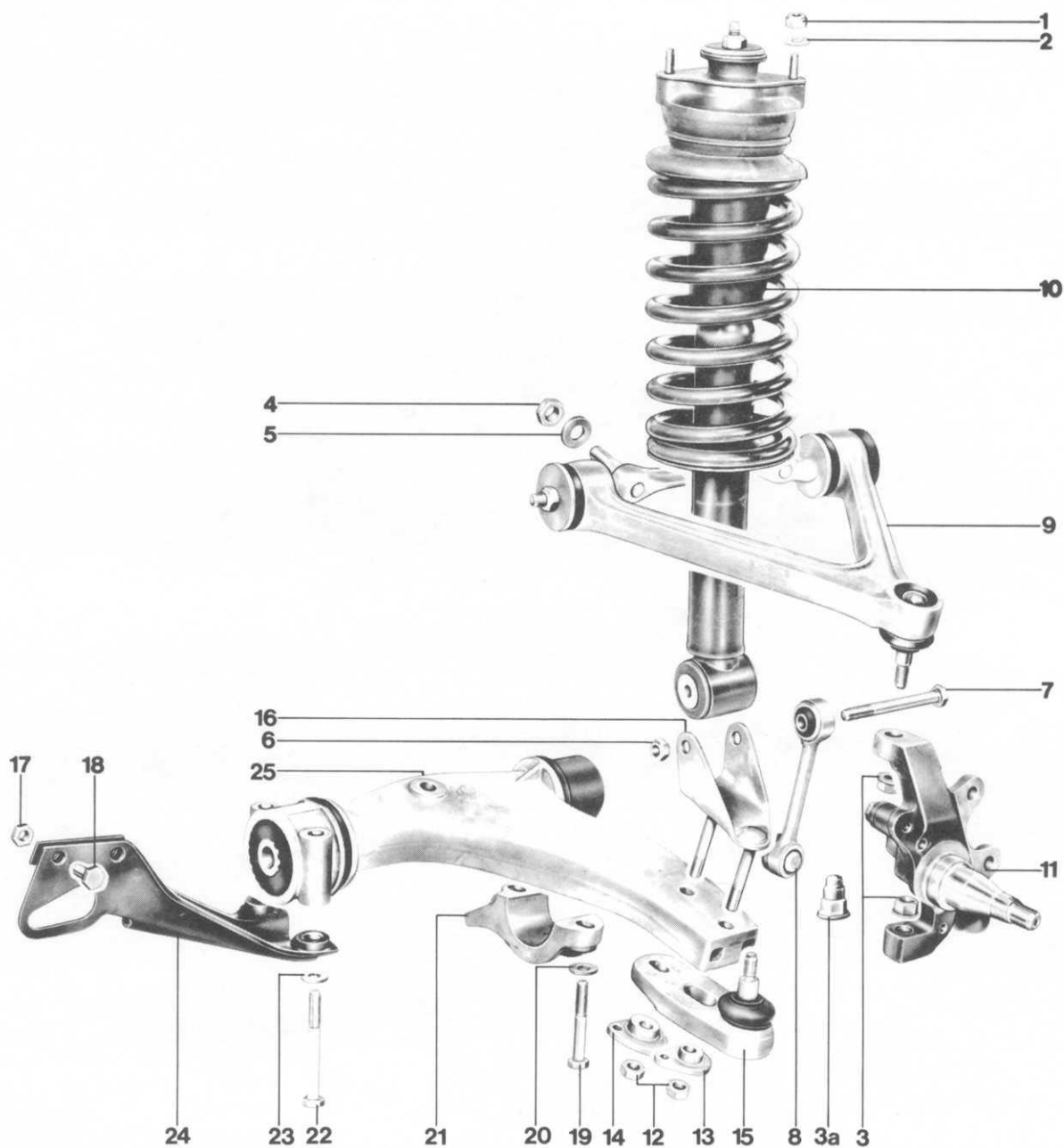
No./Description	Most Important Modifications	Remarks
1 Steering knuckle	Attachment points for brake caliper	Four-piston fixed caliper, 86 models onward
	Studs for wheel bearing (clearance and diameter for outer bearing)	
	Locator for ball joint No. 10 of the mounting	
- Wheel bearing	Outer wheel bearing larger. Distance between bearings increased	Adjust as before (every 20000 km)
- Steering offset	- 10.2 mm before - 16 mm	For braking system (four-piston fixed caliper)
		<u>Heights and wheel geometry unchanged</u>
2 Upper control arm	Shorter than before. Ball joint inclined outward	Distinguishing feature, P. 40 - 16/17
3 Dampers	Adjustment	Table P. 40 - 51
	2-pipe gas-filled dampers (Boge) standard and optional previously standard: 2-pipe pressureless (Boge) optional: 1-pipe gas-filled (Bilstein)	Combination with coil springs up to 86 models impermissible

No./Description	Most Important Modifications	Remarks
4 Coil springs	spring rate increased	<u>Only for Boge gas dampers.</u> Combination with dampers up to 86 models or Bilstein dampers impermissible P. 40 - 46
7 Stabilizer linkage	longer than before	P. 40 - 16/ 40 - 18
- <u>Stabilizer</u>	modified knuckle	P. 40 - 16/18
8 Steering track rods	approx. 10mm shorter than before	P. 40 - 16/17
9 Mounting (steel)	upright ball joint (previously trailing ball joint)	P. 40 - 19 to 40 - 21
11 Camber and caster eccentrics (same parts)	external contour smaller	External eccentric A = camber eccentric  Internal eccentric B = caster eccentric  P. 40 - 21
12 Lower control arm	shorter than before	Distinguishing feature/code P. 40 - 16/17
13 Spring strut stirrup	modified mounting point for spring strut, because control arm shorter but strut position same as in cars earlier than 86 models	Distinguishing feature/code P. 40 - 19 to 40 - 21

## TOOLS



No.	Description	Special Tools	Remarks
1	Press-out tool	VW 267 a	
2	Track rod puller		e.g. Nexus 168 - 1



No.	Description	Qty	Note When:	
			Removing	Installing
1	Locknut	3		renew, torque: 46 Nm (33 ftlb)
2	Washer	3		
3	Flange locknut (for steering knuckles without push-off lug for ball joint)	2	load ball joint by exerting pressure on upper control arm	renew, torque: 65 Nm (47 ftlb). Exert pressure on upper control arm to load ball joint
	or			
3	Flange locknut	1		
3a	Cap locknut (on steering knuckles with push-off lug for the lower ball joint). (See page 40 - 25)	1		
4	Locknut	2	to ease installation, see removing as for 86 models onward (p. 40 - 8)	renew, torque: 140 Nm (103 ftlb)
5	Washer	1		only on rear pin of control arm
6	Locknut	1		renew, torque: 85 Nm (62 ftlb)
-	Washer, 928 S only (floating caliper brake)	1		
-	Air guide plate, 928 S (floating caliper brake)	1		

No.	Description	Qty	Note When:	
			Removing	Installing
7	Hex bolt	1		
8	Stabilizer linkage	1		when replacing, do not confuse with version for 86 models onward. Installation overview, pages 40 - 16 to 40 - 18
9	Upper control arm	1		inspect, renew if necessary, reworking is impermissible
10	Spring strut	1		
11	Steering knuckle	1		inspect for damage, reworking is impermissible See page 40 - 25
12	Locknut	2		renew, torque: 120 Nm (88 ftlb)
13	Caster/camber eccentrics	1		lubricate sliding surfaces of eccentric adjustment range with Optimoly TA. Cover ball joint slots. See pages 40 19, 40 - 20 and 40 - 23
14	Camber/caster eccentric	1		see pages 40 - 19 and 40 - 20 for position and types.
15	Ball joint (mounting)	1		inspect, renew if necessary. Cover slot, see pages 40 - 19, 40 - 20 and 40 - 23

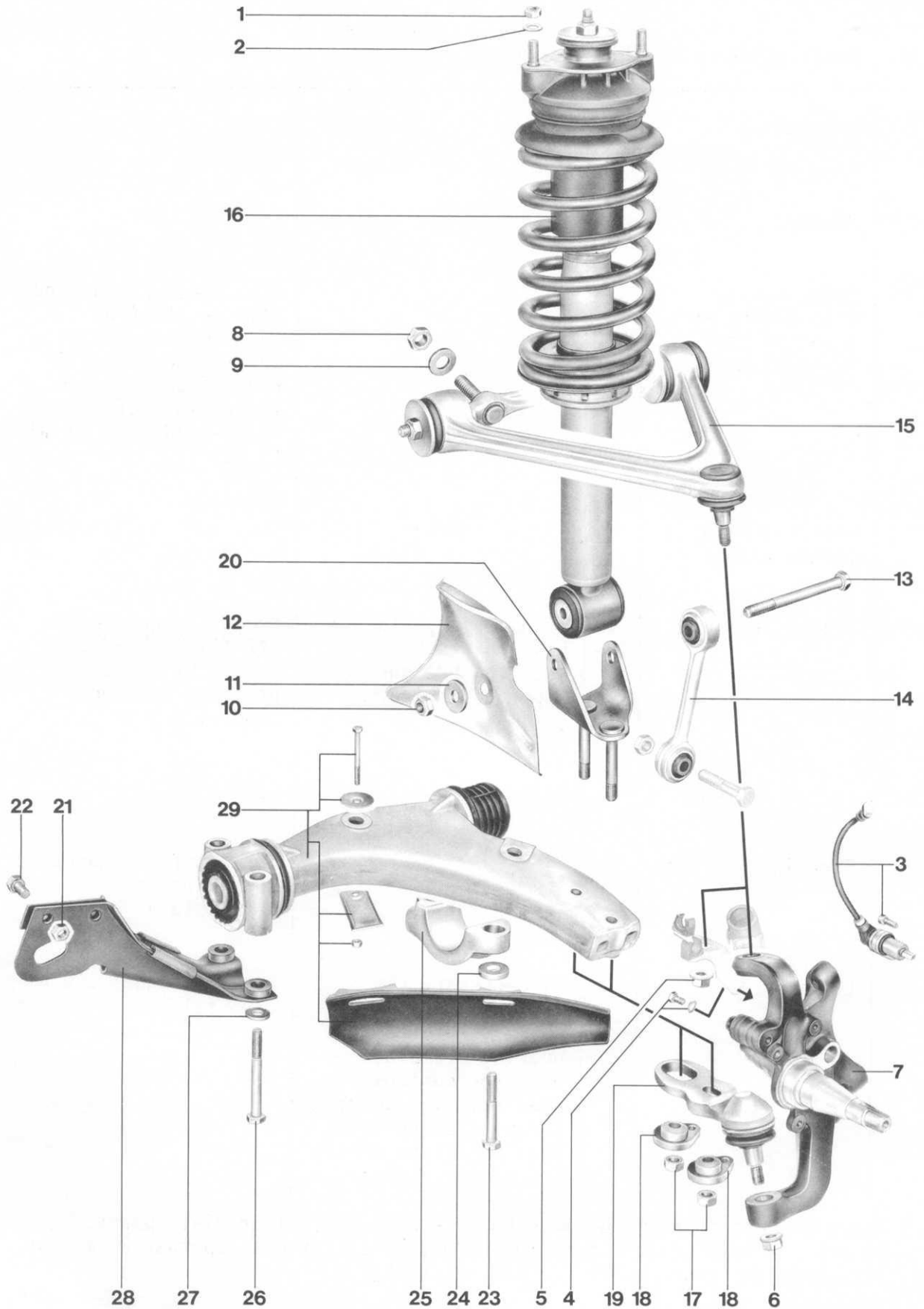


No.	Description	Qty	Note When:	
			Removing	Installing
16	Clamp	1		see pages 40 - 19 and 40 - 20
17	Locknut	2		renew, torque: 46 Nm (33 ftlb)
18	Hex bolt	2		
19	Hex bolt (10.9, 80 mm long)	2		Coat threads with Optimoly HT (do not apply Optimoly HT to bolt shank). * Screw in until only 2 threads are visible. Do not tighten to 120 Nm (88 ftlb) until assembly is completed and springs have settled
20	Washer approx. 6 mm thick, dia. approx. 30 mm	2		do not mix up with washer No. 23
21	Bearing clamp	1		inspect for damage. Tighten to specified torque
22	Hex bolt (100 mm long)	2		Coat thread with Optimoly HT. (Do not apply Optimoly HT to bolt shank). * Torque: 85 Nm (62 ftlb)

\* See notes on page 40 - 14

No.	Description	Qty	Note When:	
			Removing	Installing
23	Washer approx. 4 mm thick dia. approx. 25 mm	2		do not mix up with washer No. 20
24	Guard	1		
25	Lower control arm with* - spoiler - securing bolts - cup washers - securing brackets - locknuts	1		renew if damage sus- pected. No reworking is permissible. <u>Tighten bolts No. 19</u> <u>of bearing clamp No.</u> <u>21 as specified.</u> When replacing, do not con- fuse with control arm for 86 models onward. Installation overview, Pages 40 - 16 to 40 - 18

\* 928 S only (floating caliper brakes)



No.	Description	Qty	Note When:	
			Removing	Installing
1	Locknut	3		Renew, torque: 46 Nm (33 ftlb)
2	Washer	3		
3	Speed sensor with O-ring and mounting bolt	1		coat speed sensor and hole in steering knuckle with Molykote Longterm 2. Renew O-ring of speed sensor. Tightening torque for Allen-head bolt 10 Nm (7 ftlb)
4	Hex bolt with spring washer	1		
5*	Flange locknut	1	If necessary, load ball joints by exerting pressure on upper control arm	renew, torque: 65 Nm (47 ftlb). Load ball joints by exerting pressure on upper control arm
6	Flange locknut	1	As No. 5	As No. 5
7	Steering knuckle	1		inspect for damage. No reworking is permissible.
8	Locknut	2	If necessary (to increase working space), remove bearing clamp No. 25 of lower control arm. When removing bearing clamp, slacken locknuts No. 17 on caster and camber eccentrics.	renew, torque: 140 Nm (103 ftlb)

\* There is no difference between No. 5 and No. 6 (collar dia. approx. 24 mm). In some cars, a nut (No. 5) with a collar dia. approx. 26 mm was fitted to the upper joint (to use up stock).

No.	Description	Qty	Note When:	
			Removing	Installing
9	Washer	1		only on rear control arm mounting
10	Locknut	1		renew, torque: 85 Nm (62 ftlb)
11	Washer	1		
12	Air guide plate	1		
13	Hex bolt	1		
14	Stabilizer linkage	1		<p>when replacing, do not confuse with version for cars earlier than 1986. Spare part number on linkage.</p> <p>Tightening torque for upper and lower mountings : 85 Nm (62 ftlb).</p> <p>Install right way round. <u>Cranked end</u> at top (at spring strut mounting) and tilted forward (no difference between left-hand and right-hand parts).</p>
15	Upper control arm	1		inspect, renew if necessary. No re-working is permissible. Attachment to body: lubricate thread and shank with Opti-moly HT.
16	Spring strut	1		Coil spring page 40-46 Damper installation overview, page 40-51

No.	Description	Qty	Note When:	
			Removing	Installing
17	Locknut	2	only slacken if part of control arm with clamp and ball joint (mounting) must be replaced	renew, torque: 120 Nm (88 ftlb)
18	Caster or camber eccentric (outer eccentric - camber	2		coat sliding surfaces of eccentric adjustment range with Optimoly TA. Cover slots of ball joints, page 40 - 23. When replacing, note page 40 - 21.
19	Ball joint (mounting)	1		inspect, renew if necessary. Close slot, page 40 - 23
20	Clamp	1		when replacing, do not mix up with version for cars earlier than model year 86. See page 40 - 21. After inserting in lower control arm, coat thread with Optimoly HT. Do not allow Optimoly HT to touch shank of bolt or to penetrate hole in light-alloy member (see page 40 - 14).
21	Locknut	2		renew, torque: 46 Nm (33 ftlb)
22	Hex bolt	2		

No.	Description	Qty	Note When:	
			Removing	Installing
23	Hex bolt (10.9/ 80 mm long)	2		coat thread with Optimoly HT (Optimoly HT on bolt shank is impermissible). * Screw in until only 2 threads are visible. Do not tighten to 120 Nm (88 ftlb) until assembly is completed and springs have settled.
24	Washer approx. 6 mm thick, dia. approx. 30 mm	2		do not mix up with washer No. 27
25	Bearing clamp	1		check for damage. Tighten as specified.
26	Hex bolt (100 mm long)	2		coat threads with Optimoly HT (Optimoly HT is not permissible on bolt shank) * Torque: 85 Nm (62 ftlb)
27	Washer approx. 4 mm thick, dia. approx. 25 mm	2		do not mix up with washer No. 24
28	Guard	1		

\* See note page 40 - 14

No.	Description	Qty	Note When:	
			Removing	Installing
29	Lower control arm with spoiler securing bolts cup washers securing brackets locknuts	1		<p>Renew if damage suspected. No reworking is permissible.</p> <p><u>Tighten bolts No. 23 of bearing clamp No. 25 as specified.</u></p> <p>When replacing, do not mix up with control arm for cars earlier than model year 86. Part marked "Porsche" (before 86 model years, without Porsche inscription).</p> <p>Installation overview, see pages 40 - 16/ 40 - 17</p>

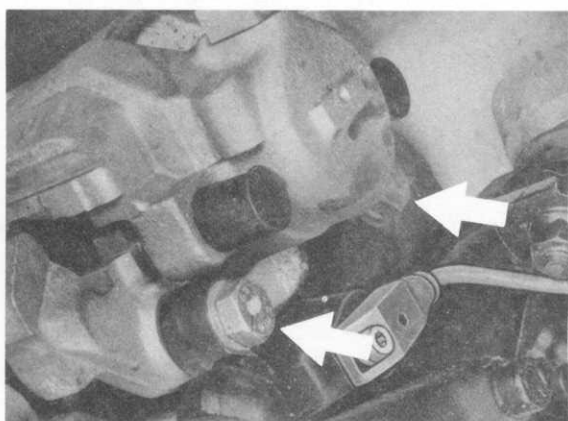


## INSTRUCTIONS FOR ASSEMBLY AND DISASSEMBLY

## D i s a s s e m b l i n g

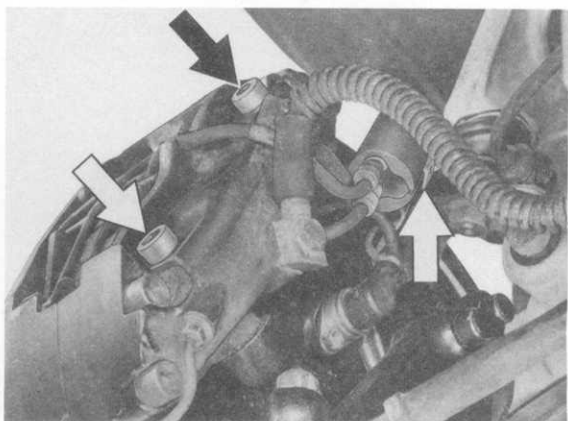
1. Unbolt brake caliper and move aside without imposing strain on brake hose.

Mounting: until end of model year 85

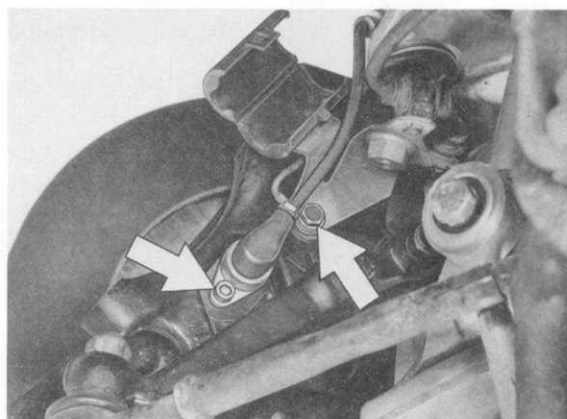


Mounting: 86 models onward

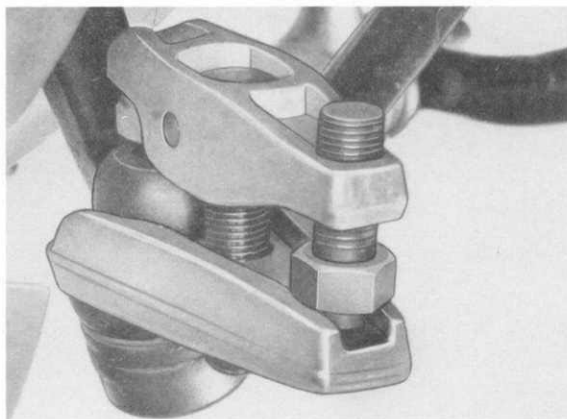
Beforehand, open plug-in connector of ABS and brake-pad wear cable and disconnect.



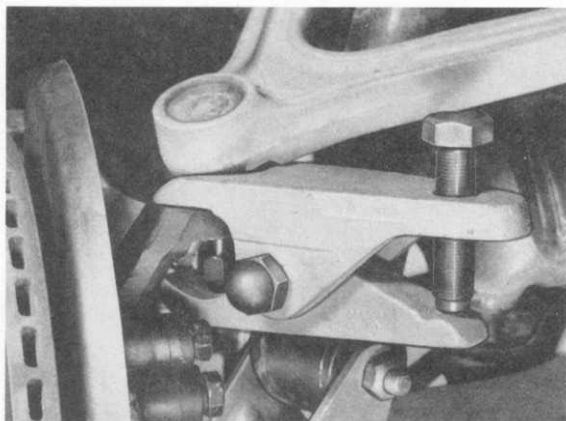
2. Disconnect ground lead (86 models onward). Remove speed sensor.



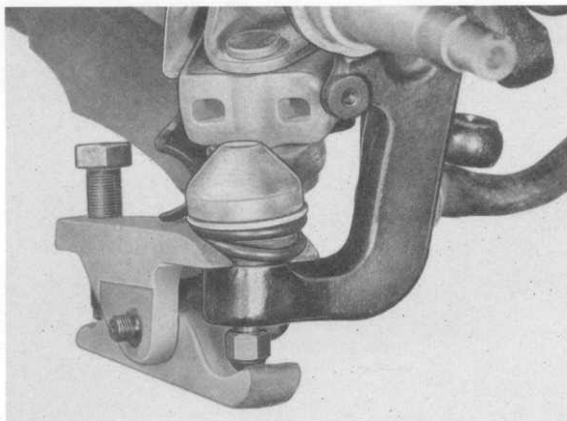
3. Press out track rod with extractor, e.g. Nexus 168-1.



4. Use VW 267a to press out ball joint. Take care not to damage protective caps of joints. (Steering knuckle with cap nut, see page 40 - 25). If collar nuts difficult to remove, see Installing, Item 3.



Wheel suspension, 86 models onward (lower ball joint).



## Installing

### Note:

When using Optimoly HT or TA assembly paste, note the following:

#### Optimoly HT (copper-colored)

For steel-steel threaded connections and contact surfaces of assembly parts.  
Never use Optimoly HT on contact surfaces of steel to light alloy, as moisture will produce corrosion. When applied to threads, this lubricant has no effect on tightening torques.

#### Optimoly TA (aluminum color)

For all connections with aluminum or with magnesium, for corrosion protection.  
When applied to threads, this lubricant has a slight effect on tightening torques.

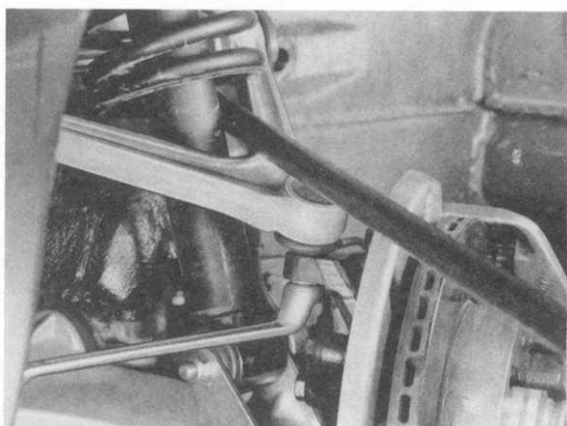
1. Subject all parts to visual inspection, if necessary, compare with new part.  
If replacement parts are fitted, check installation overview, see pages 40 - 16 to 40 - 21

2. When installing lower control arm, screw bolts of rear bearing clamp into body until only 2 threads are visible.

Do not tighten the two bolts to specified torque until assembly is completed and springs have settled. This keeps front of car down.

Close slots for outer cams (page 40 - 23).

3. To prevent ball pins turning and to allow installation of collar nuts (also for disassembly), apply pressure to upper control arm to load ball joints.



**Note :**

Spray adjustment plate on lower control arm with eccentrics, threaded section of track rod, threaded pins in upper bearing joint and threaded pins in lower bearing joint with Tectyl-UL 846 (Valvoline). This prevents corrosion of the threaded elements, thus facilitating maintenance and repair work.

## WHEEL SUSPENSION COMPONENTS - INSTALLATION OVERVIEW\*

Fig. No.	Description	Identification - Distinguishing Features**	
		Version A until end of model year 85	Version B 86 models onward
1	Upper control arm	longer than 86 models onward, ball joint at right angle to suspension link	shorter than until end of model year 85, ball joint inclined outward
2	Lower control arm	longer than 86 models onward, no identification marking	shorter than until end of model year 85, bears "Porsche" inscription
3	Track rod	longer than 86 models onward	shorter than until end of model year 85
4	Stabilizer linkage	shorter than 86 models onward, marked with spare-part number	longer than until end of model year 85, marked with spare-part number
5	Stabilizer	stabilizer knuckle shorter and less cranked than 86 models onward (until end of model year 79, solid stabilizer, 80 models onward, tubular stabilizer)	stabilizer knuckle longer and more cranked than until end of model year 85

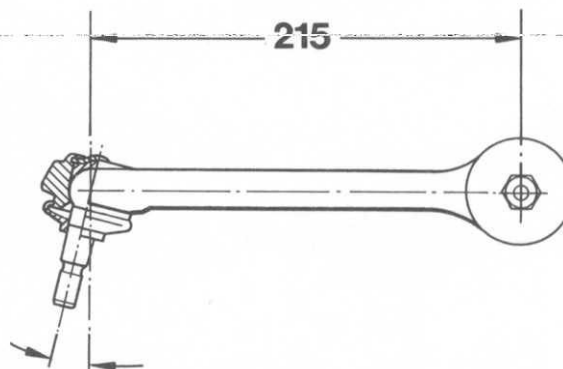
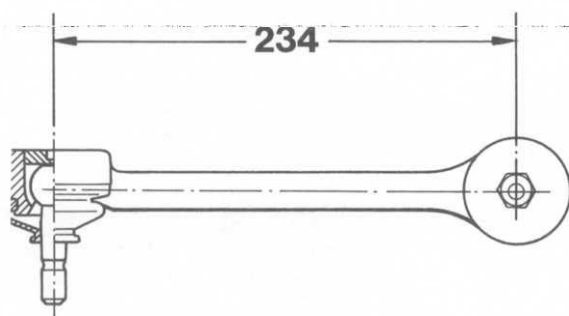
\* Mounting, clamp, camber and caster eccentrics, pages 40 - 19 to 40 - 21

\*\* Dimensions, see pages 40 - 17 and 40 - 18.

Version A  
until end of model year 85

Version B  
86 models onward

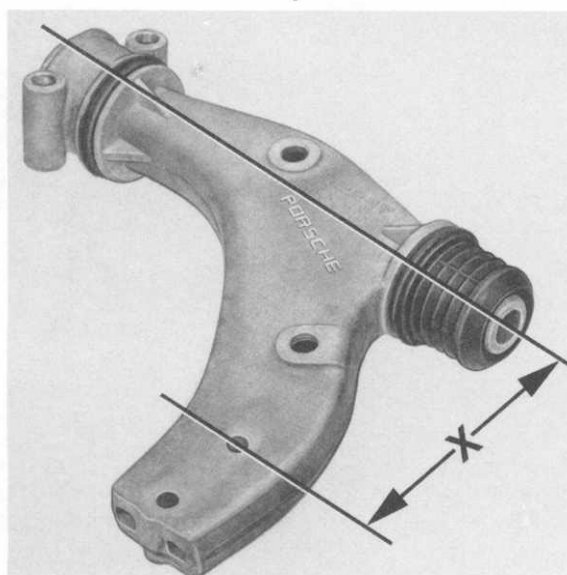
1 Upper control arm



2 Lower control arm

No "Porsche"  
inscription

Dim. X = 191 mm



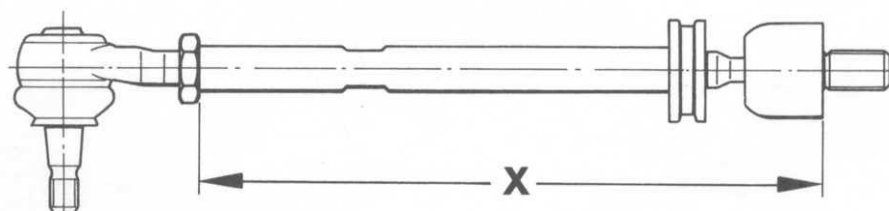
With "Porsche"  
inscription

Dim. X = 179 mm

3 Track rod

Dim. X approx. 245 mm

Dim. X approx. 235 mm



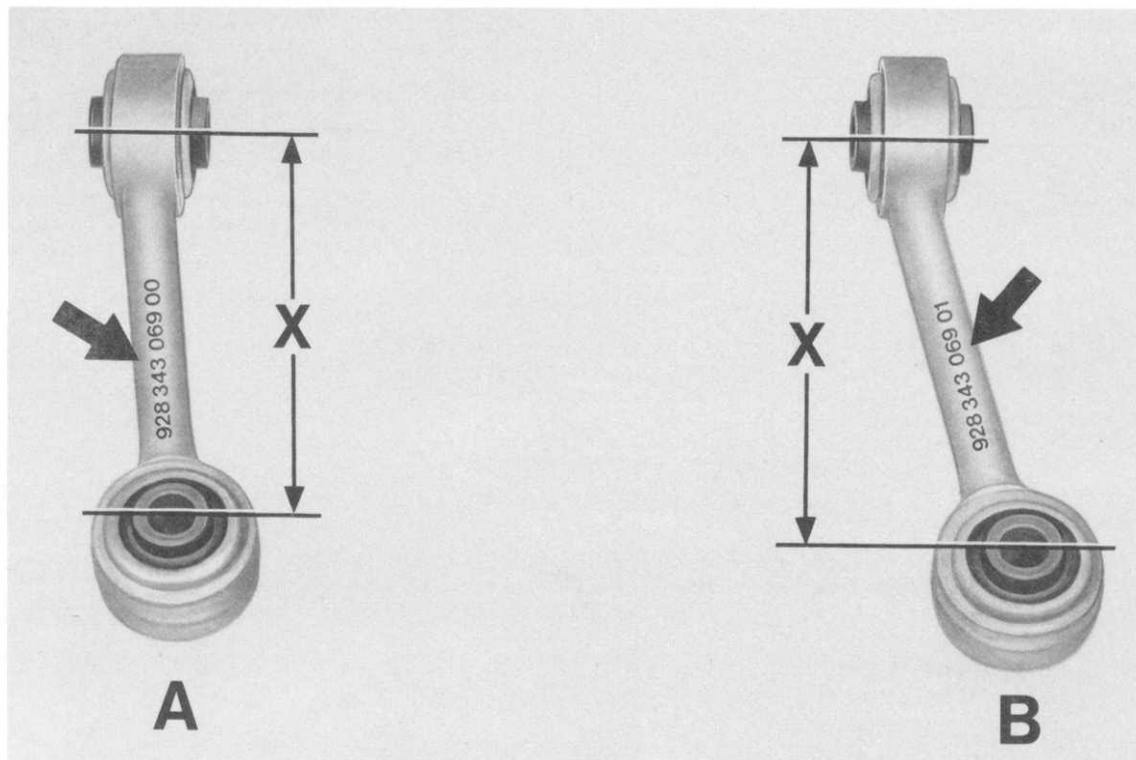
Version A  
until end of model year 85

Version B  
86 models onward

#### 4 Stabilizer linkage

Spare Part No. (arrow)  
928 343 069 00  
Dim. X approx. 135 mm

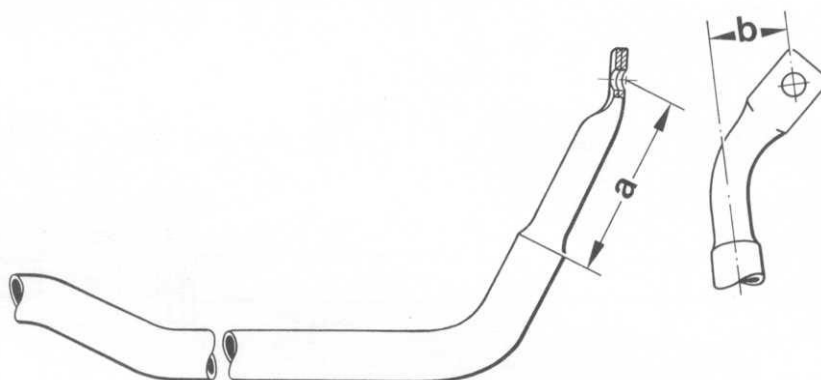
Spare Part No. (arrow)  
928 343 069 01  
Dim. X approx 142 mm



#### 5 Stabilizer

Dim. a =  $95 \pm 3$  mm  
Dim. b =  $38 \pm 1$  mm

Dim. a =  $102 \pm 3$  mm  
Dim. b =  $43 \pm 1$  mm



## MODIFICATIONS TO MOUNTINGS/NOTES FOR REPLACEMENT

Until end of model year 85, mountings with trailing ball joints were installed on the front axle. As of September 1983, steel mountings were used instead of aluminum.

This change also necessitated a modification of the camber and caster eccentric retaining clamps. The caster and camber eccentrics installed with the steel mountings are identical parts and are distinguished from the earlier versions by the stamped part No. 928 341 466 00.

Steel mountings with upright ball joints were installed from model year 86 onward (modified wheel suspension). This modification included redesigning retaining clamps and camber and caster eccentrics (retaining clamp with modified mounting point for spring strut, as control arm shorter but same strut position as in cars earlier than model year 86). There is no difference between caster and camber eccentrics, which are distinguished from the original and modified versions by the stamped part No. 928 341 466 01.

## Mountings until End of Model Year 85

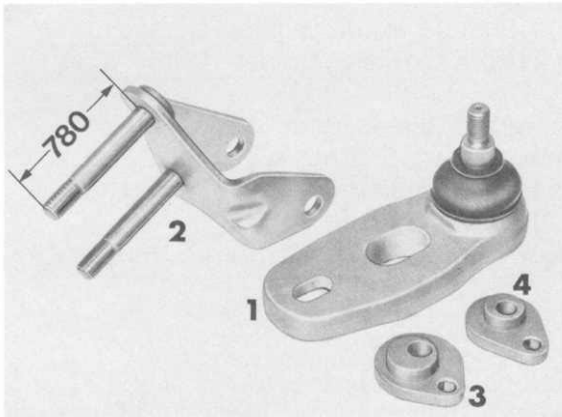
## Parts Overview:

Fig. Item*	Description	Original Version	Modified Version
1	Mounting	928.341.049.10	928.341.049.12
2	Left-hand clamp	928.341.091.03	928.341.091.05
2	Right-hand clamp	928.341.092.03	928.341.092.05
3	Caster eccentric	928.341.453.00	928.341.466.00
4	Camber eccentric	928.341.455.00	928.341.466.00

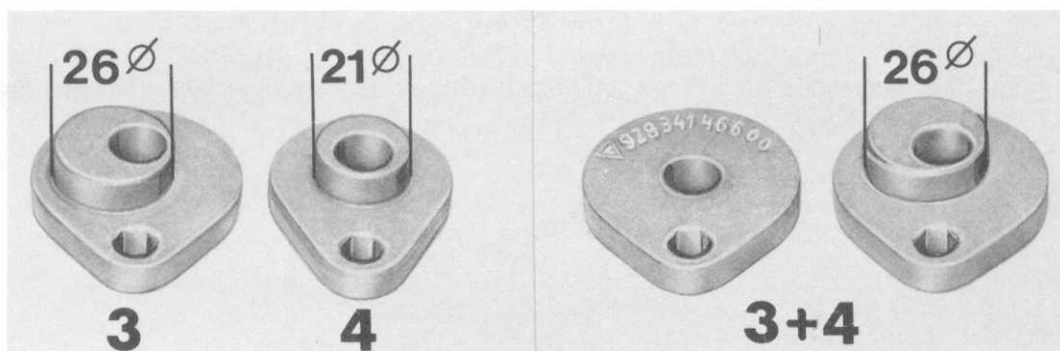
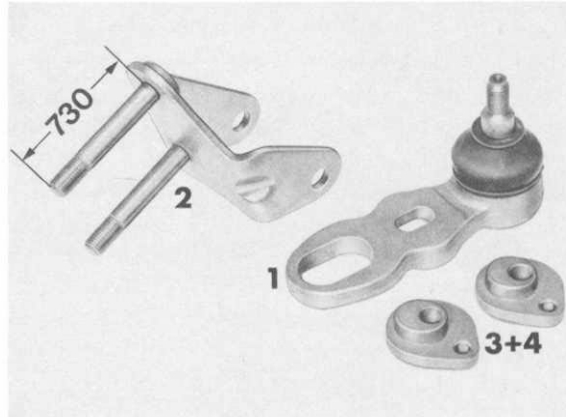
\* See Fig. on page 40 - 20

# Mountings until End of Model Year 85 (Parts Overview, page 40 - 19)

Original Version



Modified Version



The position of the eccentrics has been changed to suit the modified mountings. Caster is now set at the inner and camber at the outer eccentric.

The original type of mounting has now been discontinued. The modified versions may be retrofitted to these cars.

Original and modified parts are not interchangeable. This means that when a modified mounting is installed in an older car for the first time, new clamps and eccentrics must also be used.

It is permissible to install a modified mounting on one side only.

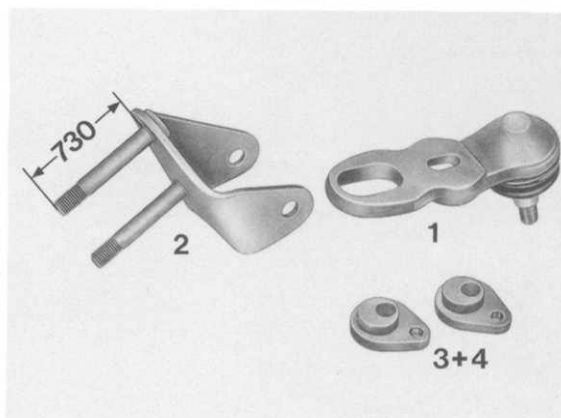
Under no circumstances may clamps for cars of model year 86 onward be used (danger of confusion, see note on page 40 - 6e).



## Mountings, 86 Models Onward

## Parts Overview

Fig. Item No.	Description	Parts No. new/current version
1	Mounting	928.341.049.08
2	Clamp, left	928.341.091.06
2	Clamp, right	928.341.092.06
3+4	Camber and caster eccentrics	928.341.466.01



As with the steel mountings in cars earlier than model year 86, the caster is set at the inner and the camber at the outer eccentric.

It is essential to ensure that incorrect parts are not installed. There is a danger of mixing up modified and new/current parts. Example: if the wrong clamp is mounted, the installation position of the spring strut is incorrect and the clearance between spring strut and upper control arm may be impaired.

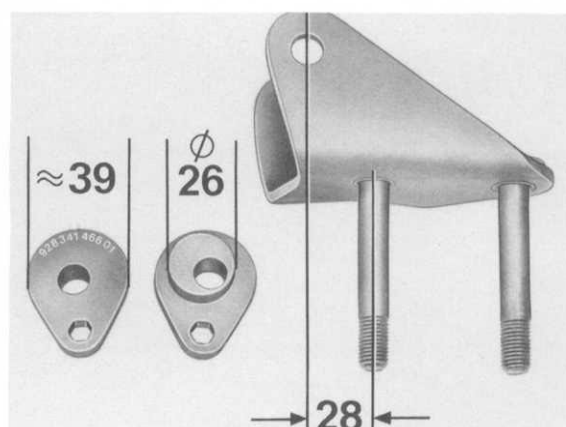
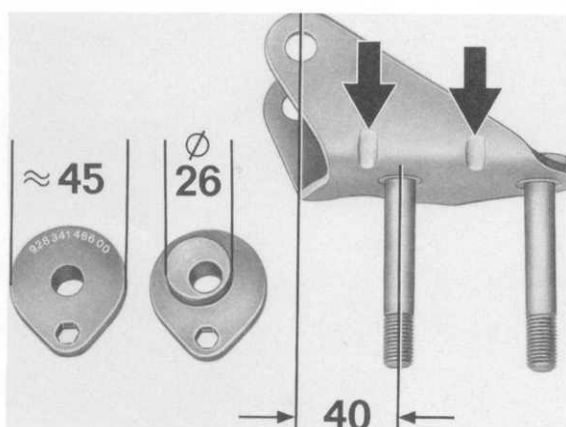
## Distinguishing Features, Identification Marking of the Modified and New/Current Components

Modified version (until end of model year 85)

New/current version, 86 models onward

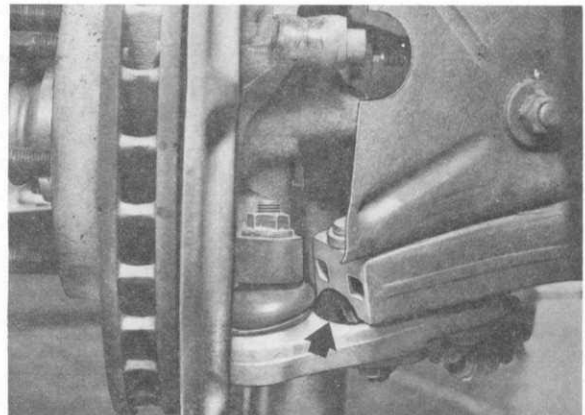
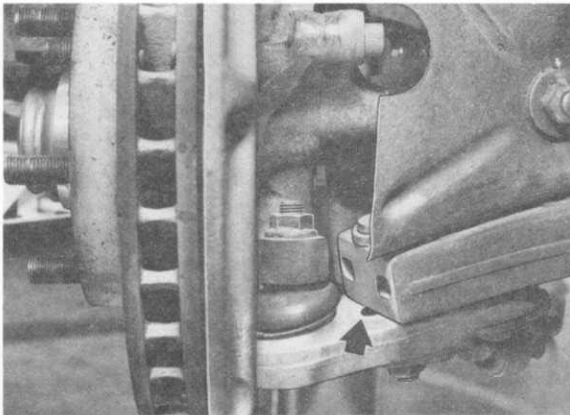
Clamp: 2 beads at front (arrows)  
Eccentric: stamped part No. 928.341.466.00

Clamp: No beads at front  
Eccentric: stamped part No. 928.341.466.01



### CLOSING SLOTS IN BALL JOINTS

As of September 1982, plastic sealing cord is used to close the slots for the outer setting eccentrics of the front-axle ball joints of new cars. In this way, dirt is prevented from penetrating the joint, making the eccentric easier to operate when servicing.



If work has been carried out on the front axle, and especially after realignment of the wheels, close the slots for the outer eccentrics with permanently-elastic sealing material on all cars (arrows). The sealing cord, part No. AKD 522.009, used to seal the 924 and 944 taillamps is suitable for this application.

Before sealing, ensure that slots are dry and free of grease.

If eccentric does not move freely (dirt in slot) we recommend removal of the outer eccentric, cleaning of the slot and spraying with rust remover. Apply Optimoly TA to sliding surface of eccentric in adjustment area and reinstall eccentric.



### Important:

Never try to free eccentric by hitting ball joint. Impact may damage the rubber cap.

If the rubber cap of a ball joint is damaged, it is essential to replace the joint. See also "Inspecting Protective Caps of Ball Joints of Control Arms and Track Rods" (page 40 - 24).

### INSPECTING PROTECTIVE CAPS OF BALL JOINTS ON CONTROL ARMS AND TRACK RODS

The rubber protective caps of the front-axle ball joints may be damaged by external influences, e.g. flying stones, or during assembly.

If a protective cap is damaged, the joint in question - upper or lower control arm, track rods - must be renewed, as the action of dirt or moisture will destroy the joint. For this reason, we also call attention to the routine listed in the vehicle maintenance plan:

"Inspect seating and operation of all joints to steering gear, track rods, suspension links and joints, as well as the leaktightness of the protective caps".

We recommend that the protective caps of the joints be checked whenever work is carried out on the front axle (visual inspection).

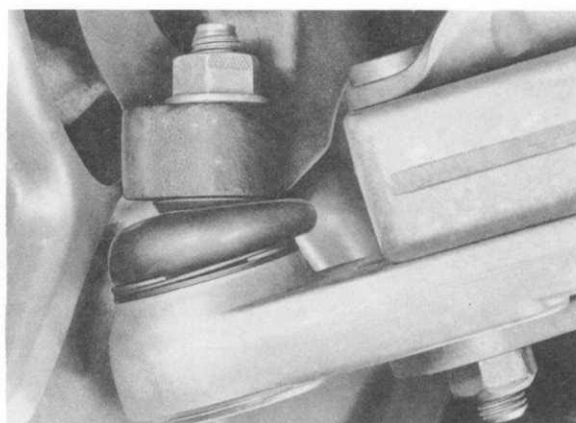
### Inspecting Rubber Protective Caps of Control Arm Ball Joints:

1. Raise car on hoist, steering lock disengaged.
2. Turn front wheels to lock.
3. Inspect visible areas on left and right after cleaning. Concealed cracks are revealed by pinching the rubber cap with the fingers.
4. Turn front wheels to opposite lock and inspect other half of rubber caps.

In the vicinity of the brake cover plates, a small area cannot be inspected visually. Check this area by hand.



Upper ball joint



Lower ball joint

## MODIFIED STEERING KNUCKLE, CARS WITH FLOATING BRAKE CALIPERS

To avoid damaging the rubber boot of the lower ball joint (mounting) with a commercial puller, the steering knuckle has a press-off lug (only steering knuckles for floating brake calipers).

Steering knuckles without press-off lug have been discontinued and are no longer available as spare parts.  
It is permissible to install the newest steering knuckle on one side only.

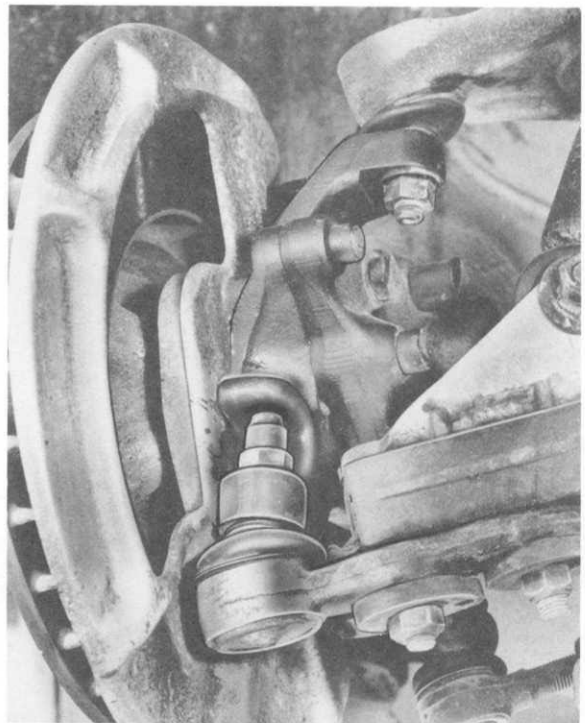
### D i s a s s e m b l y

#### L o w e r   B a l l   J o i n t

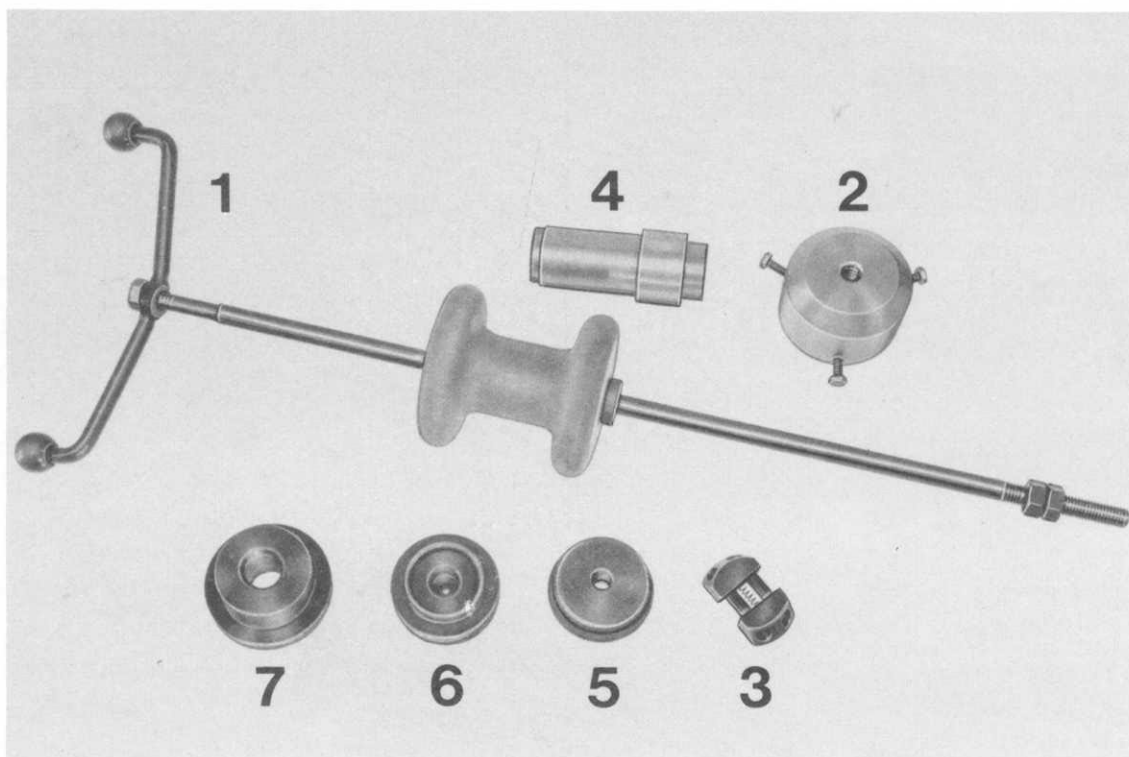
When the securing nut is slackened (cap nut - previously normal self-locking hex nut) the pin of the ball joint is pressed out of the steering knuckle, because the cap nut acts against the press-off lug.

#### U p p e r   B a l l   J o i n t

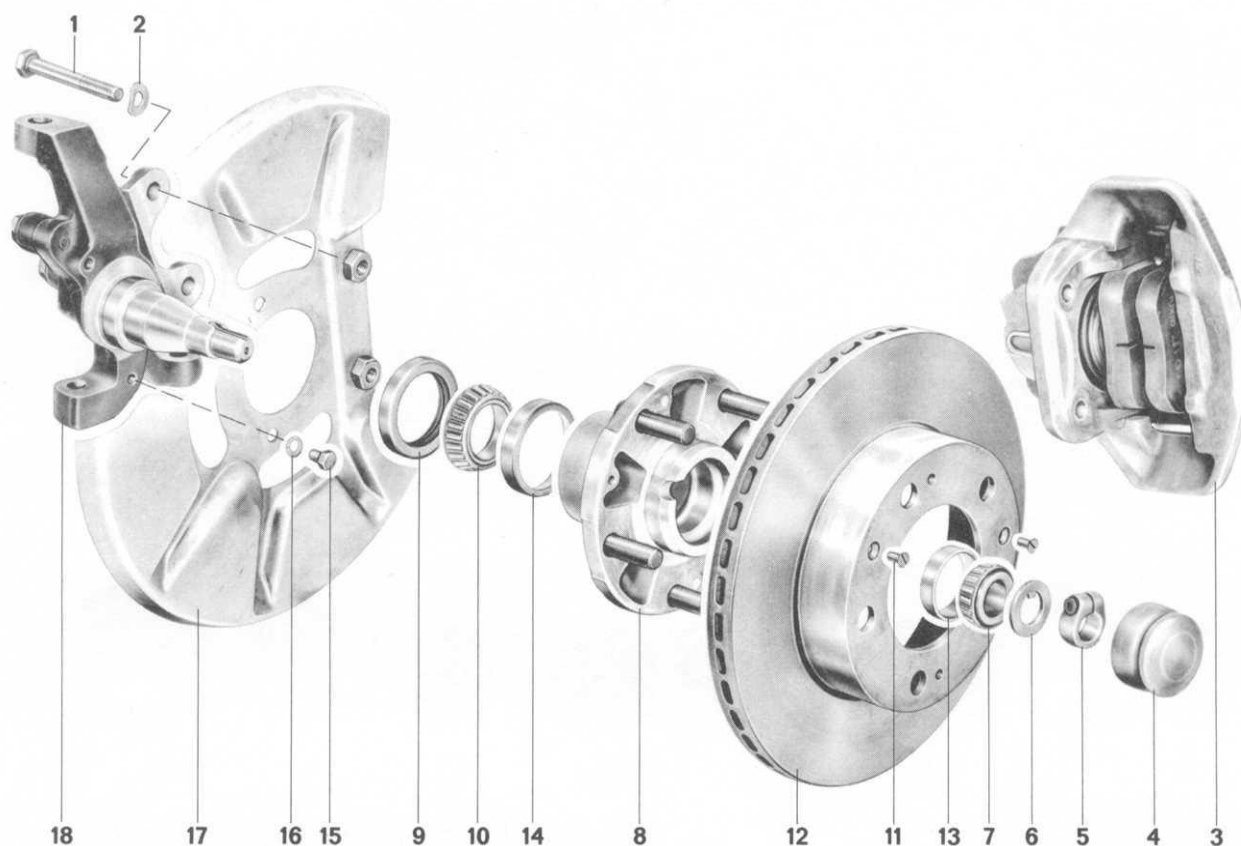
Use VW 267 a to press off as before (page 40 - 14).



## TOOLS



No.	Description	Special Tools	Remarks
1	Multi-purpose tool	VW 771	
2	Puller	9165	
3	Pressure piece	P 85	
4	Pressure piece	9154	
5	Pressure plate	VW 447 i	
6	Pressure piece	VW 433	
7	Pressure plate	VW 511	



### Notes :

- The exploded drawing shows the front-wheel bearing arrangement of cars with sliding calipers.
- If the front axle is equipped with floating calipers, brake caliper, brake disk, guard and steering knuckle are of different appearance and size.
- The following components of four-piston fixed-caliper brakes differ in appearance and size: brake disk, brake caliper, mounting bolts for caliper, outer wheel bearing, wheel hub, guard and steering knuckle.

No.	Description	Qty	Note When:	
			Removing	Installing
1	Mounting bolt (hex bolts for sliding and floating calipers)  (Panhead bolts for four-piston fixed caliper)	2		Coat threads with Optimoly HT. Torque: 85 Nm (62 ftlb)
2	Spring washer or washer of <u>four- piston fixed caliper</u>	2		Renew if necessary
3	Brake caliper	1	Do not remove brake hose when working on front-wheel suspension, attach to suitable point with wire	
4	Hub cover	1	Drive out with multi-purpose tool VW 771 and 9165	
5	Clamping nut with Allen bolt	1		Adjust play in wheel bearing. Tighten Allen bolt, torque: 15 Nm (11 ftlb)
6	Thrust washer	1		
7	Outer wheel bearing (larger as of 86 models)	1		Inspect, renew if necessary, apply coating of Shell Retinax A multi- purpose grease

No.	Description	Qty	Note When:	
			Removing	Installing
8	Front-wheel hub (modified wheel bearing, 86 models onward. No. of teeth on impulse ring for ABS: 45 instead of 90).	1		Clean centering surface for brake disk and apply thin coat of Optimoly TA assembly paste. Pack wheel bearing and wheel hub with Shell Retinax A
9	Radial seal	1	Press out with screwdriver. Take care not to damage seat and impulse ring (vehicles with ABS)	Renew. Press in with VW 433 and 9154. Place VW 511 under wheel hub as support. Pack recess with Shell Retinax A
10	Wheel bearing, inner	1		Inspect, renew if necessary, apply coat of Shell Retinax A
11	Countersunk bolt	2		
12	Brake disk	1	If difficult to remove, see P. 46-11	
13	Bearing race for outer wheel bearing	1	Heat wheel hub to 120 to 150°C	Heat wheel hub to 120 to 150°C
	Models earlier than end of 85		Press out with pressure piece 9154. Place pressure plate VW 511 beneath wheel hub as support	Place in position, press in with pressure piece 9154
	86 models onward		Drive out by placing drift in each of the grooves in turn	Place in position, press in with suitable pressure piece, e.g. VW 432

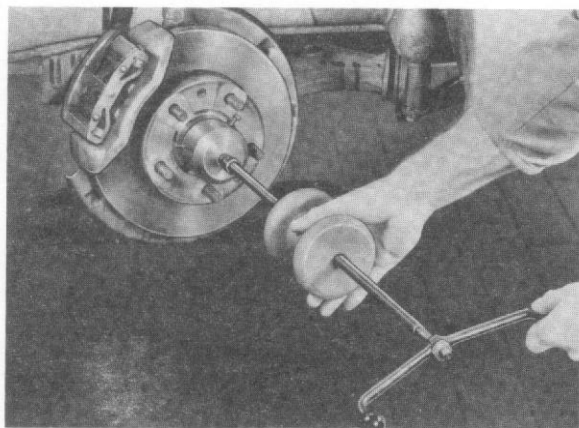


No.	Description	Qty	Note When:	
			Removing	Installing
14	Bearing race for inner wheel bearing	1	Heat wheel hub to 120 to 150°C. Press out with P 85 and 9154. As of 86 models, the race can also be removed using a drift placed in the grooves.	Heat wheel hub to 120 to 150°C. Place in position and press in with pressure plate VW 447 i and pressure piece 9154. Use VW 511 as support.
15	Hex bolt of			Torque: 15 Nm (11 ftlb). Coat thread with Optimoly HT.
	- sliding caliper	2		
	- floating caliper	4		
	- four-piston fixed caliper	4		
16	Spring ring or spring washer	2-4		Renew if necessary
17	Guard (depending on brake system)	1		
18	Steering knuckle (design depends on brake system)	1		Inspect front wheel bearing for 15 wear. Remachining is impermissible

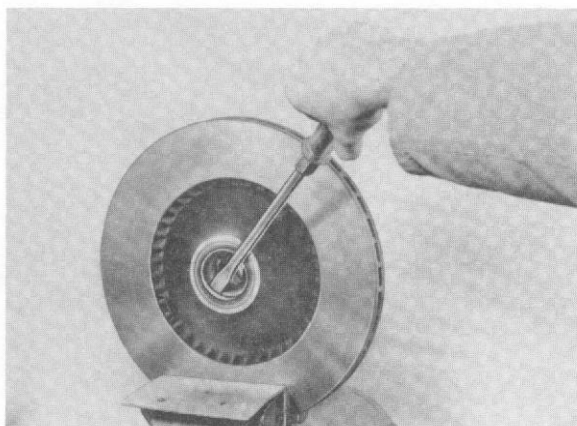
## NOTES ON DISASSEMBLY AND ASSEMBLY

## D i s a s s e m b l i n g

1. Drive off hub cover with multi-purpose tool VW 771 and 9165.



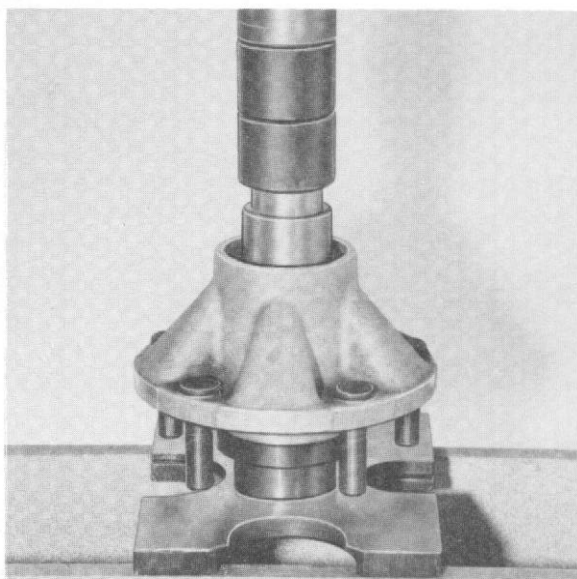
2. Use a large screwdriver to lever off radial seal. Take care to avoid damaging the seat of the seal and the impulse ring of cars with ABS.



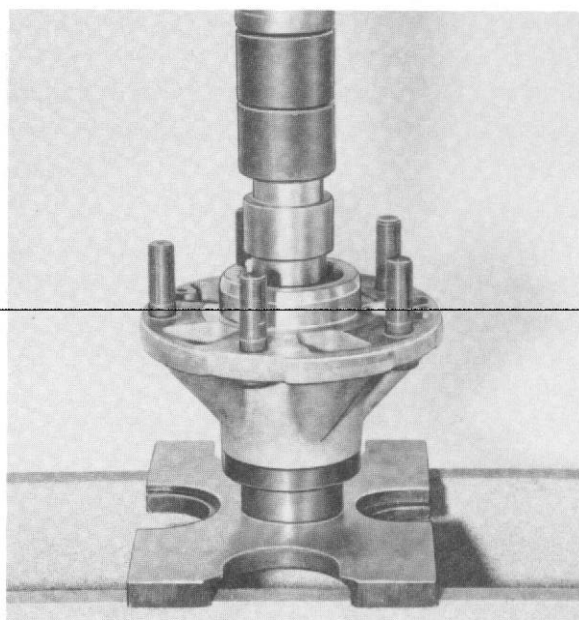
3. Separate brake disk and wheel hub. Heat wheel hub to 120-150°C.

- 4a. Cars earlier than end of model year 85: press bearing races out of wheel hub.

Bearing race for outer wheel bearing



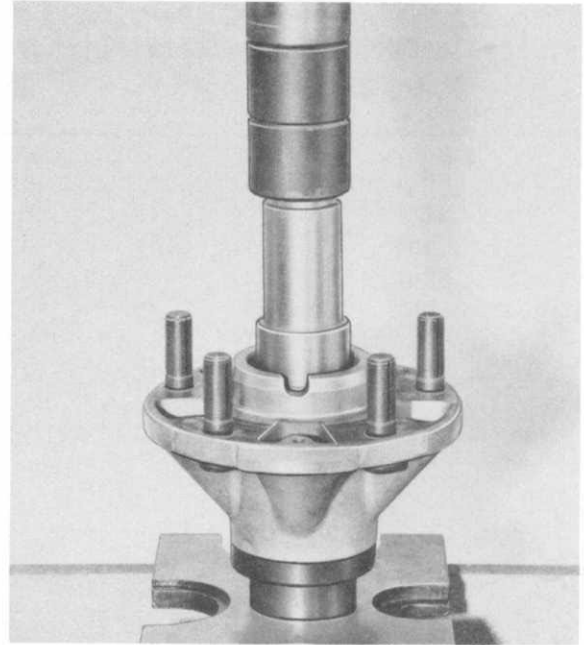
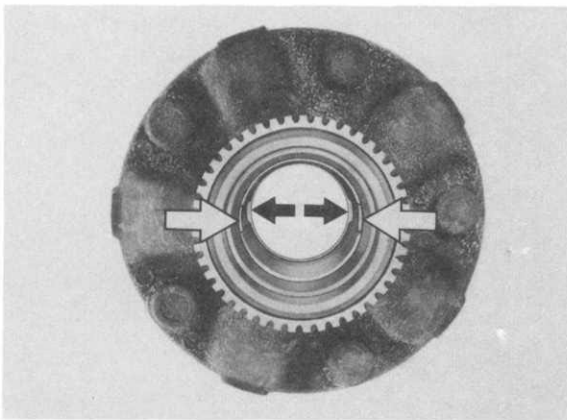
Bearing race for inner wheel bearing



4b.86 models onward: place drift in each of the grooves in turn and drive bearing races out of hub.

#### Note :

The bearing race for the inner wheel bearing can be pressed out using P 85 and 9154 as before (cars earlier than 86).



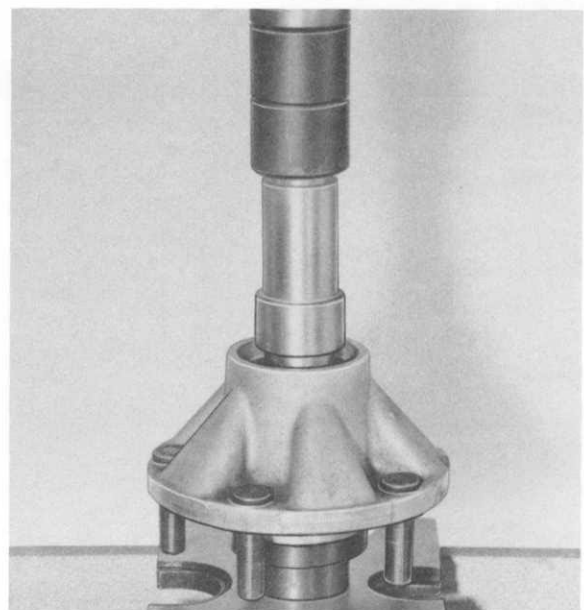
2b.86 models onward: place the outer bearing race in the wheel hub and press in until seated with suitable pressure piece, e.g. VW 432.

3. Position inner bearing race and press in until seated with pressure piece 9154 and pressure plate VW 447 i. Place VW 511 beneath wheel hub as support.

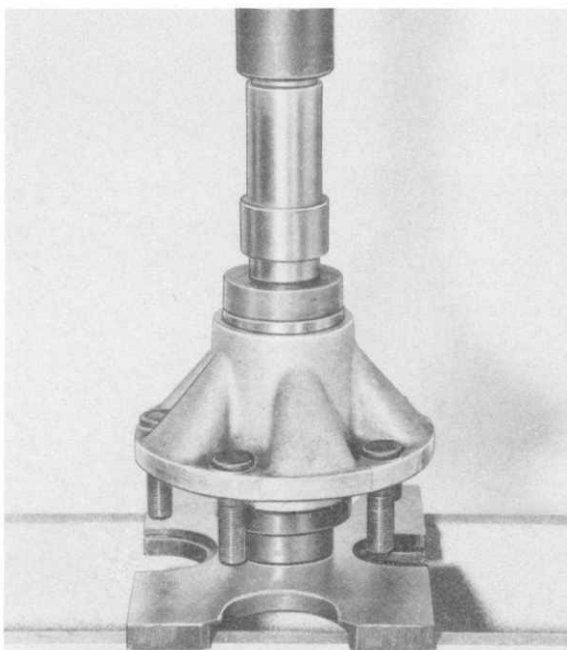
#### A s s e m b l i n g

1. Heat wheel hub to 120-150°C.

2a. Install outer bearing race and (cars earlier than end of 85) press in until seated with pressure piece 9154.



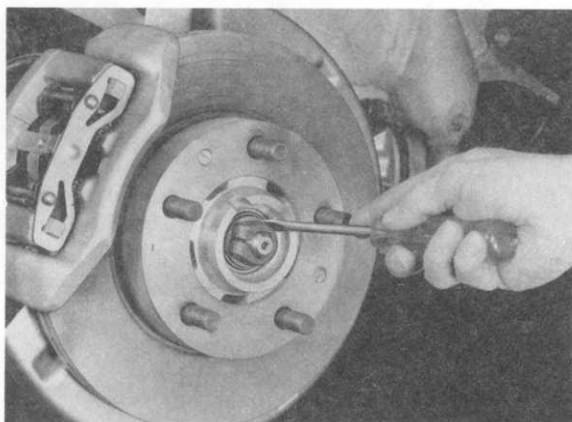
4. Press in radial seal until flush with hub.



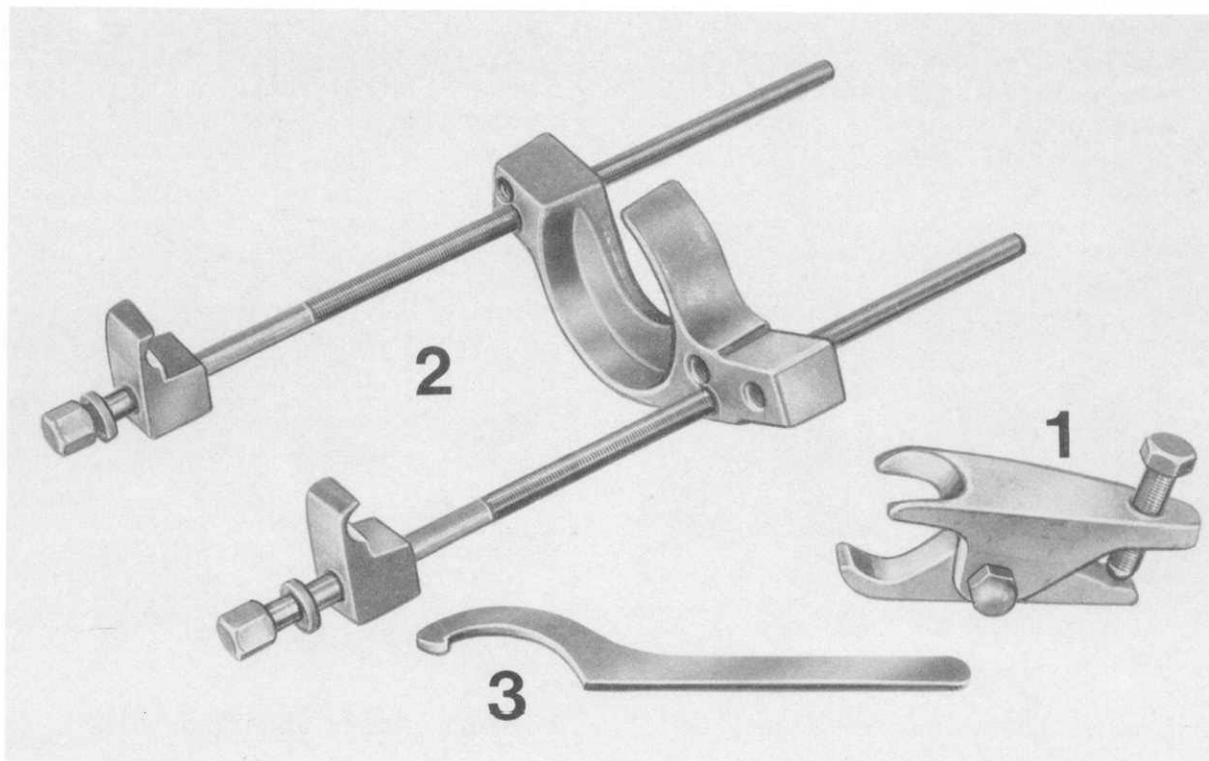
6. Tighten cap bolt of clamping nut to 15 Nm (11 ftlb), without turning the clamping nut.

7. Recheck setting by moving thrust washer, readjust if necessary.

5. Adjust front wheel bearing, noting the following points:  
Tighten clamping nut slightly, turning the hub. Slacken clamping nut until the thrust washer can just be moved with a screwdriver under finger pressure. Do not use hub as a lever for screwdriver.



## TOOLS

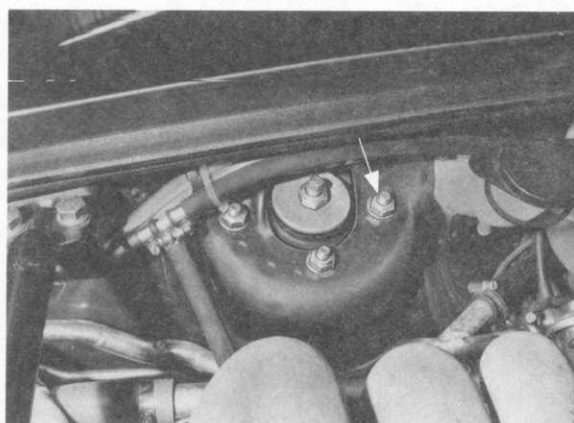


No.	Description	Special Tools	Remarks
1	Press-out tool	VW 267 a	
2	Tensioning device or	VW 340	
-	Tensioning device		Porche version manufactured by Klann, description/supplier see Workshop Manual (Workshop Equipment 3, Group 4).
3	Sickle wrench DIN 1810 dia. 80/90		Commercially available, e.g. Saltus

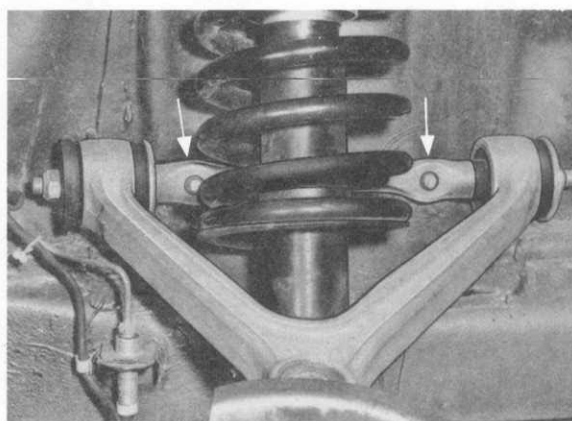
## REMOVING AND INSTALLING SPRING STRUT

### Removing

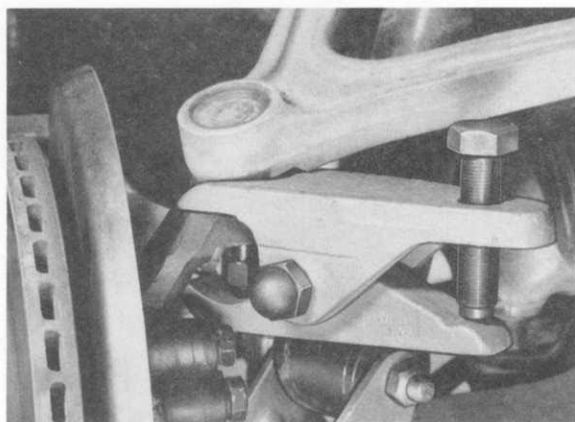
1. Working from engine compartment, remove three self-locking nuts on wheel arch.



3. Unscrew self-locking nuts from upper control arm (inside engine compartment).



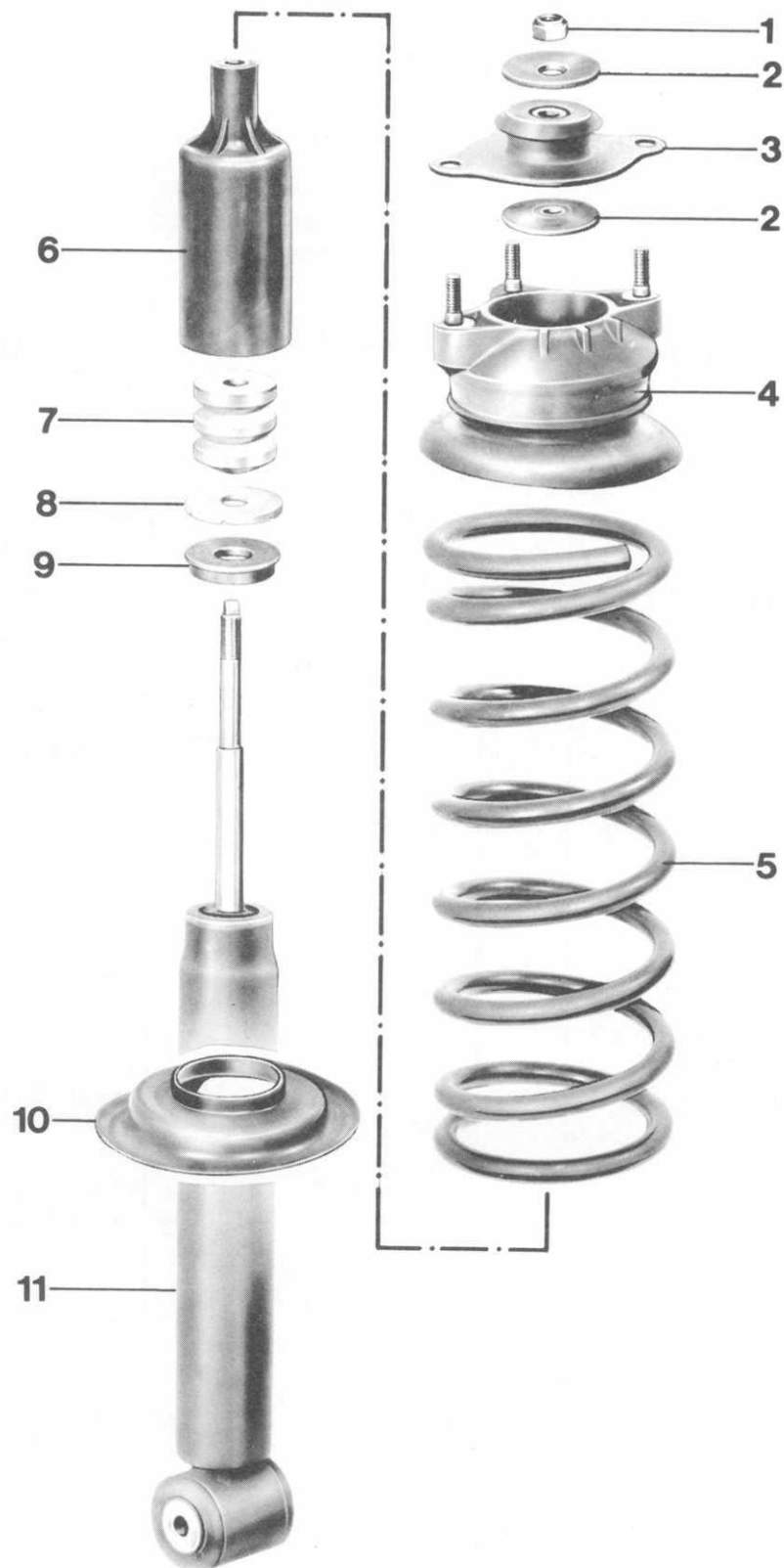
2. Remove wheel, unscrew flange lock nut and press off upper ball joint with VW 267 a



4. Remove damper mounting bolt.

### Installing

Renew all self-locking nuts. Coat rubber bush in mounting eye with Molykote U.

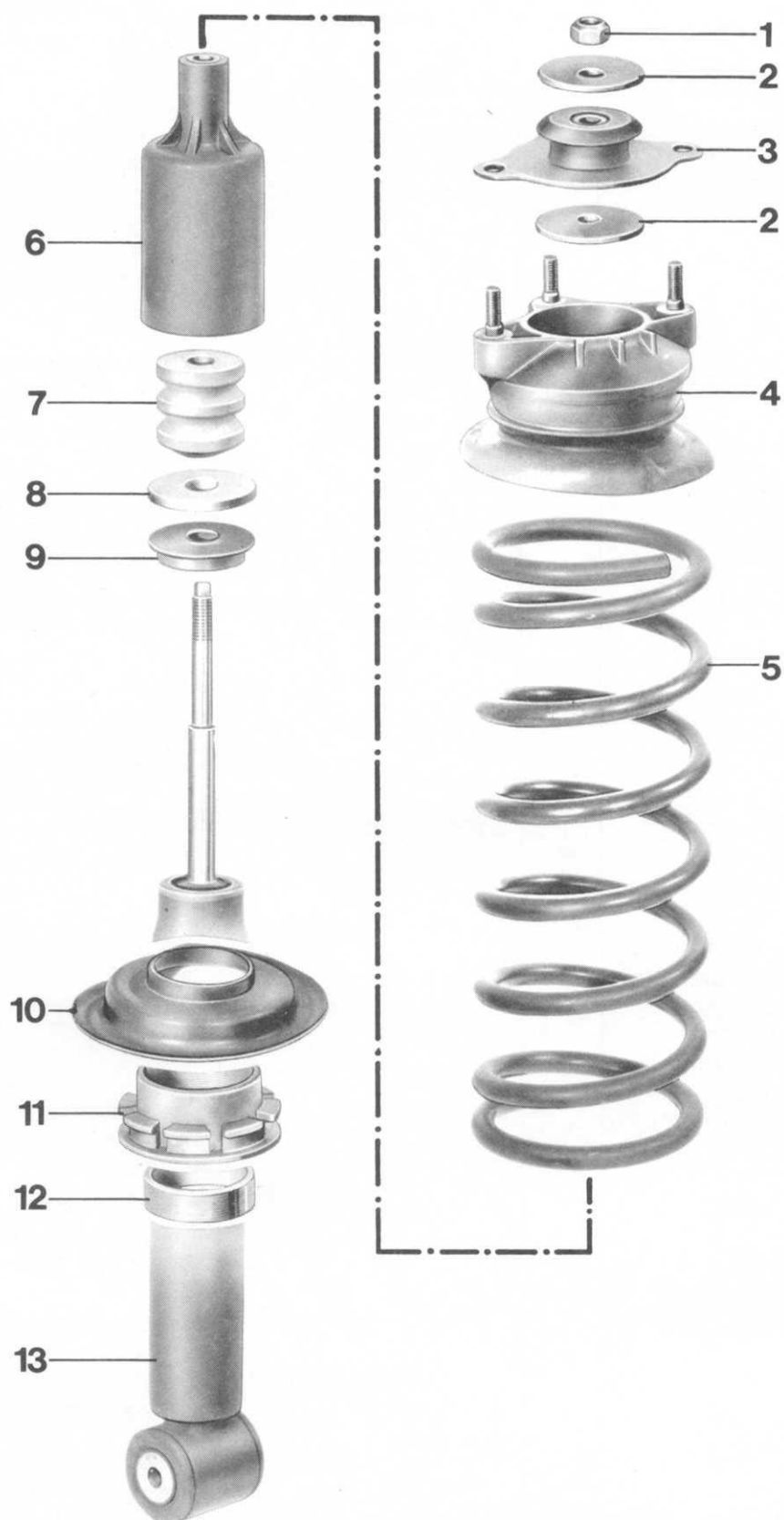


No.	Description	Qty.	Note When:	
			Removing	Installing
1*	Self-locking hex nut	1	Extend coil spring with VW 340 or Klann KL - 0014	Renew and tighten to 60 Nm (44 ftlb)
2*	Washer	2		
3*	Damper mounting, upper	1		Coat rubber bush with Molykote U
4	Spring plate, upper	1		
5	Coil spring	1		Note arrangement and assembly instructions
6	Protective tube	1		Overall length approx. 170 mm
7**	Booster spring	1		Note installation position
8*	Stop washer	1		Install with grooves down
9*	Supporting cover	1		Boge only
10	Spring plate, lower	1	Mark installation position	Install right way round
11	Damper	1		Check efficiency, renew if necessary. Standard: Boge (black)** Optional: Bilstein (green)

\* Same parts as those used in adjustable spring strut

\*\* Same parts as those used in adjustable spring struts earlier than end of model year 1985





2 Stop washers No. 8 in 928 S 4 "Club Sport-Version"

No.	Description	Qty.	Note When:	
			Removing	Installing
1*	Self-locking hex nut	1	Extend coil spring with VW 340 or Klann KL-0014	Renew and tighten to 60 Nm (44 ftlb)
2*	Washer	2		
3*	Damper mounting, upper	1		Coat rubber bush with Molykote U
4	Spring plate, upper	1		
5	Coil spring	1		Note arrangement, tolerance group and assembly instructions. Different spring rates (spring hardness)
6	Protective tube	1		Overall length approx. 150 mm
7	Booster spring, up to end of Mod. yr. 85* natural color (35 mm spring travel) 86 models onward black (39 mm spring travel)	1		Note installation position
8*	Stop washer	1 (2)		Install with grooves down, 2 washers in 928 S4 "Club Sport Version"
9*	Supporting cover	1		Boge only
10	Spring plate, lower	1	Mark installation position	Install right way round. Boge: black Bilstein: yellow

\* Same parts as used in non-adjustable spring strut.

No.	Description	Qty.	Note When:	
			Removing	Installing
11	Adjustment nut	1		Grease thread, recess and contact surface for spring plate with Optimoly TA Boge and Bilstein are different
12	Threaded ring	1		Boge only. Install with inner bevel down. Coat thread with Optimoly TA
13	Damper	1		Damper design modified, 86 models onward Damper installation overview P. 40 - 51  Spring installation overview, note P. 40 - 46

## NOTES ON DISASSEMBLY AND ASSEMBLY

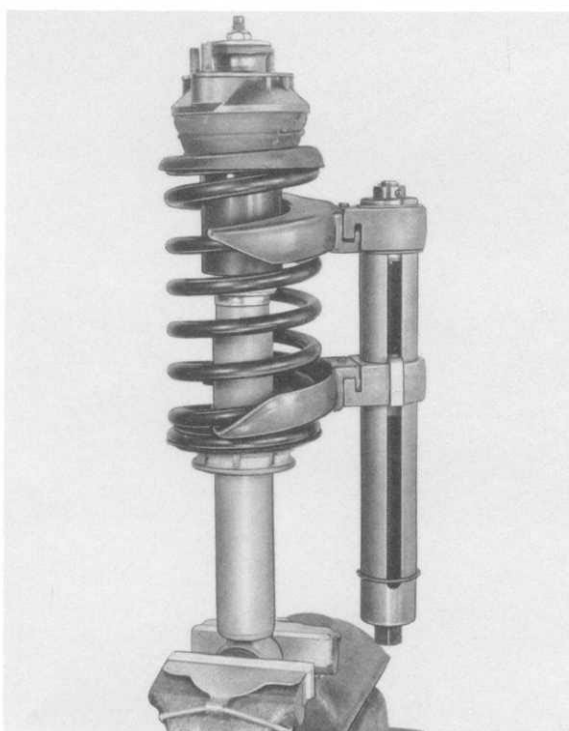
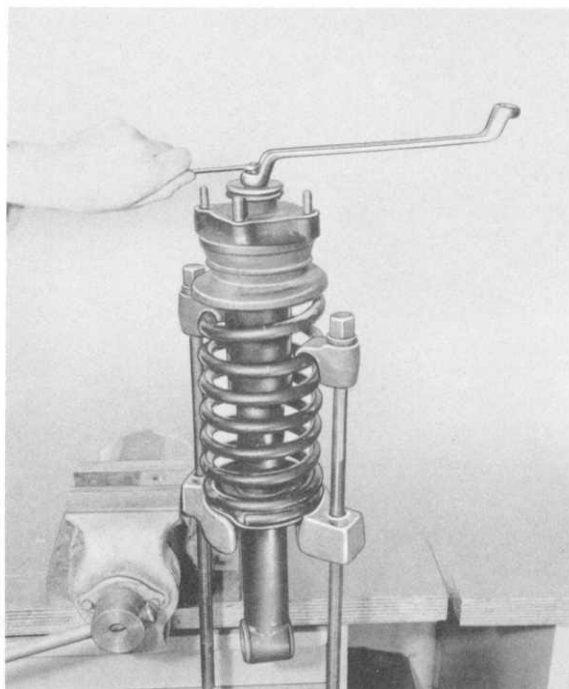
## D i s a s s e m b l i n g

VW 340

1. Mark position of lower spring plate relative to damper for reinstallation.

2. Using Porche version Klann spring tensoning device (see Workshop Manual) or VW 340, extend coil spring.  
Remove self-locking nut from piston rod.  
Remove washer and upper damper mounting.

KL - 0014 (Klann)



3. When using special tool VW 340, release coil spring by unscrewing each of the expansion bolts in turn.

## N o t e :

A great deal of caution is required when working with the extremely powerful coil spring.

### Testing Dampers

Dampers can only be tested properly on a testing machine. Dampers which no longer perform adequately cannot be identified by visual inspection or function testing, which will, however, identify completely defective units.

#### Note :

Differences between dampers, P.  
40 - 51

### Boge Pressureless Damper

With damper in installation position, extend and compress by hand. The damper must move smoothly and with uniform resistance throughout its travel. The extension and compression stage damping must be clearly perceptible up to the limit positions. Dampers which have been stored for an extended period should be operated several times in their installation position. Renew leaking dampers

### Boge Gas-pressure Dampers

With damper in installation position, extend and compress by hand. The damper must move smoothly throughout its travel. The expansion and compression stage damping must be clearly perceptible up to the final position.

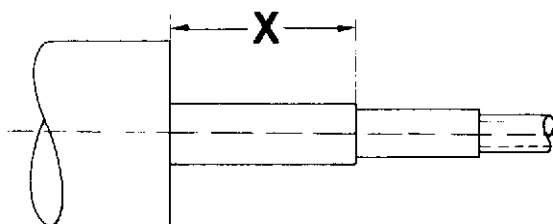
Because of the gas pressure, resistance increases as the piston rod moves further into the damper. Dampers which have been stored for lengthy periods should be operated several times in their installation position.

Renew leaky dampers.

Dampers in which the gas pressure has diminished (damper does not return automatically to the extension-stage stop), but which bear no indication of oily leaks and which fulfill all other requirements can be reused. Dampers which show traces of oil loss and which have depressurized must be renewed.

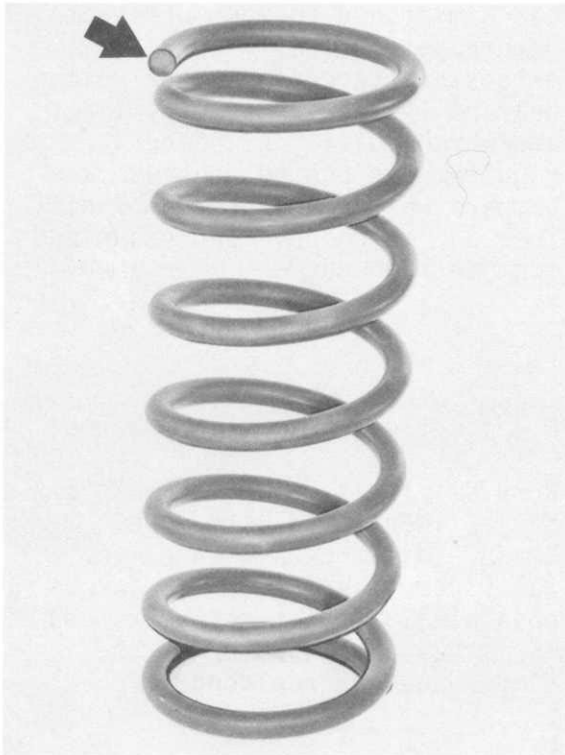
### Bilstein Dampers

Worn Bilstein Dampers can be identified with ease. Measure distance X with damper fully compressed (i.e. as far as possible). If distance X exceeds 35 mm (29.5 mm when new), the damper must be replaced.



## A s s e m b l i n g

1. Note arrangement of coil springs.  
See P. 40 - 46 for adjustable spring strut.  
See pp. 40 - 47 to 40 - 49 for non-adjustable spring struts.  
End of coil spring points toward upper spring plate.



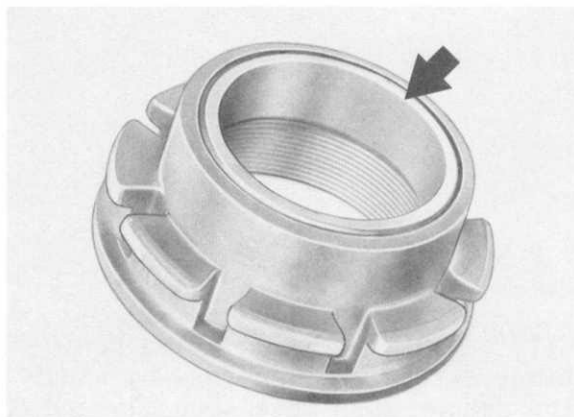
2. If parts which affect the height setting of adjustable spring struts have been replaced, begin by moving the adjuster nut to its original position. After installation, readjust height setting as necessary, see Item 5. Lubricate threaded ring or thread and adjuster nut and recess with Optimoly TA.

## N o t e (for information only)

During original assembly of the struts, the adjuster nut is mounted as follows:

Boge spring strut: threaded ring flush with adjuster nut at top (arrow) or threaded ring approx. 5 mm lower.

Bilstein strut: adjuster nut screwed down to bottom.

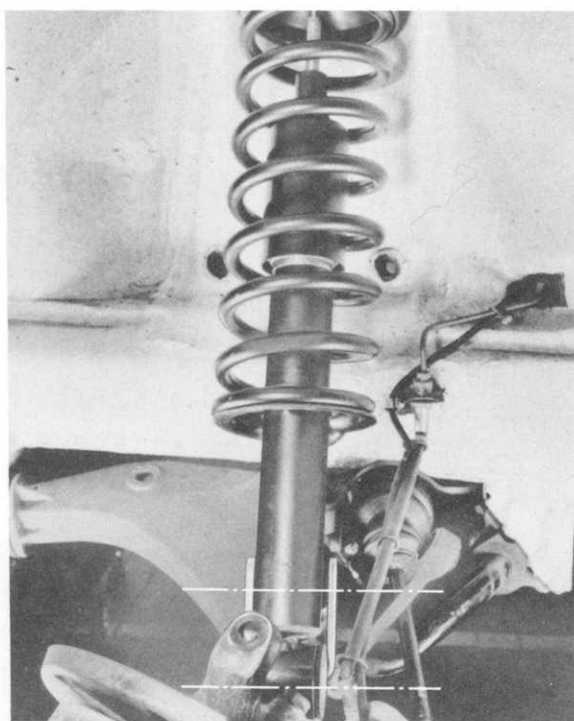


3. To avoid dislocation of the lower spring plate of non-adjustable spring struts, only 2 spacers may be used per strut for height adjustment. When converting from Bilstein to Boge dampers (pressureless), the white/green spring can be reused if a spacer is installed (P. 40 - 47 to 40 - 49).

4. Because of the  $14^\circ$  offset of upper spring plate to mounting eye (of control arm) when the strut is installed, it may be necessary to determine the position of the lower spring plate as follows when the strut is assembled:

Mount upper spring plate on car. With lower spring plate and coil spring at damper installation position, set damper on lower control arm.

Move end of coil spring to upper spring plate stop. Turn lower spring plate until the spring touches the lower stop as well. Mark position of lower spring plate to damper. Assemble struts as marked.



#### Note :

- Adjustable spring struts can also be brought to their installation positions by turning the adjuster nut (hold strut at bottom). Turn nut in the direction which allows end of spring to remain against spring-plate stop.
  - If a Klann spring tensioner is used (no vise required) the strut can be brought to its installation position with the spring pre-tensioned. Screw self-locking nut onto piston rod (risk of accident).
5. Adjust height setting of adjustable spring struts as necessary.

#### Note :

Moving the adjuster nut (spring pre-load) through 5 mm adjusts the vertical setting by approx. 10 mm.

In this context, note the following:

Any one-sided height adjustment also changes the wheel loading. When the load on any one wheel is changed the loads on the other wheels also change.

If no wheel-load meter is available, the 2 height adjuster nuts on a common axle should be changed by the same amount to keep the wheel-load difference from left to right within permissible limits. (Difference from left to right per axle, max. 20 kg).

## COIL SPRINGS FOR ADJUSTABLE SPRING STRUTS

Two types of front-axle springs are available. The springs have different spring rates (spring hardness). The springs are color-coded.

The springs with green and brown codes are subdivided in tolerance groups.

When repairs are carried out, always install springs with the same color code. As the vehicle height can be adjusted, it is not necessary to select spring groups to suit certain models (e.g. left-hand or right-hand drive).

Coil Spring Part No. 928 343 511 06 (green)

Used in: 928 S with pressureless Boge dampers from September 1983 to end of model year 85.  
928 S with Bilstein dampers from February 1984 onward.

Group	Color code	Spring force F where length $L_1 = 191$ mm	Ordering index	Free length (new springs)
1	1 x green	6377 - 6573 N	201	approx. 350 mm
2	2 x green	6574 - 6769 N	202	approx. 350 mm
3	3 x green	6770 - 6965 N	203	approx. 350 mm

Coil Spring Part No. 928 343 511 09 (brown)

Used in: 928 S with Boge gas-pressure dampers as standard and optional extra (sport)  
- 86 models onward

Group	Color code	Spring force F where length $L_1 = 191$ mm	Ordering index	Free length (new springs)
1*	1 x brown*	6375 - 6570 N	401	approx. 340 mm
2	2 x brown	6571 - 6766 N	402	approx. 340 mm
3	3 x brown	6767 - 6963 N	403	approx. 340 mm



## COIL SPRINGS FOR NON-ADJUSTABLE SPRING STRUTS

Three types of front-axle springs are available. The different types are color-coded - blue, white, white/green.

The springs with blue and white coding are subdivided in tolerance groups.

When repairs are carried out, always install springs with the same color coding. As the car tends to settle in the course of its service life and installation of a single spring could upset the vehicle height, we recommend replacement in pairs.

C o i l   S p r i n g   P a r t   N o .   928.343.511.01 (blue)

Used in: 928/982 S with Boge dampers  
As of start of range up to following chassis numbers:

92 A0 80 0645	928 Europe/rest of the world/Japan
92 A0 81 0714	928 USA
92 A0 82 0127	928 S

Group	Color code	Installed in	Spring force F where length $L_1 = 217$ mm	Ordering index
1	1 x blue	Vehicles without air conditioner	6377...6573 N	301
2	2 x blue	Vehicles with air conditioner	6574...6769 N	302
3	3 x blue		6770...6965 N	303

For a brief period, group 1 springs with spacers were installed in vehicles equipped with air conditioners.  
Group 2 and 3 springs without spacers can be installed in these vehicles.

Coil Spring Part No. 928.343.511.03 (white)

Used in: 928/928 S with Boge dampers  
as of following chassis numbers:

92 A0 80 0646	928 Europe/rest of the world/Japan
92 A0 81 0715	928 USA
92 A0 82 0128	928 S

Group	Color code	Installed in	Spring force F where length $L_1 = 211$ mm	Ordering index
1	1 x white	L-H drive cars	6377...6573 N	901
2	2 x white	R-H drive cars	6574...6769 N	902

Group 1 springs with spacers have also been installed in right-hand drive cars. Refer to table when replacing.

Springs with 3 white dots (discontinued) were installed in a small number of cars. Use group 2 springs as replacements.

Coil Spring Part No. 928.343.511.04 (white/green)

Used in: 928/928 S with Bilstein dampers for all cars.

Group	Color code	Installed in	Spring force F where length $L_1 = 205$ mm	Ordering index
1	1 x white/ green	all cars	6377...6630 N	none

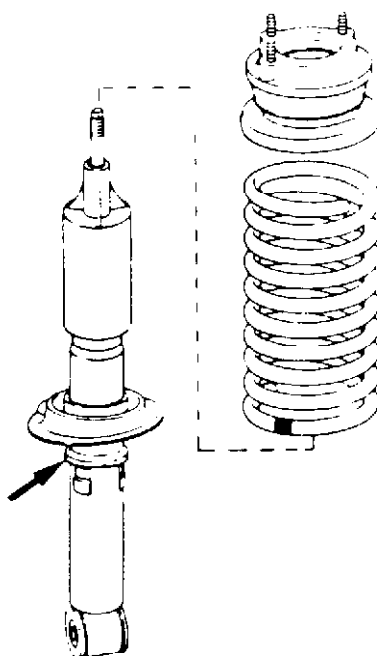
## Effect on Height of Front Axle

### 1. Front Axle Springs

Springs with approx. 200 N more force at a standard test length (e.g. tolerance group II springs as opposed to group I) increase the height of the front axle by approx. 5 - 15 mm.

### 2. Spacer

Placing a spacer beneath the lower spring plate increases the height of the front axle by approx. 10 mm. A maximum of 2 spacers per spring strut is permissible.



### 3. Gas - pressure Dampers ( Bilstein )

If Boge dampers are replaced by Bilstein dampers and no further changes implemented, i.e. the same coil springs are reused, the front axle is raised by approx. 10 mm because of the gas pressure in the latter dampers. We recommend use of springs Part No. 928.343.511.04 in conjunction with the gas-pressure dampers.

## DAMPERS - INSTALLATION OVERVIEW, IDENTIFICATION AND DISTINGUISHING FEATURES

	<div>Front axle</div> <div>Rear axle</div> <div>Single pipe</div> <div>Double pipe</div> <div>Pressureless</div> <div>Gas pressure</div> <div>Boge</div> <div>Bilstein</div>								Paint coding, Identification
Non-adjustable front- axle spring strut									
928/928 S standard	X			X	X		X		black* black**
928/928 S optional extra	X		X				X	X	green green
Adjustable front- axle spring strut									
928 S standard until end of model year 85	X			X	X		X		black* black**
928 S optional extra until end of model year 85	X		X				X	X	gold gold
928 S standard 86 models onward	X			X			X	X	grey grey
928 S optional extra 86 models onward alternative	X			X			X	X	red red gold gold

\*/\*\* Identical parts

Note :

Optional Extra = Sport Tuning

When removed, the pressureless damper will remain in any desired position.  
When the gas pressure damper is removed it extends to the expansion stage stop.

## Technical Data

### Rear Axle

Wheel suspension Independent wheel suspension with lower diagonal suspension links and upper wishbones, coil springs and internal dampers.

Springs 1 coil spring per wheel

Dampers double-action hydraulic dampers  
Make/Installation page 42 - 18 d

Stabilizers Ø 21 mm  
Ø 22.5 x 3.5 mm (tubular stabilizers)  
modified in course of model year 1981

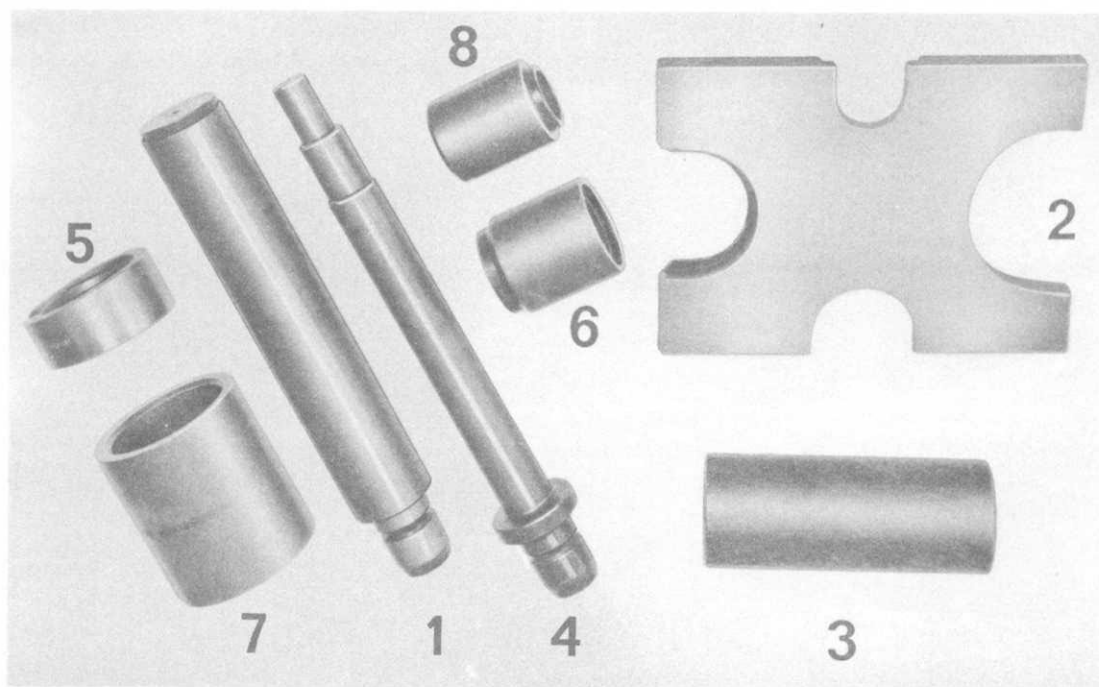
Spacers standard up to end of MY '91 -----  
"Club-Sport"-Version 17 mm per wheel  
standard as of MY '92 38 mm per Rad

## TIGHTENING TORQUES FOR REAR AXLE

Location	Description	Thread	Material	Torque Nm (ftlb)
Tranverse member to body	Hex bolt	M 10	8.8	46 (33)
Light alloy casting (suspension link bearing) for lower control arm (86 models onward) to body	Hex bolt	M 10		46 (33)
Lower suspension link to transverse member (camber eccentric)	Locknut	VNM 14 x 1.5	10	200 (146)
Lower suspension link to body or light-alloy casting (track eccentric)	Locknut	VNM 12 x 1.5	10	120 (88)
Bearing link to lower suspension link	Locknut	VNM 12 x 1.5	8	85 (62)
Brake caliper to wheel carrier	Hex bolt	M 12 x 1.5	8.8	85 (62)
Wheel carrier to lower suspension link	Locknut	VNM 14 x 1.5	8	140 (103)
Upper suspension link to transverse member, upper suspension link to wheel carrier	Locknut	VNM 10	8	46 (33)
Propshaft or rear axle to wheel hub	Locknut	VHM 22 x 1.5	8	460 (322)
Propshaft to differential and input shaft	Cap bolt	M 10	12.9	81 (59)
Wheel to wheel hub	Wheel nut	M 14 x 1.5	AL	130 (94)
Spring strut to body	Locknut	VNM 10	8	46 (33)

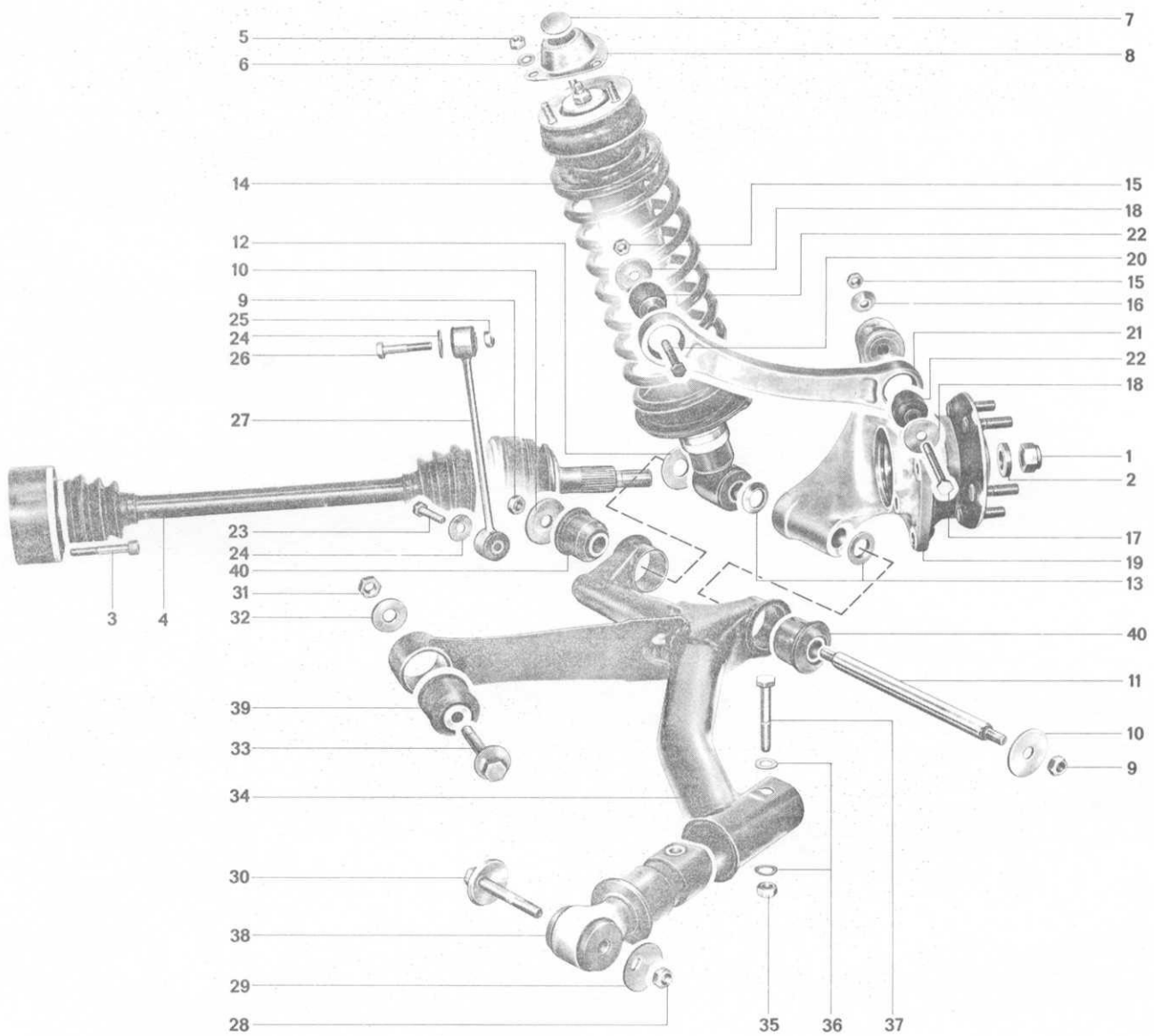
Location	Description	Thread	Material	Torque Nm (ftlb)
Rubber bushing on piston rod (spring strut)	Locknut	VNM 12 x 1.5	8	58 (42)
Transmission bearing to rear-axle transverse member	Hex bolt	M 12 x 1.5	8.8	85 (62)
Stabilizer bearing to body	Hex bolt	M 10	8.8	46 (33)
Stabilizer linkage to lower suspension link	Hex bolt	M 10	8.8	46 (33)
Stabilizer linkage to stabilizer	Locknut	VNM 10	8	46 (33)
Speed sensor to wheel carrier	Cap bolt	M 6	8.8	10 (7)
Angle bracket to wheel carrier	Hex bolt	M 6	8.8	10 (7)
Angle bracket to transverse member	Locknut	VM 6		6 (4)
Guard to wheel carrier	Locknut	VEM 8	8	23 (17)
	Hex bolt	M 6	8.8	10 (7)

## TOOLS



No.	Description	Special Tool	Remarks
1	Punch	VW 407	
2	Thrust plate	VW 402	
3	Tube	VW 415 a	
4	Punch	VW 408 a	
5	Support ring	VW 440	
6	Thrust tube	VW 455	
7	Remover/installer	VW 459/2	Part of VW 459
8	Thrust tube	P 263	





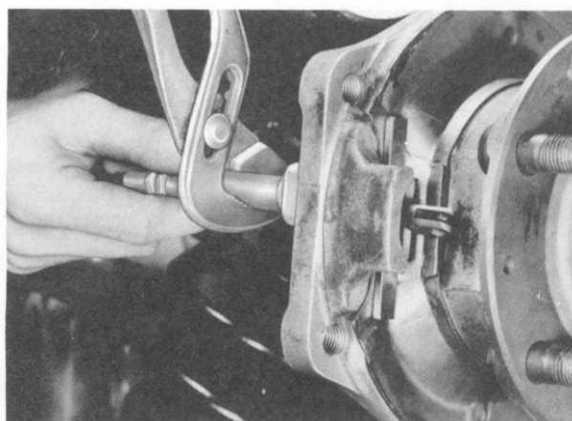
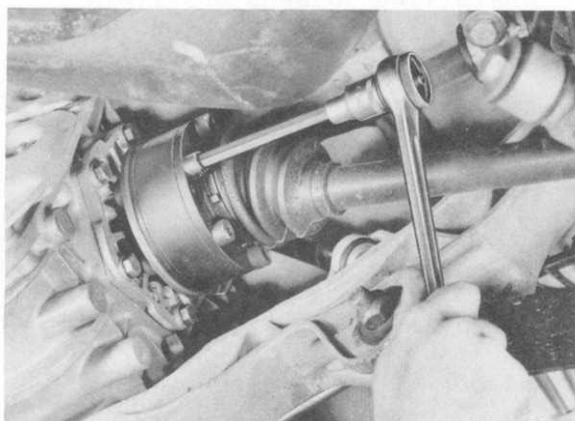
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Self-locking nut	1		Replace if necessary. Tighten to specified torque	
2	Washer	1			
3	Socket head bolt	6		Tighten to specified torque	
4	Axle shaft	1		Check for damage	
5	Locknut	3		Replace, tighten to specified torque	
6	Washer	3			
7	Plug	1			
8	Cover	1			
9	Locknut	2		Replace, tighten to specified torque	
10	Washer	2			
11	Pivot pin	1			
12	Washer	1			
13	Cone washer	2			
14	Spring strut	1		If necessary, replace seal on mounting plate	
15	Locknut	2		Replace, tighten to specified torque	
16	Cone washer	1			
17	Bolt	1			
18	Cone washer	2			
19	Hub assembly	1			Straightening not permitted
20	Bolt	1			

No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
21	Upper control arm	1			Straightening not permitted
22	Upper arm mount	2		Position correctly	
23	Bolt	1		Tighten to specified torque	
24	Washer	2			
25	Locknut	1		Replace and tighten to specified torque	
26	Bolt	1			page 42 - 6
27	Stabilizer suspension	1		Check for damage	
28	Locknut	1		Tighten to specified torque	
29	Eccentric disc	1			
30	Eccentric bolt	1			
31	Locknut	1		Tighten to specified torque	Left and right sides not interchangeable, welding and straightening not permitted
32	Washer	1			
33	Eccentric bolt	1		Lubricate with MoS <sub>2</sub> grease	
34	Lower control arm	1		Check for damage	
35	Locknut	1		Replace and tighten to specified torque	
36	Washer	2		Replace if necessary	page 42 - 6
37	Bolt	1			
38	Mount	1		Position correctly	
39	Rubber mount	1			
40	Rubber mount	2			

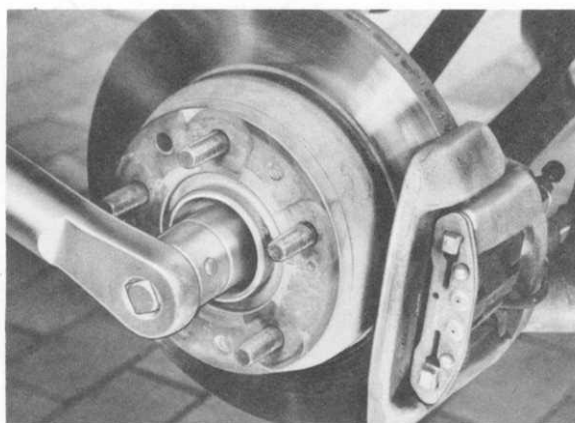
## NOTES ON DISASSEMBLY AND ASSEMBLY

## D i s a s s e m b l i n g

1. Remove propshaft with drive shaft.



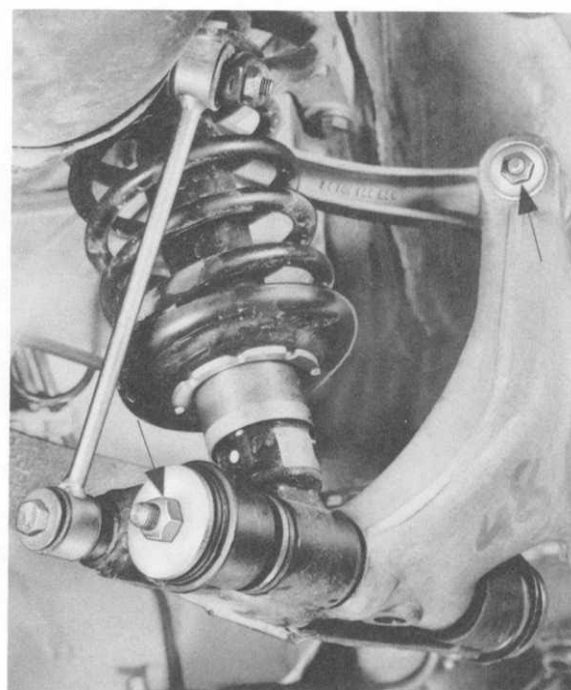
5. Remove wheel carrier.



2. Remove brake caliper.

3. Take off brake disk after removing two countersunk screws.

4. Remove parking brake shoes and expansion lever. Pull parking brake cable out of its guide in wheel carrier.



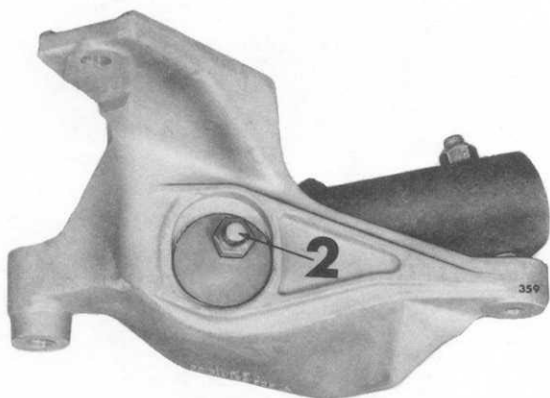
6. Unscrew eccentric bolts and stabilizer linkage bolt and remove lower diagonal suspension link.

### Notes on Wheel Suspension, 86 Models Onward.

The exhaust system has been modified as of model year 86. Two secondary mufflers are mounted near the control arms, one on each side.

This modification has necessitated modification of the following components:

- Rear axle transverse member
- Bearing link of lower suspension link mounted on a removable light-alloy casting (instead of directly on body).
- The length of the track eccentric bolt (2) has been changed to suit the modified bearing (bolt shank approx. 10 mm longer).



2. Coat shanks of camber and track eccentric bolts with Optimoly TA (instead of multi-purpose grease with MoS<sub>2</sub>) and coat thread with Optimoly HT. Apply a coating of Molykote U to rubber bushing of stabilizer linkage and rubber bushings No. 39 and 40 of lower control arms (page 42 - 2) before installing suspensions links in car.

See Table of Consumables (Technical Information Group X) for further lubrication notes and specifications.

### Note :

Spray toe-in eccentrics and camber eccentrics on both sides, adjustment for spring plate on damper and ends of bearing bolt threads (wheel carriers) with underbody wax such as Tectyl - UL - 846 manufactured by Valvoline. This precaution prevents corrosion of the threaded connections, thus facilitating future maintenance and repair work.

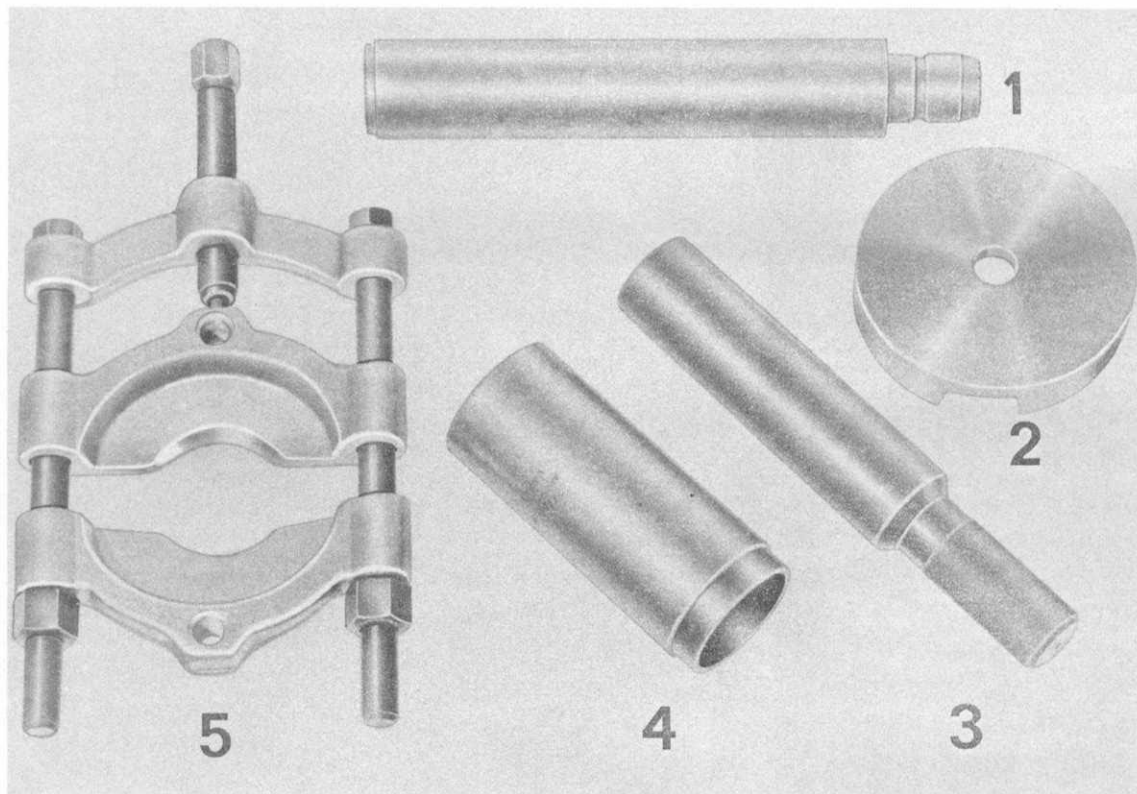
3. Tighten bolts and nuts to specified torque.

4. Align axles.

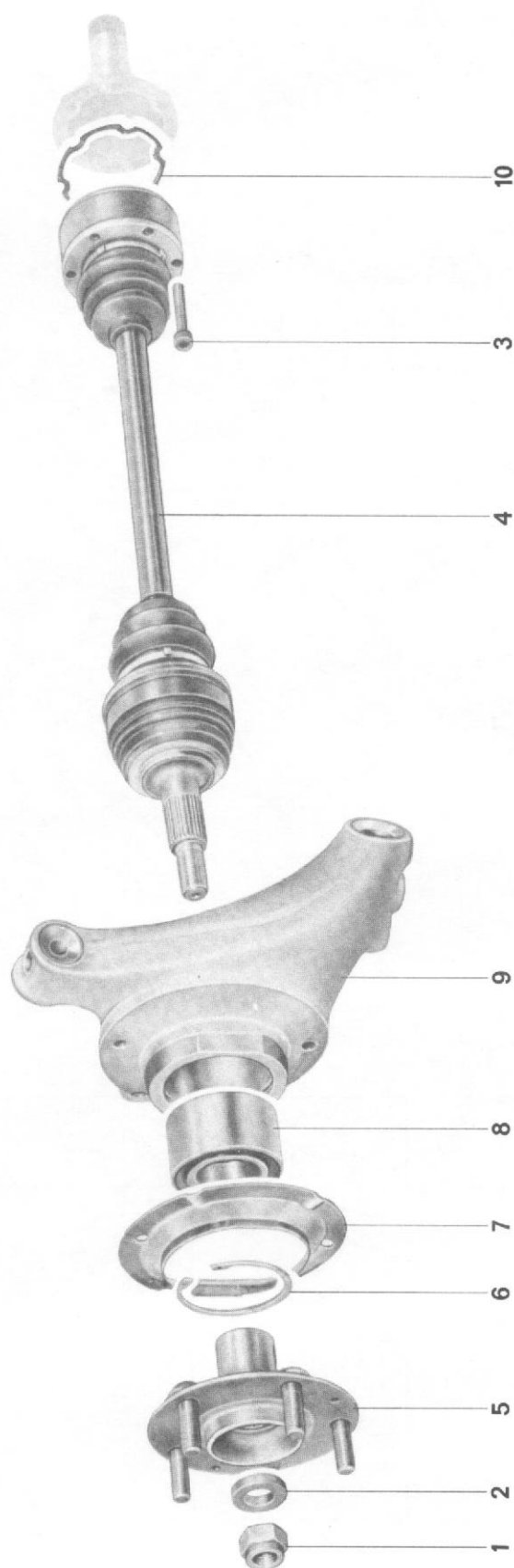
### Assembling

1. Inspect parts for damage, compare suspect parts with new parts. Do not mix up left-hand and right-hand lower diagonal suspension links (otherwise spring travel is impaired).

## TOOLS



No.	Description	Special Tool	Remarks
1	Punch	VW 407	Standard
2	Base plate	VW 441	
3	Drive sleeve	VW 244 b	
4	Tube	VW 415 a	
5	Extractor	-	



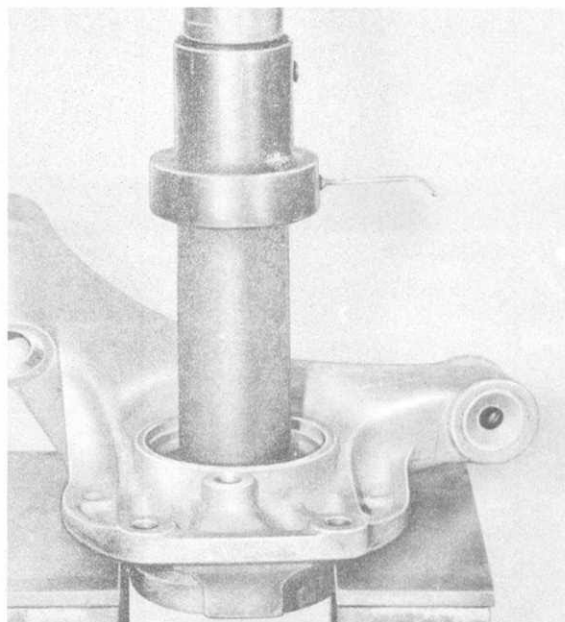
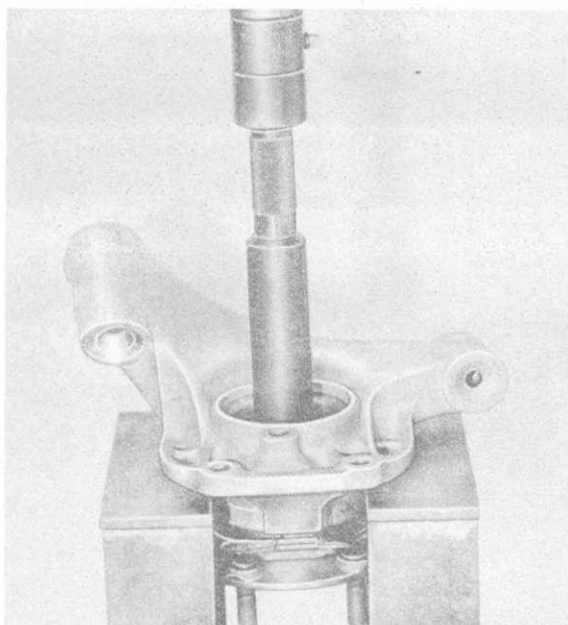
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Self-locking nut	1		Replace if necessary, tighten to specified torque	
2	Washer	1			
3	Socket head bolt	6		Tighten to specified torque	
4	Axle shaft	1		Check for damage	
5	Wheel hub	1	Press off with VW 244 b and suitable base plates	Press on with VW 244 b, whereby ball bearing inner race must be on VW 415 a	
6	Circlip	1		Replace if necessary	
7	Brake backing plate	1		Insert wheel hub in ball bearing before pressing in	
8	Ball bearing	1	Heat hub carrier to 120 - 150° C (248 - 302° F), Press out with VW 415 a	Heat hub carrier to 120 - 150° C (248 - 302° F). Install new bearing. Place VW 441 underneath hub carrier and press on lightly with VW 415 a, being careful that inner races do not fall out	
9	Hub carrier	1			
10	Gasket	1		Replace	



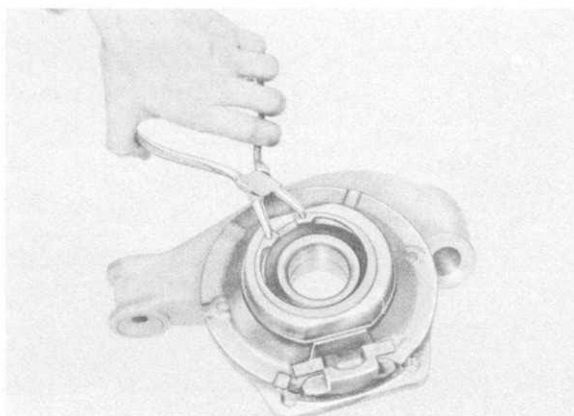
## DISASSEMBLING AND ASSEMBLING HUB ASSEMBLY

## Disassembling

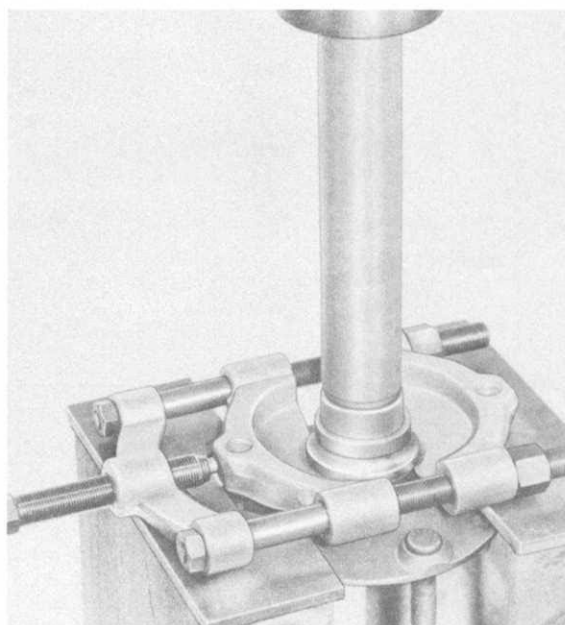
1. Press out wheel hub with VW 244 b and suitable base plates.



2. Remove circlip.



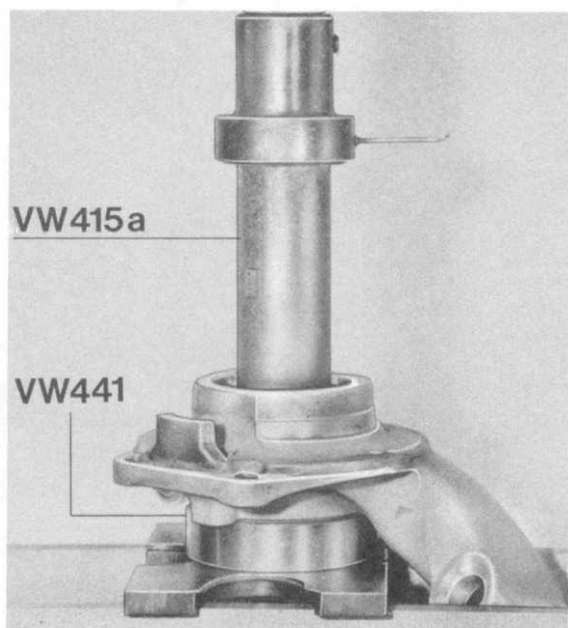
4. Press bearing inner race off of wheel hub with an extractor and Special Tool VW 407.



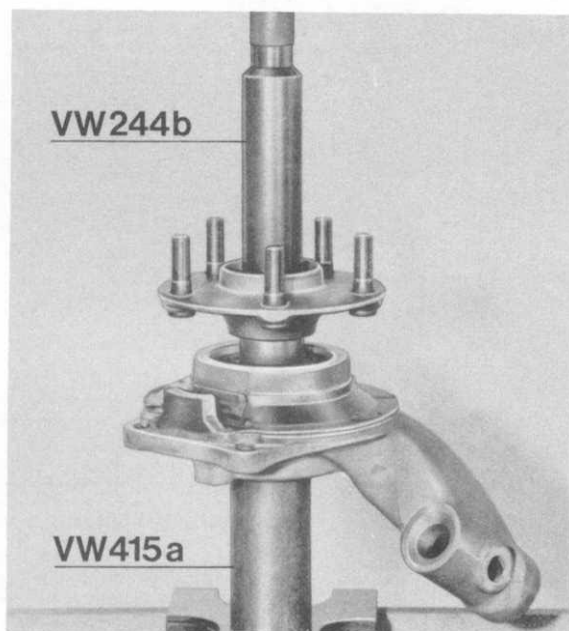
3. Press out ball bearing with VW 415 a after heating hub carrier to 120 - 150° C (248 - 302° F).

### Assembling

1. Heat hub carrier to 120 - 150° C (248 - 302° F), install ball bearing and then press on slightly.



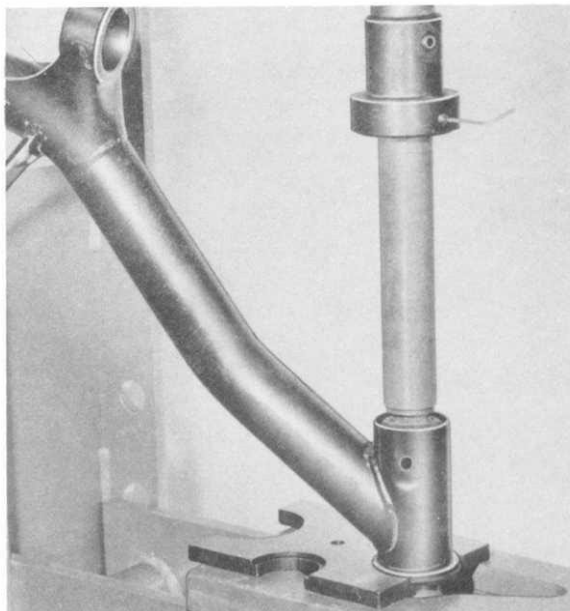
2. Press in wheel hub after installation of circlip and brake backing plate.



## REPLACING LOWER DIAGONAL CONTROL ARM LINK PIN

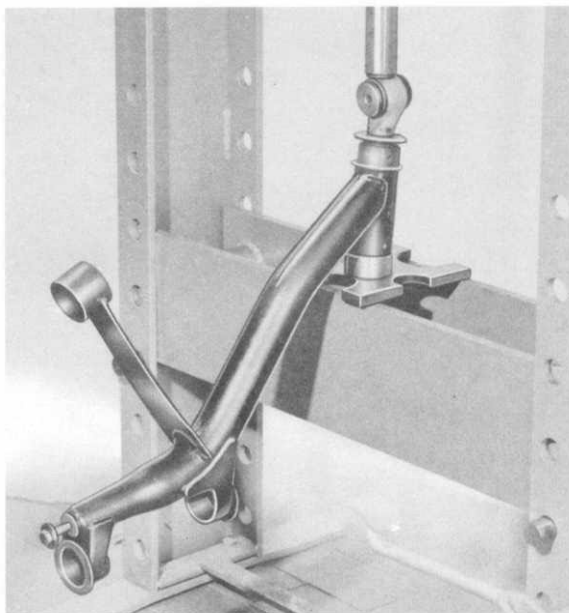
## Removing

1. Remove bolt from link pin.
2. Place lower control arm on Special Tool VW 402. Press out link pin with Special Tool VW 407.



## Installing

1. Coat holder and link pin with waxfree Capella Oil B (Texaco). Install link pin by hand so that bend of link pin faces in toward lower control arm and holes for mounting bolt are aligned.
2. Press in link pin far enough so that bolt can be installed without applying force.



## Note

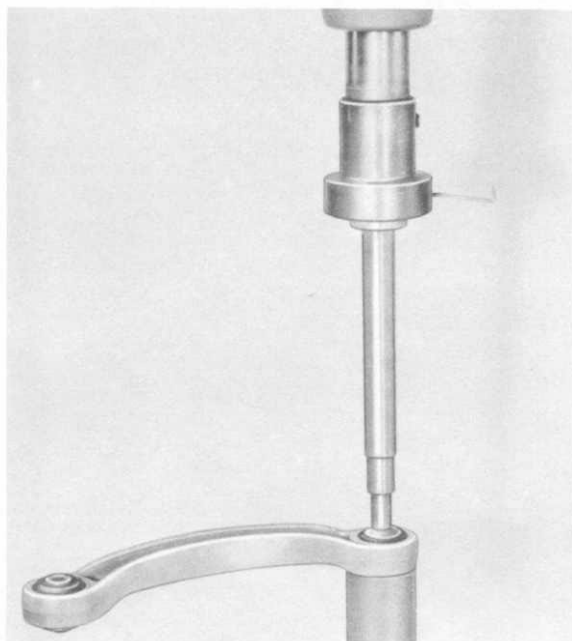
Rubber mounts used for lower control arms have a long service life, but if they do have to be replaced this can be accomplished with the following tools and application of waxfree Capella Oil B.

	Removal	Installation
Rubber mount for pivot pin of shock absorber and hub carrier	VW 459/2 VW 408 a P 263 First press out inner metal bushing.	VW 459/2 VW 455 Make sure that inner bushing is not displaced.
Rubber mount for camber eccentric bolt	VW 402 VW 407	VW 402 VW 407

## REPLACING UPPER CONTROL ARM MOUNT

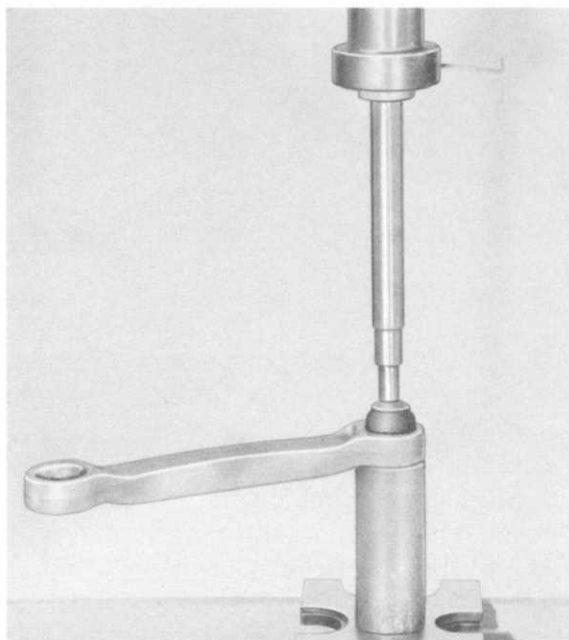
## Removing

Press out mount with Special Tool VW 408 a, using Special Tool VW 415 a as a base.



## Installing

Press in mount, using waxfree Capella Oil B (Texaco) and Special Tools VW 415 a and 408 a. Position correctly. Apply pressure pad to conical end of metal bushing to prevent any change in position between the metal bushing and rubber mount.



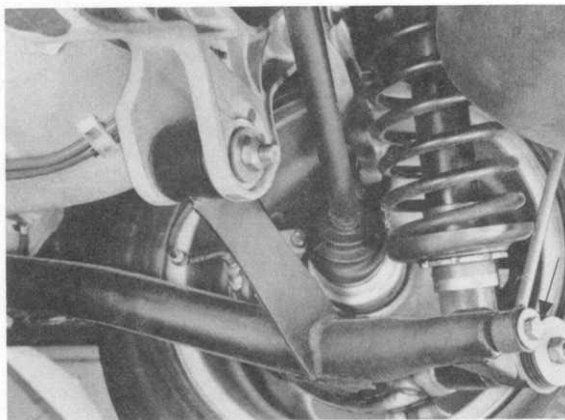
## REMOVING AND INSTALLING SPRING STRUT

## Removing

1. Unscrew three self-locking nuts from spring strut in luggage compartment.

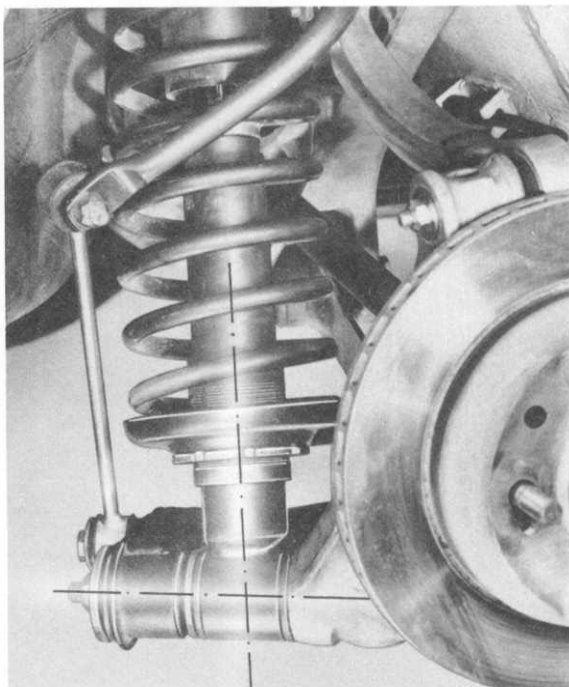


2. Remove wheel.
3. Unscrew front nut on pivot pin of lower control arm, counterlocking and counterholding the rear nut with a separate M 14 x 1.5 nut. Remove pivot.
4. Disconnect stabilizer bar link at control arm.



## Installing

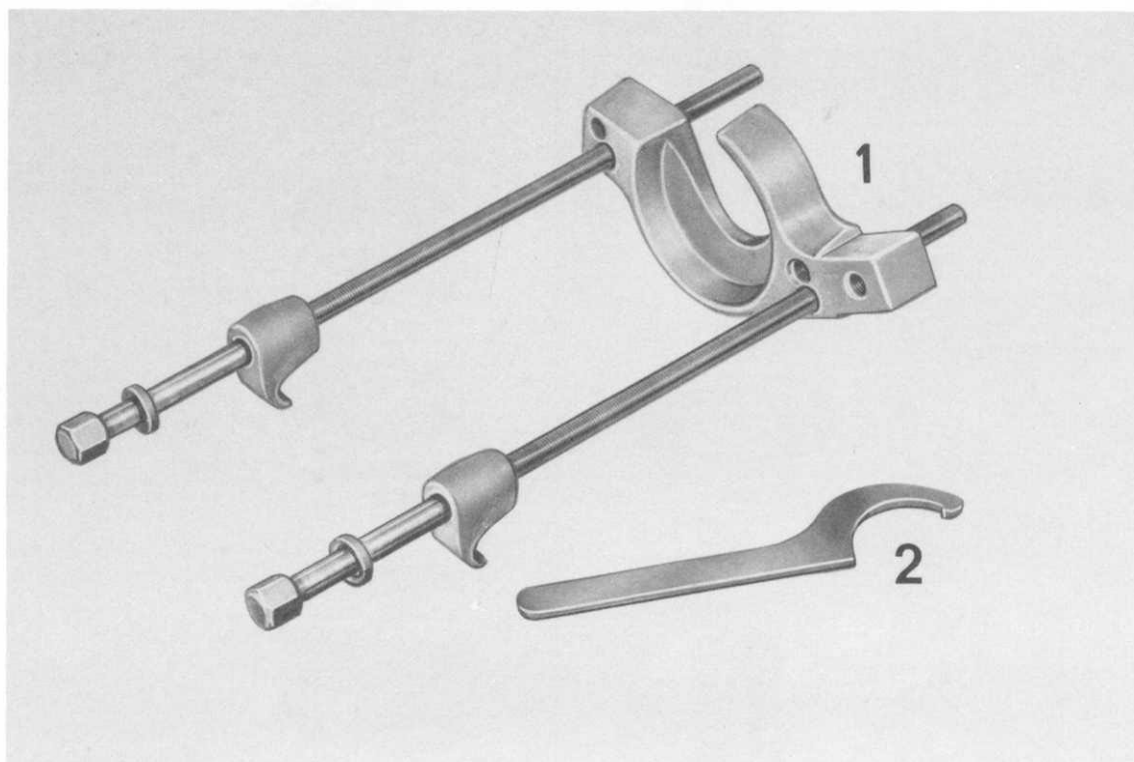
1. Replace self-locking nuts. Check spring strut seal, making a new permanently elastic seal on the mounting plate 300mm long and circular in shape with, for example, Prestik 4 mm dia., Item No. 0593 from Bostik. Coat rubber mount on mounting eye with Molykote U.
2. Tighten to specified torques.
3. Note installed position of lower shock absorber.



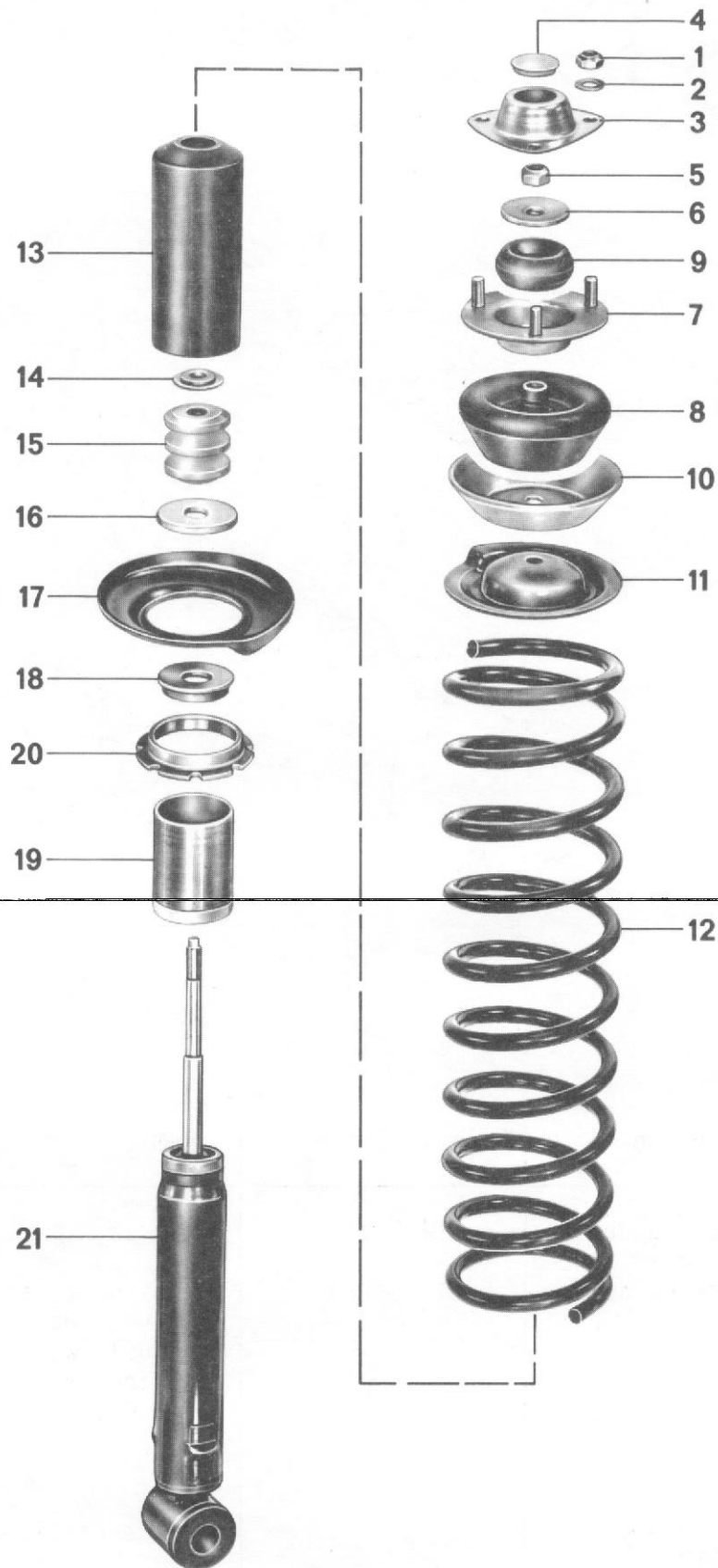
## Note

Turn lower shock absorber to correct position with a hook wrench applied to adjusting nut. Select direction of turning so that stop of spring retainer remains on end of spring. Further the adjusting nut must not be turned against the threaded sleeve, so that the car height adjustment is not changed.

## TOOLS



No.	Description	Special Tools	Remarks
1	Tensioning device or	VW 340	
-	Tensioning device		Porsche version by Klann, see Workshop Manual (Workshop Equipment 3, group 4) for description/supplier.
2	Sickle wrench DIN 1810 dia. 80/90		commercially available, e.g. Saltus



No.	Description	Qty	Note When:	
			Removing	Installing
1	Locknut	3		renew, torque: 46 Nm (33 fltb)
2	Washer	3		
3	Cover	1		
4	Dirt excluder	1		
5	Locknut	1	Stretch coil spring with VW 340 or Klann KL - 0014	renew, torque: 58 Nm (42 fltb)
6	Washer	1		
7	Mounting plate	1		
8	Rubber support	1		coat with Molykote U
9	Damper bushing	1		coat with Molykote U
10	Support plate	1		see note on page 42 - 18c
11	Spring plate	1		see note on page 42 - 18c
12	Coil spring	1		note allocation, tolerance group and remarks on page 42 - 18b/c
13	Protective tube	1		



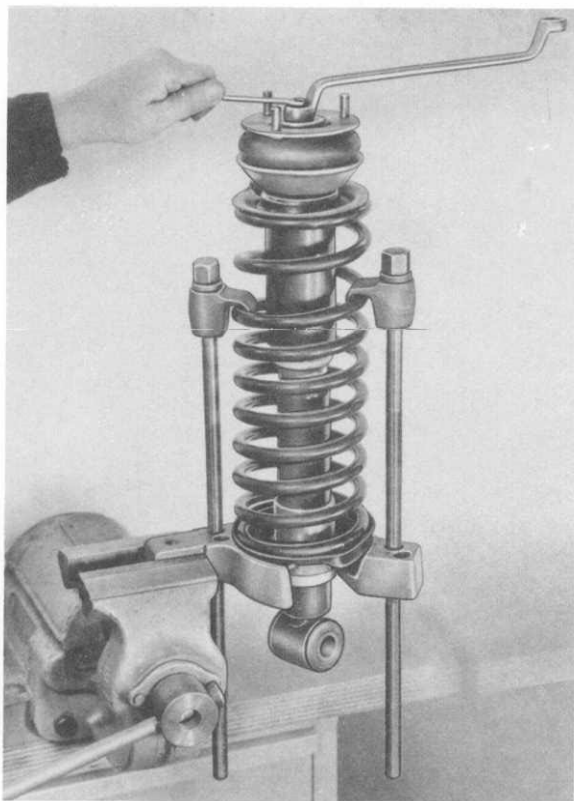
No.	Description	Qty	Note When:	
			Removing	Installing
14	Circlip	1		
15	Secondary spring	1		Check installation position
16	Stop	1		Install with grooves down
17	Lower spring plate	1		Coat contact surface for adjuster nut with Optimoly TA. Note remarks on page 42 - 18c
18	Support cover	1		Boge only
19	Threaded sleeve	1		Coat thread with Optimoly TA. See remarks on page 42 - 18c
20	Adjuster nut	1		Check freedom of movement (to facilitate adjustment). Boge and Bilstein are different. See remarks on page 42 - 18c
21	Damper	1		Check efficiency, renew if necessary. Modified dampers as of model year 86. Damper installation overview, page 40 - 18d

## NOTES ON DISASSEMBLY AND ASSEMBLY

## D i s a s s e m b l i n g

1. Using Porsche-version Klann spring tensioning device (see Workshop Manual) or VW 340, stretch coil spring. Remove self-locking nut from piston rod. Remove mounting plate with support plate.

VW 340



2. If special tool VW 340 is used, relax tension on coil spring by screwing down each of the clamping bolts in turn.

## T e s t i n g   D a m p e r s

Dampers can only be tested properly on a test bench. Although inefficient dampers cannot be identified, a visual inspection or check of operation will identify completely defective dampers.

## N o t e :

Distinguishing features of dampers, see page 42 - 18d.

B o g e   D a m p e r s ,  
P r e s s u r e l e s s

With damper in installation position, extend and compress by hand. The damper must move smoothly and with uniform resistance through its entire travel. The extension and compression-stage damping must be felt clearly right up to the final positions. Dampers which have been stored for an extended period of time should be pumped in and out several times in the installation position. Replace leaking dampers.

B o g e   G a s   P r e s s u r e  
D a m p e r s

With damper in installation position, extend and compress by hand. Damper must move smoothly throughout its travel. Extension and compression-stage damping must be felt clearly right up to final positions. Because of the gas pressure, the resistance of the

piston rod increases as the rod moves into the damper. If dampers have been stored for a long time, pump in and out several times in installation position.

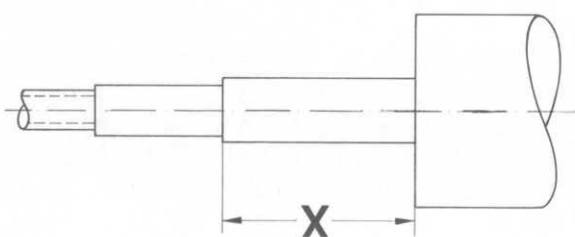
Replace leaky dampers.

If dampers have depressurized (damper does not return automatically to expansion-stage and stop), but show no signs of escaping oil (oil stain) and fulfill the remaining requirements, they can be reused. Dampers which show traces of oil leaks and have lost their gas pressure must be replaced.

### B i l s t e i n D a m p e r s

Worn B i l s t e i n dampers can be readily identified.

Measure dimension X with damper completely compressed (i.e. as far as possible). If dimension X is larger than 18 mm (new damper 8.5 mm), the damper must be replaced.



### A s s e m b l i n g

Rear-axle springs are available in three versions. The versions are color-coded.

The springs with green, yellow and blue coding are further subdivided in tolerance groups.

When replacing, always install springs with the same color coding. Under no circumstances may yellow, green and blue springs be combined.

As car height is adjustable, it is not necessary to correlate spring groups with certain model types (e.g. with or without air conditioner, left-hand or right-hand drive).

Coil spring (green)  
928, until end of model year 78  
Part No. 928.333.531.09

Gr.	F where $L_1 = 272 \text{ mm}$	Color code	Order- ing Index
1	4719...4817 N	1 green	201
2	4818...4915 N	2 green	202
3	4916...5013 N	3 green	203

Coil spring (yellow)

928/928 S from 79 models until  
current 84 model year (see note  
below), Part No. 928.333.531.12

Gr.	F where $L_1 = 253.5 \text{ mm}$	Color code	Order index
1	4710...4810 N	1 yellow	101
2	4811...4910 N	2 yellow	102
3	4911...5010 N	3 yellow	103

N o t e :

As of the following chassis  
numbers:

92 ES 840 416	928 S Europe/r.o.w
92 ES 849 568	928 S Japan
92 ES 860 562	928 S USA

in the current 84 model year, the  
coil springs, both spring plates of  
the supporting plate and the adjust-  
er nut with threaded sleeve have  
been modified to reduce weight.

Coil spring (blue)

928 S, installed in the current 84  
models as of the chassis numbers  
listed above, Part No. 928.333.  
531.14.

Gr.	F where $L_1 = 249.8 \text{ mm}$	Color code	Order index
1	4680...4800 N	1 blue	301
2	4801...4920 N	2 blue	302
3	4921...5040 N	3 blue	303

## DAMPERS - INSTALLATION OVERVIEW, IDENTIFICATION AND DISTINGUISHING FEATURES

	Front axle		Rear axle		Single pipe		Double pipe		Pressureless		Gas pressure		Boge		Bilstein	Paint coding, Identification
Non-adjustable front- axle spring strut																
928/928 S standard	X				X	X			X							black* black**
928/928 S optional extra	X		X					X		X						green green
Adjustable front- axle spring strut																
928 S standard until end of model year 85	X				X	X			X							black* black**
928 S optional extra until end of model year 85	X		X					X		X						gold gold
928 S standard 86 models onward	X				X			X	X							grey grey
928 S optional extra 86 models onward alternative	X				X			X	X							red red gold gold

\*/\*\* Identical parts

Note :

Optional Extra = Sport Tuning

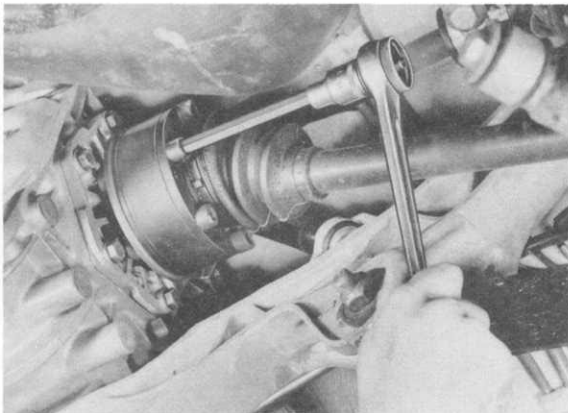
When removed, the pressureless damper will remain in any desired position.  
When the gas pressure damper is removed it extends to the expansion stage stop.

## REMOVING AND INSTALLING AXLE SHAFT

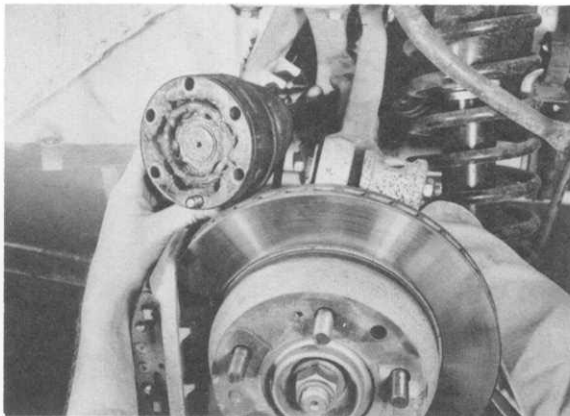
## Axle Shaft Bolted on Both Sides

## Removing

1. Remove cylinder head bolts on transmission and wheel ends.



2. Run out axle shaft on righthand side toward inside.
3. Run out axle shaft on lefthand side toward outside, after removal of rear wheel. Make sure that grease from constant velocity joint does not come on brake disc.



## Installing

Clean axle shaft flange surfaces to remove grease.  
Tighten bolts to 83 Nm.

## Axle Shaft Welded on One Side

## Removing

1. Remove socket head bolts on transmission end and self-locking nut on wheel end.

## Note:

Self-locking nut is accessible after removing wheel cover.

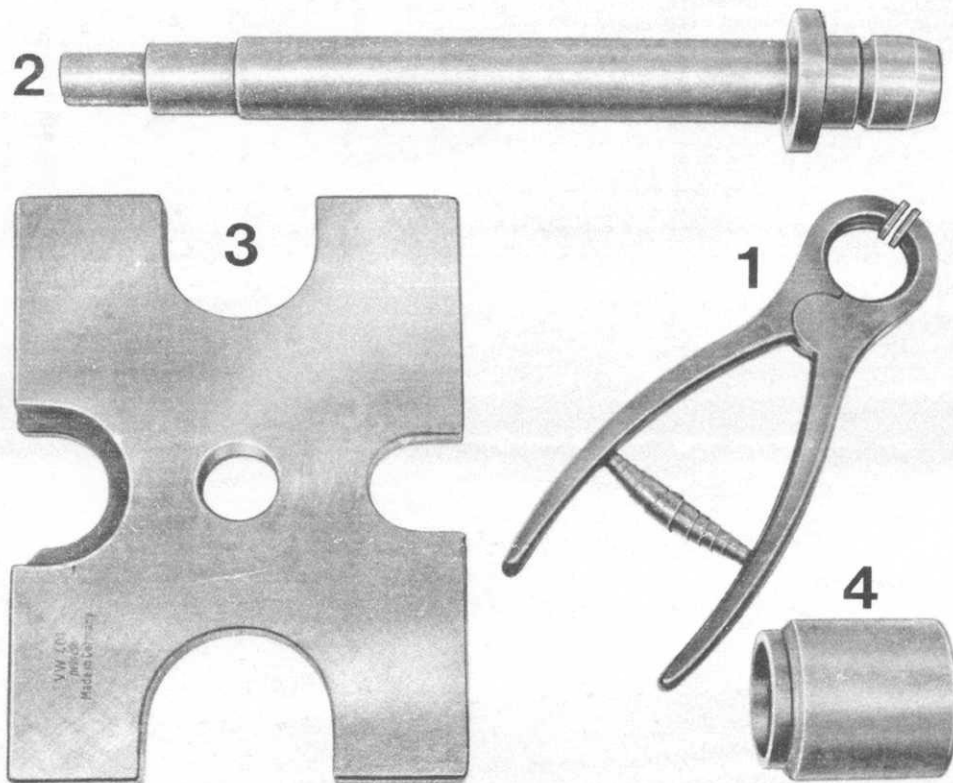
Wheels do not have to be removed.

2. Run out axle shaft on right and left sides toward inside.  
Lower rear end of exhaust assembly on left side.

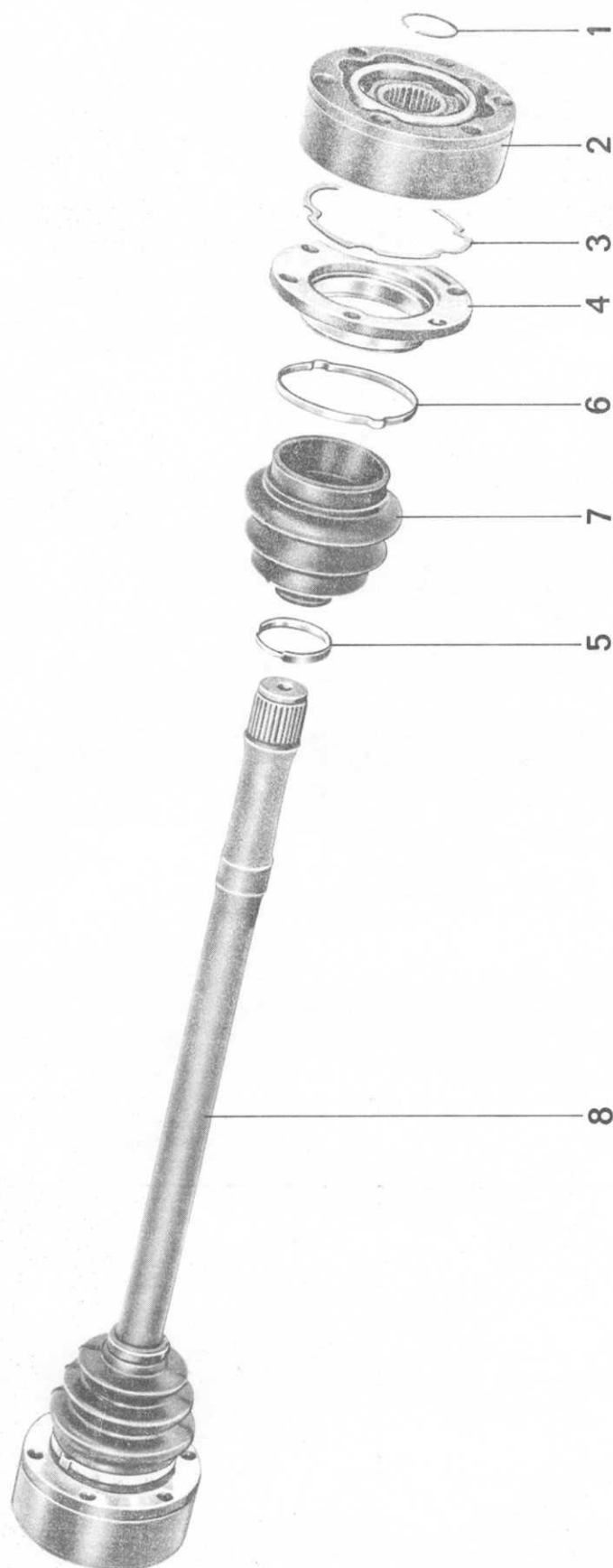
## Installing

1. Run axle shaft into wheel hub on wheel end (lubricate splines and threads with Optimoly HT).
2. Install socket head bolts on transmission end (axle shaft flange surfaces must not have grease).
3. Tighten socket head bolts to 83 Nm and self-locking nut to 460 Nm.

## TOOLS



No.	Description	Special Tool	Remarks
1	Circlip pliers	VW 161 a	
2	Punch	VW 408 a	
3	Plate	VW 401	
4	Sleeve	VW 455	





No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Circlip	2		Replace, make sure of correct fit	Only special grease (spare part delivery)
2	Constant velocity joint	2		Pack 80 grams of grease in each joint groove on outside diameter of joint to outside of propeller shaft. Grease quantity only valid for joints	
3	Gasket	2		Replace	
4	Sealing flange	2		Bearing surface must be grease free	
5	Clamp	2			
6	Clamp	2	Cut open with side nippers	Install clamps between machined shoulders	
7	Dust boot	2		Replace, if necessary	
8	Shaft	1		Check runout	

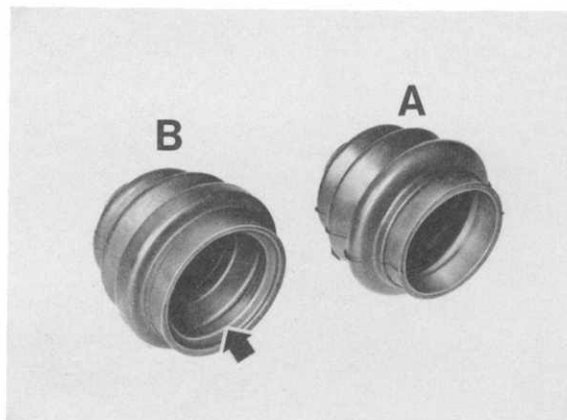
### Modified Axle Shaft

Axle shafts with welding on one side are installed since 1982 models. The transmission end shaft is still bolted as before, while on the wheel end the axle shaft and drive shaft are welded.

Welded axle shafts can also be installed retroactively in older models. Bolted axle shafts on both ends, however, cannot be installed in cars after 1982 models on (would scrape on wheel carrier).

### Dust Cover Versions

The welded axle shaft has a different dust cover with improved sealing. The dust cover has a bead (arrow) and the sealing flange a groove.



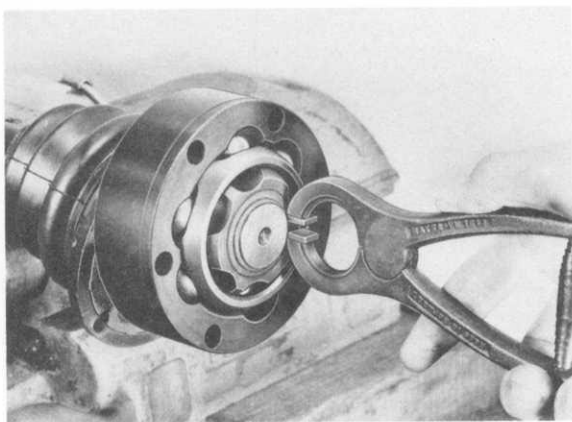
A For bolted axle shaft on both ends

B For welded axle shaft on one end

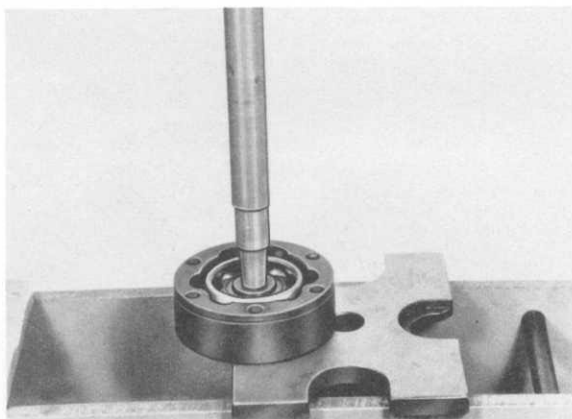
## DISASSEMBLING AND ASSEMBLING AXLE SHAFT

### Disassembling

1. Clamp axle shaft in a vise fitted with soft jaws.
2. Remove clamp and push dust boot with sealing flange toward inside of axle shaft.
3. Remove circlip.

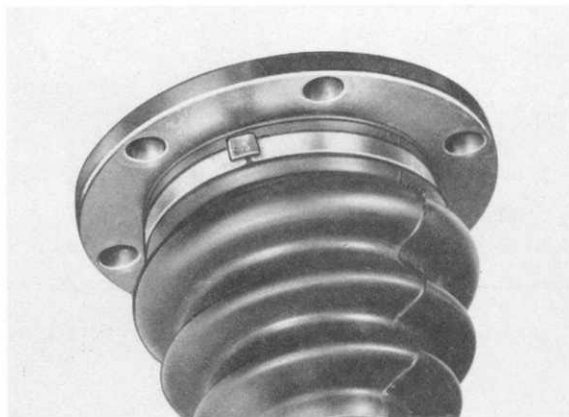


4. Press off constant velocity joint using special tools VW 401 and VW 408 a.



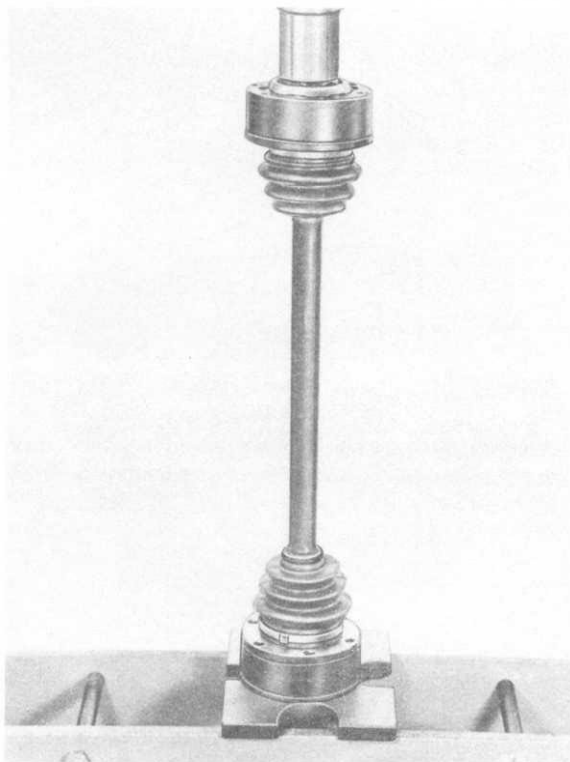
### Assembling

1. Seal large diameter end of new dust boot with an adhesive. This requires that seats of sealing flange and boot be clean and free of grease.  
Adhesive: 3 M Scotch Seal 750  
(available in 5 oz. tubes)
2. Squeeze new clamp with a special pliers, e.g. VW 1275, between machined shoulders of sealing flange.



3. Replace gasket on flange cover.
4. Push dust boot with sealing flange on to shaft.
5. Pack constant velocity joint from each side with approx. 40 grams of special grease uniformly. Total quantity of grease: 80 grams. Special grease is only for joint. Never use grease in dust cover.  
80 grams of special grease is delivered with each spare dust boot and each spare constant velocity joint.

Press constant velocity joint on to shaft. Install a new circlip.



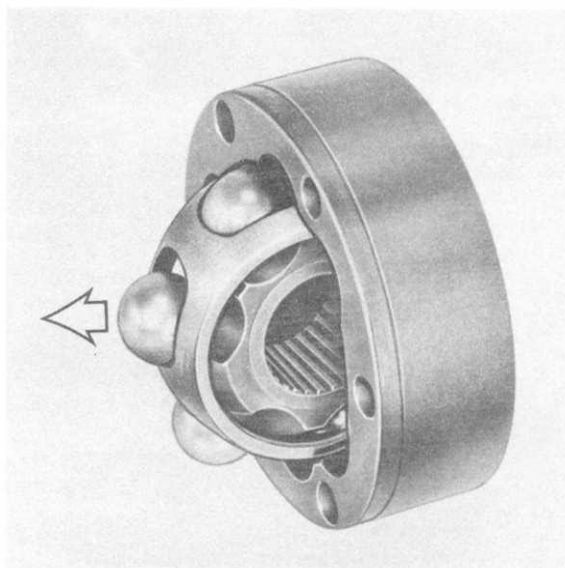
6. Position dust boot correctly. Install lamp.

## Disassembling and Assembling Constant Velocity Joint

### Disassembling

Joint must be disassembled to replace grease when seriously contaminated or when bearing surfaces and balls have to be inspected for wear or damage.

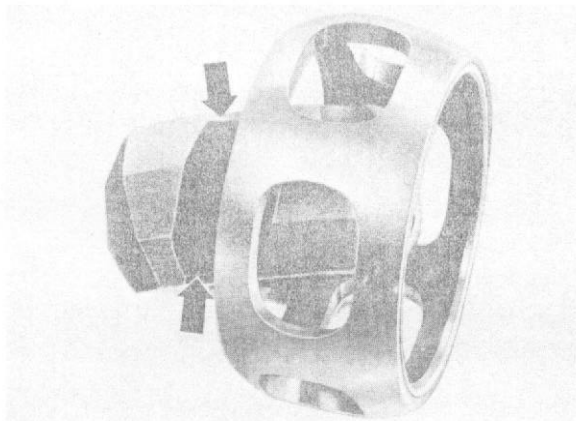
1. Swing out ball hub and ball cage from joint and press out in direction of arrow.



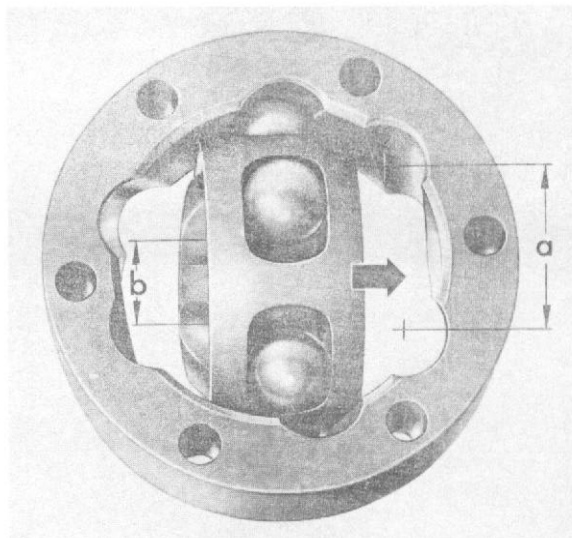
### Note

Ball hub and joint are paired. Don't mix them up. The 6 balls for each joint also belong to one tolerance group.

2. Tilt ball hub out of ball cage via ball groove (arrows).



4. Install hub with cage and balls in joint pointing up. Make sure that after swinging in hub into joint one wide ball groove "a" on joint is together on one side with a narrow groove "b" of hub.

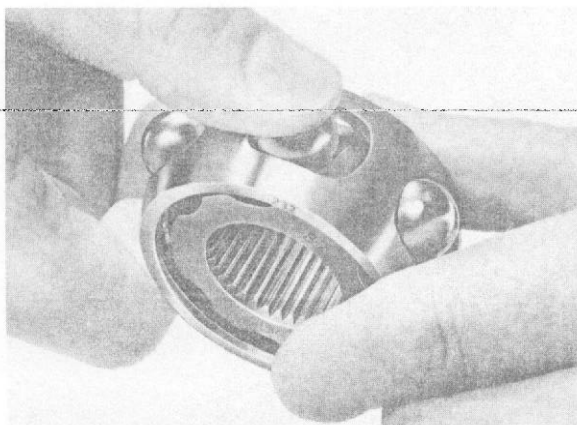


#### Assembling

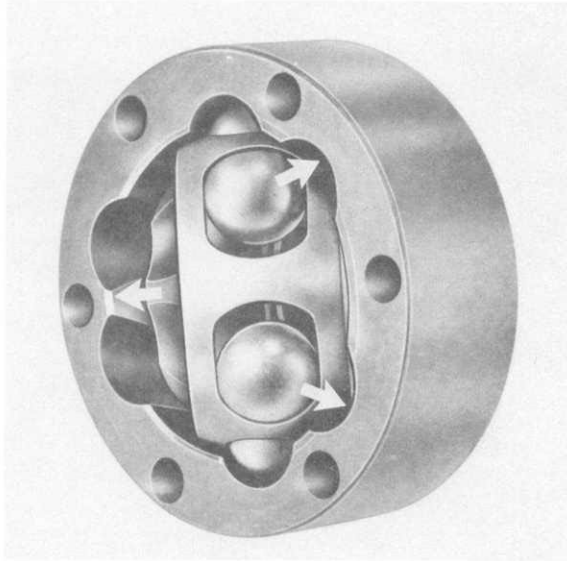
1. Check joint, ball hub, ball cage and balls for pitting and scoring. Excessive radial play in joint will be noticed by knocking noises when accelerating/decelerating. Replace joint in such a case. Slight wear spots and tracks of balls are no reason to replace joint.
2. Place ball hub in ball cage. Any installed position is okay.
3. Press balls into cage.

#### Note

Groove of ball hub and running around periphery of outside diameter on joint must face end of axle shaft.

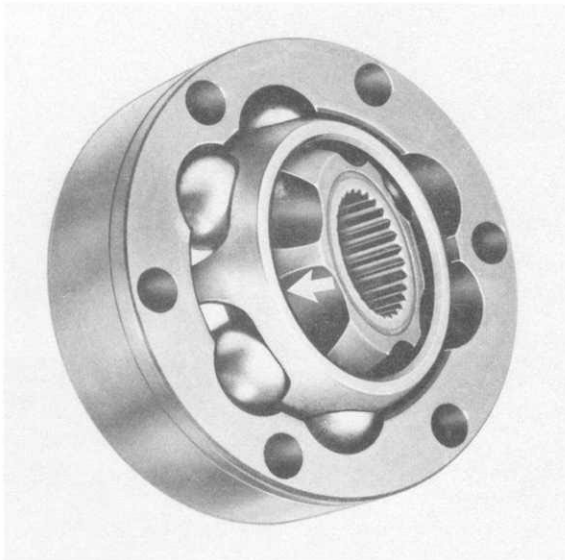


5. Swing in ball hub with cage. To accomplish this, swing out hub from cage so far that balls are at same distance as orbits (arrows).



7. Check function of joint. Constant velocity joint has been assembled correctly, if ball hub can be pushed back and forth by hand over the entire axial compensation distance.

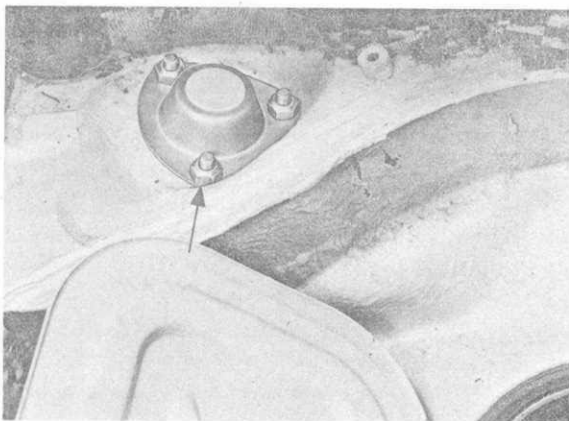
6. Press hub with balls into joint (arrow).



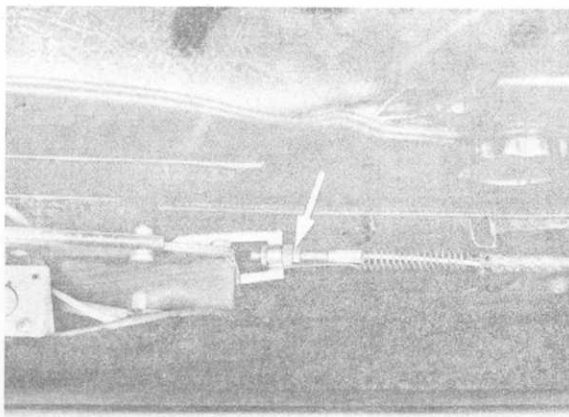
## REMOVING AND INSTALLING REAR AXLE ASSEMBLY

## Removing

1. Unscrew M 10 self-locking nuts (3 per side) from spring struts in luggage compartment. Remove rear wheels.

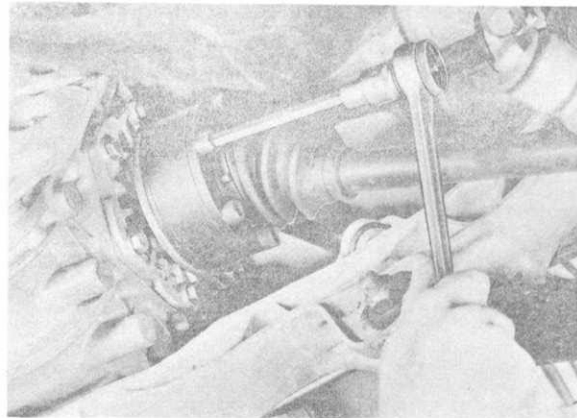


2. Disconnect parking brake cable at connector and pull back out of guide.

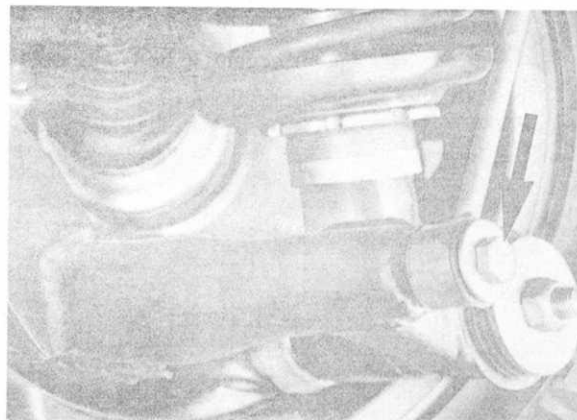


3. Detach brake calipers and suspend from piece of wire. Be sure that brake hoses are not too tight.
4. Remove exhaust system as far as necessary depending on version.

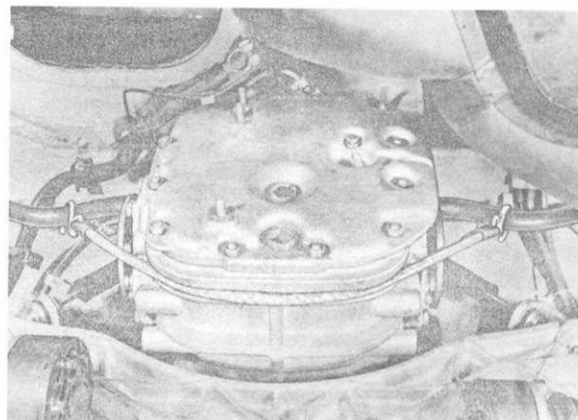
5. Disconnect axle shafts at transmission and suspend from wire in horizontal position on rear axle cross member.



6. Disconnect stabilizer at lower control arm.



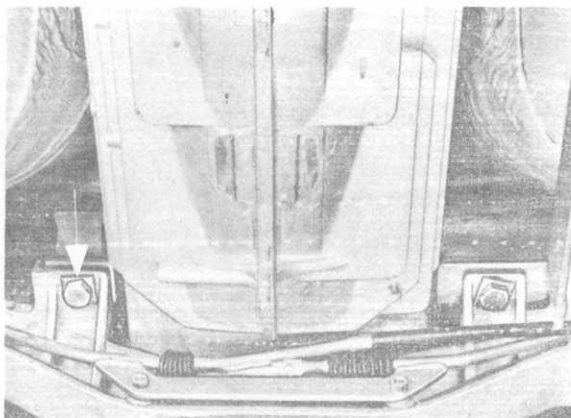
7. Support transmission from stabilizer bar with special tool US 8031.



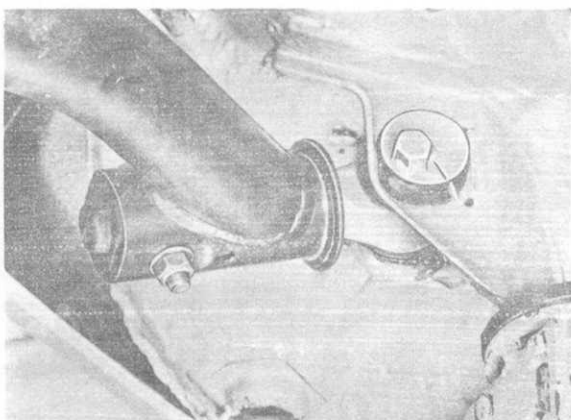
8. Unscrew two mounting bolts of rear axle cross member as well as two bolts of transmission mounts.

#### Note

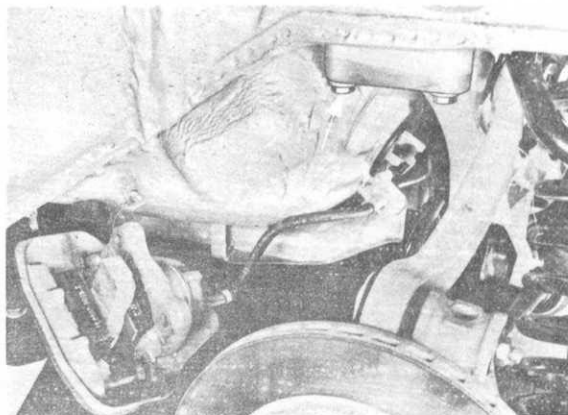
Since shims are installed between transmission mounts and the rear axle cross member, note quantity, thickness and location for installation later.



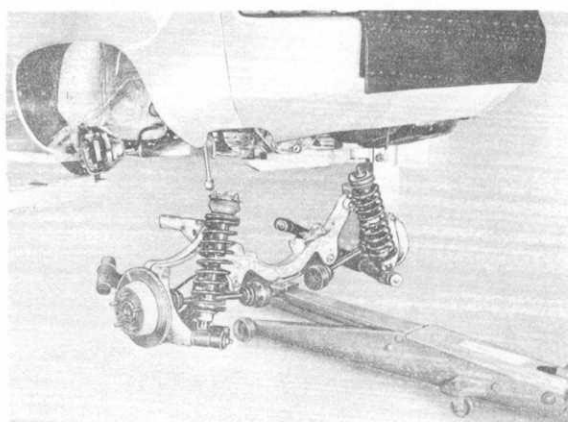
9. Mark position of (toe) eccentric bolts. Remove bolts from rear axle cross member.



10. Place floor jack underneath rear axle cross member. Mark position of rear axle cross member. Remove remaining 4 bolts of rear axle cross member.



11. Lower rear axle carefully and be careful not to twist the spring struts, control arms or rear axle cross member.



#### Installing

1. Check spring strut seal (seal between mounting plate and body). If necessary, make a new permanently elastic seal, e.g. 4 mm dia. Presik, Item No. 0593 from Bostik, 300 mm long, circle-shaped, on the mounting plate.



2. Move in rear axle. Install mounting bolts and align axle to original position as marked. Tighten bolts to specified torque.
  
3. Align transmission suspension (see point 8.). Refer to Group 34 if transmission suspension has to be completely aligned, using new parts.

---



## Wheels and tires

### Tire condition / tire pressure

Tires are safety-relevant items that are only capable of meeting the requirements applicable if they are run at the correct tire pressure and with sufficient tread depth.

The tire pressures indicated are minimum pressures. The tires must never be run at lower pressures since this affects roadholding in a negative manner and may lead to severe tire damage.

Valve caps protect the valve against dust and dirt and therefore help prevent leaks. Always screw on caps tightly and replace missing caps.

For safety reasons, do not limit tire checks to checking the tire pressure but also check for sufficient tread depth, ingress of foreign matter, pinholes, cuts, tears and bulges in the sidewall (cord breakage)!

### Tire pressure of cold tires (approx. 20°C) (summer and winter tires)

#### 15 and 16 inch

	Summer tires*	Winter tires
front	2.5 bar pos. pressure	2.5 bar pos. pressure
rear	3.0 bar pos. pressure**	3.0 bar pos. pressure

#### 17 inch

	Summer tires	Winter tires
front	2.5 bar pos. pressure	2.5 bar pos. pressure
rear	2.5 bar pos. pressure	3.0 bar pos. pressure

### Collapsible spare tire

front and rear	2.5 bar pos. pressure	for 8 PR 89 P / 92 P tires
front only	2.2 bar pos. pressure	for 4 PR 83 P tires

\* Due to changes in standards and legislation, "V" and "ZR" tires require tire pressures that deviate from the values indicated in the Owner's Manual.

Always use the new tire pressures indicated above. Relevant adhesive labels are available from all official Porsche dealers.

\*\* In some cases, only allowed up to 2.5 bar (36 psi) in the U.S.A. This depends on the tire in question since earlier tires have a sidewall lettering that limits the admissible tire inflation pressure (max. press) for North America to 36 psi (2.5 bar). Lettering for tire pressures of 3.0 bar = max. press 44 psi or 300 Kpa.

**Tire and wheel overview / tire specification character**

For a tire and wheel overview for summer and winter tires, refer to the relevant Technical Information (TI), Group 4.

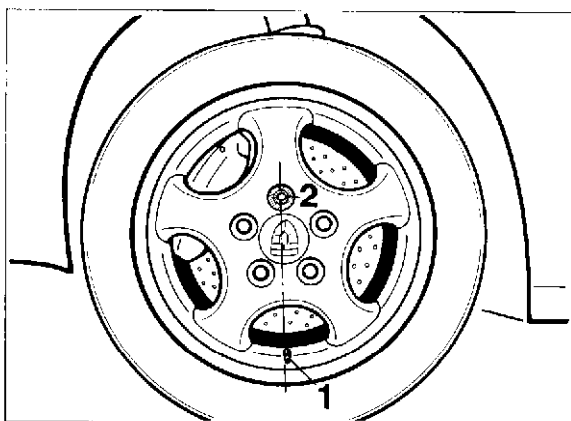
**When replacing summer tires, check for the correct tire specification character.** The specification characters N 0, N 1, or N 2, respectively, help to distinguish summer tires approved by Porsche from other versions of identical tire type and the same tire size. The tires approved by Porsche are also identified in the corresponding TI.

N0, N1 and N2 tires must not be mixed on one and the same vehicle, even if they are of the same make.

## Fitting the 17 Inch Wheels (Cup Design) to the Vehicle

On the 17" Cup Design wheels, the valve (No. 1) and the locking wheel nut cannot be arranged on the same side (as on previous models).

For correct installation, the valve (No. 1) must face the color-coded stud (No. 2). Be sure to fit the locking wheel nut to the color-coded stud (Nr. 2).



583-44

If required, mark the wheel stud located opposite the valve before removing the wheel.

For stationary balancing of the wheels (with step rings), turn the wheel in such a manner that the valve points to the bottom. Tighten the wheel in this position.

After balancing, mount the wheel to the vehicle in an identical position (valve faces to the bottom / color-coded wheel stud and locking wheel nut located on top).

### Important note

Fitting (and tightening) procedures of all other wheel types (16-inch Design 90 etc.) for stationary balancing remain unchanged.

This means: Coded stud, valve and locking wheel nut are located on the same side. When tightening, valve must point up (same position as on balancing equipment).

It is recommended to add an extra reference to the modified assembly in the "Wheel balancing and General notes on fitting tires" chapter.

## Wheel alignment measuring data

The following values apply at empty weight in accordance with German DIN 70020 standard (car with full fuel tank, spare wheel and tools).

		Adjustment values and tolerance	Max. difference between left/right
<b>Front axle</b>			
Height adjustment:			
From wheel contact patch to Measuring surface on rear control arm pivot		$180 \pm 20 \text{ mm}^*$	10 mm
Toe-in, no pressure applied		$+ 15' \pm 5'$	
Toe-out on turns at $20^\circ$ steering lock		$- 1' \pm 20'$	Can only be varied by renewing steering arms
Camber		$- 30' \pm 10'$	10'
Caster	1990 models inclusive	$3^\circ 30' + 30^{***}$	20'
	From 1991 models on	$4^\circ + 1^{***}$	20'
<b>Rear axle</b>			
Height adjustment:			
From wheel contact patch to measuring surface on lateral subframe		$173 \pm 10 \text{ mm}^*$	10 mm
Toe-in, each wheel		$+ 10' \pm 5'$	10'
Camber		$- 40' \pm 10'$	10'

\* Height adjustment settings apply to new cars. After cars have been driven for a period the height may be max. 10 mm less, in other words the downward tolerance can vary by 10 mm more. However, this must then apply to both axles.

\*\* The caster angle value of  $4^\circ + 1^\circ$  can be adopted retrospectively on cars back to the 1986 model year inclusive (from introduction of vertical ball joint at front axle subframe pivot / refer to Page 40 - 19). The caster tolerance range on the measuring chart should be modified if necessary. The printed measuring chart will not be amended until a new issue is printed.

## Specimen measuring chart\*

Name: \_\_\_\_\_ Vehicle: All Porsche Types 928

Vehicle Ident. No.: \_\_\_\_\_ Licence plate No.: \_\_\_\_\_ miles/km: \_\_\_\_\_

Date: \_\_\_\_\_ measured by: \_\_\_\_\_

Rims and tires (damage and treads)

\_\_\_\_\_

\_\_\_\_\_

### MEASURING CHART

Difference angle at 20° turning radius

2 1 0

20° right turn-in measured left

2 1 0

20° left turn-in measured right

Vehicle: Empty weight according to DIN 70020 (with full fuel tank, spare wheel and tools)

Vehicle: Empty weight according to DIN 70020 (with full fuel tank, spare wheel and tools)

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

5 4 3 2 1 0 1 2 3

max. caster-difference left to right = 20°

mm

Car's height\* (nominal value 190 - 20 mm)

mm

bar psi

Wheel load in kg\* Max. difference between left and right: 20 kg

bar psi

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

1 0 1

Rear-wheel adjustment

toe-in

bar psi

Car's height\* (nominal value 173 ± 10 mm)

mm

Wheel load in kg\* Max. difference between left and right: 20 kg

bar psi

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

5 4 3 2 1 0 1 2 3

max. camber-difference left to right = 10°

camber

4260.20 \* Refer to instructions in Repair Manual Printed in Germany

\* The caster adjustment setting has been changed for 1991 models on to 4° + 1° (previously 3° 30' + 30'). This changed caster value can be adopted retrospectively on cars back to 1986 models inclusive (from introduction of vertical ball joint at front axle subframe pivot / refer to Page 44 - 19).

## Wheel alignment measuring data

The following values apply at empty weight in accordance with German DIN 70020 standard (car with full fuel tank, spare wheel and tools).

**OLD**

**FOR GENERAL INFO ONLY**

		Adjustment values and tolerance	Max. difference between left/right
<b>Front axle</b>			
Height adjustment: From wheel contact patch to Measuring surface on rear control arm pivot		190 -20 mm*	10 mm
Toe-in, no pressure applied		+ 15' ± 5'	SEE NEW SHEET Can only be varied by renewing steering arms
Toe-out on turns at 20° steering lock		- 1' ± 20'	
Camber		- 30' ± 10'	10'
Caster	1990 models inclusive	3° 30' + 30***	20'
	From 1991 models on	4° + 1***	20'
<b>Rear axle</b>			
Height adjustment: From wheel contact patch to measuring surface on lateral subframe		173 ± 10 mm*	10 mm
Toe-in, each wheel		+ 10' ± 5'	10'
Camber		- 40' ± 10'	10'

\* Height adjustment settings apply to new cars. After cars have been driven for a period the height may be max. 10 mm less, in other words the downward tolerance can vary by 10 mm more. However, this must then apply to both axles.

\*\* The caster angle value of 4° + 1° can be adopted retrospectively on cars back to the 1986 model year inclusive (from introduction of vertical ball joint at front axle subframe pivot / refer to Page 40 - 19).

The caster tolerance range on the measuring chart should be modified if necessary. The printed measuring chart will not be amended until a new issue is printed.

## Specimen measuring chart\*

Name: \_\_\_\_\_ Vehicle: All Porsche Types 928

Vehicle Ident. No.: \_\_\_\_\_ Licence plate No.: \_\_\_\_\_ miles/km: \_\_\_\_\_

Date: 02.03.92 measured by: \_\_\_\_\_

Rims and tires (damage and treads)

\_\_\_\_\_

\_\_\_\_\_

### MEASURING CHART

Difference angle at 20° turning radius

2 1 0

toe-in

toe-out

20° right turn-in measured left

2 1 0

toe-in

toe-out

20° left turn-in measured right

2 1 0

toe-in (not pressed)

Car's height\* (nominal value 190 - 20 mm)

mm

mm

Wheel load in kg\* Max. difference between left and right: 20 kg

mm

mm

Vehicle: Empty weight according to DIN 70020 (with full fuel tank, spare wheel and tools)

comber

5 4 3 2 1 0 1 2 3

max. camber-difference left to right: 10°

caster

5 4 3 2 1 0 1 2 3

max. caster-difference left to right: 20°

comber

5 4 3 2 1 0 1 2 3

max. camber-difference left to right: 10°

caster

5 4 3 2 1 0 1 2 3

max. caster-difference left to right: 20°

4260.20

Rear-wheel adjustment

1 0 1

toe-in

1 0 1

toe-out

Car's height\* (nominal value 173 ± 10 mm)

mm

mm

Wheel load in kg\* Max. difference between left and right: 20 kg

mm

mm

\* Refer to instructions in Repair Manual

Printed in Germany

\* The caster adjustment setting has been changed for 1991 models on to 4° + 1° (previously 3° 30' + 30'). This changed caster value can be adopted retrospectively on cars back to 1986 models inclusive (from introduction of vertical ball joint at front axle subframe pivot / refer to Page 44 - 19).

The caster tolerance range on the measuring chart should be modified if necessary. The printed measuring chart will not be amended until a new issue is printed.

## Alignment

### General

Use an optical or electronic axle measuring device to align the vehicle. Refer to the operating instructions for the axle measuring device for the measuring procedure.

The following preconditions must be fulfilled before starting alignment:

- Vehicle at curb weight as per DIN 70020, i.e. ready for the road with full tank, spare wheel and tools.
- Correct joint and wheel-bearing play
- Prescribed tyre inflation pressure, more or less uniform tyre tread

If vehicle is to be aligned front and rear, first check and/or adjust the wheel values for the rear axle. Center the steering wheel and steering for track adjustment.

Before starting to adjust the wheel values for front or rear axles, it may be advisable or necessary\* to check the rear axle height setting at DIN curb weight, as well as the front axle for vehicles with adjustable front spring struts.

If wheel-load scales are available, it is possible to keep the difference between right and left wheel loads as low as possible thanks to the height adjustment facility. The difference in wheel load is adjusted by altering the height of the vehicle within the height tolerance. Priority is given to the least possible difference between right and left wheel load.

\* following work which causes an alteration in height or if the height is incorrect.



## Important notes for alignment

The following must be observed during alignment:

1. Actual vehicle height
2. Height setting / alteration in wheel load

### To 1: (Actual vehicle height)

Explanation of vehicle heights:

#### *Specified vehicle height*

Corresponds to the specified value. The tolerance range may be used to reduce the difference in wheel load.

#### *Actual vehicle height*

- Should be within the tolerance range for the specified vehicle height.
- Is lost if the vehicle or front axle have been raised.
- Is recovered after a longer journey or longer operating period. Exact value can be achieved by pulling the front axle downward in a precisely defined way.
- Description in the following text.

#### *Influenced vehicle height*

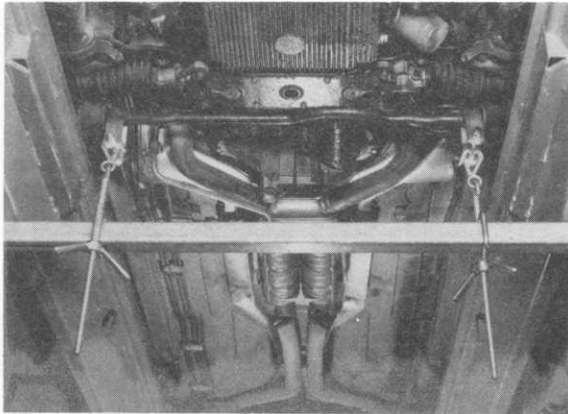
Existing height value after the vehicle or front axle have been raised. Never use this height value as a starting point, to prevent:

- a) a result of height measurement that does not correspond to the actual vehicle height, or
- b) a toe-in value, when correcting the wheel position, which, because of the FA kinematics, does not comply with regulations at actual vehicle height.

#### *Obtain actual vehicle height as follows:*

- After the vehicle has been raised, starting at the influenced vehicle height, pull the front axle down by 60 - 70 mm and hold for 1 minute. Use special tool 10 - 222 A for this. Keep to the specified time.
- After releasing the vehicle, bounce the front and rear axles – approx. 25 mm – a few times.

For the pulling down procedure, fasten the engine support (prop device) 10-222 A to the stabilizer. Use suitable hooks or straps. The transport lugs (strap No. 28, Page 40 - 7) may be used if there is enough distance between the rails of the platform. This is possible without removing the sump guard.



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### To 2: (Height adjustment/alteration in wheel load)

Changing the height on one side causes an alteration in wheel load. If there is an alteration in wheel load for one wheel, the loads for the other wheels also change.

An increase in spring pretension (raising the vehicle) on one side causes an increase in wheel load.

A reduction in spring pretension (lowering the vehicle) on one side reduces the wheel load.

An alteration in wheel load always acts on the wheel diagonally opposite. In other words, if the wheel load of one wheel is increased or reduced, the diagonally opposite wheel undergoes the same alteration.

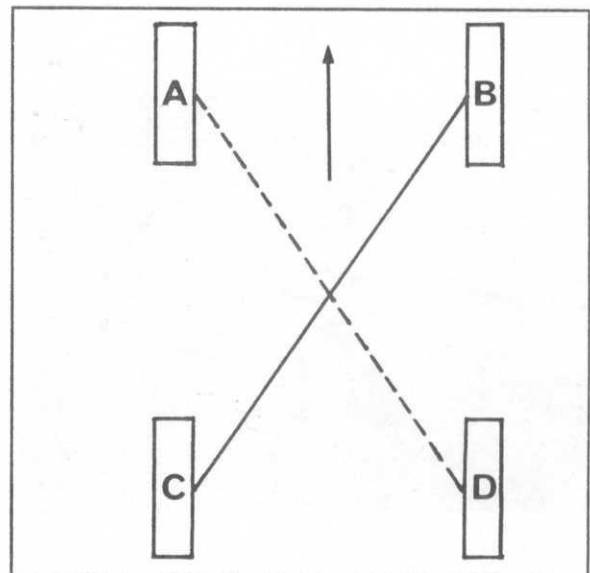
### Example

Spring pretension is increased at the rear left C.

This means that the wheel load:

- increases rear left C and front right B

- reduces rear right D and front left A



The difference between left and right wheel load should be kept as low as possible for front and rear axles (less than 20 kg).

## Check/adjust height

### Note

The adjustment facility is used to correct differences between left and right wheel loads. If the height is correct, the differences in wheel load are within a permitted tolerance as long as the coil springs on each axle are the same length (spring pretention).

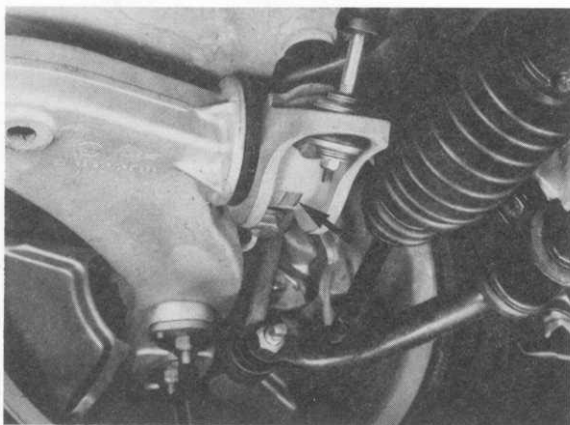
Tolerance  $\pm 1$  mm.

It is possible to keep the differences in wheel load as low as possible if wheel-load scales are used. The tolerance between right and left on front and rear axles less than 20 kg.

## Front axle

### 1. At actual vehicle height

(Page 44 - 2 / 44 - 2a), measure the distance between the tire contact surface and the measuring point on the rear link bearing.



Nominal value  $180 \pm 10$  mm  
max. difference between left and right 10 mm.

### 2a) If spring struts are not adjustable

the vehicle height at the front axle is determined by the coil spring and cannot be adjusted. It is only possible to make a correction by replacing the front axle coil springs or fitting spacers under the lower spring seat.

No more than max. 2 spaces may be fitted to each spring strut to ensure that the guide for the lower spring seat is maintained. Bear in mind that a settling allowance must be made for new vehicles and replaced axle components.

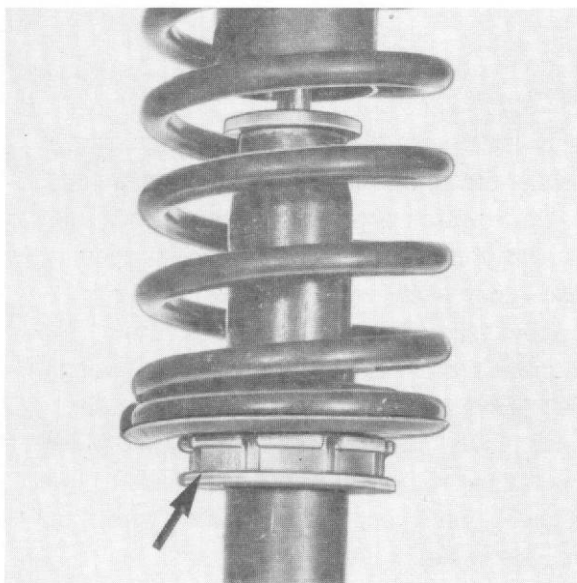
### 2b) If spring struts are adjustable

the vehicle height is adjusted at the front axle by turning the adjusting nut. Set the wheels to a suitable lock to give access to the adjusting nut (do not raise the vehicle). Should the vehicle be raised, restore to actual vehicle height before checking the height again.

#### Adjusting nut

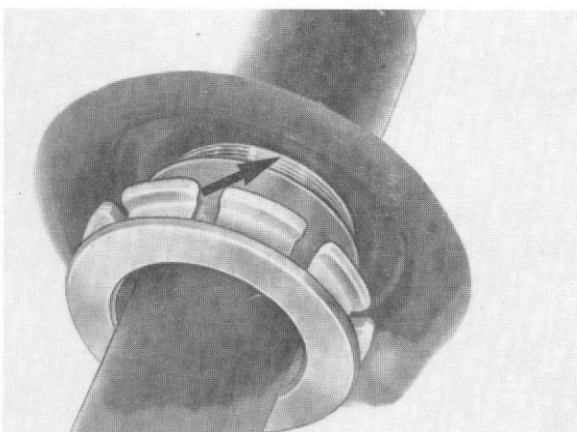
- turn to the right = vehicle higher
- turn to the left = vehicle lower

Adjust using the same tools as for the rear axle.



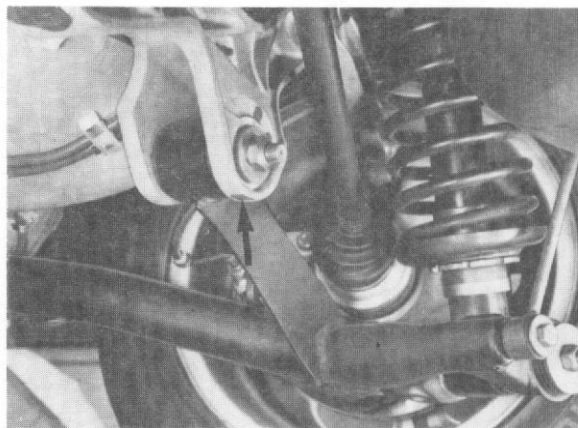
#### Note

If **Bilstein spring struts** are installed, the adjusting range for lowering the vehicle is limited by a stop for the adjusting nut. If **Boge spring struts** are installed, the adjusting nut turns too easily at the lowest position. This means that the lower spring seat no longer has contact with the adjusting nut, but with the threaded sleeve. Under normal conditions, this acceptable range is not reached (if height is adjusted according to regulations).



#### Rear axle

1. At actual vehicle height  
(Page 44 - 2 / 44 - 2a) measure from tire contact surface to measuring point on the cross member.



Specified value  $173 \pm 10$  mm  
max. difference between left and right 10 mm

2. The vehicle height is adjusted at the rear axle by turning the adjusting nut. Use an extended hook wrench (with welded-on pipe) or Special Tool VW 637/2 (lever) to turn the nut accordingly. Do not raise the vehicle.

#### Adjusting nut

- turn to the right = vehicle higher
- turn to the left = vehicle lower

## Wheel alignment values

### Important notes

Only check and/or adjust wheel alignment values if the specified preconditions have been fulfilled (Page 44 - 1 under general) and at actual vehicle height (Page 44 - 2/ 44 - 2 a).

If the vehicle is to be aligned front and rear, first check and/or adjust the rear axle.

### Front axle

Prepare the vehicle for checking and/or adjusting the wheel alignment values. Position the front wheels on rotary plates, etc.

If the vehicle is not driven onto rotary plates, but raised, or raised for any other reason, the actual vehicle height must then be restored by pulling down.

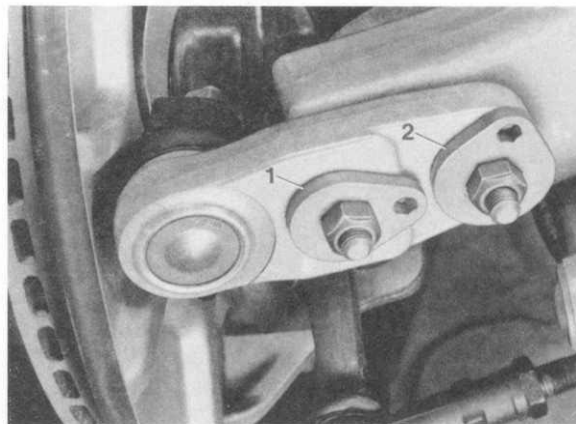
### Adjust camber and caster

Camber and caster are both adjusted by means of eccentrics on the lower control arm. Tighten self-locking hexagon nuts with 120 Nm (88.5 ft. lb.)

Seal the slit openings for the adjusting eccentrics (Page 40 - 23).

### Note

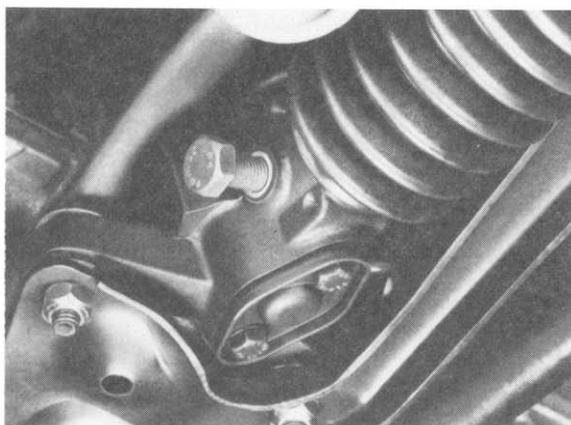
If vehicles have **aluminium joint carriers**, always turn the caster eccentric from small values towards large caster values, i.e. if the caster value is too high, first turn the eccentric back completely and then adjust to the correct value. This guarantees that the camber and caster values are always maintained, even under extreme operating conditions. If it is not possible to achieve the prescribed caster value, adjust the other side to the higher value if necessary (up to 4 degrees 30' is acceptable).



No.	for aluminium joint carrier	for steel joint carrier
1	Caster eccentric	Camber eccentric
2	Camber eccentric	Caster eccentric

### Adjusting toe

- Preparation: Center steering gear with Special Tool 9116. If the steering wheel is offset, relocate at the best value.  
*Then remove Special Tool 9116.*



- Clamp the steering wheel in the central position with **steering wheel lock** and adjust the toe with the tie rods.

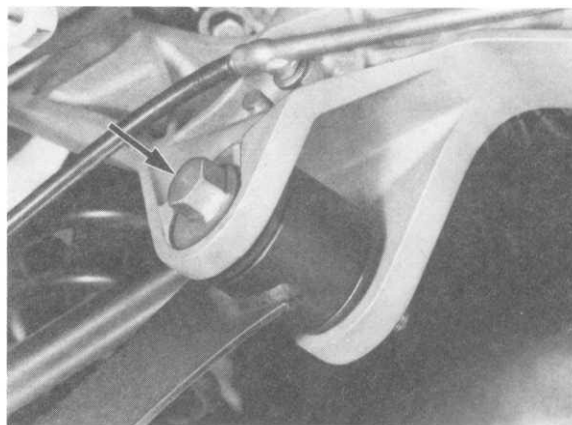
### Track difference

It is not possible to adjust the track difference (can only be affected by replacing steering arms).

### Rear axle

#### Adjust camber

The camber is adjusted by means of an eccentric screw on the inner link bearing.



#### Adjust toe

The toe is adjusted by means of an eccentric screw on the front link bearing.



## CHECKING WHEEL RIMS

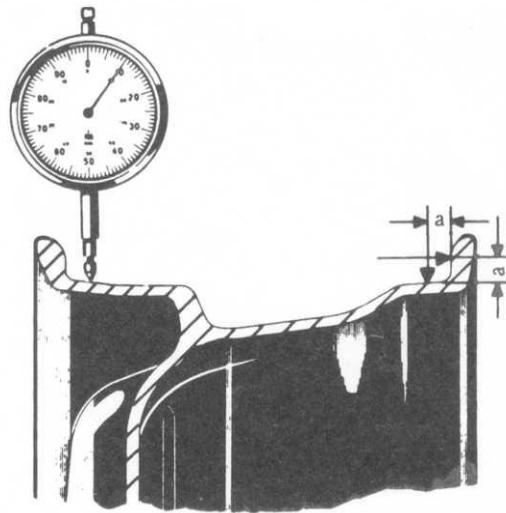
Refer to drawing for lateral and radial runout measuring points on inside of rim.

Max. permissible lateral and radial runout on aluminum rims = 1,0 mm

Max. permissible lateral and radial runout on rim with tire = 1,25 mm  
(also refer to page 44 - 8)

## Note

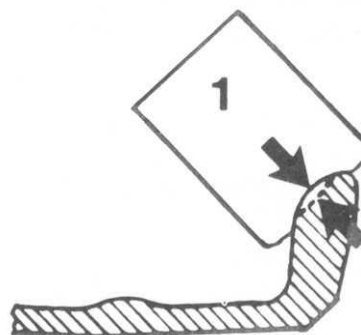
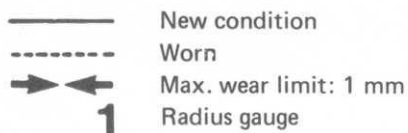
Damaged rims should never be straightened.



Distance "a" = 8 mm

Check flanges of aluminum wheel rims for wear. The inside rim flange is more subject to wear. Use a standard 8 or 10 mm radius gauge for checking. Remove any sharp edges or burrs before checking. Wear limit: 1 mm. Replace wheel rim, if necessary.

## Checking Rim Flange Shape



8 mm radius gauge for cast wheel rims

10 mm radius gauge for forged wheel rims

## General assembly information, tires

**Always use new rubber valves when replacing tires.**

**Attention:** When fitting tires, always comply with any instructions on the side walls with regard to direction of rotation or side-specific assembly (e.g. arrow or "outer/inner")

When fitting tubeless tires, check that the sealing areas of the tire and the disk wheel are clean and look for any damage. With regard to this, always bear in mind that a tubeless tire is sealed by the bead base. If the side wall of the bead were used for sealing, it would be possible for air to escape under extreme driving conditions.

Check the rim flange of light alloy disk wheels for wear (see Page 44 - 6).

When fitting the tire beads into place, use only the tire assembly compounds specified below. **If an unsuitable assembly compound is used, the following may occur:** Tire may rotate on the wheel, bead core may break during fitting and the rim surface may be damaged by aggressive substances. **Caution: Use only TIP TOP Universal, Order No. 593 0601 (3.5 kgs can) or Contifix as tire assembly compound.**

**If Contifix is used,** coat beads sparingly (to avoid tire rotation on the wheel rim) and avoid driving the car for 24 hours after tire fitting or matching if possible.

Tell your clients to avoid extreme driving behavior (acceleration, braking) during the first 60 to 120 miles with new or newly fitted tires to prevent the tire twisting on the rim under driving conditions. Mark the tires if necessary.

A maximum of 20 mm twisting of the tire on the rim must be regarded as the ultimate limit value. The best result of the wheel balancing in such cases is usually only moderate. This will have a detrimental affect on an optimally balanced wheel.



Mount the tire in a beneficial position to the rim (matching) in order to achieve optimum smooth running. The following text describes both uncontrolled matching and controlled matching with identification marking or using a wheel-balancing machine with matching program.

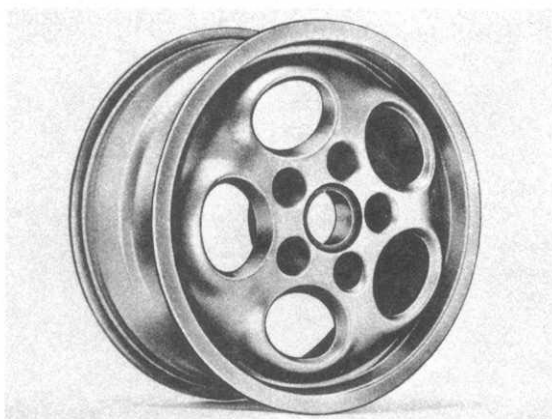
After fitting, inflate tubeless tires to approx. 4 bar (58 psi) without valve inserts, to ensure that they are correctly seated on the rims. At 3.3 bar (4.5 bar for wheels with **asymmetrical hump**), at the latest, the tire bead must jump from the well base over the hump of the bead seat to avoid breaking the bead core. Screw in the valve insert and inflate to the prescribed tire pressure.

The max. permitted radial and lateral run-out of the wheel (tire + rim) is 1.25 mm. Try to achieve values less than 1.0 mm and greater than 0.5 mm.

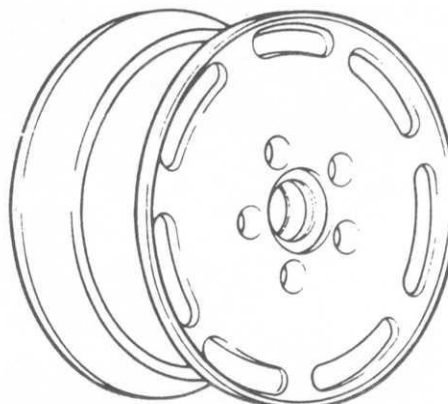
If necessary, turn the tire on the rim by 90° or 180° to obtain an acceptable value (uncontrolled matching). Controlled matching: align the highest point of the rim with the green or white dot on the side wall of the tire. The highest point of the rim must be determined beforehand. *In the case of forged disk wheels, however, this is identified by a milled recess in the rim well as well as by a red dot glued to the outer side.*

**Bear in mind that it is possible to get even better results from the point of view of smooth running in some cases using a wheel-balancing machine with matching program (true-running, imbalance and weight distribution of the balancing weights).**

*Cast light-alloy disk wheel*



*Forged light-alloy disk wheel*



*Cast light-alloy disk wheels must not be fitted to the vehicles with four-piston fixed calipers (as from Model 86).*

Club Sport version wheels (larger cutouts) have a different rim offset (see Page 44-01).

New tires should always be fitted to the front axle wherever possible (if the same wheels are fitted to rear and front axles), as

1. the rear axle is more critical with regard to stability, and
2. in wet conditions, the front wheel must first steer a course which the rear wheel can follow to a great extent. When replacing a defective tire, the difference in tread depths on one axle **must not be more than 30 %**.

If a wheel is removed from the vehicle during service operations, the wheel stud next to the valve or, in the case of 17-inch wheels (Cup Design), the wheel stud opposite the valve should first be marked with red paint. (This is to ensure that the wheel is refitted in the same position relative to the wheel hub or brake disc).

**In addition, rotate the valve so it is in the upper position or, in the case of 17-inch wheels, in the lower position, before the wheel is tightened on the wheel hub (also refer to page 44 - 13).**

This prevents the optimum balancing effect that was obtained by stationary balancing or by additional finish balancing from being lost. The lockable wheel must be fitted to the color-coded stud.

Refer to Technical Information Group 4 for further general information on tires (tire damage, tire wear, storage, *tire age* )

#### **Tire age:**

High-speed tires VR/ZR in particular, must not be too old, under no circumstances older than 6 years. The age of a tire can be determined from the manufacturer's code which follows the DOT code on the tire wall. The date of manufacture is at the end of the code number. The identification is followed by the manufacturing date. **From 1990 to 1999**, the three-digit mark is complemented by a **"triangle suffix"** (differentiation mark).

#### **Example:**

DOT DM CP 05 Y 276

27 = Production week 27

6 = Production year 1986

## Wheel balancing

### General

If the wheels are too unbalanced, this not only causes vibrations and shaking of the steering wheel but also results in higher wear on various chassis components.

*Even if wheels are balanced correctly, uneven running and steering can be caused by excessive geometry faults (radial and lateral run-out) and irregularities in tires, e.g. material accumulating in one place (when rolling under diverse suspension conditions).*

Extreme care, compliance with instructions and procedures, as well as the attempt to remedy even the last gram of imbalance is necessary to achieve a good result.

### Notes / prerequisites

- Wheel suspension elements must be technically sound.
- Wheels must be cleaned, without any foreign bodies in the tires.
- Check radial and lateral run-out on wheels without flat spots with a radial run-out measurement gauge, e.g. VAG 1435. *Try to achieve values of less than 1 mm and greater than 0.5 mm.*
- Tires must be matched to achieve minimum out-of-true characteristics or to optimize smooth running. Tips and information on this as well as tire mounting paste can be found on Page 44 - 7/8
- If disk wheels (rims) run absolutely true but there is extreme radial and lateral run-out (caused by braking flat-spots, cord breaks, other damage) replace the tire if necessary.
- *Only balance used wheels when warm as flat spots may otherwise simulate an imbalance. Never match in the case of flat spots.*
- The correct tire pressure is a crucial prerequisite
- Use self-adhesive or clamp weights according to the type of disk wheel. Use self-adhesive weights for cast light-alloy disk wheels.  
Coated clamp weight for forged light-alloy disk wheels.  
Notes on fitting the weights, see Page 44-17

### Procedure for optimizing the wheels

The complete procedure is subdivided into 4 working steps

1. Fitting the tire to the rim
2. Stationary balancing of the wheel (eliminating static and dynamic imbalance) with optimization of smooth running
3. Fitting the wheel to the vehicle
4. Electronic fine balancing (static balancing) of the wheel on the vehicle (*after stationary balancing if required - not usually necessary*)

#### *Further to 1: (Fitting the tire to the rim)*

- Clean the rim; above all, remove residual rubber and dried-on tire paste from the bead seat and the hump.
- Inspect the rim for damage, remove old balance weights.
- *Use specified tire assembly compound (refer to page 44 - 7) to keep the tire from rotating on the wheel during the first drive as this would render all the careful work useless (20 mm tire slip on the wheel may be enough to reduce good balancing results to average results only).*
- Mount the tire on the rim, aligning matching points (if available) of tire and rim. Bear in mind that it is possible to achieve an even better result in some cases from the point of smooth running and imbalance using a wheel-balancing machine with matching program (see Page 44 - 8).
- Inflate tires to approx. 4 bar; the beads should slip over the rim shoulder hump at a pressure of 3.3 bar\* at the latest.
- Check that the tire is seated correctly on the rim by means of the bead centering line.

\* 4.5 bar max. for wheels with asymmetrical hump (p. 44 - 18a).

*Further to 2: (Stationary balancing with optimization of smooth running)*

- Clamp the wheel onto a stationary balancing machine, observing the following under all circumstances:

a) Follow the operating instructions of the respective balancing machine, adjust the machine from time to time if necessary.

b) The contact surface of the wheel at the bead flange (level surface) and the middle centering device must be clean.

c) *Center from the inside outwards using a stepped ring (cylindrical ring - commercially available Porsche version, e.g. from Messrs. Schenck or Messrs. Hofmann).  
Do not center from the outside as well*

d) *Clamp the wheel onto the balancing machine as specified (valve always pointing upwards, the wheel will then drop downwards through the small amount of play necessary when centering, before tightening) and then fit to the vehicle in the same position (there may otherwise be a shift of up to 1/2 oz).*

In the case of balancing machines with horizontal wheel fixture (wheel lying), position the valve opposite the mechanic, then pull the wheel in this position in the direction of the mechanic and clamp firmly.

- Check the radial and lateral run-out during the first measurement procedure. *Try to achieve values less than 1.0 mm and greater than 0.5 mm.*

- Be critical with regard to the size of the measured balance weights and their distribution on the inner and outer rim flange.

Even distribution with low values (e.g. 3/4 / 7/8 oz) indicates that the tires are correctly fitted and that the quality of tires and rims are in good order.

Do not exceed a value of  $1 \frac{3}{4}$  /  $1 \frac{3}{4}$  oz, a widely deviating distribution, e.g.  $1 \frac{1}{2}$  /  $2 \frac{1}{2}$  oz is very unfavorable, this usually indicates a fitting fault. Problem wheels of this sort often have obvious radial and lateral run-out.

- Remedy by "matching" (use the correct fitting paste sparingly / Page 44 - 7/8)

a) Manual improvements are possible

b) Considerable improvements possible in virtually all cases with smooth-running optimization program.

- When balancing, the tire pressure should not be less than 22 psi.

- Permissible residual imbalance less than / or max. 1/10 oz per side.

Further to 3: (Fitting the wheel to the vehicle)

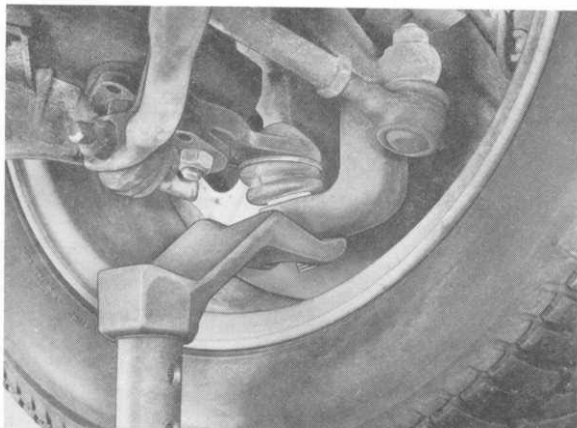
- Fasten the wheel to the wheel hub as prescribed (also see Page 44 - 9 - General assembly instructions, tires). Always fit the best wheels on the left.
- Valve must point up or, for 17-inch Cup Design wheels, down (same position as on the balancing equipment). Observe instructions on page 44 - 03.
- Bore close to valve is for wheel mounting; fit lockable wheel nut to color-coded wheel stud. On 17-inch wheels, locate the valve opposite the marked stud. Tighten nuts, start tightening equally at the top. Before lowering the vehicle onto its wheels, tighten wheels to 130 Nm (96 ftlb.) to make sure that its predefined position on the wheel hub does not change anymore.
- Tire pressure according to specification

Further to 4: (Electronic fine balancing)

- Use the RAW 04 from Messrs. Schenck ASG or ipk 2 from Messrs. Hofmann for electronic fine balancing of the wheels on the vehicle. Refer to the equipment's operating instructions for procedure.
- If all wheels are to be finely balanced, begin at the front axle.
  - 4a Fine balancing of the front wheels because of steering-wheel vibrations at approx. 120 km/h
  - 4b Fine balancing of the rear wheels because of vibrations at 180 km/h and greater 230 km/h
- **The following generally applies for front and rear axles: the measurement jacks must stand on a firm foundation, must only record at the specified points (measurement fixture situated as close to the wheel as possible), doors and hoods must be closed and the vehicle must not be touched during the measurement run. Ensure that the lifting equipment (jack, platform) has no contact with the vehicle.**
- Attach balance weights to the outside (uniform procedure / may also be distributed - or fitted to the inside).  
**Under no circumstances remove the weights fitted during stationary balancing.**  
Identify balance weights from electrical fine balancing with a center punch.

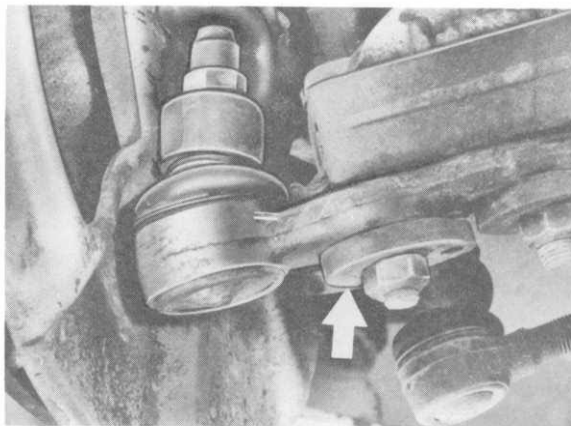
### Mounting points for fine balancing Front axle

As from Mod. 86



88/266

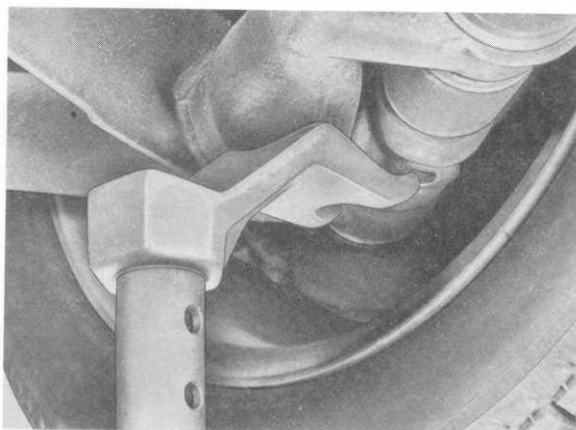
before Mod. 86  
at the outer eccentric (arrow)



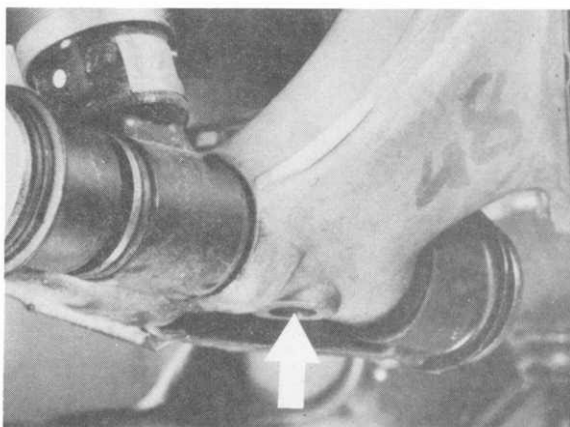
10778 A

### Rear axle

When using the Hofmann finish balancer, use the special mounting forks with spigots (Hofmann Part No. 641 4113), which fit into the recess of the wheel mount (arrow).



88/265



4858 A

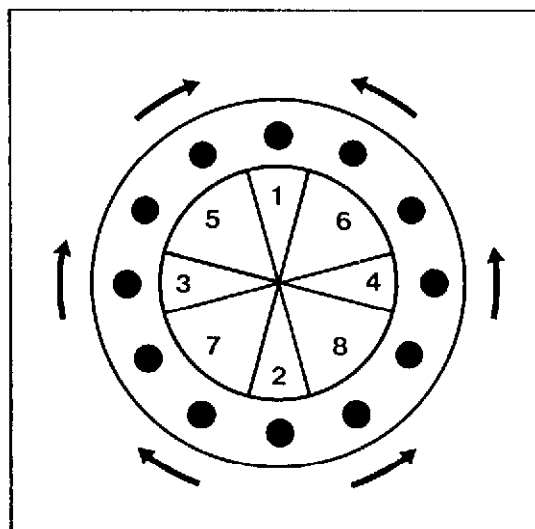
### Notes

Make sure that no parts are damaged by the mounting forks of the measuring jack. *Make sure that the vehicle cannot slide off the measuring jack before making the first measurement run.*

Further to 4 a: (Fine balancing of the front wheels)

- Position one or both measuring jacks (see mounting points).
- Set the sensitivity controller to position 5.5 for Hofmann, or 5 for Schenck. Make a measurement run.
- Fit balance weights if necessary. Then make a check run. If the result is not acceptable (assuming orderly work), calibrate the finish balancer - adapt the sensitivity controller to the actual conditions.
- If the balancing result is still not completely acceptable (e.g. 5 g) even after calibration, alter the balance weight according to the balance correction table and eliminate the residual imbalance. (Balance correction schematic on the measuring unit in the case of the Schenck RAW 04).

Balance weight in section	Modification of the balance weight
1	enlarge at the same position
2	reduce at the same position
3 or 5	place in arrow direction in case of same size
5 or 6	enlarging and place in arrow direction
7 or 8	reducing and place in arrow direction





*Further to 4 b: (Fine balancing of the rear wheels)*

- Position measuring jack *right and left* (see mounting points). *The driven axle may only be balanced if both wheels are jacked up simultaneously.*
- Set the sensitivity controller to position 3 for Schenck or 3.5 for Hofmann
- Make a measurement run at a speed of 130 km/h or 1150 - 1200 rpm (wheel rotations) with the Schenck RAW 04, in top gear or in the top driving position.  
Fit appropriate balance weights.
- Make a check run. If the balance result is not acceptable, calibrate the finish balancer - i.e. adapt the sensitivity controller to the actual conditions.
- Subsequently (with a good balance result) slowly increase the speed to 190 km/h and pay particular attention to the areas where there are obvious vibrations in the steering wheel and/or in the seat (predominantly at  $175 \pm 5$  km/h).

*Maintain this speed* and rebalance the wheels as for 130 km/h. Do not fit new weights, but make improvements by *altering those already fitted* according to the "balance correction" schematic.

*Note: The imbalance values apparent in this speed range are not "real" values. Their actual values amount to max. 1/4 - 1/3 of those indicated.*

The subjective impression in the vehicle plays an important role. The balancing procedure may only be terminated when the driver can no longer detect vibrations caused by imbalance.

### Notes for fitting the self-adhesive weights

- Determine the precise location of the balance weights (possibly by fitting balance weights provisionally with tape until the correct position has been determined).
- Prepare the sticking area on the rim. This area must be absolutely clean and free of grease.
- Pull the protective paper from the adhesive surface of the weight and press on firmly.

#### Note

Only remove the protective foil immediately before sticking on the weight as the adhesive capacity is reduced when exposed to the air and there is also the risk of contamination.

- The self-adhesive weight must be fitted carefully on the smooth ring surface of the wheel. It must fit evenly over the entire contact area.



- Check that the balance weight is fitted securely. The new fitted weight must not come away from the rim when subjected to transversal shearing stress to its longitudinal extension.

### Notes for fitting the clamp weights

- When fitting clamp weights, unseat the tire with a tire caliper after letting out the air.
- Use a tire unseating caliper for this, e.g. from Messrs. Hofmann 6409 757
- Insert the spring clamp

#### Note

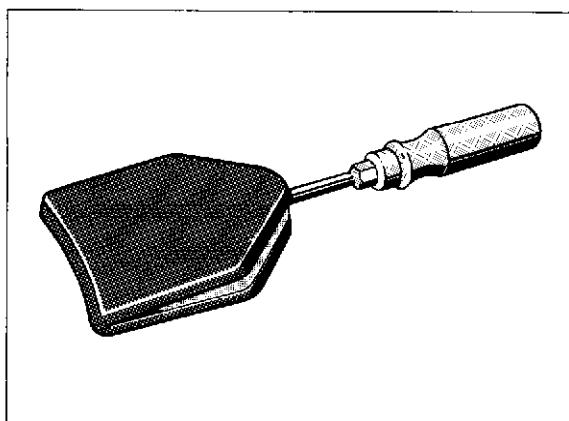
Do not knock in the spring clamps or apply fitting paste to them as this will have a detrimental effect on the correct seating of the spring clamps.

## Tire fitting

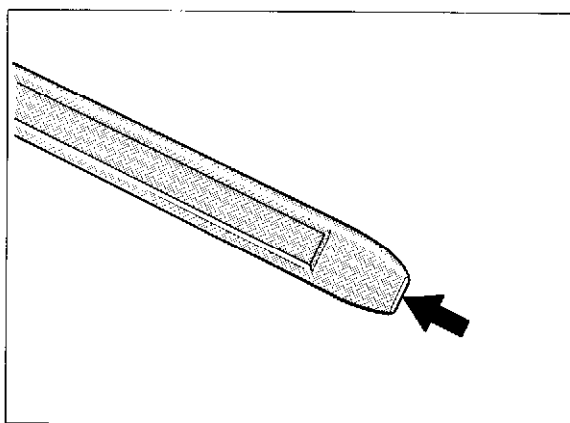
The following assembly and dismantling procedures refer to the 17-inch Cup Design wheels with asymmetric hump.

### Notes / tools

- Avoid damaging the wheel paintwork.
- To remove / fit a tire, a tie-down tool – Special Tool 9539 – is required. In addition, the tire lever should be flattened along its front face and should then be rounded (arrow).



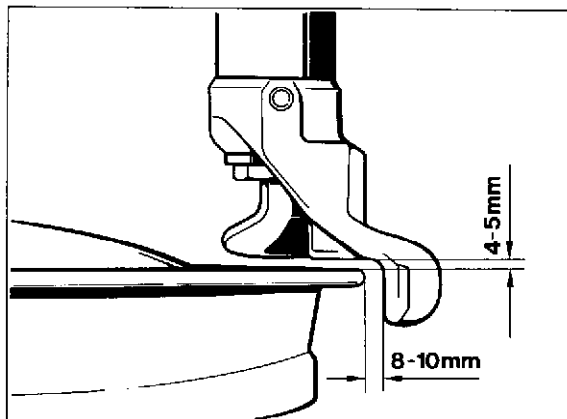
1012 - 44



1013 - 44

### Tire assembly

- Fit wheel to assembly stand and coat inside of wheel and both tire beads with tire assembly compound. Replace the valve whenever a tire is fitted or refitted.
- Set assembly tool to correct clearance.



1014 - 44

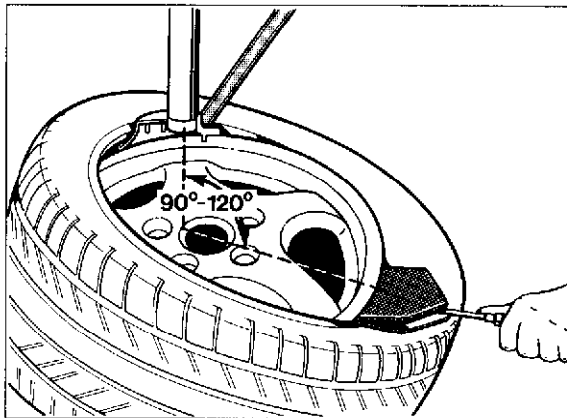
- Fit first tire bead in the usual manner.

### Note

The asymmetric hump changes its cross-section across the circumference. The following points must therefore be observed when fitting or removing a tire.

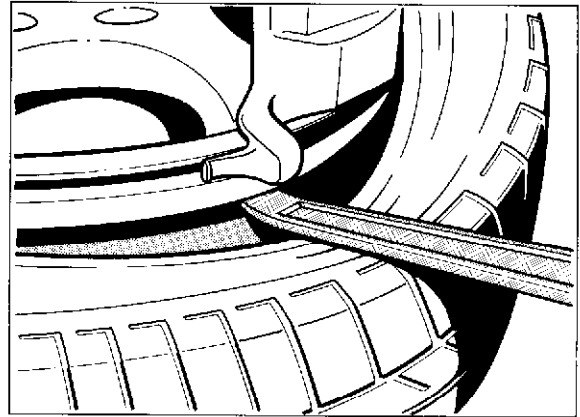
- When starting to fit the **second bead**, the assembly arm should be located **opposite the valve**. Then place the second bead as flat as possible onto the wheel, guide it across the assembly head and tie it down with Special Tool 9539, keeping it offset by approx. 90 to 120 deg.

While performing the turning motion and fitting the **second bead**, use a second tire lever and Special Tool 9539 to locate the tire bead in the drop center.



1015 - 44

- To facilitate assembly, position the additional tire lever below the hump.



1016 - 44

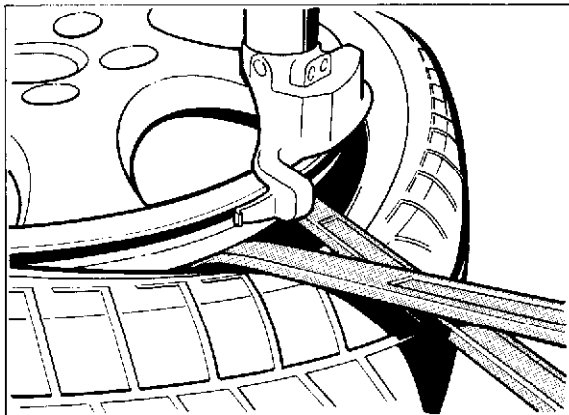
- When inflating the tire, the beads must jump over the hump at a positive pressure of 4.5 bar at the latest. The bead still located in the drop center must therefore be positioned **opposite the valve (flatter hump section)** when the tire is pumped up. If required, rotate the tire accordingly and coat with assembly compound again.

### Removing the tire

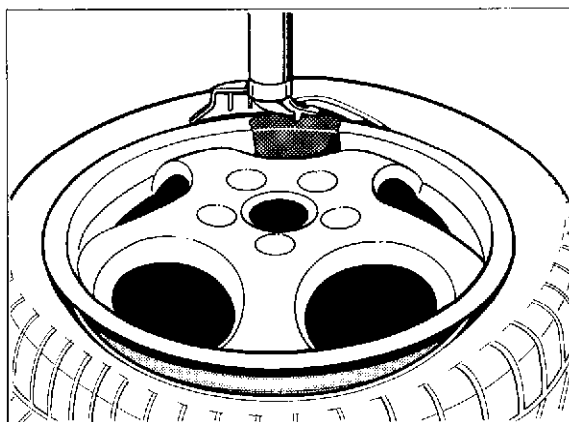
- Adjust assembly head as for tire fitting (Fig. 1014 - 44).
- When pressing off the tire, start at the valve since the levering force required in this area is somewhat lower. Then press off the tire on both sides, coating the rim flange with assembly compound.

- **Lift the first side of the tire** over the assembly head (Fig. 1017 - 44). Place a rag or a leather cloth between the wheel and the tire lever.

In addition, make sure the tire remains in the drop center opposite the disassembly head (Fig. 1018 - 44). Use Special Tool 9539 to facilitate this.



1017-44



1018-44

- **Remove the second side of the tire** in the usual manner.

## INSTALLING AND REMOVING WHEELS ON CAR

### General Information:

Aluminum wheel nuts may only be loosened and tightened with Special Tool P 300.

Aluminum wheel nuts could shear through:

- use of unsuitable tools (wheel nuts held by only about 2/3rds of total depth),
- excessive tightening torque,
- erratic loosening (impact tool) and
- missing or unsuitable lubricant.

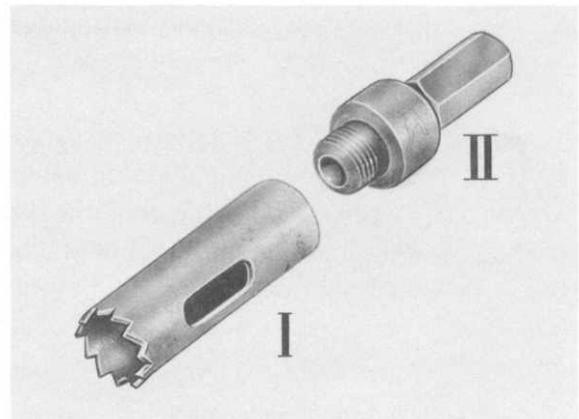
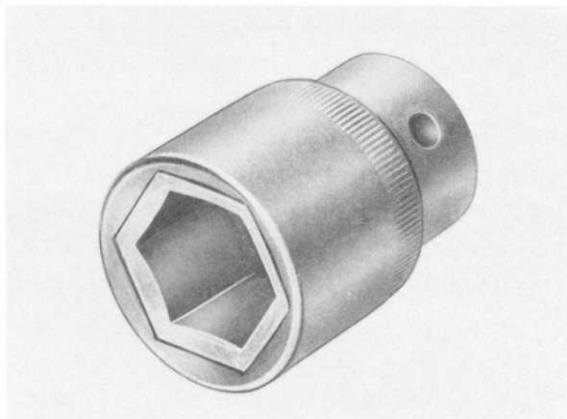
In this case the calotte would shear off of the wheel nut's hexagon exactly at the point of transition and impair removal of rim.

### Installing and Removing

1. Always use a perfect-condition Special Tool P 300.  
Other socket wrenches, wrench sockets or wheel bolt wrenches may not be used. Impact tools must never be used regardless of circumstances.

### Removal with Sheared Off Nut(s)

The rim can be taken off of the wheel hub without damage with the tools listed below. However, damaging the wheel bolt(s) cannot be avoided.



2. Lubricate threads and calotte with Optimoly TA.
3. Always tighten nuts to specified torque of 130 Nm.

- I. Compass saw, 17.5 mm diameter. This tool can be used after grinding off and smoothing inside diameter (welding seam must be eliminated).
- II. Shaft for mounting compass saw.
- III. Standard portable drill.

## Delivery and Supply Sources

Sauer-Werkzeug GmbH & Co. KG  
Humboldstr. 53

2000 Hamburg 76

Tel.: 040/223322  
2296666

Telex: 214120

### Order Numbers:

303 017 — Compass saw 17.5

303 161 — Adapter, size 1

or on commercial market

Manufacturer: The Cooper Group  
Deutschland GmbH  
7122 Besigheim

### Order Numbers:

261 110 00 — Compass saw 17.5 — H 111

264 020 00 — Adapter M 402 H

1. Grind off calotte with the mentioned tools. Work with a speed of approx. 450 rpm to guarantee good chip removal. Also bleed tool.  
The calotte will jump off of the wheel bolt after complete removal of threads from the sheared off wheel nut.

### Note:

The wheel rim might be ground slightly during this step, but this is not important.

2. Replace pertinent wheel bolt(s) on removed wheel hub.  
Use a proper size drift for removal and installation.  
Front wheel hub must be heated to 120 — 150 °C for this step.

## Tire pressure warning system - General

### General

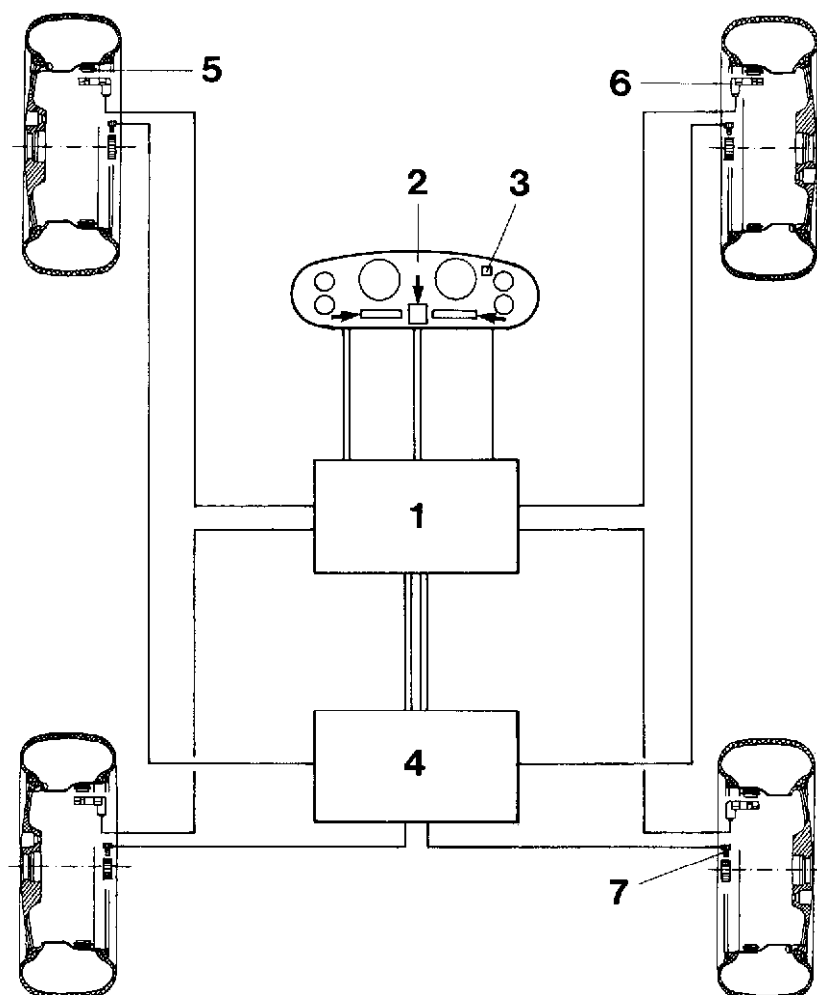
A tire pressure warning system is fitted to 928 S 4 vehicles as standard, from Mod. 1989 onwards, initially excluding USA and Canada, however. The tire pressure warning system is another development which constitutes a significant contribution towards road safety. The tire inflation pressure is monitored by the control system, which

- monitors the correct inflation pressure with a greater degree of accuracy and reliability than any pressure tester in the on-board tool set, at the garage or in the workshop
- automatically allows for temperature's influence on the air pressure (temperature-compensated threshold value system)
- Ensures perfect driving behavior and low fuel consumption as a result of correct inflation pressure
- Helps to prevent initial tire damage and increased tread wear as a result of inadequate inflation pressure.

The tire pressure warning system detects inadequate inflation pressure in one or several wheels, and displays this on the instrument cluster after at least 20 m distance at a speed of more than 5 km/h.



## Tire pressure warning system - diagrammatic view



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1- Control unit

4 - ABS control unit

2 - Instrument cluster

5 - 2 pressure-operated switches per wheel  
(offset by 180°)

Arrow = Display boxes for the information  
system (fault display - tire pressure warning  
system)

6 - 1 HF sensor per wheel (high frequency  
sensor)

3 - Warning lamps

7 - ABS speed sensor

## Tire pressure warning system

### Description

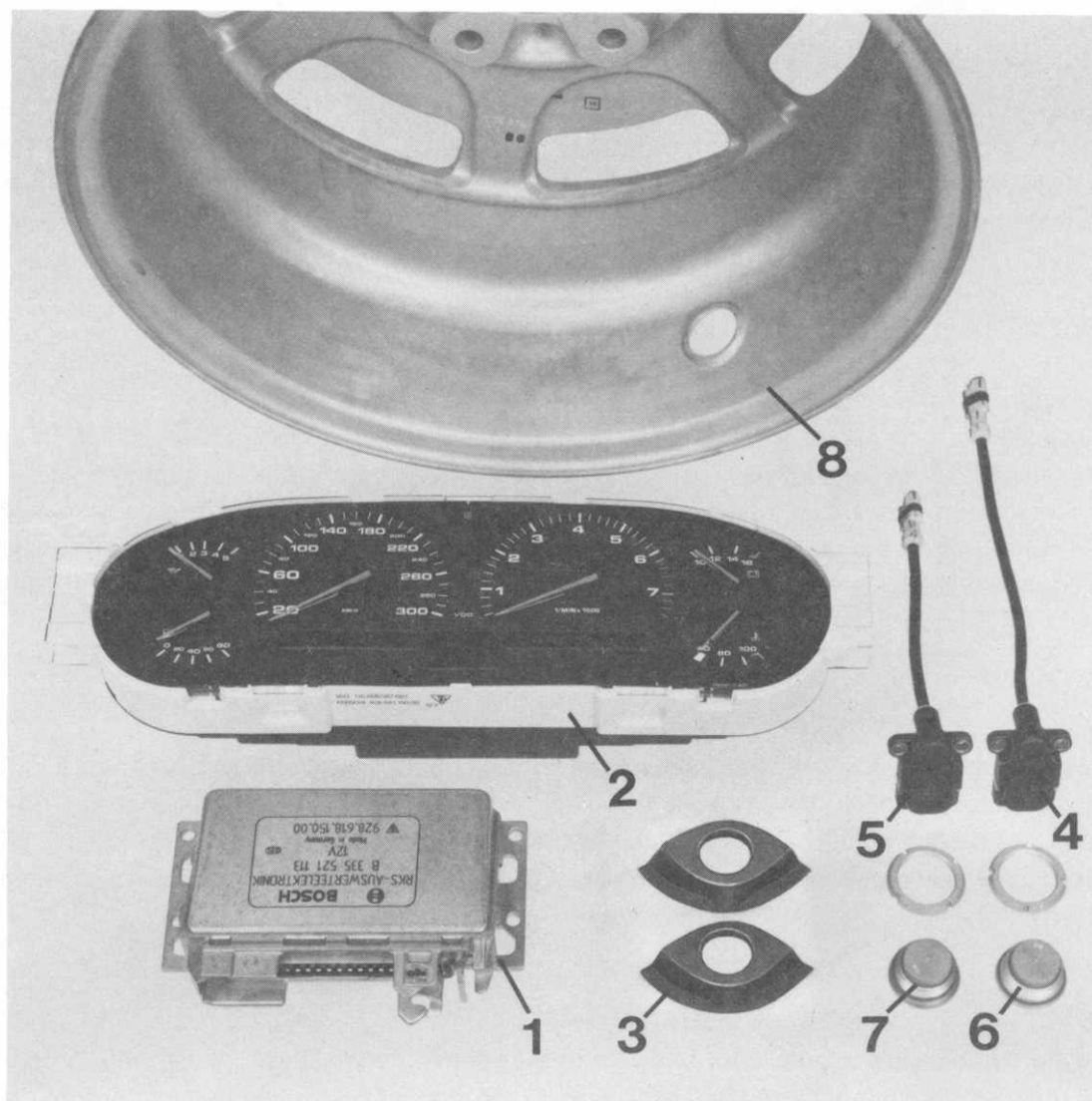
Two pressure-sensitive switches are allocated to each wheel, fitted to the rim well, 180° apart. The pressure-sensitive switches are subjected to the tire inflation pressure and act as switches for a resonant electric circuit, integrated into the pressure-sensitive switch. The resonant circuit remains closed as long as the tire inflation pressure remains above a specific setpoint value for the switch. If the inflation pressure drops below the setpoint value, the pressure-operated switch opens the resonant circuit.

A high-frequency sensor (HF sensor) is fitted to the wheel mount or steering knuckle of each wheel. The HF sensors are connected to the control unit of the tire pressure warning system. Each HF sensor generates an electromagnetic field on the sensor side which is directed towards the diaphragm-type pressure-operated switches. If the wheel turns, the pressure-operated switches are led past the HF sensor. At the same time, the resonant circuit of the pressure-operated switch enters the effective range of the HF sensor's electromagnetic field. An inductive coupling is produced between HF sensor and pressure-operated switch.

If the inflation pressure is correct (resonant circuit closed) current flows in the resonant circuit of the pressure-operated switch, as the resonant circuit acts like a consumer, thanks to the circuit design. This additional current requirement is detected by the tire pressure warning system control unit and processed into voltage pulses. These voltage pulses are compared with the wheel speed pulses from the ABS control unit.

If there are two HF sensor pulses for one turn of the wheel, the tire pressure warning system control unit detects adequate inflation pressure. If there are less than two pulses per turn, the control unit detects a fault which is indicated by a corresponding warning on the instrument cluster.

## Tire pressure warning system components



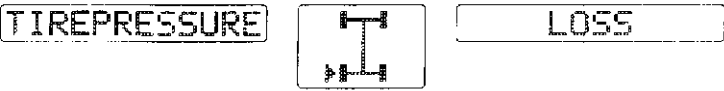
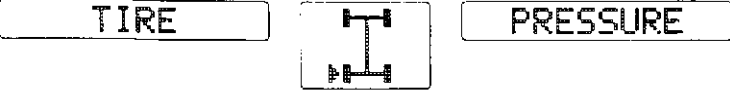
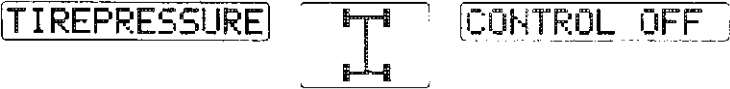
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- |  |  |
|--|--|
| 1 - Control unit (Position see page 44 - 33) | 6 - Pressure-operated switch<br>2.5 bar, front |
| 2 - Instrument cluster                       | 7 - Pressure-operated switch<br>3.0 bar, rear  |
| 3 - Deflector for pressure-operated switch   | 8 - Wheel                                      |
| 4 - High-frequency sensor - front            |  |
| 5 - High-frequency sensor - rear             |  |

## RDK - possible fault displays and their causes

### Possible RDK fault displays

Tire pressure at each wheel is monitored by two pressure sensing switches installed in the wheel. If the tire pressure drops below the nominal value to which the pressure sensing switch is set, or if a system fault develops, a warning appears on the instrument panel: the warning light at the top right comes on and the corresponding fault display is shown in the display panels.

Possible fault display	color
A 	red
B 	orange
C 	red

When the ignition is turned on, the warning light comes on as a bulb test. It goes out when the engine is started. Tire pressure monitoring starts after the car has been driven for approx. 20 m and when a minimum speed of 5 km/h has been reached.

Display A: Arrow indicates wheel with low tire pressure (cause in wheel area).

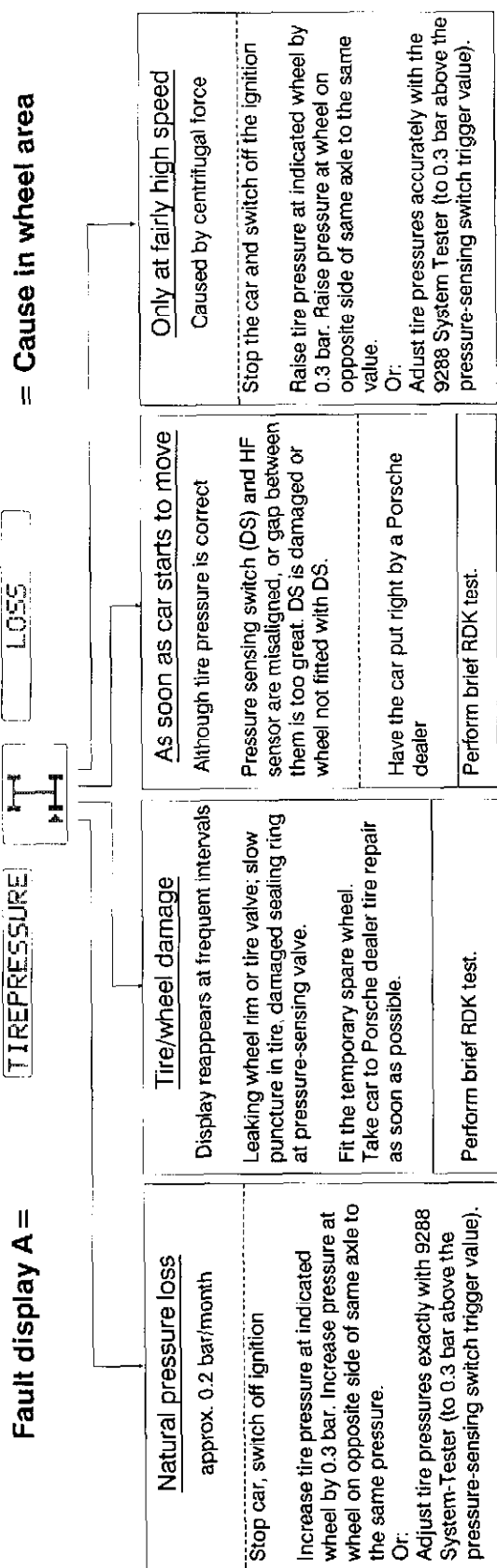
Display B: Appears for approx. 2 minutes after switching off the ignition as a reminder.

Display C: RDK system fault has occurred. Tire pressures are no longer being monitored (cause in system).

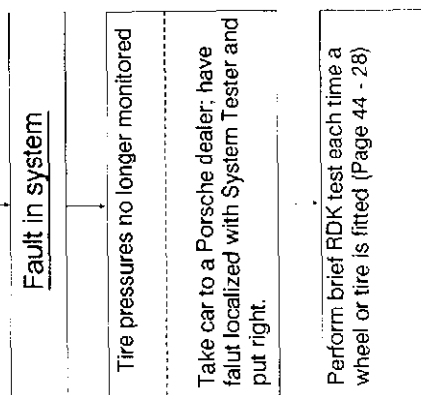
If a system fault has occurred, the cause is stored in the fault memory of the RDK control unit and can be called up by means of the diagnostic facility (from Page 44 - 301).

The fault display (RDK system fault and pressure warning) can be acknowledged with the in-car computer control lever, after which the text display will disappear. However, displays re-appear periodically until the fault is eliminated.

# RDK - Possible causes if a fault is indicated



**Fault display C =**   **= Cause in RDK system**



## Tire pressures on cars with RDK

### Important notes

The tire pressure control system takes the effect of tire temperature on tire pressure into account. Despite this, it is possible for the tire not to reach the nominal pressure only in a particular vehicle operating situation.

In other words, a pressure loss display may not necessarily appear immediately the car is driven away. It may also fail to appear after switching the ignition off and on and driving the car away a second time. This merely indicates that the same vehicle operating conditions do not apply on this occasion. Nevertheless, the driver should be aware that tire pressure remains too low for a certain combination of temperature and road speed, in other words for a given driving situation.

**When low pressure has been indicated even once, it should be corrected as soon as possible in the interests of safety.**

**If tire pressures are too low, the car's road behavior is adversely affected. In addition, wheels and tires may suffer damage.**

If the information system indicates a loss of pressure several times in rapid succession, or if the pressure is indicated as well below the nominal value, this suggests that tire damage has occurred or that the tire valve or the wheel rim are damaged (see Page 44 - 26).

Very slight tire pressure loss occurs all the time, since a small amount of air escapes through the tire rubber (this process is known as diffusion).

To avoid damaging the pressure sensing switches, never inflate tires to a pressure of more than 6 bar when fitting them.

### Checking and correcting tire pressures

When tire pressures are corrected, a distinction has to be made between the conventional method (method A) and the more accurate method in conjunction with the 9288 system tester (method B).

**Do not check tire pressure by the conventional method (method A) unless pressure loss has been indicated on the instrument panel.**

By using the 9288 system tester, however, tire pressure can be checked and accurately adjusted at any time (method B). This is practicable during wheel and tire fitting work or when the car is brought into the workshop for any other reason.

Tire pressure should be checked and corrected if necessary when the "Pressure Loss" fault display appears.

## A: Conventional adjustment of tire pressure

If the "Pressure Loss" fault display appears, tire pressure at the affected wheel must be increased by 0.3 bar or at least to the specified pressure at that wheel. Since diffusion losses are approximately the same at the two wheels on any one axle, the tire pressure at the other wheel should therefore be increased by the same amount. But do not reduce the tire pressure if too high a value is measured.

**The specified tire pressures at 20°C are: front 2.5 bar, rear 3.0 bar (2.5 bar for 17" summer tires)**

Note also in this connection that a small amount of air escapes when the pressure gauge is removed from the tire valve. Since the RDK system responds to even slight losses of pressure, this should be taken carefully into account.

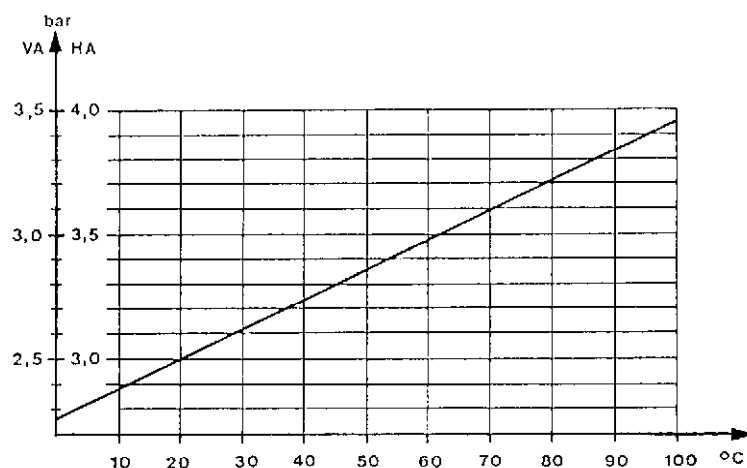
Stop the engine while correcting tire pressures, so that the control system can register the new pressure settings.

After the car has been driven for a short distance (at least 20 meters) and has reached a speed above 5 kph, the RDK system will have registered the new tire pressures. If the low pressure warning persists, increase tire pressure further at the affected axle.

Repeat this procedure until no further warning is displayed.

However, do not exceed maximum tire pressures of 3.5 bar at the front wheels and 4.0 bar at the rear wheels (3.5 bar for 17" summer tires), since these pressures correspond to tire temperatures which will never be reached in normal driving conditions. Normal conditions basically assume that tire pressures are correct. **If a loss of pressure is still shown when 3.5 or 4.0 bar respectively have been reached, the pressure sensing switch must be faulty, a wheel without a pressure sensing switch has been fitted to the car or the pressure sensing switch has become displaced to one side of the HF sensor (see also Page 44 - 26).**

To measure and adjust the tire pressure to precisely the correct value (see chart), tire temperature must therefore be known or else the tire pressure must be adjusted accurately with the 9288 system tester. For each 10°C increase in the temperature of the air in the tire, its pressure rises by approx. 0.1 bar. In other words, the correct pressure at any given moment is always higher than the nominal tire pressure once the tire has become hot, and for this reason should never be reduced.



## B: Accurate adjustment of tire pressures with the 9288 system tester

In view of tire pressure gauges' display tolerances and the difficulty of measuring the temperature of the air in the tire accurately, cars with what appear to be correctly adjusted tire pressures are very often only just above the switching threshold of the diaphragm-pattern pressure sensing switches. When a slight centrifugal force acts on the diaphragm at high speed, an entirely **justifiable tire pressure warning is displayed**.

To avoid this problem, tire pressures in the workshop should always be adjusted as follows with the Porsche 9288 system tester, and not with a conventional tire pressure gauge:

1. Connect the Porsche 9288 system tester and select the RDK control unit.
2. Call up the "Switch Inputs" menu with the "Pressure Switch" display.

Pressure Switch	
FL: closed	FR: open
RL: open	RR: closed
Continue:	N

3. By pushing the car or, if it is on a hoist, by turning one wheel (for instance a rear wheel), position one of the pressure sensing switches precisely opposite its high-frequency transmitter. This adjustment can be carried out with the aid of the tester: at the correct wheel position the display for the RL or RR pressure sensing switch changes from "**Open**" nach "**Closed**" (assuming that the tire pressure is correct; in case of doubt, slightly increase the tire pressure temporarily).

Next, reduce the tire pressure until the display changes from "**Closed**" to "**Open**" (switching point of pressure-sensing switch).

Now increase tire pressure again slowly until the switching point is just reached (display changes from "**Open**" to "**Closed**"). Take an accurate reading of the pressure then shown on the gauge, and add 0.3 bar to it. Adjust the tire pressure at the other wheel on the same axle to the same value.

**If the wheels register different temperatures, for example because of exposure to the sun on one side of the car only, the switching point must be determined for all wheels and the tire pressure adjusted as already described.**

4. Adjust front wheel tire pressures in the same manner as described in Item 3.

This method of adjustment ensures that tire pressures are 0.3 bar higher than the switching point of the pressure sensing switches, regardless of tire temperature and measuring equipment tolerances. Unless there are air leaks at the tire or the wheel rim, it also ensures that no tire pressure warnings will occur for a lengthy period.



## Quick test of RDK

Whenever a wheel or tire is changed, it is essential to perform a quick test of the tire pressure control system.

If only one wheel was removed, the quick RDK test need only be performed at this wheel.

A short test drive for a distance of at least 20 meters, at a road speed of between 5 and 40 kph and at the following tire pressures is sufficient:

1. Tire pressure 0.5 bar below nominal value:\*      front 2.0 bar  
   rear 2.5 bar (2.0 bar for 17" summer tires)

The relevant arrow(s) must flash on the instrument cluster display panel.

If an arrow is continuously illuminated instead of flashing, one pressure sensing switch for the wheel concerned is faulty and must be replaced. (Check pressure sensing switch by using the 9288 system tester, see Page 44 - 311).

Do not drive the car at more than 50 kph. Above this speed, the display always begins to flash.

2. Tire pressure 0.5 bar above nominal value:\*      front:    3.0 bar  
   rear:    3.5 bar (3.0 bar for 17" summer tires)

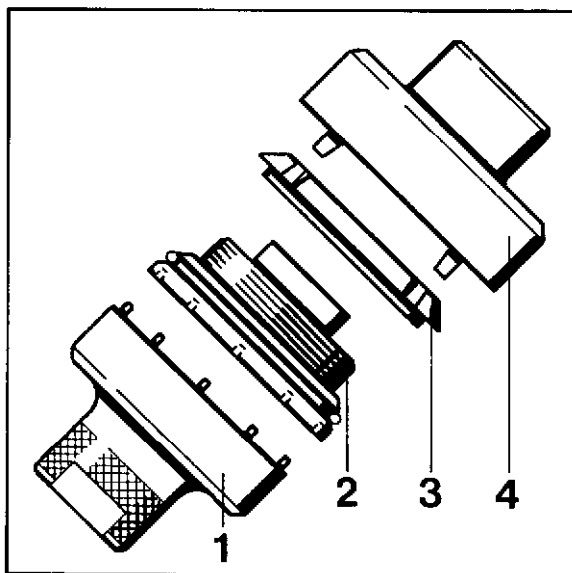
No fault display should occur. If it does, this indicates a system fault or a faulty pressure sensing switch (diagnosis from Page 44 - 301 on).

3. After the quick test, restore tire pressures to the nominal value\*, or preferably 0.3 bar above the pressure sensing switches' switching points (Page 44-27).

\* Nominal tire pressures: front 2.5 bar / rear 3.0 bar (17" summer tires = 2.5 bar) at 20° C tire air temperature

## Removing and installing pressure-operated switches (tire pressure warning system)

### Special tools



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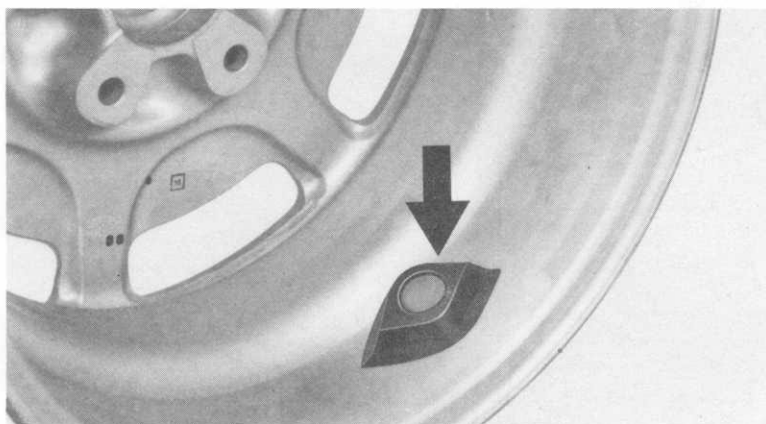
No.	Designation	Special tool	Order number	Remarks
1	Pin socket wrench	9273	000 721 927 30	
4	Mounting wrench	9274	000 721 927 40	

## Removing and installing pressure-operated switch (tire pressure warning system)

### Important note/preparation

The tire must be removed from the rim before removing or installing a pressure-operated switch. The following points must be observed under all circumstances when dismounting or mounting the tire:

- Clean dirty wheels before removing the tire. Mark the position of the tire on the rim for reassembly.
- Apply the forcing blade of the tire mounting unit at the central point between both pressure-operated switches. The deflector (arrow) must remain fitted while removing and fitting the tire to protect the pressure-operated switch.



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- The diaphragm of the pressure-operated switch must not come into contact with grease, tire assembly paste or similar under any circumstances.
- Always replace the fastening nuts and torroidal sealing rings for the pressure-operated switches.
- The tire inflation pressure must not exceed 6 bar in order to prevent damage to the pressure-operated switch.

## Removing and installing pressure-operated switches

### tire pressure warning system)

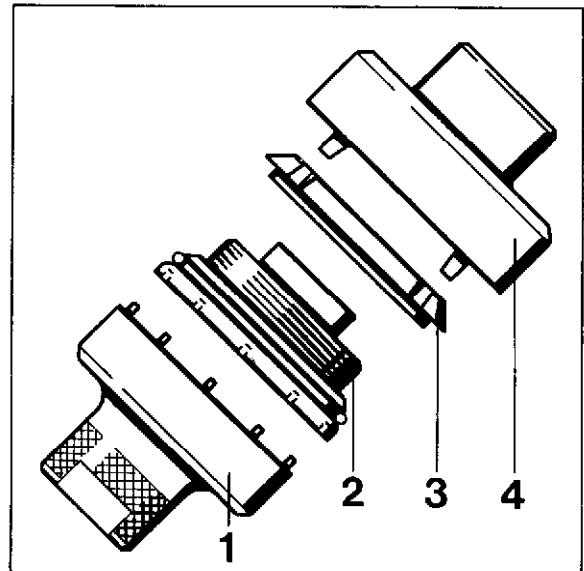
1. Turn the rim and clamp onto mounting unit.  
Remove the deflector from the pressure-operated switch.
2. Remove pressure-operated switch with Special Tool 9274/9273. Hold the pressure-operated switch with Special Tool 9273 while undoing fastening nut.
3. Fit the correct pressure-operated switch (marked with specified pressure (2.5 - or 3.0 bar) as follows:

Apply pressure-operated switch with new seal. Apply a film of Vaseline to the seal before fitting. Center pressure-operated switch and tighten new fasten nut by hand.

Call on the services of a second mechanic to counter the pressure-operated switch while you tighten the fastening nut. Tightening torque for the fastening nut 20 Nm (15 ftlb.)

### Note

*The pressure-operated switch must not turn while tightening the fastening nut. (Damage to the seal/leak).*



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- 1 Tool to counter (9273)
- 2 Pressure-operated switch with seal. Specified pressure  
front 2.5 bar / rear 3.0 bar or 2.5 bar  
(P. 44 - 01)
- 3 Fastening nut
- 4 Tool to tighten (9274)

4. Remove protective foil from the diaphragm side if necessary. Press deflector onto the fastening nut and adjust. Check for secure fitting.

5. Mount tire (max. 6 bar tire pressure) and balance wheel.

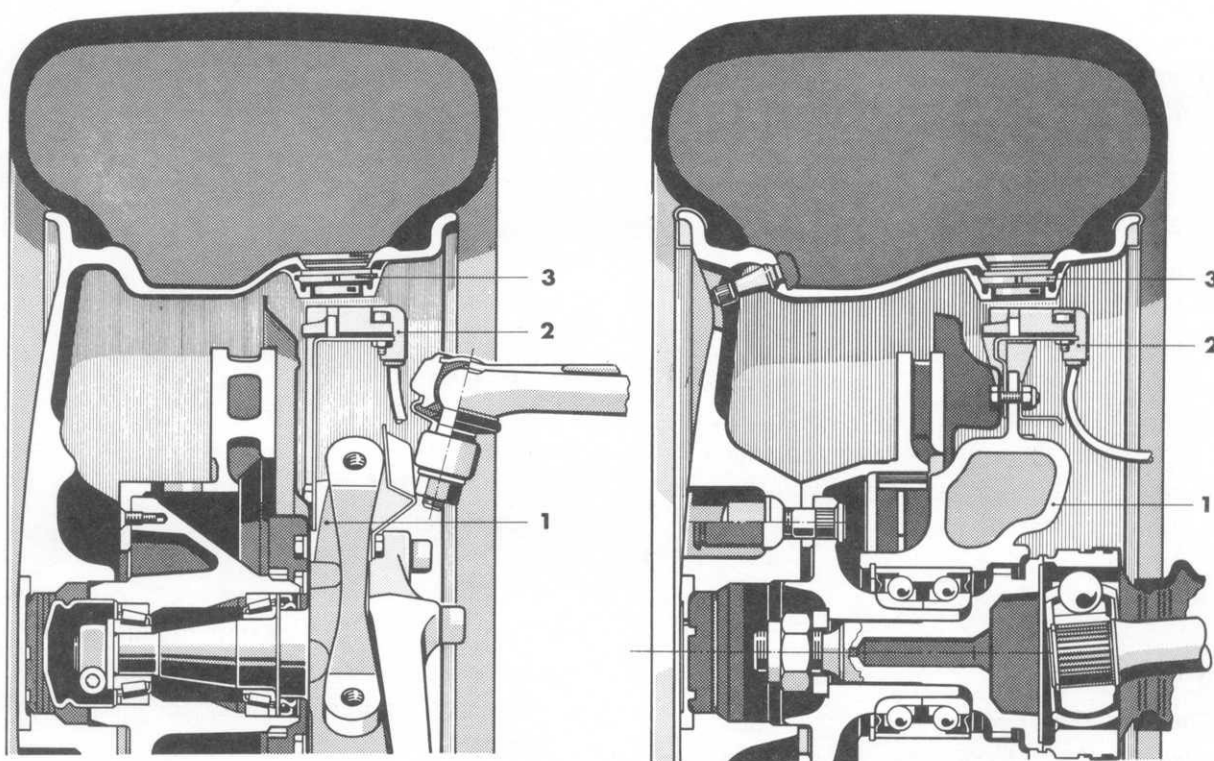
6. Mount wheel onto hub and carry out short test for tire pressure warning system (page 44 - 28)

## Removing and installing high-frequency sensor (tire pressure warning system)

### Notes

The front and rear high-frequency sensors (HF sensors) (2) have different cable lengths. The rear sensors have shorter cables.

The distance between HF sensor (2) and the pressure-operated switch (3) is approx.  $6 \pm 2$  mm. This distance is maintained as long as the HF sensor holder is not out of shape.



1. Remove the HF sensor fastening screws from the holder.
2. Slide the HF sensor (2) out of the holder.
3. Undo and separate the HF sensor connectors at steering knuckle or wheel mount (1).
4. Carry out HF sensor test after installation (tire pressure warning system diagnosis, menu 2, refer to Page 44-310)

## Removing and installing RDK control unit

### Notes

The RDK control unit is in the footwell on the driver's side, above the base of the storage compartment. On right-hand drive cars, the RDK control unit is attached to the right side panel in the driver's footwell.

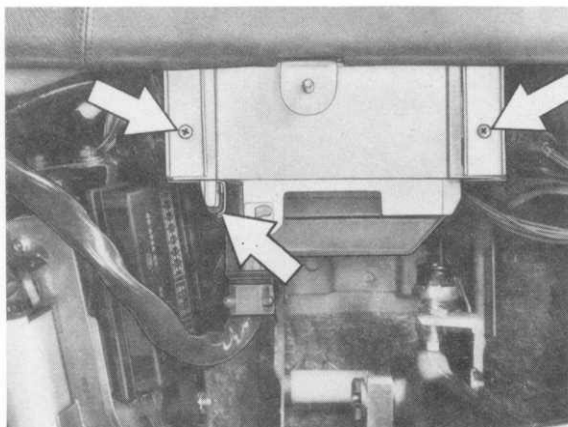
When the RDK control unit is removed or installed, the ignition must be switched off.

Remove the storage compartment (4 retaining nuts).

From software status R 02 on, the RDK control unit has an event memory for tire pressure losses. This was introduced during the 1991 model year / amended part number index for control unit. Any tire pressure losses on the last 8 occasions that the car was driven can be read out with the 9288 system tester (Page 44 - 302).

### Removing

Unscrew and remove the screws holding the RDK control unit. Remove control unit with plug from holder, release the plug by applying pressure to the retaining clip and pull it off the control unit.



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### Installing

Proceed in the opposite order of work.

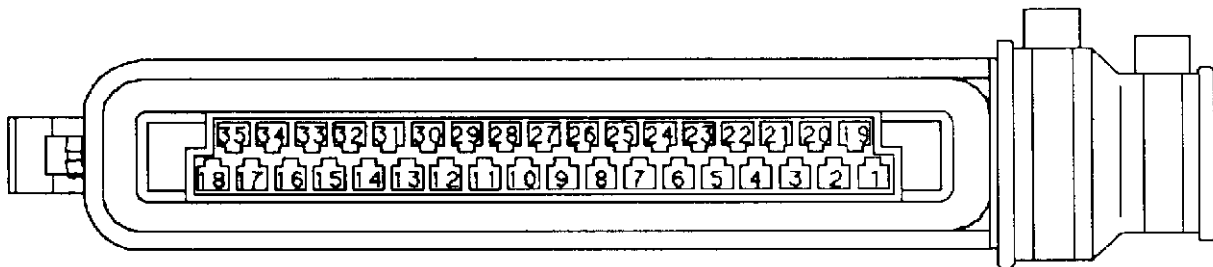
Make sure that the plug locates correctly in the control unit. After installing, perform the quick RDK test (page 44 - 28).

After this, read out the fault memory with the 9228 system tester (menu 1). Erase any faults stored in the memory.

### Note

When attaching the control unit, first push it into the clips at the rear. Make sure that no wiring is trapped between the control unit and the holder.

## Connections at RDK control unit plug

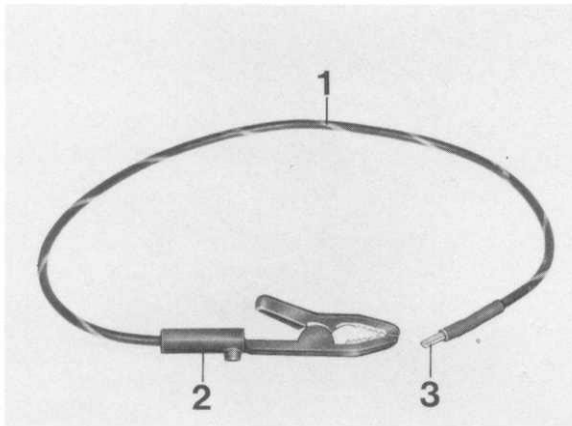


- |  |                               |
|--|-------------------------------|
| 1 Data line to instrument cluster<br>Plug 2 PIN 10 | 20 Data line to diagnosis (K) |
| 2 Data line to instrument cluster<br>Plug 2 PIN 11 | 21 not in use                 |
| 3 RDK warning light                                | 22 to alternator, terminal 61 |
| 4 not in use                                       | 23 not in use                 |
| 5 not in use                                       | 24 not in use                 |
| 6 not in use                                       | 25 not in use                 |
| 7 not in use                                       | 26 Speed sensor, RL           |
| 8 Speed sensor HR                                  | 27 not in use                 |
| 9 not in use                                       | 28 Speed sensor, FR           |
| 10 not in use                                      | 29 Speed sensor, FL           |
| 11 not in use                                      | 30 not in use                 |
| 12 not in use                                      | 31 not in use                 |
| 13 Ground  | 32 not in use                 |
| 14 not in use                                      | 33 Power supply, terminal 15  |
| 15 not in use                                      | 34 HF transmitter, FL         |
| 16 not in use                                      | 35 HF transmitter, RR         |
| 17 HF transmitter, FR                              |                               |
| 18 HF transmitter, RL                              |                               |
| 19 Data line to diagnosis (L)                      |                               |

## Notes on trouble-shooting - Tire pressure warning system

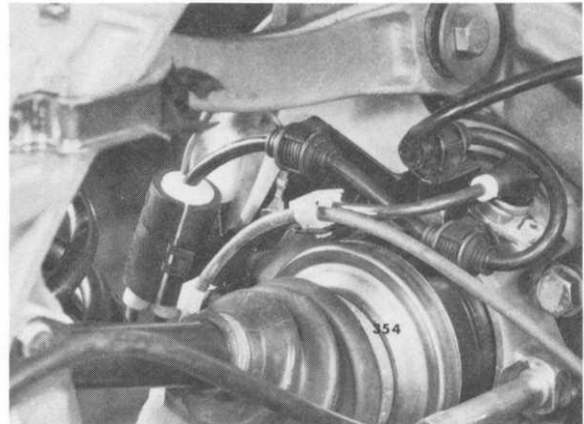
### Aids

Use 1 or 2 auxiliary cables (own construction) for measurements on the control unit connectors and plug connections with the same contacts (flat contacts). This will prevent the contacts becoming deformed.



- 1 - Highly flexible line
- 2 - Crocodile clips (standard)
- 3 - Flat connector 2.8 (N 17.457.2)

### Combined plug connections - distinguishing line features



There are several combined plug connections of the same type in the lines for brake-pad wear, speed sensors and HF sensors. The lines in this area can be distinguished from one another as follows:

- Sheathed lines for HF sensors and speed sensors. For brake-pad wear: 2 lines protected by tubing.
- The HF sensor connectors have 1 pin and 1 socket. The connectors for the speed sensors have 2 pins with 2 sockets on the other side.
- There are 2 combined connectors on top of one another in the area of the spare wheel. The lines here are marked with RL - rear left and HR - rear right.



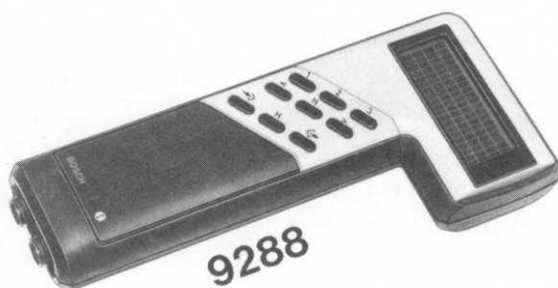
### **Important notes when working on vehicles with the tire pressure warning system**

- Always carry out a tire pressure warning system short test on the respective wheel every time a wheel or tire is changed.
- After the wheels have been finally balanced or after running on the test bench, erase the fault memory in the tire pressure warning system control unit.
- If Club-sport vehicles are fitted with winter tires, remove the spacer on the rear axle if necessary. This is only necessary if the vehicle is fitted with permitted rims having a different offset. If the spacers are not removed, the pressure-operated switch will be offset in relation to the HF sensor which will activate the pressure loss display on the instrument cluster.
- Rims without pressure-operated switches must not be fitted to vehicles with the tire pressure warning system.

## Tire pressure warning system (RDK) diagnosis

### General

- The system tester 9288 will be used for PORSCHE DIAGNOSIS from Mod. 89 onwards. PORSCHE DIAGNOSIS can be used for all systems capable of self diagnosis. Capable of self diagnosis means: the control unit can detect, store and output system errors.
- Read out tire pressure loss event memory (from control unit version R02 on (introducing during 1991 model year).
- As the number of systems capable of self diagnosis will be increasing in the foreseeable future, diagnosis of the relevant system will be filed at the end of the respective repair group as of now. The pages in repair group 03 continue to be applicable. Apart from the diagnosis procedure filed there to date (flashing code diagnosis with tester 9268) this will also contain a description of how to operate system tester 9288 (OFF-board diagnosis with plain text output).
- Tire pressure warning system diagnosis is *not* possible using tester 9268 (flashing code diagnosis).



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### Areas of application for the 9288 system tester on the RDK tire pressure control system

- Reading out the fault memory
- Reading out the tire pressure loss event memory, from control unit version R 02 on (introduced during 1991 model year)
- Checking the correct functioning of various components with the tester
- Switch inputs can be checked



88/323

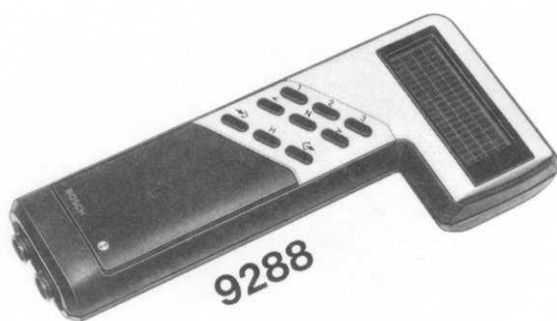
### Connecting the 9288 system tester, testing procedure

#### Notes

- RDK diagnosis with the 9288 system tester must be carried out with the ignition switched on and the car standing still.
1. Connect the 9288 tester to the diagnosis socket under the booster cover next to the passenger's seat, using connecting lead 9288/1 (adapter lead).



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2. Switch on the ignition and the tester. The tester can be switched on by pressing any button. For 9288 tester operating instructions, refer to Repair Group 03.

**Important:** Never select any speed range at the automatic transmission while testing, because engine speed may be raised by the tester when the engine is running.

## 3. Select vehicle type and system (RDK).

**Note:**

If the display shows:

- No Data Exchange Possible  
Restart: >  
Terminate: N
- the > (Restart) button should be pressed.

If the RDK is not mentioned in the "Installed Systems" display, the reason may be one of the following:

- Power supply to control unit interrupted
- No ground connection
- Leads K or L from diagnosis are not intact
- Control unit is faulty

## 4. Selection from menu

**Possible RDK menus / Explanation**

- |   |
|---|
| 1 = <u>Fault memory</u><br>Read out fault memory /<br>eliminate fault<br>Erase fault memory |
| 2 = <u>Sensors</u><br>Check HF sensor / speed sensor  |
| 3 = <u>Switch inputs</u><br>Pressure sensing switch test                                    |

- |   |
|---|
| 1* = <u>Events</u><br>Read out tire pressure loss<br>event memory |
|---|

5. Notes on desired menu

Menu 1 = **Fault memory:**

From Page 44 - 305 on

Menu 2 = **Sensors**

Checking HF sensor and speed sensor:  
Page 44 - 310

Menu 3 = **Switch inputs:**

Pressure switch test Page 44 - 311

Menu 1\* = **Events**

Read out event memory for any tire pressure losses during the past 8 journeys from  
Page 44 - 312 on.

- \* Additional RDK menu from control unit version R 02 on (introduced during 1991 model year). This menu should normally have the serial number 4. However, since the tester only has selection buttons marked 1, 2 and 3, the menu at the top of the display, in this case the Events menu, starts again with the number 1.  
To change from the one to the other Menu 1 display (either Events or Fault Memory), use the > or < keys (page forward, page backward).

### Important notes on the diagnosis and assessment of RDK faults

- When the RDK control unit plug is disconnected, the display panel shows "RDK SHUT DOWN" after the engine has been started. This display is supplied from the instrument panel.
- If a wheel without a pressure sensing switch is fitted to the car, "TIRE PRESSURE LOSS" appears on the display panel after a short time, and the affected wheel is indicated by an arrow.
- The system fault display takes precedence over the pressure loss display (in the event of pressure loss and an RDK fault, the RDK system is shut down).
- **If tire pressure loss is indicated continuously**, inspect the tire for external damage or penetration by foreign bodies, and check the wheel for leaks. Perform the quick RDK test (Page 44-28), in order to determine whether a pressure sensing switch is faulty. If necessary, localize the faulty pressure sensing switch (there are 2 pressure sensing switches for each wheel) with the 9288 system tester, menu 3 = Switch Inputs (pressure sensing switch test).  
1991 model cars (with RDK control unit software status from 02 on) have an event memory integrated into the RDK control unit. This enables conclusions to be reached concerning possible leaks at one or more wheels.  
The event memory stores data from the last 8 times the car was driven. The event memory is read out with the 9288 system tester; there is no provision for erasing it (Page 44 - 312).
- Not all system faults are identified by the RDK control unit as faults (in this connection, refer to Page 44 - 305).

## Menu 1 = Fault memory Reading out fault memory / eliminating faults

### Important notes

- Faults which were not present during the last journey and the test conditions applying them can-not be measured (with one exception). The relevant fault path should therefore be inspected visually, **since with this type of fault** the cause is either poor electrical contact, contact resistance or corrosion at the plug connections.  
**Exception:**  
"HF sensor signal not plausible" (fault code 1-4). This fault is always output by the system tester as "Not Present". However, it is possible that the fault is present and can be measured by way of the sensor test (menu 2).
- A displayed fault, for example "HF sensor ground short", refers not only to the HF sensor but to the complete circuit path as far as the control unit input.
- After eliminating the fault, erase the fault memory. After a short test drive (approx. 500 meters), read out the fault memory again.
- The fault code for the fault output is displayed as additional information if button 1 is pressed. In addition, from control unit software status R 02 on (introduced during 1991 model year), the road speed when the fault first occurred is memorized.
- **If the 9288 system tester is connected, make quite sure that no speed range is selected at the automatic transmission, since when the engine is running the tester could increase its running speed.**
- Not all system faults are identified by the RDK control unit as faults. This applies to the RDK control unit itself. If the fault display "RDK SHUT DOWN" appears and no fault is stored in the control unit, the following points must be checked or confirmed before the RDK control unit is replaced:
  - a. Is the control unit plug attached correctly and are the connection contacts between the plug and the control unit in good condition?
  - b. When the ignition is switched on, a voltage higher than 9 Volt must be present at PIN 13 (ground) and PIN 33 of the disconnected control unit plug (refer to Page 44 - 34).
  - c. There must be no break in the data line from RDK control unit PIN 2 to instrument cluster plug 2, PIN 11.
- The following display may appear as a fault output although no fault is present:  
Data line - interruption - not present (fault code 18).

(Menu 1 = fault memory)

Fault/Fault code	Possible causes Remedy/Remarks
<b>HF sender rear left</b> Fault code - 1 -	<ul style="list-style-type: none"> <li>- <b>Short to ground</b> <ul style="list-style-type: none"> <li>- may also be checked via menu 2 = sensors. In this case, <b>HF sensor defective</b> appears regardless of the wheel position if there is a ground fault.</li> <li>- Disconnect the control unit plug and measure from PIN 18 to ground (<math>\approx 5 \text{ kOhm}</math> would be displayed if there is no ground fault). Check the entire line path between control unit plug and HF sensor according to the circuit diagram.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>- <b>Open circuit</b></li> </ul>	<ul style="list-style-type: none"> <li>- may also be checked via menu 2 = sensors. In this case, <b>HF sensor defective</b> appears regardless of wheel position if there is discontinuity.</li> <li>- Open HF sensor connector on the wheel carrier. Check cable path for discontinuity from the socket of the combined connector to PIN 18 of the control unit plug. If it is not possible to determine any discontinuity, check whether ground is present at the pin of the combined connector. If both are OK, replace HF sensor.</li> </ul>
<ul style="list-style-type: none"> <li>- <b>Signal improbable</b></li> </ul>	<ul style="list-style-type: none"> <li>- Continue HF sensor test via menu 2 = sensors. If <b>HF sender rear left O.K.*</b> (meaning HF sensor attenuated) appears during this test regardless of the wheel position, replace the HF sensor.</li> </ul>

Fault/Fault code	Possible causes Remedy/Remarks
<b>HF sender rear right</b> Fault code - 2 -	- Proceed as for fault code - 1 - for all faults, but use PIN 35 of the control unit plug.
<b>HF sender front left</b> Fault code - 3 -	- proceed as for fault code - 1 - for all faults, but use PIN 34 of the control unit plug.
<b>HF sender front right</b> Fault code - 4 -	- proceed as for fault code - 1 - for all faults, but use PIN 17 of the control unit plug.
<b>ABS speed sensor rear left</b> Fault code - 5 -	<div data-bbox="239 1271 470 1347">           - <b>Open circuit/ short to ground</b> </div> <div data-bbox="628 1271 1398 1424">           - Check speed signal via menu 2 = sensors.            If no bar diagram appears when the wheel is turned, <b>but ABS serviceable</b>, the fault lies in the line path between ABS control unit and tire pressure warning system control unit.         </div> <div data-bbox="647 1464 926 1497">           Connector assignment:         </div> <div data-bbox="647 1537 1232 1645">           ABS control unit 55-pole PIN 12            ABS control unit 35-pole PIN 30            Tire pressure warning system control unit PIN 26         </div>



Fault/Fault code	Possible causes Remedy/Remarks
	<ul style="list-style-type: none"> <li>- If the ABS is also deactivated, look for the fault in the area of the speed sensor or in the fault path between ABS control unit and speed sensor.</li> <li>- If no fault found, repeat. If the fault is still apparent, try replacing the ABS control unit.</li> </ul>
- Signal improbable	<ul style="list-style-type: none"> <li>- Fault not present: This could have occurred under certain environmental conditions, e.g. driving in the vicinity of powerful transmitters. There is no fault in the vehicle.</li> <li>- Fault present: First try replacing the ABS control unit then the tire pressure warning system control unit.</li> </ul>
<b>ABS speed sensor rear right</b> Fault code - 6 -	<ul style="list-style-type: none"> <li>- proceed as for fault code - 5 - for all faults.</li> </ul> Connector assignment:  ABS control unit 55-pole PIN 10 ABS control unit 35-pole PIN 31 Tire pressure warning system control unit PIN 8
<b>HF sender front left</b> Fault code - 7 -	<ul style="list-style-type: none"> <li>- proceed as for fault code - 5 - for all faults.</li> </ul> Connector assignment:  ABS control unit 55-pole PIN 16 ABS control unit 35- pole PIN 17 Tire pressure warning system control unit PIN 29

Fault/Fault code	Possible causes Remedy/Remarks
<b>ABS speed sensor front right</b> Fault code - 8 -	<ul style="list-style-type: none"> <li>- proceed as for fault code - 5 - for all faults.</li> <li>Connector assignment:               <ul style="list-style-type: none"> <li>ABS control unit 55-pole PIN 53</li> <li>ABS control unit 35- pole PIN 23</li> <li>Tire pressure warning system control unit PIN 28</li> </ul> </li> </ul>
<b>RDK control light Combi instrument</b> Fault code - 9 -	<ul style="list-style-type: none"> <li>- <b>Open circuit / Short to ground</b> <ul style="list-style-type: none"> <li>- In the case of discontinuity, ground fault or short circuit, check the line from PIN 3 of the tire pressure warning system control unit connector to PIN 6 of instrument cluster connector 1</li> </ul> </li> <li>- <b>Short to B +</b></li> </ul>
<b>Data lead RDK combi instrument</b> Fault code - 18 -	<ul style="list-style-type: none"> <li>- <b>Open circuit</b> <ul style="list-style-type: none"> <li>- Check the data line from PIN 1 of the tire pressure warning system control unit connector to PIN 10 of instrument cluster connector 2</li> </ul> </li> </ul>

## Menu 2 = Sensors

## Check HF sender and ABS speed sensor

Component to be tested/ Remarks	Preconditions Fault / Remedy
<b>1 = HF sender</b>	
Each test with attenuated and unattenuated HF sensor	<ul style="list-style-type: none"> <li>- Required display: OK* for attenuated HF sensor OK for unattenuated HF sensor</li> </ul>
<u>Attenuated means:</u> Closed pressure-operated switch (Tire pressure greater than switching pressure) above the HF sensor	<ul style="list-style-type: none"> <li>- If display shows: <b>defective</b>, there is a fault in the HF sensor or in the line to the control unit.</li> </ul>
<u>Unattenuated means:</u> a) Open pressure-operated switch (Tire pressure less than switching pressure) above the HF sensor or b) neither of the pressure-operated switches above the HF sensor	Refer to menu 1 (fault memory) to remedy faults for fault code 1 - 4
<b>2 = ABS speed sensor</b>	
	<ul style="list-style-type: none"> <li>- When the wheel is turned, a <b>bar diagram</b> appears, dependent on speed.</li> </ul> If no signal appears, remedy fault according to information from menu 1 (fault memory) fault code 5 - 8.

### Menu 3 = Input signals Pressure switch

#### Important notes

- A defective pressure-operated switch adopts a condition which is defined by the HF sensor as being a standard operational condition. Example: If the pressure-operated switch diaphragm is deformed, the switch assumes the closed state, therefore OK state, even if the tire pressure is too low.
- The HF sensor must be tested and OK before the pressure-operated switch can be diagnosed correctly.

#### Component to be tested/Remarks

#### Preconditions

#### Fault, Remedies

#### Pressure switch

2 pressure-operated switches  
(offset by 180°) must be  
checked per wheel

Align pressure-operated switch with HF sensor. Then  
a) tire pressure\* greater than switching pressure

Required display: **CLOSED**

If the "**OPEN**" display appears,

- the distance or offset between switch and HF sensor is too great or
- the pressure-operated switch is defective

b) Tyre pressure\* less than switching pressure

Required display: **OPEN**

If the "**CLOSED**" display appears, the pressure-operated switch is defective.

\* For practical purposes, the test pressures as used in the short test (Page 44-28) are used as tire pressures.

## Menu 1\* = Events

### Read out the tire pressure loss event memory

#### Important notes

**From control unit version 02 on**, the RDK control unit contains an event memory which stores data on any pressure losses at one or more tires during the last 8 journeys made by the vehicle. It also indicates the road speed at which the event occurred, and whether either one or two pressure-sensing switches were open.

This event memory permits conclusions to be reached regarding **unnatural pressure losses** at one or more wheels. Eliminate the cause of any unnatural pressure loss immediately.

Possible causes are stated on Page 44-26.

**Of the 8 recorded journeys, journey 8 is the most recent.**

**When the event memory is read out the most recent journey, that is to say journey 8, is shown on the system tester's display.** The event memory cannot be erased.

If the > button is pressed, the next wheel for which a tire pressure loss event was recorded will be displayed, or if no other wheel was affected during this journey, the previous journey appears on the tester's display panel.

**Event storage: when a new journey is started (after the ignition has been switched off), journey No. 1 is erased from the event memory and the previous journey Nos. 8 to 2 moved up to become journey Nos. 7 to 1.**

- \* Additional RDK menu from control unit version R 02 on (introduced during the 1991 model year). This would normally have the serial number Menu 4, but since the tester only has selector buttons 1, 2 and 3, the menu at the top of the display, in this case the event menu, starts again at No. 1.  
To change from one Menu 1 to the other (Event or Fault memory), page forward or back with the > or < keys.

**Procedure:** call up the event menu. Press the > key repeatedly until the event memory is read out in full. The tester indicates this (test end).

### Example

#### Event

#### Displayed data

Journey - 8 - of 8 (last journey made)  
Left rear wheel (RL)  
Pressure loss detected by 2 switches  
at 270 kph

Drive - 8 - of 8 RL  
pressure loss  
2 switches open  
v: 270 km/h 168 mph >

Right rear wheel (RR)  
No pressure loss

< Drive - 8 - of 8 RR  
no pressure loss

>

Left front wheel (FL)  
Pressure loss detected by 1 switch  
at 100 kph

< Drive - 8 - of 8 FL  
pressure loss  
1 switch open  
v: 100 km/h 62 mph >

Right front wheel (FR)  
Pressure loss detected by 2 switches  
at 270 kph

< Drive - 8 - of 8 FR  
pressure loss  
2 switches open  
v: 270 km/h 168 mph

Journey - 7 - of 8  
At all wheels  
No pressure loss

Drive - 7 - of 8  
no pressure loss

Event	Displayed data
Journey - 6 - of 8 At all wheels No pressure loss	<div>Drive - 6 - of 8 no pressure loss</div>
Journey - 5 - to journey - 1 - of 8 No pressure loss at any wheel	as for journeys 7 and 6 No pressure loss but with the appropriate journey number (Journey - 5 - of 8 Journey - 4 - of 8 etc.)
Display after Journey 1:	<div>Results testing completed  return N</div>

## General

As of MY '84, the Porsche 928 S is optionally available with anti-lock system (ABS) (option M593). As of model year 1986, the 928 S is fitted with ABS as standard equipment worldwide

The anti-lock braking system represents an important contribution to the enhancement of active safety in the vehicle.

The system prevents the wheels from locking when the brakes are applied, thus assuring full steerability and directional stability. **Furthermore, the braking distance is optimized under all road conditions.**

However, it is still the responsibility of the driver to adapt his driving to road and weather conditions and to the prevailing traffic situation.

The decisive advantage offered by ABS lies in the stability and maneuverability of the vehicle in moments of danger - when the brakes are fully applied, even in a curve.

It is not possible to retrofit ABS in cars built before model year 84, as the body has undergone a number of changes since then.

### Modifications, 86 models onward

As of model year 1986, the 928 S is fitted with ABS as standard equipment worldwide. At the same time, the following modifications were incorporated.

Optimization of plug-in connectors of speed sensors to cable. The cable routing has also been modified.

Number of teeth on impulse ring reduced from 90 to 45 (improved signal registration).

ABS control unit changed (adaption to impulse ring with 45 teeth). **When replacing, ensure that the correct control unit is used. The only outward differences of the control units are the Part No. and Bosch part no., respectively. Observe correct usage references acc. to the spare parts catalog.**

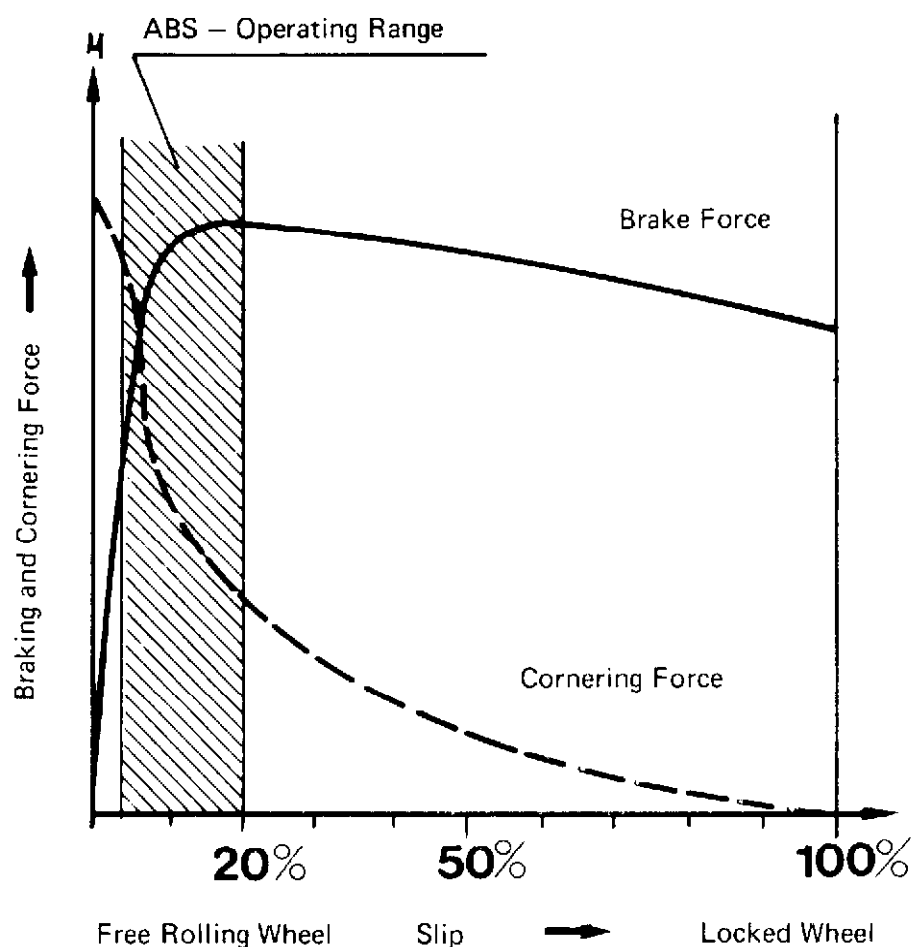
### Modifications as of MY '90

Starting with MY '90, the 928 is fitted with a PSD (electronically controlled Porsche limited slip differential). For details, refer to page 45 - 08.



## DIRECTIONAL CONTROL AND STEERABILITY WHILE BRAKING

Acceleration and braking forces have to be transmitted to the road surface by the tires. When a free-rolling wheel is slowed down by applying the brakes, there is slip, i. e. the difference between wheel circumferential speed and vehicle speed. The wheel circumferential speed will be slower than the vehicle speed.



The diagram shows the interrelations of braking force, cornering force and slip. An increase in braking force causes a very fast reduction in cornering force and consequently in directional control and steerability of wheels.

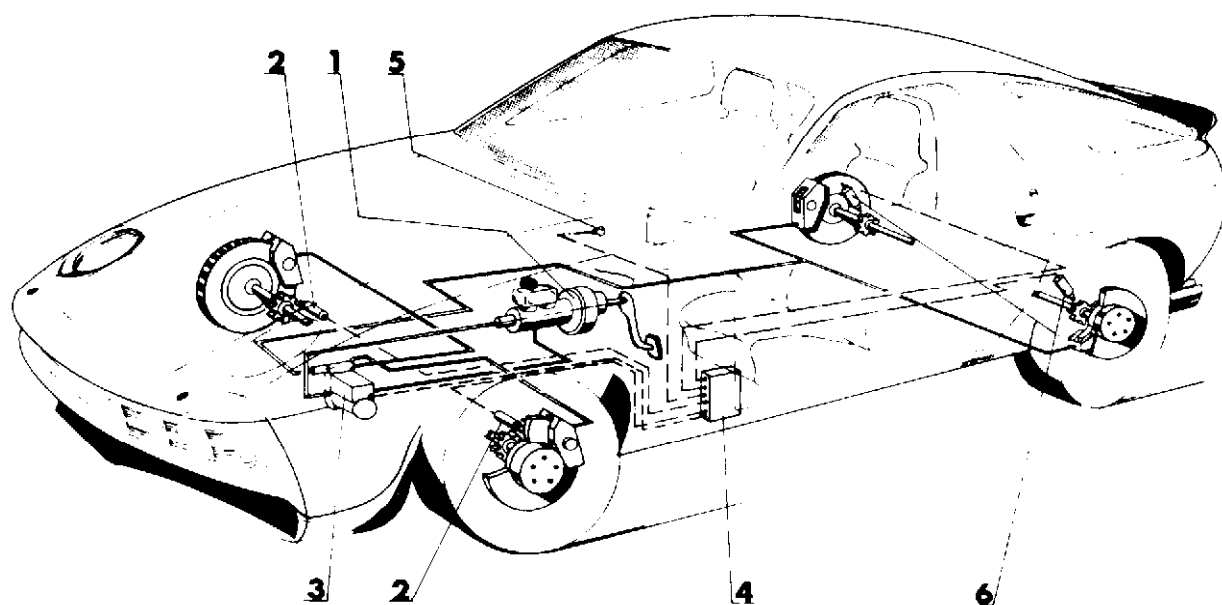
It is well known that absolutely no steering correction is possible when wheels have locked (100 % slip) – the car slides straight ahead in spite of turned front wheels. The operating range of ABS is designed to always provide sufficient cornering force with simultaneous introduction of maximum possible braking force.

ABS regulates the braking pressure in a range of 4 to 20 % slip (car moving straight ahead).

## DESIGN

The major components of ABS are: hydraulic unit,  
electronic control unit,  
four speed sensors \* and  
wire harness with relays and  
overvoltage tripout  
(on central electric board).

These components are integrated in the conventional braking system of cars beginning with 1984 models. The conventional braking system of cars beginning with 1984 models has been changed as compared to that of older models in brake circuit division (now by axles), stepped brake master cylinder (piston diameter of both pistons formerly the same) and brake force regulator (see page 47 - 18 a).



- 1 — Brake booster with tandem master cylinder
- 2 — Front speed sensors \*
- 3 — Hydraulic unit (with screwed in brake force regulator, pump motor and valve relay)
- 4 — Electronic control unit
- 5 — ABS indicator lamp
- 6 — Rear speed sensors \*

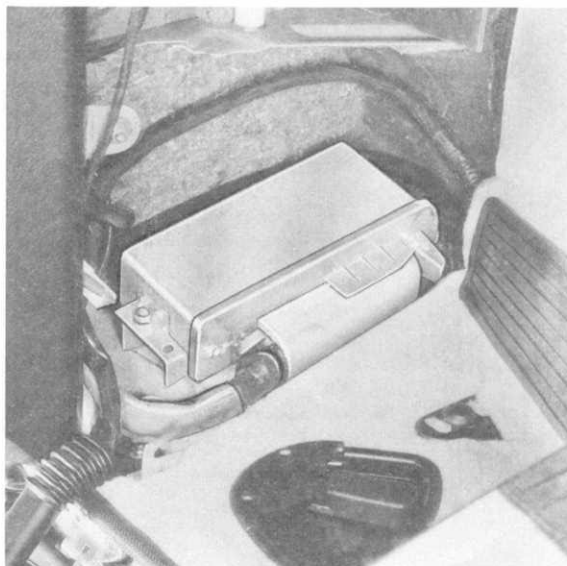
\* A pulse gear belongs to each speed sensor. Pulse gears are pressed on front wheel hubs of front axle and machined on axle shafts of rear axle.

## ABS COMPONENTS

## ABS Control Unit

The electronic control unit is located above the hood release handle on driver's side of car (above central electric board in RHD cars).

The control unit uses the speed sensor signals to calculate the necessary control and regulation commands for the hydraulic unit.

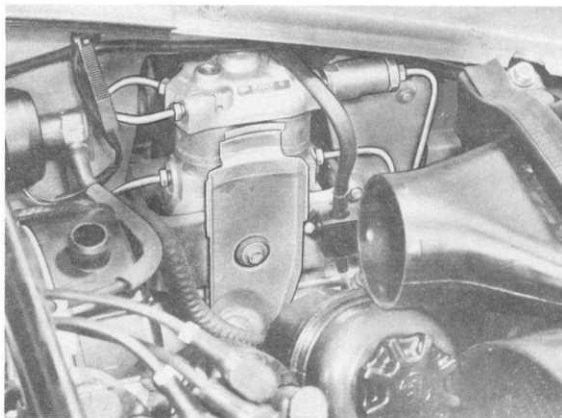


## Hydraulic Unit

The hydraulic unit is located on the left front wheel house wall. It processes the electric signals coming from the electronic control unit.

The hydraulic unit can change the hydraulic pressure to the wheel brake cylinders independently of pressure in the brake master cylinder. However, a higher pressure than that of the brake master cylinder is not possible.

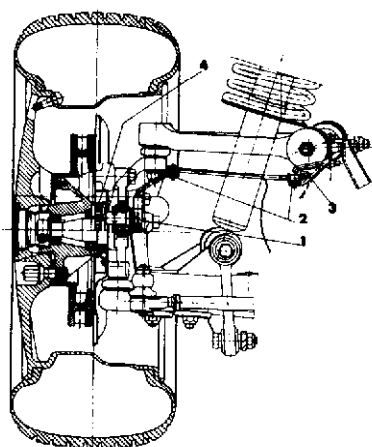
Depending on the amperage, with which the electric solenoid valves are activated, the hydraulic pressure in wheel brake cylinders can be



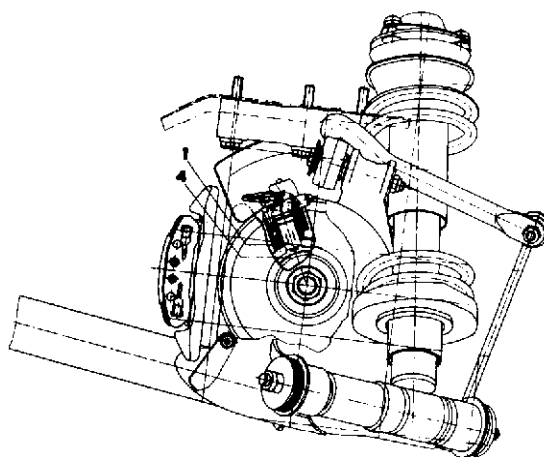
- |            |                               |
|------------|-------------------------------|
| increased  | — pressure building-up phase, |
| maintained | — pressure holding phase, or  |
| reduced    | — pressure dropping phase.    |

### Speed Sensors

Speed sensors are arranged on all four wheels. These inductive sensors are held in area of pulse gear rings of front wheel hubs or wheel end shafts on rear axle and produce an alternating voltage for each pulse tooth. This alternating voltage changes its frequency to indicate speed, acceleration and deceleration of wheels, and is processed in the control unit.



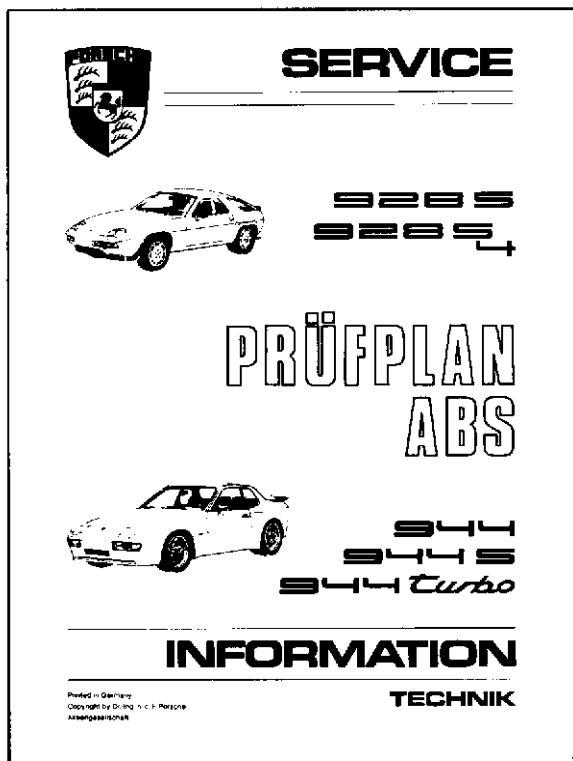
- 1 — Speed sensor
- 2 — Wire holder
- 3 — Speed sensor wire
- 4 — Pulse gear ring



## Important information on troubleshooting and ABS test program

### General

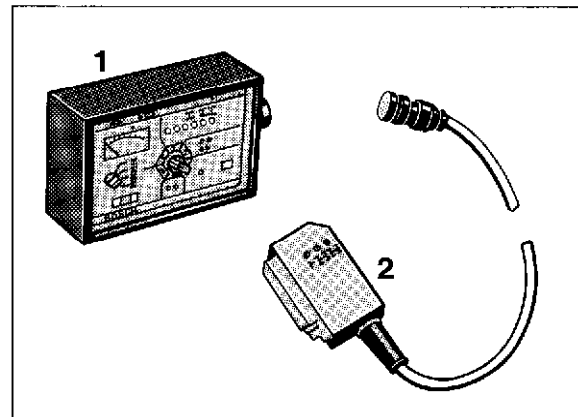
- After certain repairs to the ABS system (refer to functional check on page 45 - 07), a test program using an ABS tester must be run. The ABS test plan, Print No. WKD 493 720, is required for this test operation and for troubleshooting.



- This ABS test plan describes troubleshooting and ABS testing, respectively, with both testers, i.e. Bosch K 7 (VAG 1516) and Bosch ABS 2-LED.
- Vehicles with PSD** may only be tested with the ABS 2-LED tester in conjunction with the 55-pin adapter lead (refer to drawing 499-45).

### ABS testing on vehicles with PSD

- Following repairs affecting the ABS system (cf. page 45 - 07), a functional test using the ABS 2-LED tester must be run.



499-45

1 = ABS 2-LED tester

2 = 55-pin ABS 2-LED adapter lead.  
Same lead as for ABS testing on the 911 Carrera 4. Manufacturer and supplier = Bosch.  
For address and order no., refer to the Repair Manual 911 Carrera 4, Repair Group 45.

## Important information for repairs of vehicles fitted with ABS

**When working on vehicles equipped with ABS, observe the following items:**

### **Welding**

When welding with arc welding equipment, disconnect the connector of the electronic control unit.

### **Painting**

During paint refinishing, the electronic control unit may be exposed to a temperature of max. 95 deg. C for brief intervals and to max. 85 deg. C for longer periods (max. 2 hours).

### **Charging the battery**

When quick charging the battery, disconnect it from the vehicle wiring.

### **Jump starting**

Do not use a quick charger for starting the engine.

### **Multiplug for electronic control unit**

Never disconnect or reconnect the multiplug to the electronic control unit while the ignition is on.

### **Checking the ABS operation**

If service operations not directly related to parts of the ABS have been carried out on the brake system, a simple functional check is sufficient. I.e. after starting the engine, the warning lamp in the instrument cluster must go off if the ABS system is o.k. Operations of this type include replacement of brake pads, brake hoses, brake discs, brake booster, tandem master cylinder, brake cables and components of the parking brake as well as brake pipes that are not screwed into the hydraulic unit.

When performing service operations on the hydraulic unit\*, electronic control unit\*, on rpm sensors and/or the wiring harness or when replacing units, e.g. during accident repairs, the operation of the ABS system must be checked with the ABS tester.

\* Hydraulic unit and electronic control unit must neither be repaired nor dismantled.

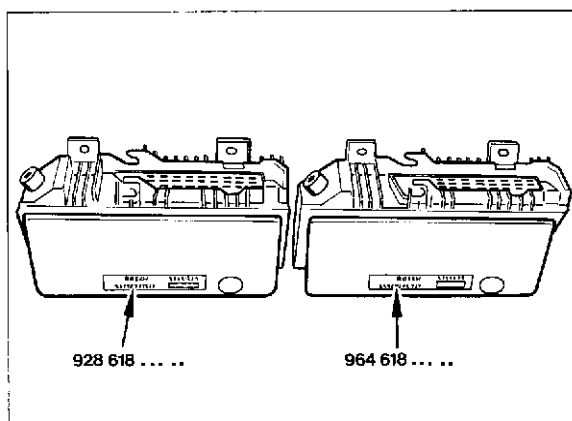
The electronic control unit checks itself via a self-diagnosis routine. For this reason, checking the control unit is only possible or required, respectively, if an ABS test is performed and only if tester version Bosch K 7 (VAG 1516) is used.

## Vehicles with PSD

The lock control assembly is located on an additional PCB in the ABS control unit. This PSD/ABS control unit has 55 pins. Previous ABS control unit versions had 35 pins. When repairs are required, make sure the PSD/ABS control unit is not confused with the PDAS/ABS control unit fitted to the 911 Carrera 4. To tell the two versions apart, refer to the Part Nos.

Control unit for 928 with PSD = 928 618... ..

Control unit for 911 Carrera 4 = 964 618... ..



810-D39/45

## Notes on ABS troubleshooting for vehicles with PSD

### General

PSD = Electronically controlled Porsche limited-slip differential.

One control unit controls both the PSD and ABS. The PSD is accommodated on an additional printed-circuit board in the ABS control unit.

Not only PSD system faults are stored in the ABS / PSD control unit, but also some ABS system faults.

### Fault displays via the instrument cluster

On vehicles with PSD, an ABS fault is indicated not only by the ABS warning lamp, but also by a plain-text display in the instrument cluster (ABS off).

ABS faults automatically lead to deactivation of the PSD.

**In this case, the display in the instrument cluster changes between:**

ABS	off
and	
PSD	off



**Possible fault displays via system tester 9288****DTCs of the PSD and ABS**

DTC	Fault type	System allocation
11	Transverse lock valve	PSD
12	Lateral acceleration sensor - short circuit/discontinuity	PSD
13	Lateral acceleration sensor - signal implausible	PSD
14	Transverse lock - deviation	PSD
15	Control unit - defective	ABS/PSD
21	Wheel speed sensor, front left	ABS/PSD
22	Wheel speed sensor, front right	ABS/PSD
23	Wheel speed sensor, rear right	ABS/PSD
24	Wheel speed sensor, rear left	ABS/PSD
31	ABS valve, front left	ABS
32	ABS valve, front right	ABS
33	ABS valve, rear axle	ABS
34	Valve relay (hydraulic unit)	ABS/PSD
35	Return pump (hydraulic unit)	ABS

**Notes on troubleshooting**

Troubleshooting / fault description for the above faults are explained under PSD diagnosis/Troubleshooting in Repair Manual Vol. 3 (Transmission) (Page D39-223).

Faults occurring in the high-pressure hydraulics of the PSD (lock operation) are not stored in the DTC memory of the ABS / PSD control unit. Troubleshooting / fault description is **also** included in Repair Manual Vol. 3 (Page D39-247).

## REMOVING AND INSTALLING HYDRAULIC UNIT

## Removing

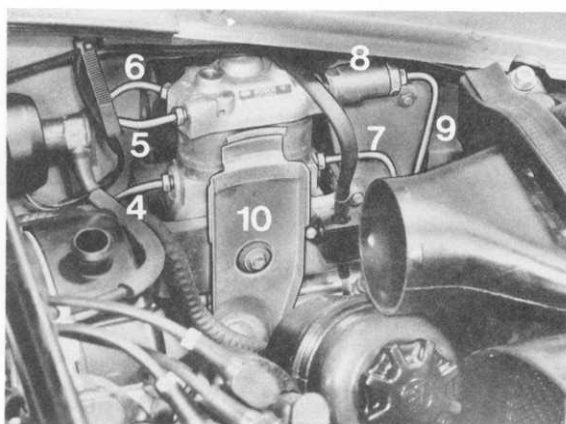
1. Turn off ignition and disconnect battery ground wire on body.
2. Remove left intake hose on air cleaner, loosen power steering supply tank on bracket (hoses remain connected), pull off ignition leads on ignition coil and take off left front wheel.

3. Disconnect brake lines as well as brake pressure regulator (no. 4 – 9) on hydraulic unit.

This is done by unclipping brake lines in holders on wheel housing (locks are opened from above).

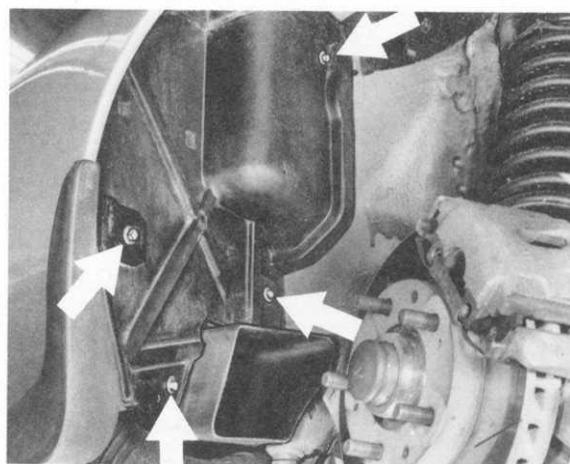
Insert plugs in open brake lines and connections immediately (danger of dirt entering system).

If plugs are not available for brake lines, first drain tank and cover lines.

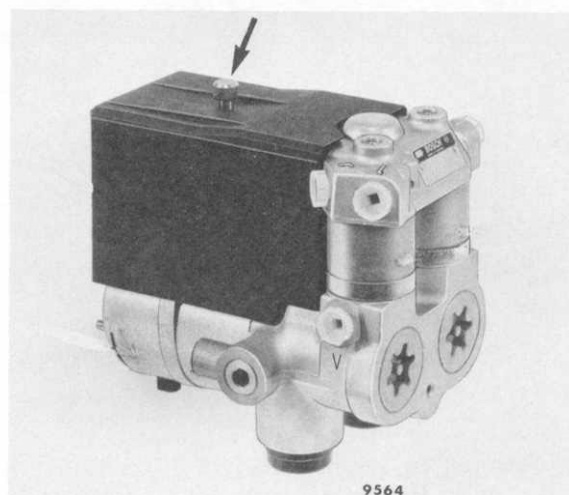


- 4 – From brake master cylinder, front wheel circuit (code V)
- 5 – Brake line front left (code l)
- 6 – Brake line front right (code r)
- 7 – From brake master cylinder, rear wheel circuit (code H)
- 8 – Brake pressure regulator
- 9 – Brake line rear (code h)
- 10 – Hydraulic unit console with spot-welded bracket for power steering supply tank

4. Remove wheel house cover.



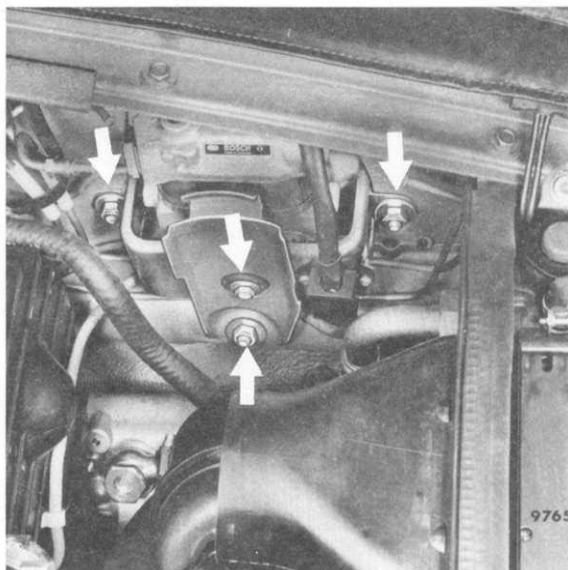
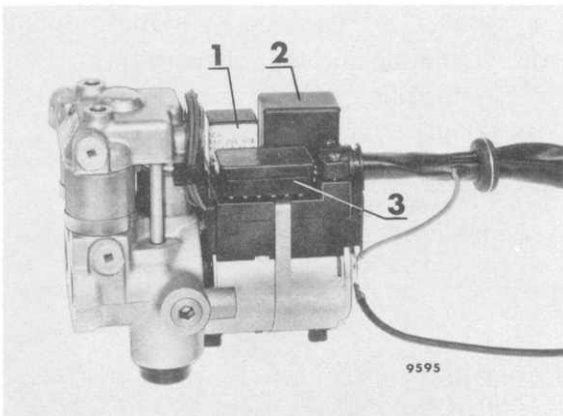
5. Remove cover.



6. Unscrew cable release and take off 12-pin plug (no. 3).

Note:

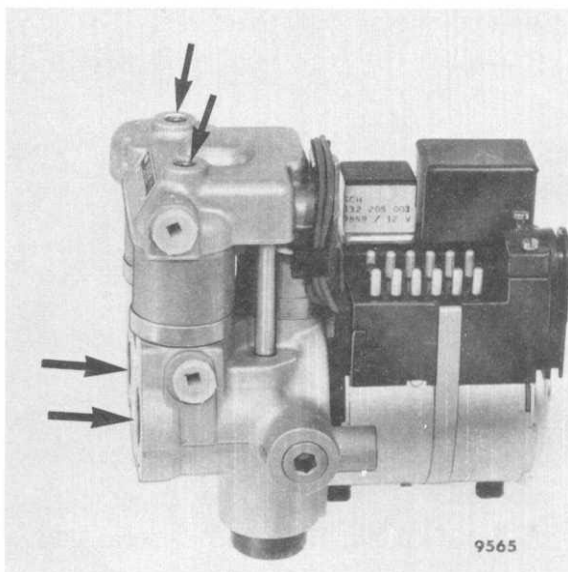
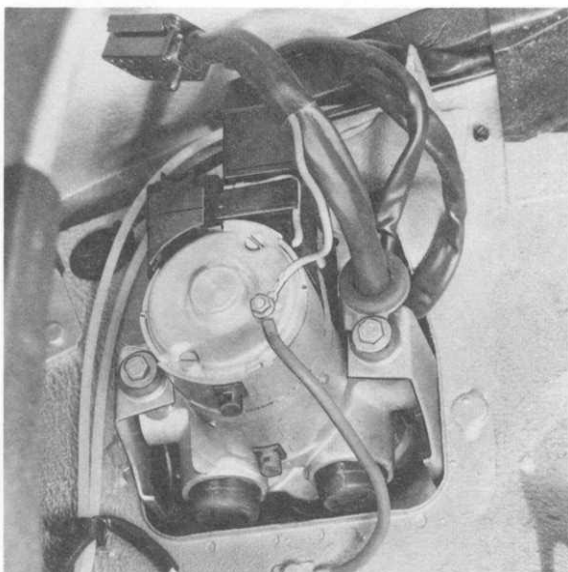
Both relays for pump motor (2) or solenoid valves (1) can be replaced (see page 45 - 6).



Note:

Never loosen or tighten bolts marked with arrows.

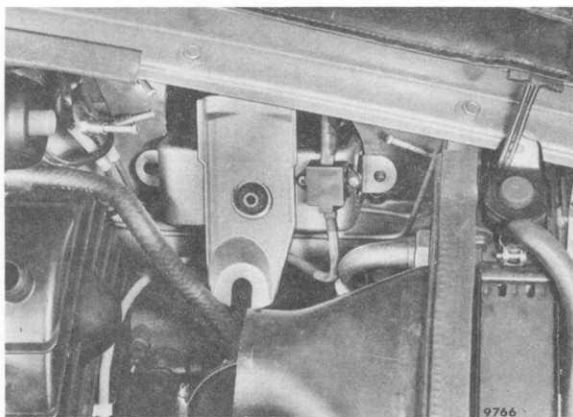
7. Disconnect ground wire on pump motor and loosen two mounting bolts.



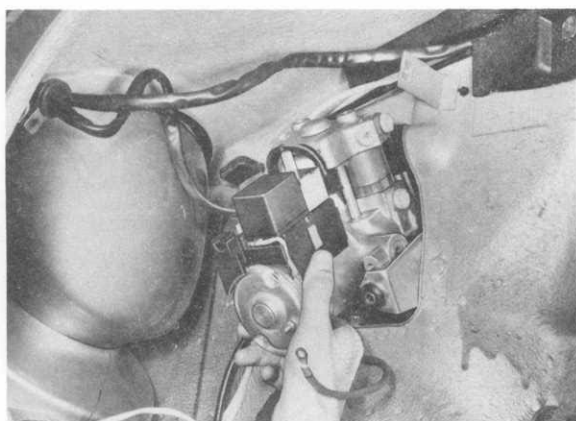
8. Loosen mounting bolt as well as bracket for hydraulic unit.  
Run out hydraulic unit (see installation points 1 + 2).

## Installing

1. Tilt down hydraulic unit bracket on wheel side.



2. Move hydraulic unit into bracket from wheel side and install two mounting bolts (position of console as described in point 1).



3. Mount hydraulic unit bracket on wheel housing wall (three self-locking nuts).

4. Finish installation of hydraulic unit on bracket. Tighten three mounting bolts.

5. Mount brake pressure regulator and brake lines on hydraulic unit in correct position. If applicable, hold brake lines in brackets on wheel housing wall with clips and engage locks.

## Note:

Make sure brake lines are routed correctly.

6. Connect 12-pin plug and secure cable release.  
Mount cover on hydraulic unit.

7. Mount wire harness on hydraulic unit bracket (loosen right bolt again).  
Connect ground wire on pump motor.

8. Bleed brakes in order of stepped brake master cylinder, push rod brake circuit (front wheels) and intermediate piston circuit (rear wheels) and check for leaks. Bleeding procedures are same as for cars without ABS.

9. Mount wheel house cover, front wheel, power steering supply tank, ignition leads on ignition coil and intake hose.  
Connect battery ground wire.

10. Check operation with an ABS tester.

## REMOVING AND INSTALLING ELECTRONIC CONTROL UNIT

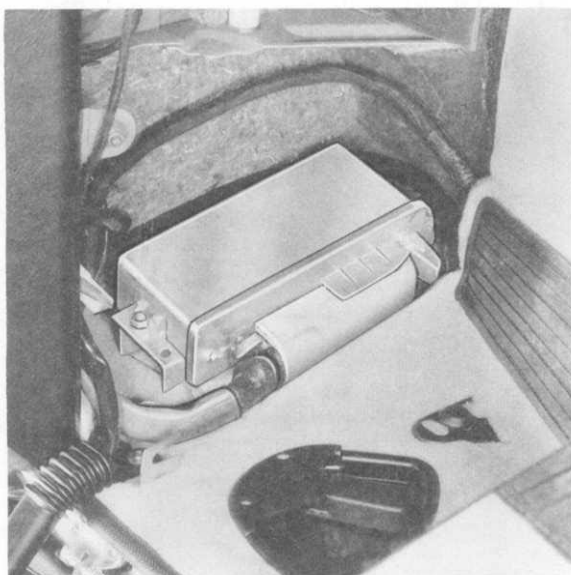
## R e m o v i n g

## N o t e :

In left-hand drive cars, the electronic control unit is mounted on the driver's side above the hood-release handle on the side panel. In right-hand drive cars, the control unit is located above the central electrics unit.

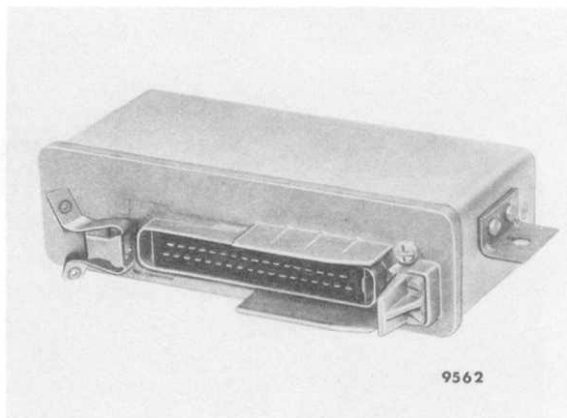
Always switch the ignition off before disconnecting the multi-pin plug from the control unit or removing the control unit.

1. Move seat to rearmost position and raise steering wheel (to facilitate work).
2. Open retaining spring (clamp) and disconnect plug from electronic control unit.



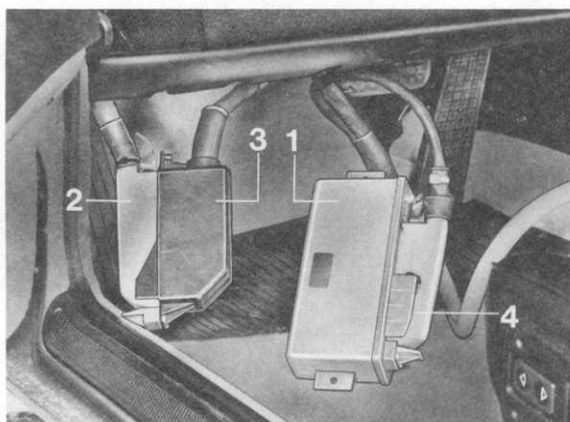
3. Unscrew mounting nuts and remove electronic control unit from holder.

\* Control unit modified as of model year 86. Ensure correct unit is installed when replacing (see page 54 - 01).



## I n s t a l l i n g \*

1. Mount electronic control unit on holder.
2. Connect ABS tester with plug of electronic control unit connected to plug of tester. Push plug of tester onto electronic control unit, the retaining spring must engage with an audible click.



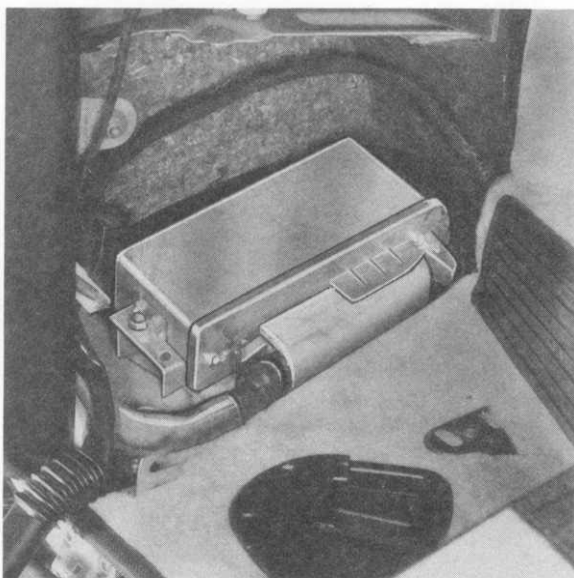
## Removing and installing electronic control unit

### Removal

#### Note

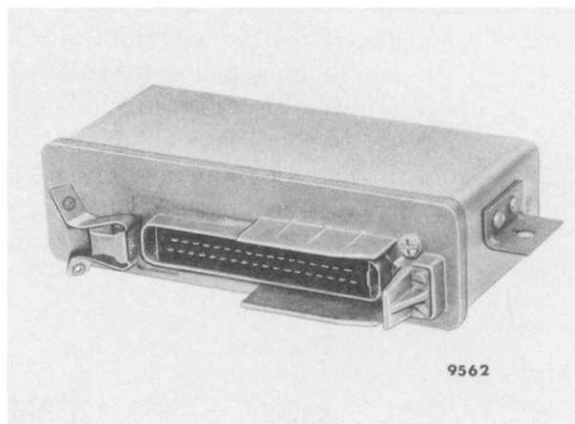
When disconnecting the multiplug from the control unit or when removing the control unit, the ignition must be switched off.

1. Actuate retainer spring (clamp) and pull connector off the electronic control unit.



9537

2. Take electronic control unit off the bracket after having undone the fastening nuts.



9562

### Installation

#### Note

Be sure to use correct control unit when replacing the units as it may be confused with other ABS control units.

The only outward differences of the control units are the Bosch and Porsche part nos., respectively.

1. Fit electronic control unit bracket.
2. Attach multiplug safely to electronic control unit.  
**The retainer spring must engage into the plug with an audible click.**

## Removing and installing relay

### General

The anti-lock system is fitted with three relays.

The ABS relay (power supply for electronic control unit and scavenge pump motor relay) is located on the Central Electrical System.

The relay for the solenoids and the relay for the pump motor are located below the cover of the hydraulic unit.

### ABS relay

#### Removing and installing

1. Flip up cover of Central Electrical System in the passenger's footwell.
2. With the ignition off, pull out and insert ABS relay, respectively (electronic relay with overvoltage protection).

### Note

The relay is located in the lower row of the Central Electrical System.

**Initial version** (up to end of MY '84)  
Relay No. XI (arrow).

The top of the relay is fitted with a 10 amps fuse insert (little fuse) that protects the ABS circuit.

### Modified version

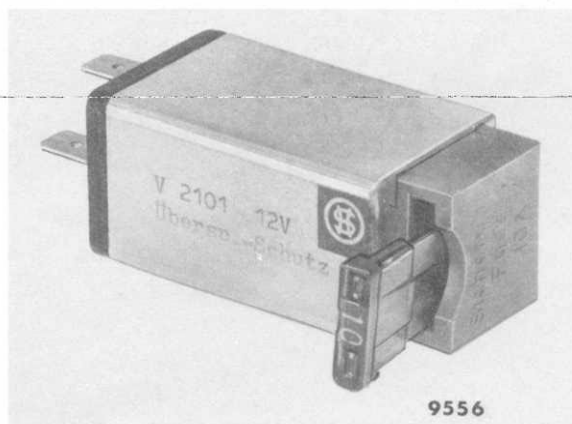
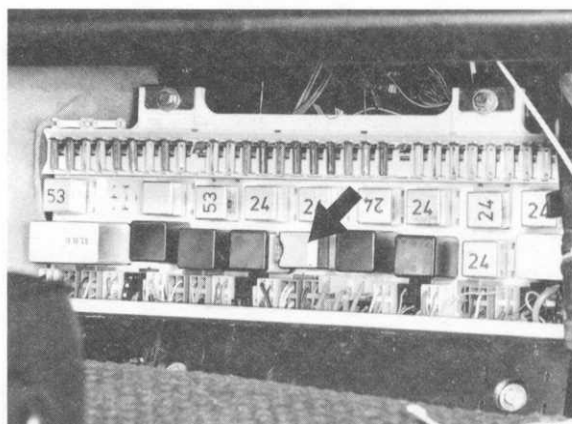
(MY '85 to MY '89) Relay No. XVII

Starting with MY '85, the fuse is no longer located inside the relay but rather in the Central Electrical System. This fuse carries the reference no. 16. It also is a 10 A fuse insert (little fuse).

### Current version as of MY '90

Relay No. XV

This fuse carries the reference no. 28



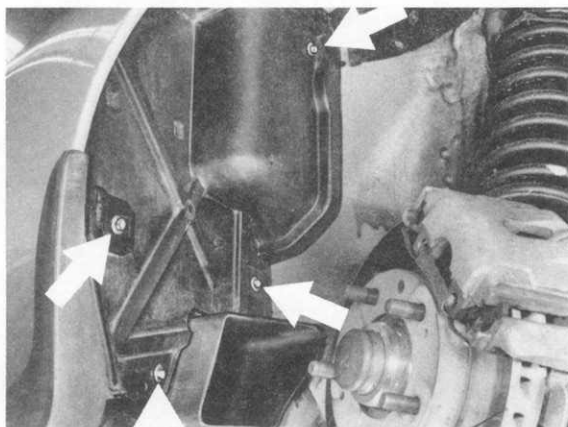
9556



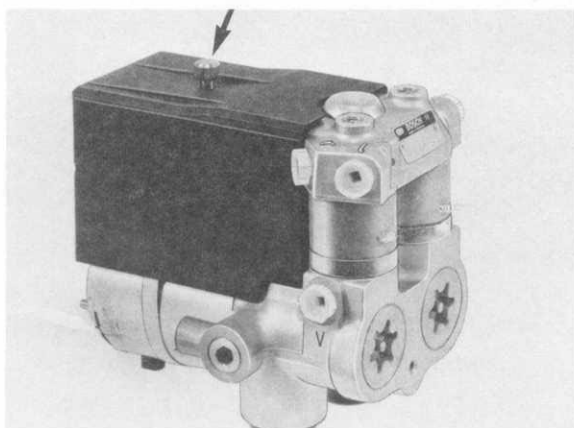
## Pump motor relay / valve relay

### Removal

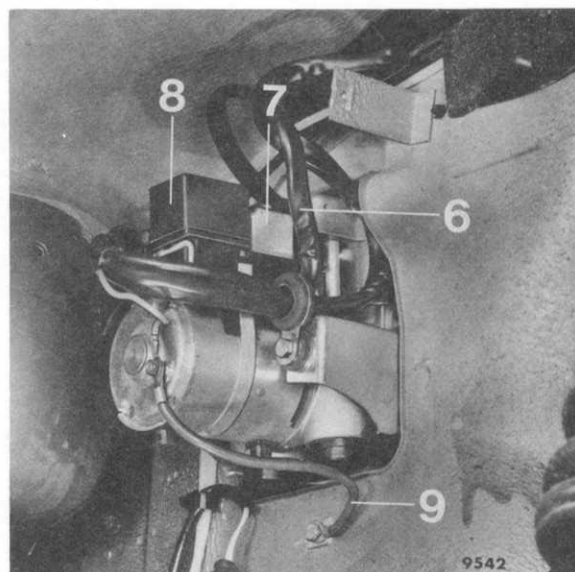
1. Remove the wheel housing cover.



2. Remove the cover hood.



3. Pull out fuse for solenoid valves No. 7 or for the pump motor No. 8 with the ignition switched off.



### Installation

Proceed in reverse order.



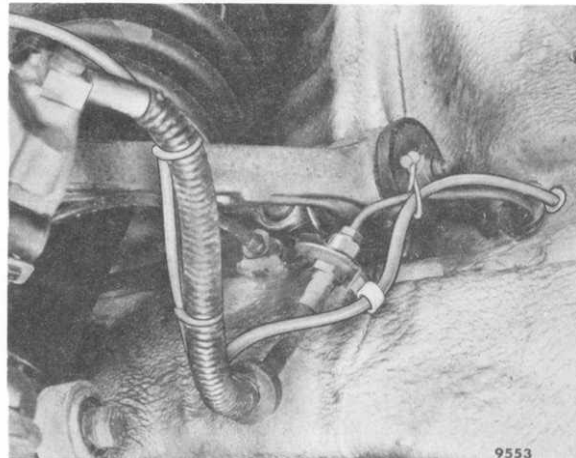
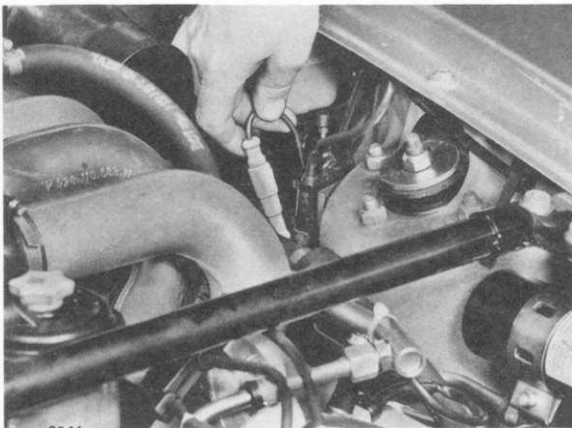
## REMOVING AND INSTALLING SPEED SENSORS ON FRONT AND REAR AXLES

### Removing and Installing

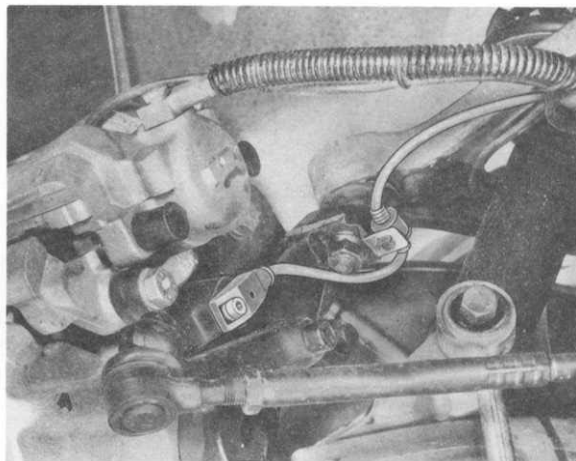
#### Front Axle

#### Removing

1. Take off front wheel. Remove intake hose on air cleaner.
2. Turn off ignition, take wire plug out of holder in engine compartment and disconnect.



4. Unclip wire on side member and in holders on steering knuckle.  
Loosen socket head screw and pull speed sensor out of steering knuckle.

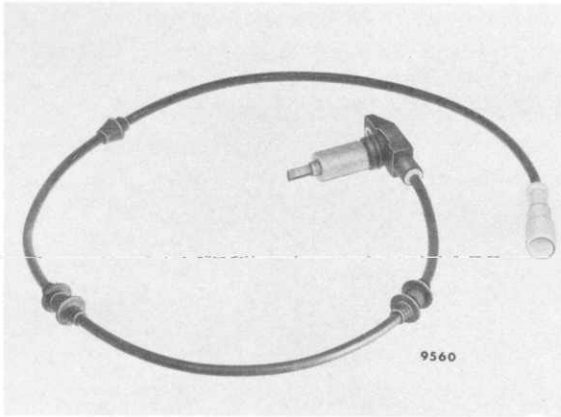


3. Remove front exhaust shield (to make procedures easier).  
Unclip wires on wheel housings and pull out with rubber grommet in direction of wheel.  
Also pull out rubber grommet for brake line.

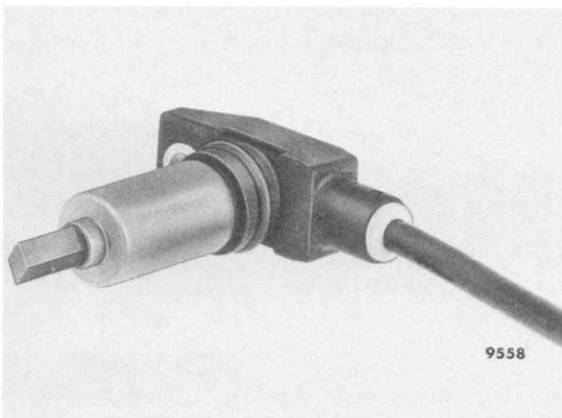
#### Installing

##### Note:

- Rubber mounts and grommets on speed sensors are connected with wire covers in precise position.
- Take speed sensors out of protective packaging only briefly before installation (loss of permanent magnetism).
- Make sure that there are no foreign metal particles (burrs) on magnetic edge of speed sensor before installing.



1. Coat speed sensor and bore in steering knuckle with Molykote Longterm 2. Replace O-ring of speed sensor.



2. Insert speed sensor in steering knuckle without application of force and tighten socket head screw to 10 Nm/7 ftlb.

#### Note:

The distance between speed sensor and pulse gear is given by design and cannot be adjusted.

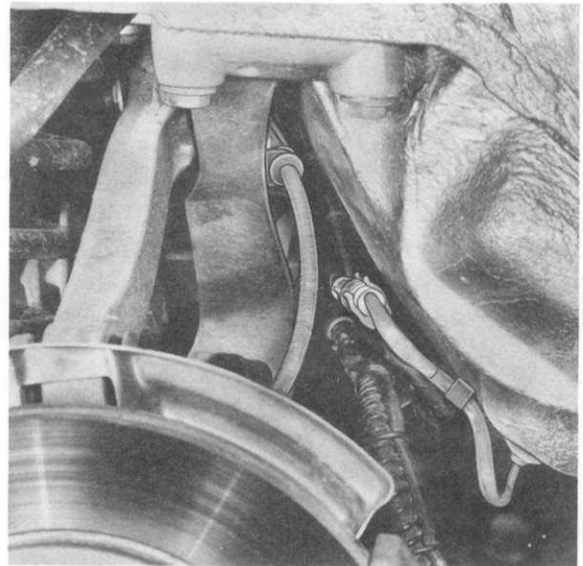
3. Route wires correctly (insert rubber grommets and clip rubber mount in holder).  
Install exhaust shield.  
Connect wire plug and press into holder.  
Install front wheel and intake hose.

4. Check operation with ABS tester.

#### Rear Axle

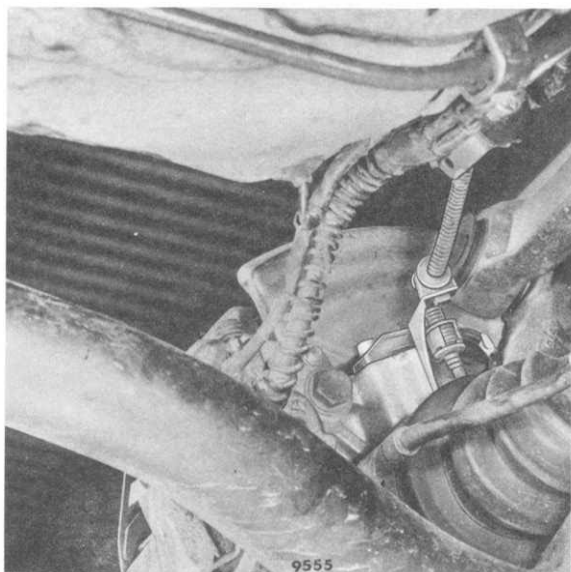
#### Removing

1. Take off wheel.
2. Turn off ignition, take wire plug out of holder and unclip wire on rear axle carrier.



3. Disconnect wire plug.

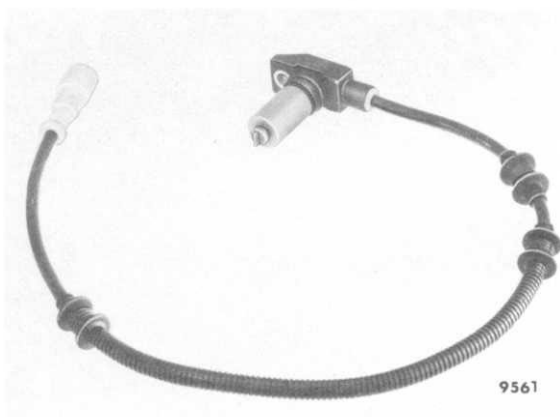
4. Unclip wire in holders on wheel carrier.  
Loosen socket head screw and pull speed sensor out of wheel carrier.



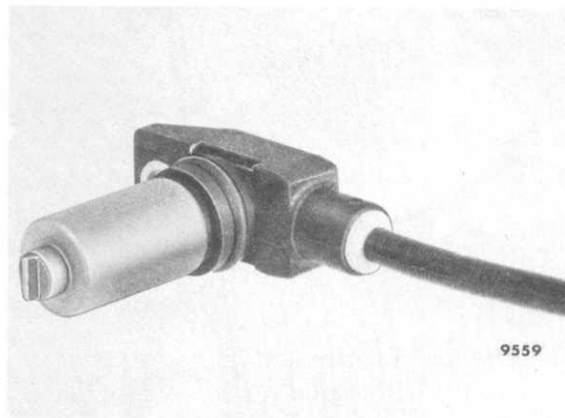
### Installing

#### Note:

- Rubber mounts on speed sensors are connected with wire covers in precise position.
- Take speed sensors out of protective packaging only briefly before installation (loss of permanent magnetism).
- Make sure that there are no foreign metal particles (burrs) on magnetic edge of speed sensor before installing.



1. Coat speed sensor and bore in wheel carrier with Molykote Longterm 2.  
Replace O-ring of speed sensor.



2. Insert speed sensor in wheel carrier without application of force and tighten socket head screw to 10 Nm/7 ftlb.

#### Note:

The distance between speed sensor and pulse gear is given by design and cannot be adjusted.

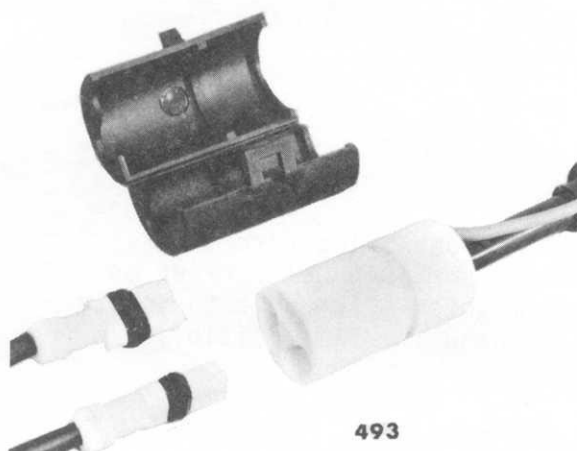
3. Clip wire in holders on wheel carrier and rear axle cross member.
4. Connect wire plug and insert in holder.  
Install wheel.
5. Check operation with ABS tester.

## REMOVING AND INSTALLING SPEED SENSORS ON FRONT AND REAR AXLES, 86 MODELS ONWARD

### Front Axle

#### Removing

1. With ignition switched off, open ABS cable plug-in connector on the steering knuckle and disconnect.



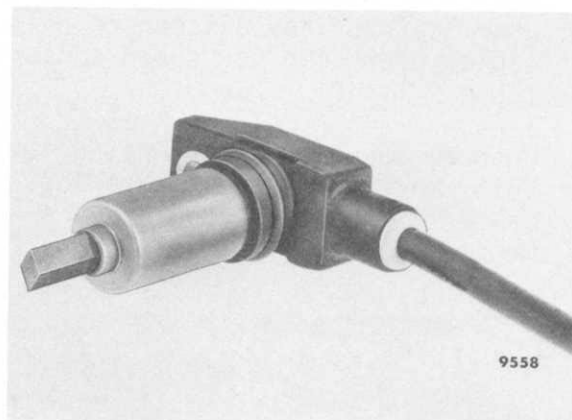
2. Unscrew mounting bolt (Allen bolt) of speed sensor and withdraw sensor from steering knuckle.

#### Installing

##### Note :

- Do not remove speed sensor from its protective package until shortly before installation (loss of permanent magnetism)
- Before installation, check that no foreign bodies (metal shavings) have been caught on the magnetic edge of the speed sensor.

1. Coat speed sensor and hole in steering knuckle with Molykote Longterm 2. Renew speed sensor O-ring.



2. Without using force, insert sensor in steering knuckle and tighten Allen bolt to secure. (Torque 10 Nm (7ftlb)).

##### Note :

The distance between speed sensor and impulse ring is a design feature and cannot be adjusted.

3. Reconnect cable and place in holder on steering knuckle.
4. Check operation with ABS tester.

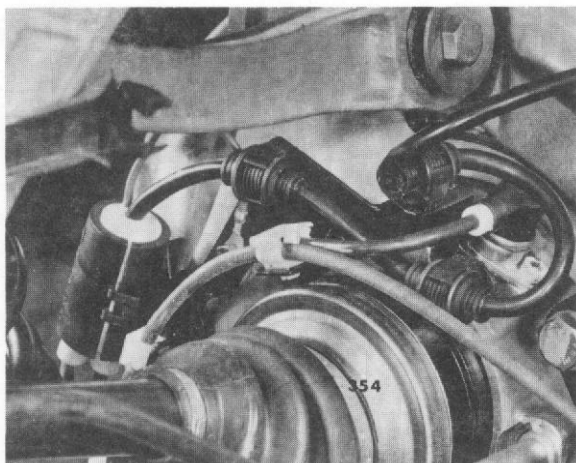
## Rear Axle

## Removing

1. Remove wheel.

2. With ignition switched off, open ABS cable plug-in connector on wheel carrier and disconnect cable. Open clip for speed sensor cable.

Unscrew speed sensor mounting bolt. Make space by withdrawing cable from holder above the mounting bolt.



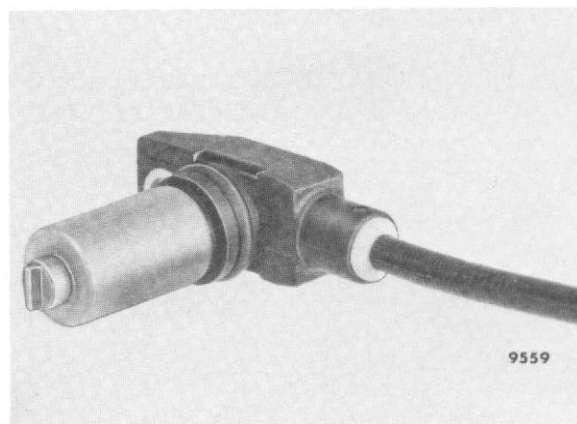
3. Withdraw speed sensor from wheel carrier.

## Installing

## Note :

- Do not remove speed sensor from protective packing until shortly before installation (loss of permanent magnetism).
- Before installing, check that the magnetic edge of the speed sensor is free of foreign particles (metallic shavings).

1. Coat speed sensor and hole in wheel carrier with Molykote Long-term 2. Renew speed sensor O-ring.



2. Without using force, insert speed sensor in wheel carrier and tighten Allen bolt to secure. Torque: 10 Nm (7 ftlb).

## Note :

The distance between speed sensor and impulse ring is a design feature and cannot be adjusted.

3. Place cable in clip on wheel carrier. Close clip. Insert cable in holder above sensor mounting bolt.

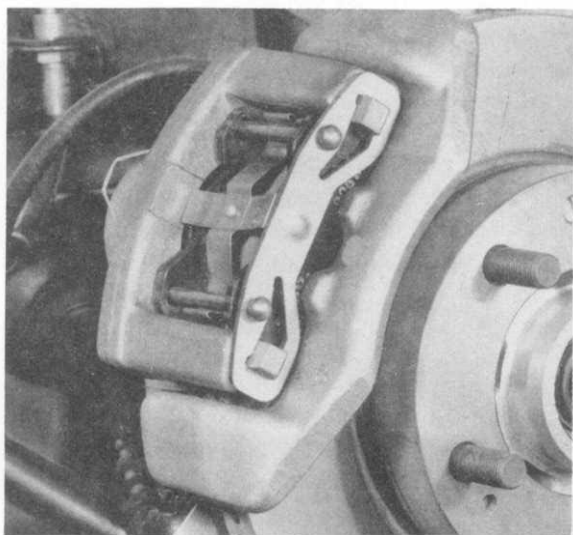
4. Insert plug-in connector and place in holder. Mount wheel.

5. Check operation with ABS tester.

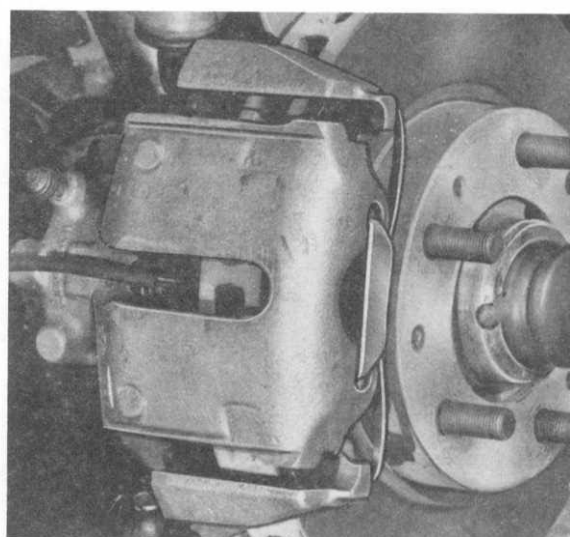
## GENERAL

Braking System Until  
End of Model Year 1985

Until end of model year 1985 and depending on type and model year, the front-axle disk brakes use either sliding or floating calipers. All brake disks are ventilated. The brakes of the 928 S (with floating calipers) have auxiliary ventilation via air guide ducts. In all cars, sliding brake calipers are mounted on the rear axle. Brake pads with differing friction values are used. It is essential to ensure that the appropriate parts are installed (page 46 - 3).



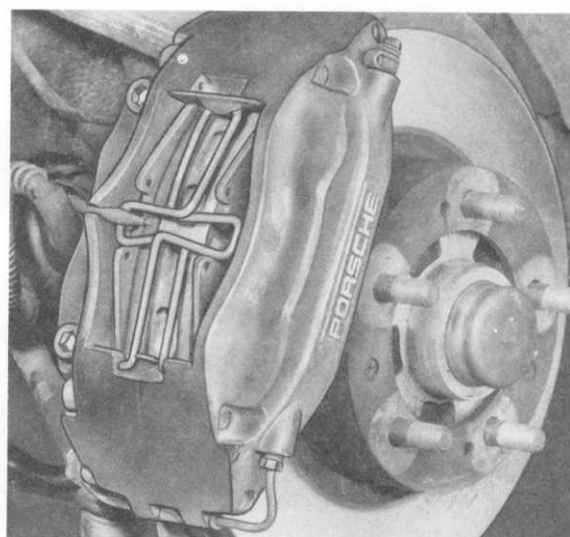
Sliding brake caliper



Floating caliper

## Braking System, 86 Models Onward

Four-piston fixed-caliper brakes are fitted on front and rear axles instead of the sliding-caliper (floating or sliding caliper) systems installed in earlier models.



Four-piston fixed caliper

## TECHNICAL DATA

Description	Remarks Specifications	Wear Limit
Foot brakes	Hydraulic, dual circuit braking system with disc brakes and diagonal division up to end of 1983 models; axle circuit division since 1984 models, brake booster, floating frame caliper disc brakes on front axle and floating frame or fist caliper disc brakes on front axle. Since 07.12.1977 to end of 1983 models (diagonal division) one brake pressure regulator for each rear axle circuit. Since 1984 models one screw-in brake pressure regulator on brake master cylinder or on hydraulic unit (cars with ABS) for rear axle brake circuit. Since 1984 models optionally extra with ABS, which is integrated in the conventional brake system.	
Brake booster dia. Up to 08.01.1979 Since 09.01.1979	9 inches 10 inches, internal ratio 3.0 for floating frame caliper disc brakes 10 inches, internal ratio 3.8 for fist caliper disc brakes	
Brake master cyl. dia. Up to 1983 models Since 1984 models	23.81 mm 23.81/19.05 mm	
Brake pressure regulator	3 versions	
Switching pressure for brake pressure regulator		
Version I (9" brake booster)	55 bar	
Version II (10" brake booster)	33 bar	
Version III (10" brake booster and screw-in regulator)	33 bar	
Caliper piston dia. Front Rear	54 mm 36 mm	
Brake disc dia. Front Rear	282 mm 289 mm	
Eff. brake disc dia. Front — floating frame caliper fist caliper Rear	220 mm 228 mm 235 mm	



Description	Remarks Specification	Wear Limit
Pad thickness		
Front, floating frame	13 mm	2 mm
floating caliper	13 mm	2 mm
Rear	13 mm	2 mm
New brake disc thickness		
Front, floating frame	20 mm	
grooved disc	20.5 mm	
floating caliper	32 mm	
Rear	20 mm	
Min. thickness after machining *		
Front, floating frame	19.2 mm	18.6 mm
floating caliper	31.2 mm	30.6 mm
Rear	19.2 mm	18.6 mm
Thickness tolerance for brake discs	max. 0.02 mm	
Lateral runout for brake discs	max. 0.05 mm	
Lateral runout for wheel hubs	max. 0.05 mm	
Lateral runout for installed brake discs	max. 0.1 mm **	
Max. surface finish of brake discs after machining	max. 0.006 mm	
Play on brake pedal with brakes bled and engine stopped	10 mm	
Hand brakes (parking)	Mechanical action on both rear wheels (drum brakes)	
Brake drum dia.	180 mm	181 mm
Brake shoe width	25 mm	
Brake surface per wheel	85 cm <sup>2</sup>	
Brake liner thickness	4.5 mm	2 mm

\* Brake discs must be machined symmetrically, i. e. evenly on both sides.

\*\* See page 46 - 16.



## TECHNICAL DATA 86 MODELS ONWARD

Description	Remarks Specifications	Wear Limits
Foot brake	<p>Hydraulic, dual-circuit braking system with separate front/rear axle braking circuits (black/white), brake booster, ventilated brake disks with four-piston fixed calipers front and rear. Push-rod braking circuit for front wheels.</p> <p>A braking-force regulator is bolted on the main brake cylinder or on the hydraulic unit (with ABS system) for the rear-axle braking circuit.</p> <p>Anti-lock braking system (ABS), optional on 86 models, standard on 87 models onward. The ABS is integrated in the standard footbrake.</p>	
Brake booster i <sub>v</sub>	<p>10" dia. 4.5 (internal boost ratio)</p> <p>87 models onward, pedal free travel is shorter</p>	
Brake master cylinder	<p>Tandem cylinder with 2 central valves 23.81/20.64 mm dia.</p>	
Braking force regulator (screw-in regulator) Switchover pressure Reduction factor	<p>18 bar 0.46</p>	

Description	Remarks Specifications	Wear Limits
Brake disk dia. front rear	304 mm 299 mm	
Effective brake disk dia. front rear	250.8 mm 246 mm	
Piston dia. in caliper front	86 models, each fixed caliper 2 x 42 + 2 x 36 mm	
front	87* models onward each fixed caliper 2 x 44 + 2 x 36 mm	
rear	each fixed caliper 2 x 30 + 2 x 28 mm	
Pad surface per front wheel	126 cm <sup>2</sup>	
Pad surface per rear wheel	86 cm <sup>2</sup>	
Total pad surface	424 cm <sup>2</sup>	
Pad thickness front rear	13 mm 13 mm	2 mm 2 mm
Brake disk thickness new front rear	32 mm 24 mm	

\* Fixed calipers with pistons of dia. 42/36 mm were installed in some cars (USA, Canada, Australia and Arabian countries) in the 1987 model year.

The front-axle brake calipers with 44/36 mm dia. pistons can be retro-fitted in 86 models only in pairs.

Description	Remarks Specifications	Wear Limits
Min. brake disk thickness* after machining      front rear	30.6 mm 22.6 mm	30 mm 22 mm
Max. brake disk thickness tolerance	0.02 mm	
Max. brake disk lateral runout	0.05 mm	
Max. lateral runout of installed brake disk	0.1 mm**	
Max. surface roughness after machining	0.006 mm	
Play at brake pedal, brakes bled and engine stopped (footbrake arm without stop)	approx. 10 mm usually (i.e. without any means of support for foot- brake arm), determined by permanently set clearance at points inside braking unit	
P a r k i n g   b r a k e*** (handbrake)	Drum brakes applied mechan- ically on both rear wheels	
Parking brake drum dia.	180 mm	181 mm
Brake shoe width	25 mm	
Brake liner surface area per wheel	85 cm <sup>2</sup>	
Brake liner thickness	4.5 mm	2 mm

\* Brake disks may only be machined symmetrically, i.e. evenly on both sides.

\*\* See page 46 - 16

\*\*\* 87 models onward, parking brake liners made of asbestos-free material (Energit 559). The liners can be retrofitted to vehicles earlier than model year 87 (right-hand and left-hand sides).

## TORQUE SPECIFICATIONS FOR MECHANICAL PARTS OF BRAKING SYSTEM

Location	Description	Thread	Material	Torque Nm (ftlb)
Panhead screw of clamping nut	Allen-head screw	M 7	10.9	15 (11)
Brake caliper to steering knuckle	Hex screw/cap screw	M 12x1.5	8.8	85 (62)
Brake caliper to wheel carrier	Hex screw/cap screw	M 12x1.5	8.8	85 (62)
Floating caliper to bracket	Guide pin	M 9		15 - 20 (11 - 15)
Brake disk to wheel hub	Hex screw	M 6	8.8	10 (7)
Guard to steering knuckle	Hex screw	M 7	8.8	15 (11)
Locking pawl for handbrake to bearing bracket	Hex screw	M 8	8.8	25 (18)
Propshaft or rear axle to wheel hub	Locknut	VHM 22x1.5	8	460 (336)
Wheel to wheel hub	Wheel nut	M 14x1.5	A1	130 (95)

Location	Description	Thread	Material	Torque Nm (ftlb)
Locking pawl to handbrake lever	Locknut	M 8	8	23 (17)
Guard to wheel carrier	Locknut, Hex bolt	VFM 8	8	23 (17)
		M 6	8.8	10 (7)
Speed sensor to wheel carrier and steering knuckle	Socket-head screw	M 6	8.8	10 (7)

## Technical data as of MY '92

Designation		Remarks, dimension 928 GTS	Wear limit 928 GTS
<b>Operating brake (foot brake)</b>		Hydraulic twin-circuit brake system with front axle/ rear axle circuit division. Vacuum booster, internally vented brake discs with four-piston fixed caliper on front and rear axles. The pushrod circuit is assigned to the front wheels. ABS standard.	
Brake booster	Ø inch	10	
Boost ratio		4.5	
Brake master cylinder	Ø front Ø rear	23.81 mm 20.64 mm	
Brake booster Vacuum reduction factor		18 bar - 0.46	
Brake disc Ø	front rear	322 mm 299 mm	
Effective brake disc Ø	front rear	259.6 mm 246 mm	
Piston Ø in fixed caliper	front rear	2 x 44 + 2 x 36 mm 2 x 30 + 2 x 28 mm	
Brake pad area	front rear	302 cm <sup>2</sup> 172 cm <sup>2</sup>	
Total brake pad area		474 cm <sup>2</sup>	
Pad thickness	front rear	approx. 12 mm approx. 12 mm	2 mm 2 mm

Designation		Remarks, dimensions 928 GTS	Wear limit 928 GTS
Brake disc thickness new	front	32 mm	
	rear	24 mm	
Min. brake disc thickness * after machining	front	30.6 mm	30.0 mm
	rear	22.6 mm	22.0 mm
Thickness tolerance of brake disc max.		0.02 mm	
Runout of brake disc max.		0.05 mm	
Runout of wheel hub max.		0.05 mm	
Runout of brake disc when fitted max.		0.1 mm	
Surface roughness of brake disc after machining max.		0.006 mm	
Pushrod clearance (measured at brake pedal plate)		approx. 10 mm**	
<b>Parking brake (handbrake)</b>		Drum brake, acting mechanically on both rear wheels	
Parking brake drum Ø		180 mm	181 mm
Brake shoe width		25 mm	
Brake lining thickness		4.5 mm	2 mm

\* The brake disc must only be machined symmetrically, i.e. by a uniform amount on both sides.

\*\* provided normally by preset air gap in brake booster if no support is provided for operating brake lever.

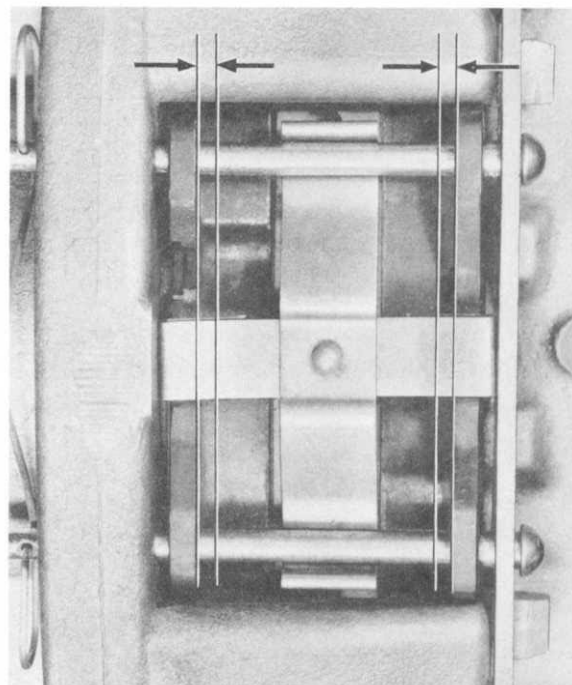
## CHECKING THICKNESS OF BRAKE PADS

All brake pads on one axle must be replaced when "brake pad" indicator comes on, however at latest when pad thickness is worn to 2 mm.

If the indicator lamp reports the brake pad wear, the warning contact (sensor plus wire and plug) must also be replaced.

The complicated and expensive replacement of the warning contact can be avoided by replacing the brake pads at the latest when thickness is 4 mm (or 2.5 mm for version described below).

This will depend on the location of the warning contact in the brake pad. The pad end take-up bore has been moved 1.5 mm in direction of the pad back-plate as from April of 1982. Tolerances on the warning contact have also been limited. The warning contacts must be replaced when the core of the wire has been ground. Replacement is not necessary when only the plastic part of the warning contact has been ground.



1. Remove wheels to check the brake pads.

Floating Frame Caliper Disc Brake

2. Visually inspect brake pads for wear.

3. Visually inspect pads of floating frame disc brakes through opening of housing (frame).



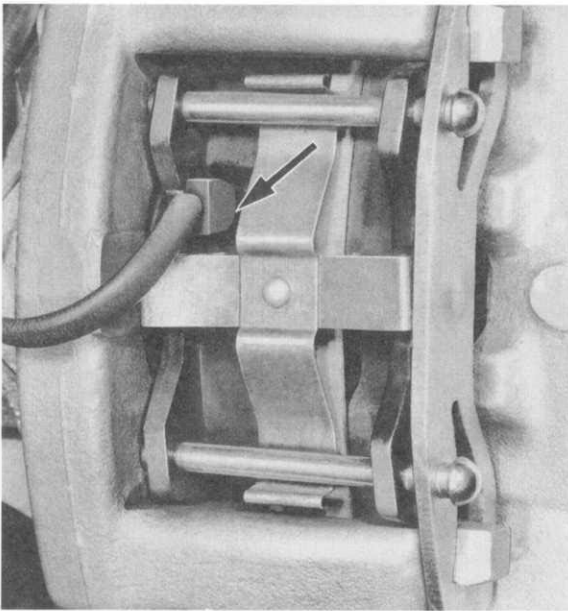
## REMOVING AND INSTALLING BRAKE PADS (Floating Frame Caliper Disc Brakes)

### Removing

#### Note

If brake pads can be re-used, mark them for reassembly when removing. Pads must not be moved from outside to inside and vice versa or from right to left wheels. This would cause uneven braking effect.

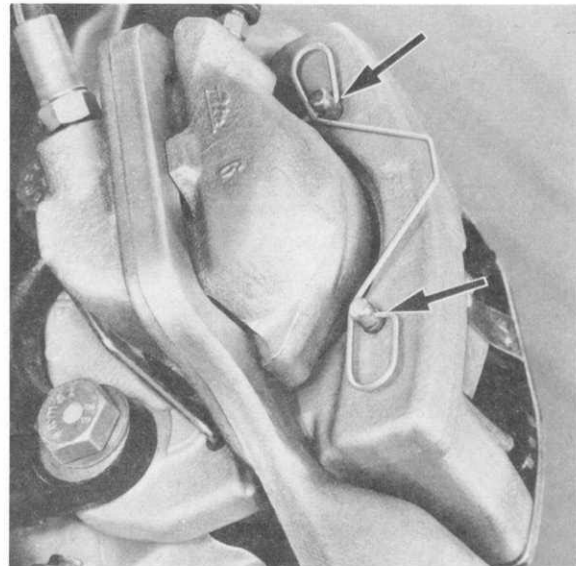
1. Pull warning contact out of pad plate.



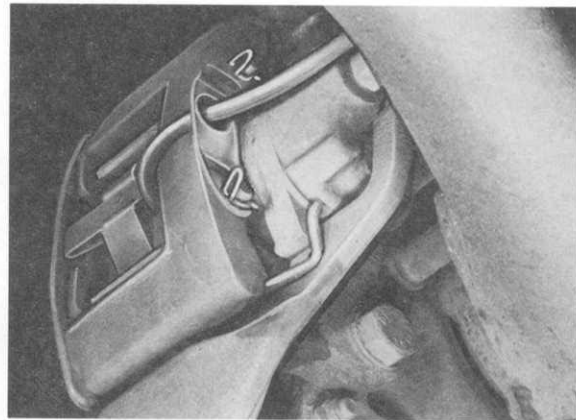
#### Note

Replace warning contacts when core of wire has been ground through or down. The warning contact can still be used when plastic part of warning contact has traces of wear.

2. Remove spring lock or lock wire with wire guide plate from retaining pins.

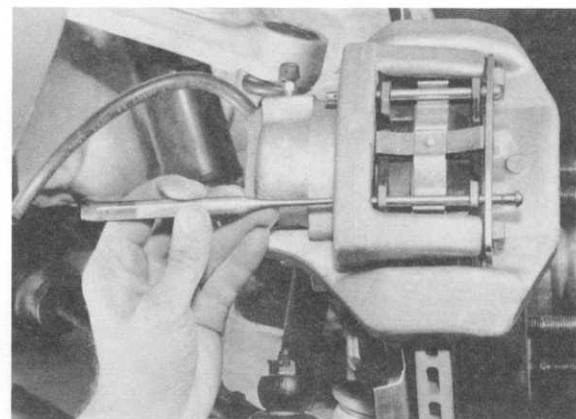


Spring Lock

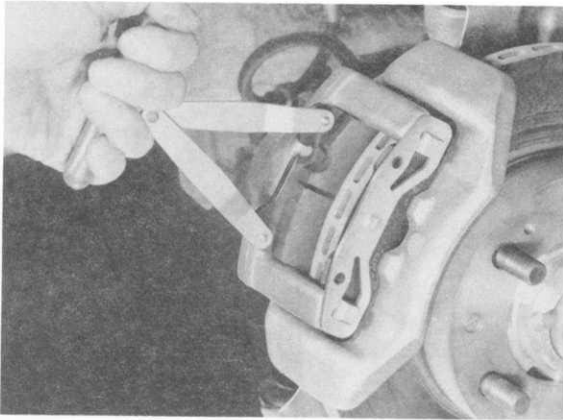


Lock Wire with Wire Guide Plate

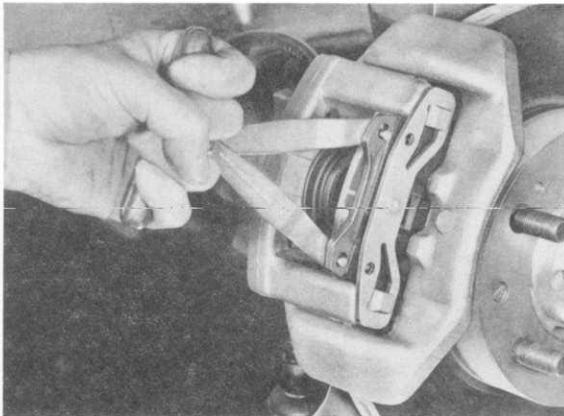
3. Remove retaining pins.



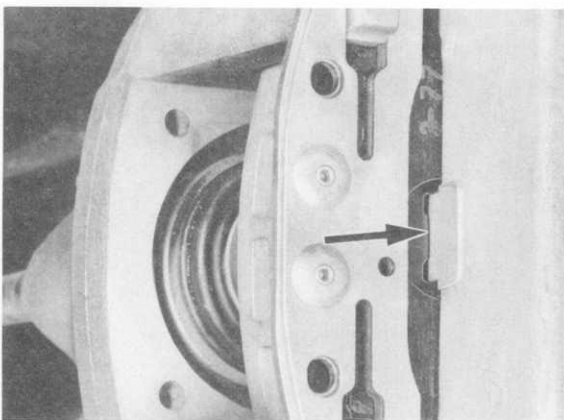
4. Remove inner brake pad with a pulling hook or impact puller.



5. Pull out outer brake pad. This requires pressing out floating caliper frame until brake pad protrudes out of pin on floating caliper frame.



Front Brake Caliper



Rear Brake Caliper

### Installing

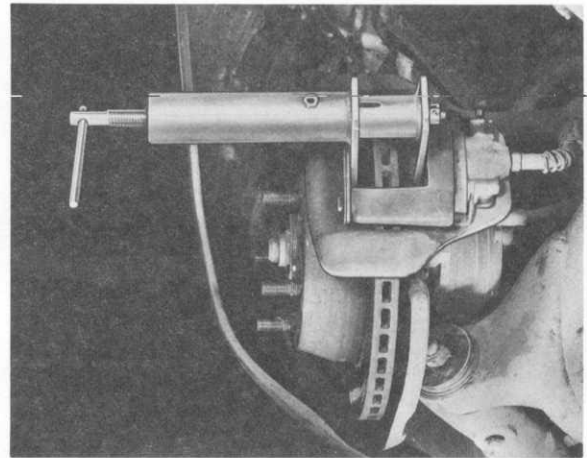
1. Replace brake pads, which show deep cracks, have become loose from backplate or are covered with oil. Also in this case replace all four pads of one axle.

Brake pads with different friction values are installed depending on version. Make sure that all four wheels have brake pads of same type to correspond with brake caliper combination.

Floating frame caliper, front axle  
Floating frame caliper, rear axle  
Energit 394 GG/380

Floating caliper, front axle  
Floating frame caliper, rear axle  
Jurid 226 FF/238

2. Press back piston to initial position with a special tool.



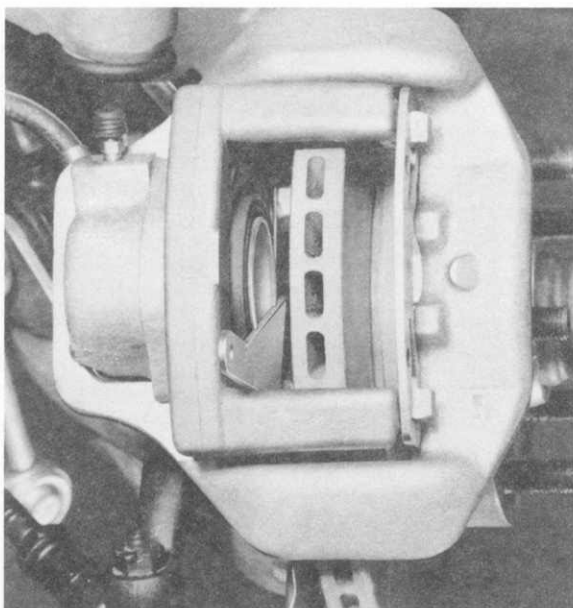
### Note

To prevent brake fluid tank from overflowing, draw off small amount of brake fluid before pressing back piston. Use syringe reserved exclusively for brake fluids. Brake fluids are poisonous and must not be syphoned off through a hose.

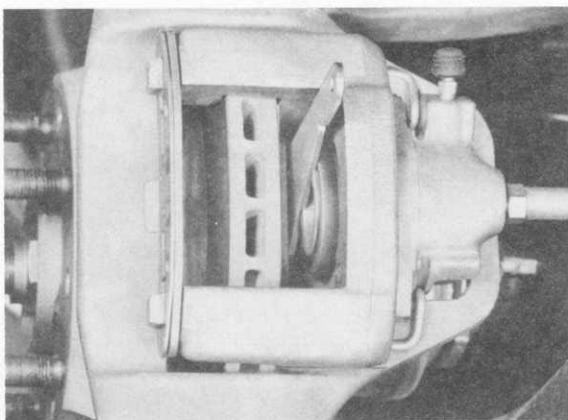
3. Clean bearing and guiding surfaces of brake pads in brake calipers with gasoline or a cylindrical brush. Never use solutions containing mineral oil or sharp edged metal tools.

4. Check 20° piston position and if necessary adjust with piston turning pliers.

Hold piston gauge at bottom guide surface on front brake caliper.



Hold piston gauge at top guide surface on rear brake caliper.



5. Insert outer brake pad and press floating caliper frame in direction of brake disc so far, that pin engages in groove of pad backplate.

#### Note

To prevent seizure of brake pads in brake calipers due to corrosion, apply a thin coat of grease on bearing and guiding surfaces.

Use Optimoly HT (copper paste) or Plastilube.

6. Insert inner brake pad.

7. Install cross spring, retaining pins and spring lock or lock wire with wire guide plate.

8. Press warning contact into pad in correct position.

9. Depress brake pedal of stationary car hard several times to move brake pads to their normal operating position. Now check level of brake fluid in tank, adding more if necessary.

#### Bedding-In Brake Pads

Brand-new brake pads have a once only loss of braking effect (thermal fading), which disappears after a breaking-in time of about 200 km (125 mi.). During this period full stops from top speeds should be limited to emergency situations. New pads must be bedded in by applying medium forces to brake pedal and at larger intervals. Brake pads will first provide maximum braking effect after being bedded in.

## REMOVING AND INSTALLING BRAKE PADS (Floating Caliper Disc Brakes)

### Removing

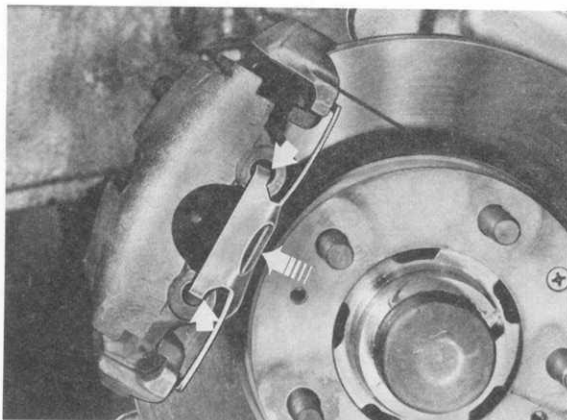
When brake pads can be used again, they must be installed on same wheel (otherwise non-uniform braking effect).

1. Pull warning contact (wear sensor) out of inner pad plate.

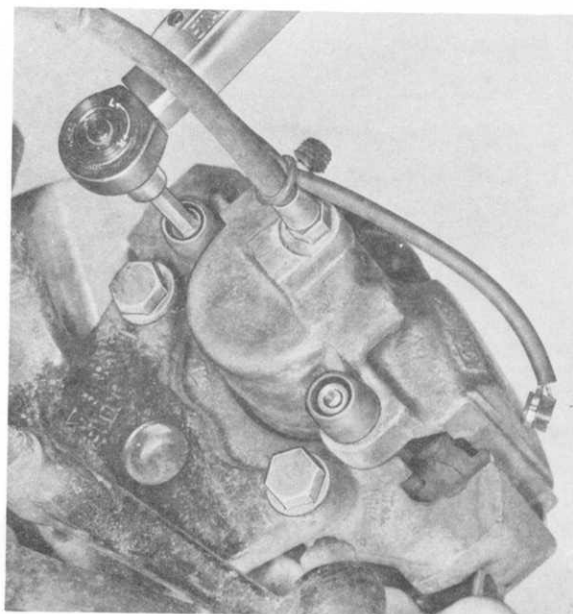
### Note

Replace warning contacts with ground through or down wire cores. Warning contacts can still be used when only plastic parts of warning contact have traces of wear.

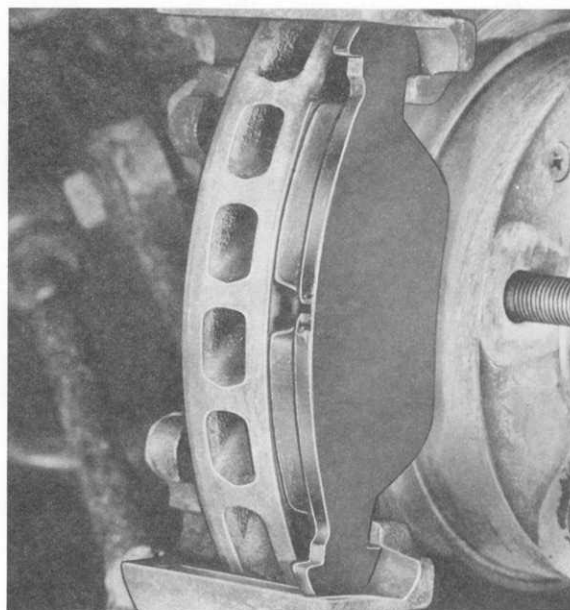
2. Remove housing retaining spring. This requires applying pressure in center (large arrow) of spring until it disengages in the housing bores. Then remove spring toward outside at same time without applying force. Never bend spring by applying force.



3. Remove any dirt on guide pins between holder and housing.
4. Pull plugs out of guide sleeves. Unscrew guide pins with a 7 mm socket wrench and pull out of guide sleeves.

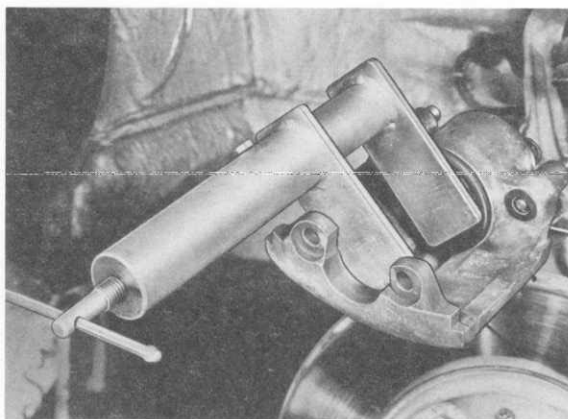


5. Pull housing toward outside of car by hand to push back the piston slightly. Then remove the housing. Pull piston end brake pad out of piston.
6. Lay housing (first) aside and suspend from suitable point on car with a piece of wire. Remove outer brake pad from holder.



## Installing

1. Push back piston completely with special tool.



## Note

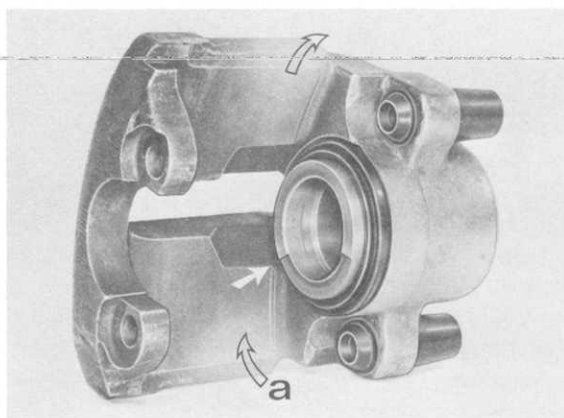
To prevent brake fluid from being forced out of tank, it might be necessary to drain some of the brake fluid prior to pushing back the piston. Use a syringe for this work, which is reserved exclusively for brake fluid. Brake fluid is poisonous and must never be sucked out through a hose.

2. Clean pad guiding surfaces in housing and holder. Never use sharp-edged tools or cleaning solutions with mineral oil content. Check seals, caps, guide pins, guide sleeves as well as housing retaining springs and brake pads for damage, replacing if necessary.  
Watch pairing of brake pads for front/rear axles.

Two types of brake pads are used on the rear axle.

Rear axle pads for pairing  
floating frame caliper disc brakes on all wheels.  
Rear axle pads for pairing  
floating caliper disc brakes on front axle and  
floating frame caliper disc brakes on rear axle  
(see page 46 - 3).

3. Check 20° piston position and adjust with special piston pliers, if necessary. Stepped surface of piston faces down toward brake disc inlet side. Edge on bottom of housing (see arrow) can be used as a reference point.



Arrow a = brake disc inlet side

4. Push brake pad with riveted retaining clip into piston and place second pad on outside of holder's guiding surface on brake disc.

Place housing over brake disc and brake pad, screw in guide pins with a 7 mm socket wrench and tighten to specified torque.

## Note

To prevent seizure of brake pads in brake calipers due to corrosion, apply a thin coat of grease on pad guiding surfaces.  
Use Optimoly HT (copper paste) or Plastilube.

5. Insert plugs in guide sleeves.
6. Engage housing retaining spring.  
Check that spring locates properly in hole. Do not use force to bend spring.
7. Insert warning contact: renew if necessary.
8. Press brake pedal several times so that piston and housing align brake pads with brake disk, or until clearance adjusts itself correctly.
9. Check level of brake fluid in reservoir, top up to MAX mark with fresh brake fluid if necessary.
10. Check operation and efficiency of brakes, check system for leaks.

#### R u n n i n g   i n   t h e B r a k e   P a d s

New brake pads must be run in over the first 200 km. Only then are the friction and wear characteristics optimized. During the running-in period, severe braking from high speeds should be limited to emergency situations.



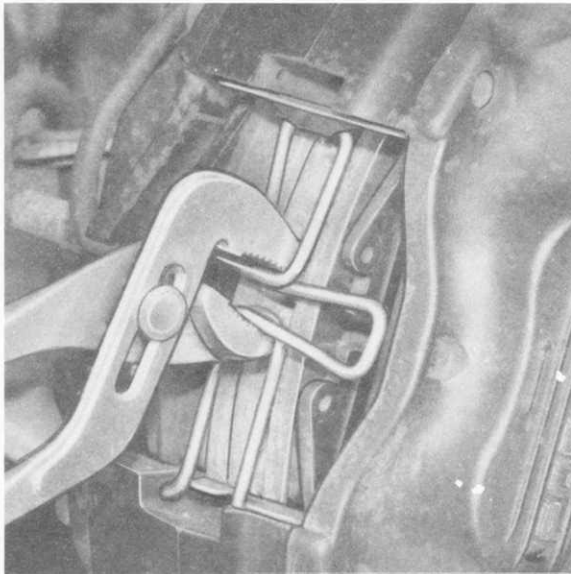
## Removing and installing brake pads (four-piston fixed caliper disk brakes)

### Removing

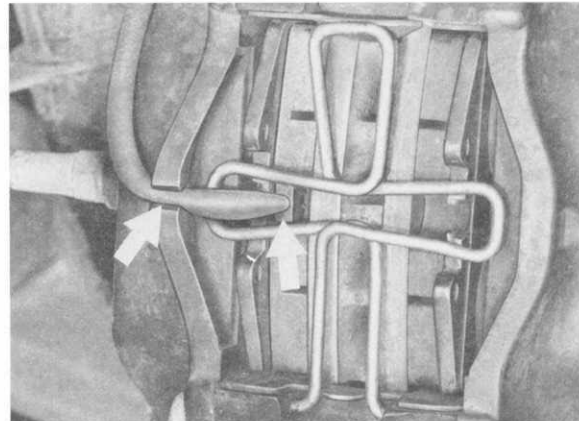
#### Note

If the brake pads are to be installed again, they must be marked with their positions when removed. It is forbidden to interchange the inside and outside brake pads or those from the left and right wheels, and this can result in uneven braking.

1. Press the spreader spring together in the center and disengage it from its holder.  
**At the same time, or before pressing the spreader spring together, press it towards the brake disk in the retaining plate area, to relieve the load. This will avoid damage to the retaining plate.**



2. Run the warning contact lead out at the brake caliper and pull the warning contact out of the brake pad plate.



#### Note

Renew warning contacts if the core wire has been abraded away or ground through. If there are rubbing marks on the plastic part of the warning contact, it can be re-used.

3. Pull the brake pads out with the brake pad extractor tool. On brake calipers with damper plates, always note the following:

Run the brake pads out together with the damper plates. If this is not possible (it depends on the degree of brake pad wear), separate the damper plates from the brake back-plate with a suitable spatula before removing the pads. In either case, first move the brake pads back as far as possible with the piston re-setting tool. If necessary, draw off a small amount of brake fluid from the reservoir first. Important: the spatula must be inserted accurately between the brake pad and the damper plate, in order to avoid damaging the brake piston seals.

## Installing

### Notes

- On four-piston fixed caliper brakes, damper plates must be installed when asbestos-free brake pads are used. For details of the correct damper plates for the various brake calipers, refer to Group 4 Technical Information.
  - Renew the damper plates each time the brake pads are renewed.
  - It is forbidden to mix asbestos-free brake pads and brake pads containing asbestos on the same car.
  - Asbestos-free brake pads are also available for cars with fist-type and floating caliper disk brakes.
1. If necessary, move the pistons back to their initial positions with the resetting tool.
  2. Clean the seat and guide faces for the brake pads in the brake caliper with spirit and a special cylinder brush or similar, to ensure that the pads move freely in their bores. Make quite sure that the brake piston seals are not damaged.
  3. Check that the brake calipers are installed in the correct positions. The small pistons must be at the side where the brake disk enters. This can also be checked at the arrow above the PORSCHE logo; this arrow shows the direction of brake disk rotation.

### Note

From 1987 models on\*, the **front** brake caliper piston diameters were changed to 44/36 mm (previously 42/36 mm).

During the 1989 model year, a further modification was introduced. The piston seal was changed from the scraper ring type to the protective cap type. (Technical Information Gr. 4 No. 1/89) Notes on replacement: refer to Pages 47-04 / 47-05.

\* On some cars (those for the USA, Canada, Australia and Arab countries), fixed calipers with piston diameters of 42/36 mm were still used in the 1987 model year. For notes on replacement, refer to Page 47-04.



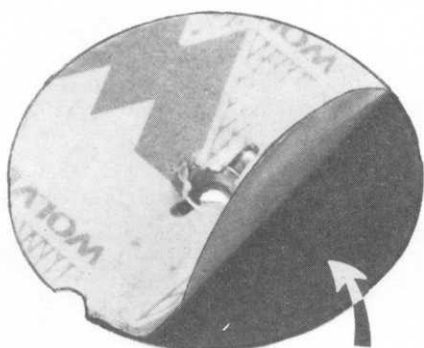
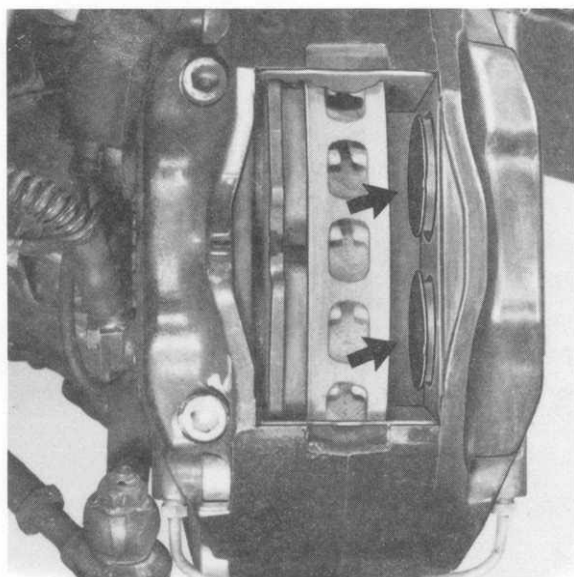
#### 4. Installing new damper plates in the pistons.

When installing, make sure that the internal diameters of the spring and piston are correctly matched together (Technical Information Gr. 4 and Part List).

The damper plates should engage in the pistons when light pressure is applied, but must not be too loose (no radial play is permissible).

The damper plates are provided with an adhesive and protective foil.

The protective foil must be pulled off before installation.



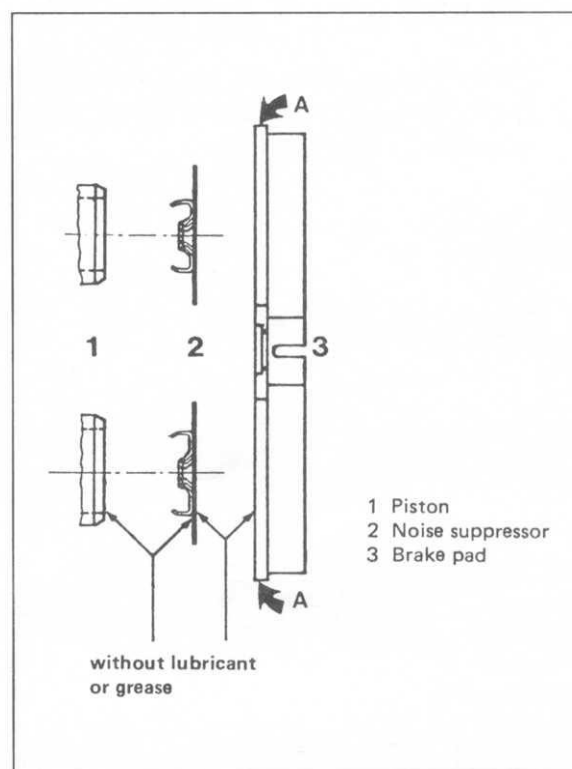
#### 5. Insert the brake pads. **Make sure that the correct grade of brake pad is used.**

##### Note

**When damper plates are installed, the brake carrier plates (back of brake pads) must not be greased.**

However, to prevent the brake pads from corroding and seizing in the brake caliper, the seat and guide faces (arrows A) are given a thin film of grease.

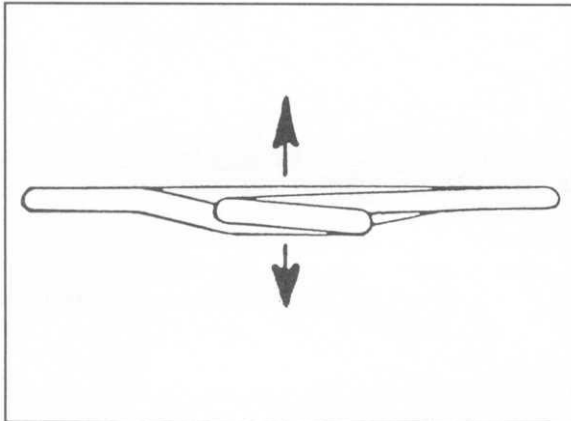
Use Optimoly HT (Cu paste) or Plastilube (Schillings Co., P.O. Box 1703, 7080 Aalen, Federal Republic of Germany) for this purpose.



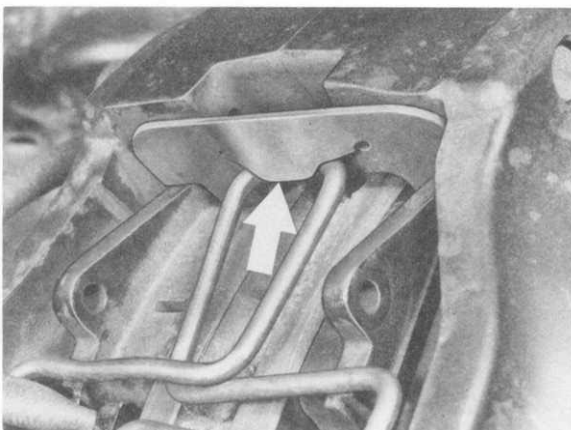
6. Grease the spreader spring retaining lugs with Optimoly TA or Plastilube. If new spreader springs are installed, the flat side should face the brake disk. If wrongly installed, correct brake pad seating cannot be guaranteed and the raised section in the center of the cross will rub against the brake disk.

**Press the spreader spring together in the center and insert it. Make sure that spreader springs engage correctly (arrow). Do not force the spreader spring into position or the retaining plate may be damaged.**

Brake disk



Outboard face



7. Press the warning contact(s) into the pad plate in the correct positions. Secure the warning contact lead to the brake caliper and, if two warning contact leads are present (from 1989 models on), to the cross spring as well.

#### Note

If tolerances are unfavorable, the spreader spring may have to be disengaged again to do this.

8. With the car standing still, depress the brake pedal firmly several times, so that the brake pads adopt a position ready for later operation. After this, check brake fluid level in the reservoir and add more fluid if necessary.

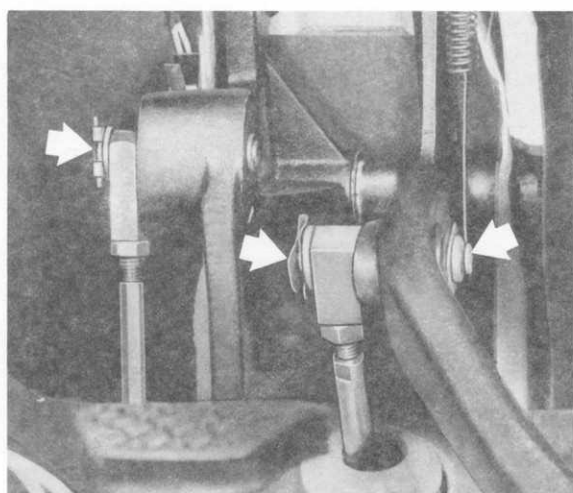
#### Running in the brake pads

New brake pads need to be used for about 200 kilometers before they develop their optimum friction and wear characteristics. During this time, avoid full brake applications from high speeds unless an emergency arises.

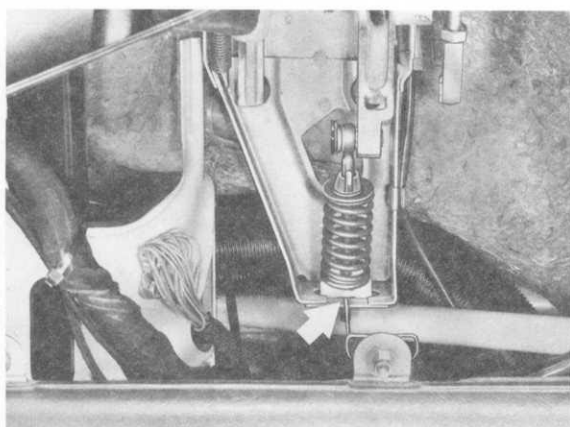
## REMOVING AND INSTALLING BRAKE PEDAL

## Removing

1. Move back seat and steering wheel up to make job easier.  
If applicable, remove shelf.
2. Disconnect return spring on brake pedal. Remove shaft for brake and clutch push rod.



3. The guide rod for clutch power spring has an assembly bore. Press down on clutch pedal until bore has cleared the bearing. Insert a piece of 3 mm dia. wire into bore in this position to remove force on pedal.



4. Remove circlip and move bearing shaft toward outside until brake pedal has been run out.



## Installing

1. Check all bushings and stops for clutch and brake pedals, replace if necessary. Lubricate all bearing and sliding surfaces with a multi-purpose grease.
2. Install brake pedal with bushings. Slide in bearing shaft and install circlip.

## Note:

Bearing shaft can only be pushed in fully, if bearing shaft and console surfaces are aligned.

3. Remove wire in guide rod for clutch power spring.
4. Install clutch and brake push rod.  
Attach return spring. Check push rod play, correcting if necessary.  
Clutch play, see page 30 - 1 (approx. 3 mm on pedal equals approx. 0.5 mm between push rod and master cylinder piston).  
If there is a mechanical stop light switch, check the adjustment.

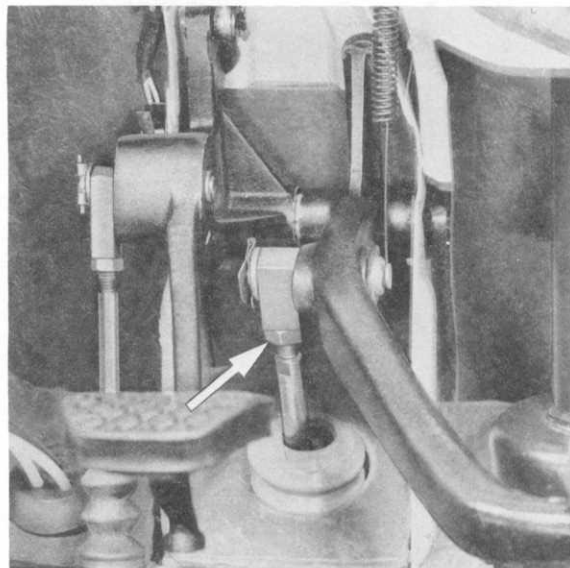
## ADJUSTING BRAKE PRESSURE ROD

Until End of Model  
Year 85  
(Stop on brake-pedal arm)

## Note :

With the pedal released, the pressure rod must exert no pressure on the brake unit.

With brakes bled and engine switched off, move pressure rod at brake pedal by hand to check play and assure adequate clearance at the brake unit.



The minimum play is 10 mm.

3. Tighten pressure rod locknut. If a mechanical stoplamp switch is fitted, check switch setting (page 46 - 10a).

## Adjusting

1. Pull brake-pedal arm back to stop.
2. Slacken pressure rod locknut and adjust pressure rod until pivot pin of adapter at brake-pedal arm is slack, or until the specified play is attained (at least 10 mm at the pedal).

## ADJUSTING BRAKE PRESSURE ROD

86 Models Onward  
(without stop on brake-pedal arm)

## Note :

It is only necessary to adjust the brake pressure rod if:

- the brake booster is replaced
- brake pressure rod adapter has been removed.
- the pressure rod or the adapter has been turned away from its original position.

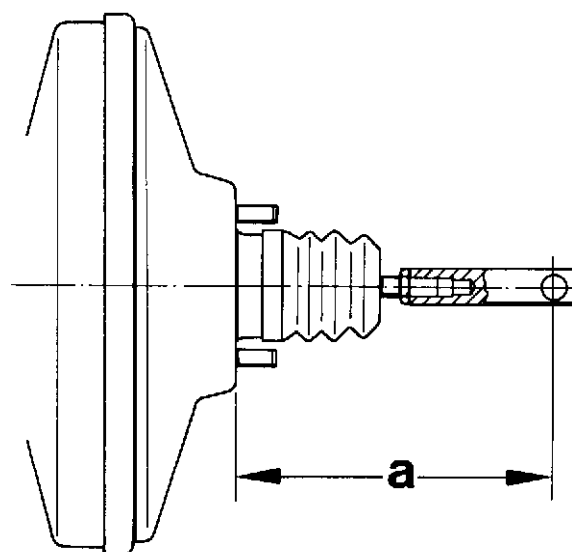
The brake-pedal arm does not have a stop. The arm is in its initial position when brake unit (brake booster + brake master cylinder) is in its released position. Since the brake pedal is unsupported in its initial position when the brake pressure rod is correctly adjusted, the permanently set clearances in the brake booster are assured. When the brakes have been bled and with the engine switched off, a pressure-rod play of approx. 10 mm can be felt at the brake-pedal plate when the pedal is depressed by hand.

## Adjusting

1. Adjust length of brake pressure rod by turning adapter or pressure rod. Length  $a$  must be  $158 \pm 2$  mm measured from the bearing face of the brake booster on the body to the center of the adapter pivot pin.

## Note :

If the car has manual transmission and the brake pedal is more than 8 mm lower than the clutch pedal, correct position of brake pedal by turning pressure rod.

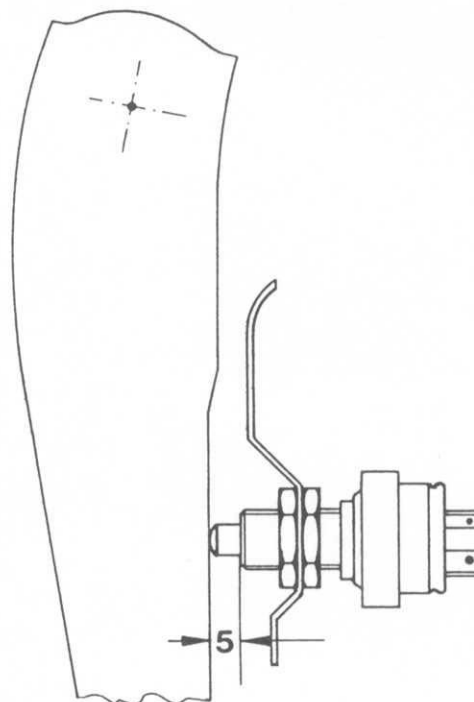
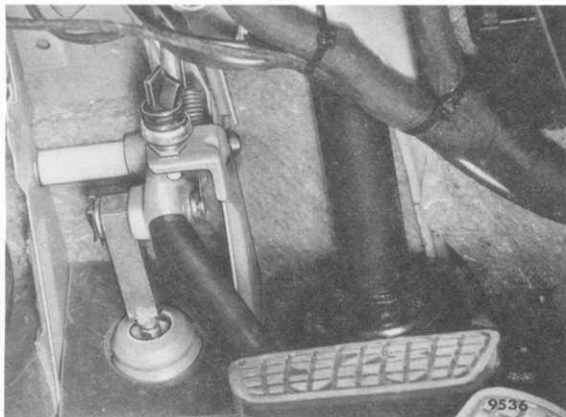


2. Tighten locknut.

3. Check setting of stoplamp switch (page 46 - 10a).

## CHECKING SETTING OF STOPLAMP SWITCH

In 1984 models onward, a mechanically operated switch mounted on a bracket above the brake-pedal arm is installed as stoplamp switch.



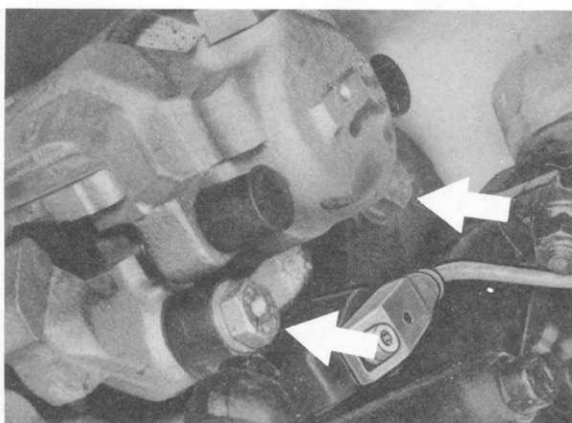
With the pedal arm against its stop (initial position), there must be a 5 mm gap between stoplamp switch and brake-pedal arm. If necessary, adjust position of stoplamp switch by turning mounting nut until the gap is as specified. Turn nuts in opposite directions (counter).

## DISASSEMBLING AND ASSEMBLING FRONT WHEEL BRAKE

## D i s a s s e m b l i n g

1. Remove brake caliper (do not disconnect brake hose) and place on upper control arm or attach to suitable support with a piece of wire.

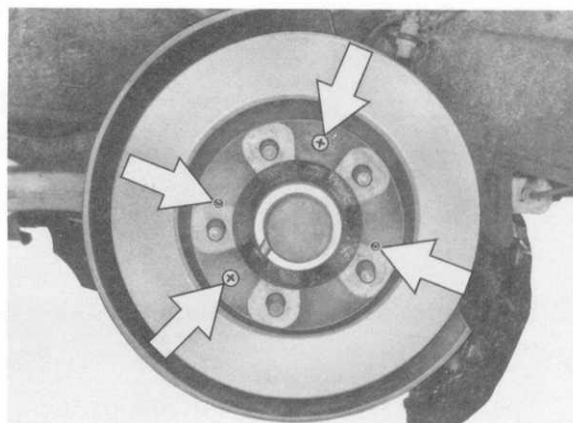
Mounting, until end of model year 85



Mounting, 86 models onward  
(fixed-caliper brake)



2. Take off brake disk after removing countersunk bolt (s). If a brake disk is so tightly seated that light blows with a nylon-headed hammer do not move it, screw hex bolts uniformly into the two 8 mm threads of the disk and press disk off. It is possible that the bolts do not sit squarely on the lugs. A modification has been incorporated.



## A s s e m b l i n g

1. Inspect all parts and replace if there is any sign of damage.
2. Clean centering face for brake disk on wheel hub and apply a thin coat of Optimoly TA.

3. Install brake disk and brake caliper. Tighten caliper retaining bolts, torque: 85 Nm (62 ftlb). Ventilation ducts of brake disks used with floating-caliper and fixed-caliper brakes are involute: do not mix up right-hand and left-hand disks.

Distinguishing feature:  
involute shape and

spare part number

The spare part number is inscribed on the brake disk.

Spare part, left-hand side  
- 3rd group number is odd

Spare part, right-hand side  
- 3rd group number is even

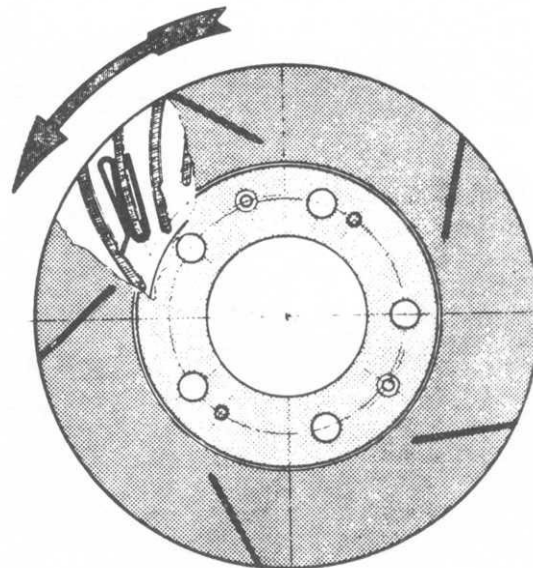
Example:

Spare part No. left-hand brake disk:

928.351.043.03 left

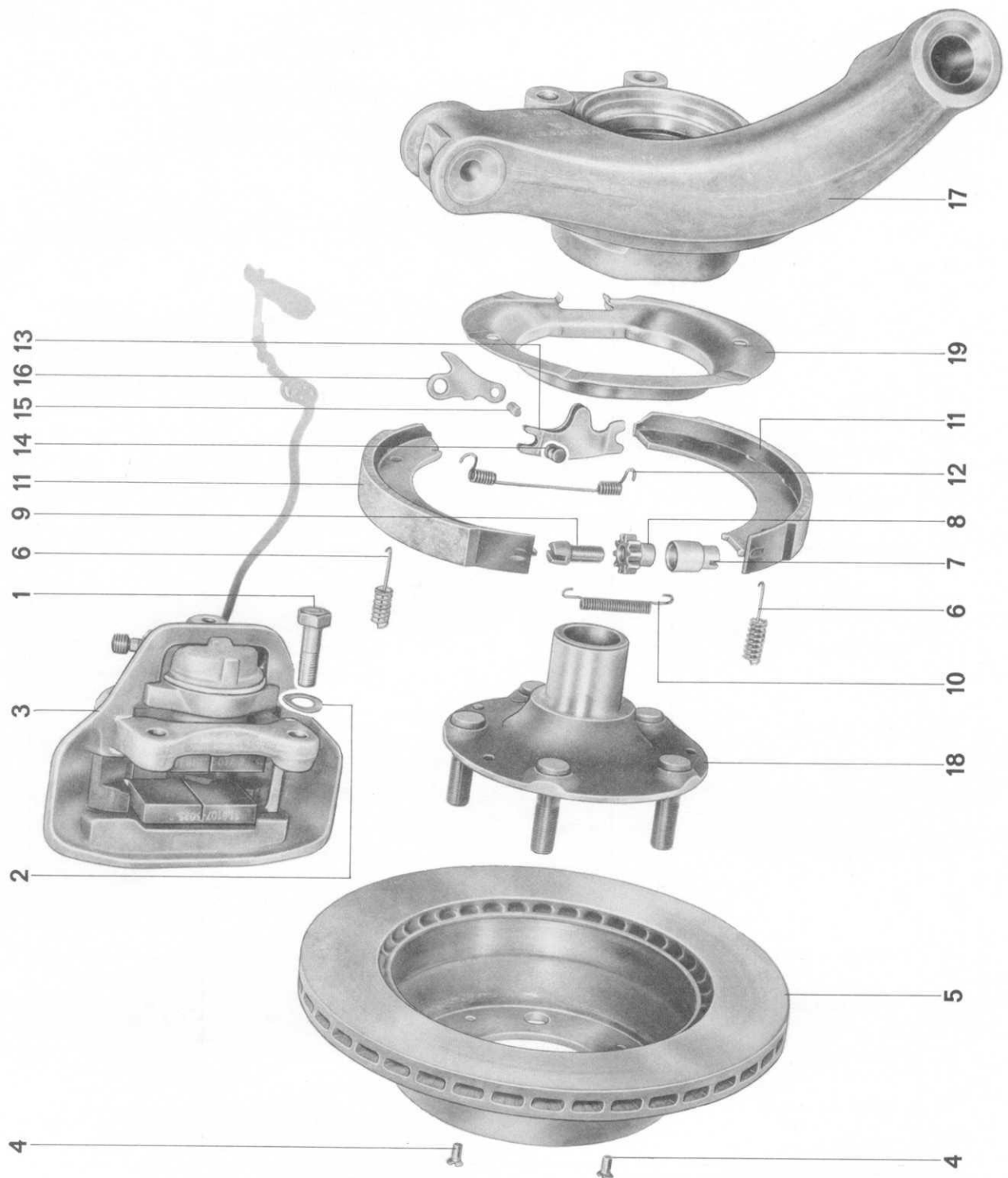
Spare part No. right-hand brake disk:

928.351.044.03 right



Forward direction of travel



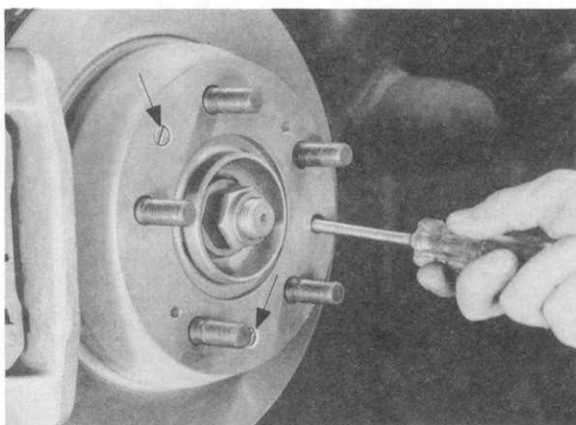


No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Bolt	2		Tighten to specified torque	
2	Washer	2		Replace, if necessary	
3	Floating frame caliper	1	Suspend from suitable point on car that brake hose is without tension		
4	Bolt	2			
5	Brake disc	1	Set back brake	Check for wear and damage	
6	Spring	2		Position correctly	
7	Support bushing	1			
8	Adjusting nut	1			
9	Adjusting screw	1			
10	Return spring	1			
11	Brake shoe	2		Replace, if necessary. Wear limit 2 mm	
12	Return spring	1		Check for correct fit	
13	Pressure bar	1			
14	Joint pin	1		Lubricate lightly	
15	Pin	1		Lubricate lightly	
16	Operating lever	1			
17	Wheel carrier	1			
18	Wheel hub	1			
19	Brake backplate	1			

## DISASSEMBLING AND ASSEMBLING REAR WHEEL BRAKE

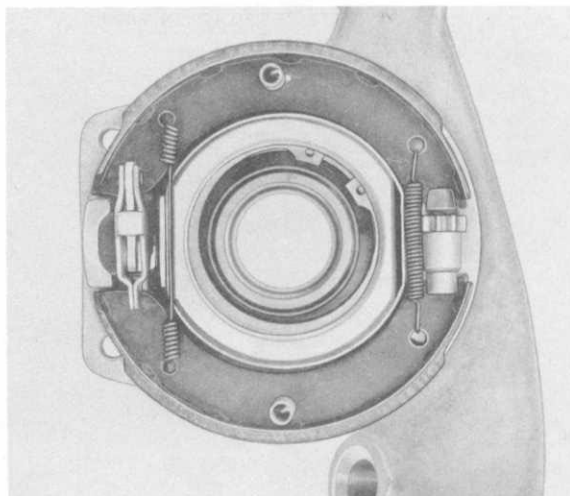
## Disassembling

1. Disconnect floating frame caliper.
2. Turn parking brake slack control toward loosening direction. Remove brake disc after unscrewing two countersunk bolts. If a seized brake disc can't be removed even with light knocks from a plastic hammer, screw two bolts in the 8 mm tapped bores of the brake disc to press off the disc.



## Note:

Install springs in correct position.



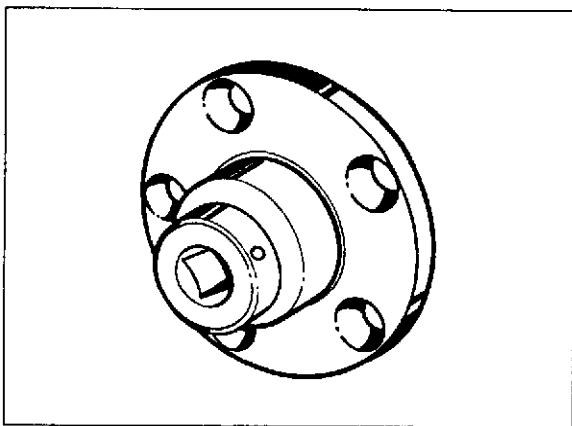
## Assembling

1. Lubricate slack control and sliding surfaces of brake shoes lightly.
2. Install spreaders, brake shoes, return springs, springs and slack control.

3. Clean centering surface on wheel hub for the brake disc and coat with Optimoly TA grease.
4. Adjust parking brake.

## Checking brake disc lateral runout

1. Measuring requirements: No tilt play present at wheel. If required, adjust wheel bearing clearance of front wheels.
2. Fit adapter plate (Special Tool 9510/1) to **wheel hub**. Tightening torque of wheel nuts (mounting nuts): 130 Nm.



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3. Engage dial gauge holder, e.g. Ate Part No. 03.9314-5500.3/01, into brake caliper, determine center position and fit by turning the wing screw.

### Notes

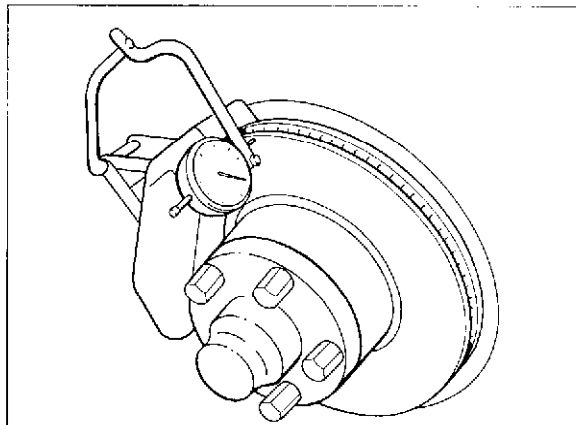
If required, fit dial gauge holder with Ate conversion kit, Part No. 03.9314-5510.3/01 (longer wing screw and bracket for dial gauge if required).

**Four-piston fixed caliper brake:** Make sure the spreader spring locating lug at the mounting plate of the fixed caliper is not damaged when the dial gauge holder is fitted in place.

**Floating caliper and sliding caliper disc brake:**

To fit the dial gauge holder, the brake pads must be removed.

4. Fit dial gauge with a slight preload. Place measuring pointer on maximum diameter of braking surface.



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5. Rotate brake disc and read off runout on dial gauge.  
Max. permissible runout of fitted brake disc **max. 0.1 mm.**

### Note

#### Runout of removed

brake disc	: max. 0.05 mm.
Runout of wheel hub	: max. 0.05 mm.

6. If the brake disc runout exceeds 0.1 mm, remove the brake disc and check runout of the wheel hub. Mark position of disc with regard to wheel hub.

7. Check wheel hub runout as follows:

Measure once outside (arrow) and once inside wheel stud area of hub face.

Lift off dial gauge carefully in cutout area of wheel hub.

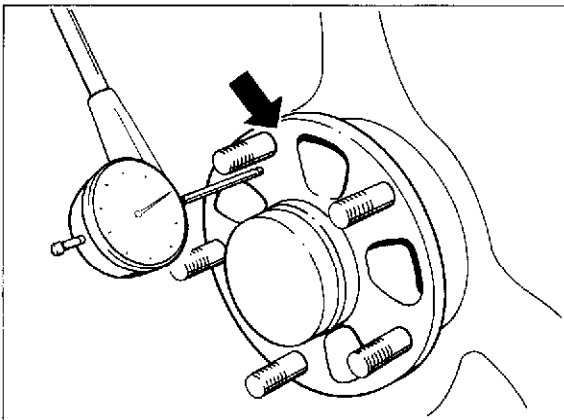
To fit the dial gauge, use either a magnetic universal dial gauge holder, e.g. as supplied by SNAP-ON (Order No. PMF 137), or a **modified (lengthened)** dial gauge holder (VW 387).

**Notes**

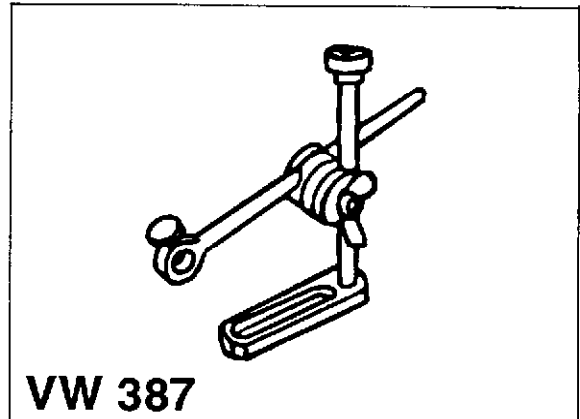
Make sure the brake hoses and brake lines are not damaged when the brake caliper is removed and installed.

The above SNAP - ON order no. PMF 137 is valid for a complete dial gauge kit since the individual dial gauge holder is not available separately.

The dial gauge kit may also be used to check the brake disc lateral runout.



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8. **Excessive wheel hub runout:**

Replace wheel hub.

**Wheel hub runout o.k.:**

Cleaning level and centering surfaces of brake disc and wheel hub. Then coat centering surface of wheel hub with a thin coat of Optimoly TA.

Fit brake disc to wheel hub in another position, offset radially with regard to wheel hub. Repeat measurements with fitted adapter plate - Special Tool 9510/1.

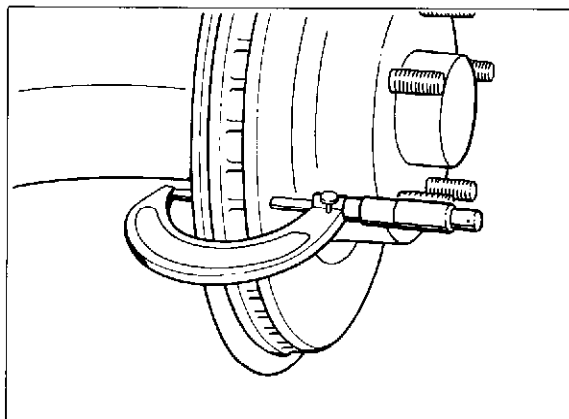
If the lateral runout is still in excess of 0.1 mm, the brake disc must be replaced.

**Note**

If the brake disc runout has been reduced by offsetting the brake disc with regard to the wheel hub, one 6 mm countersunk screw may be omitted if two 6 mm countersunk screws had been fitted.

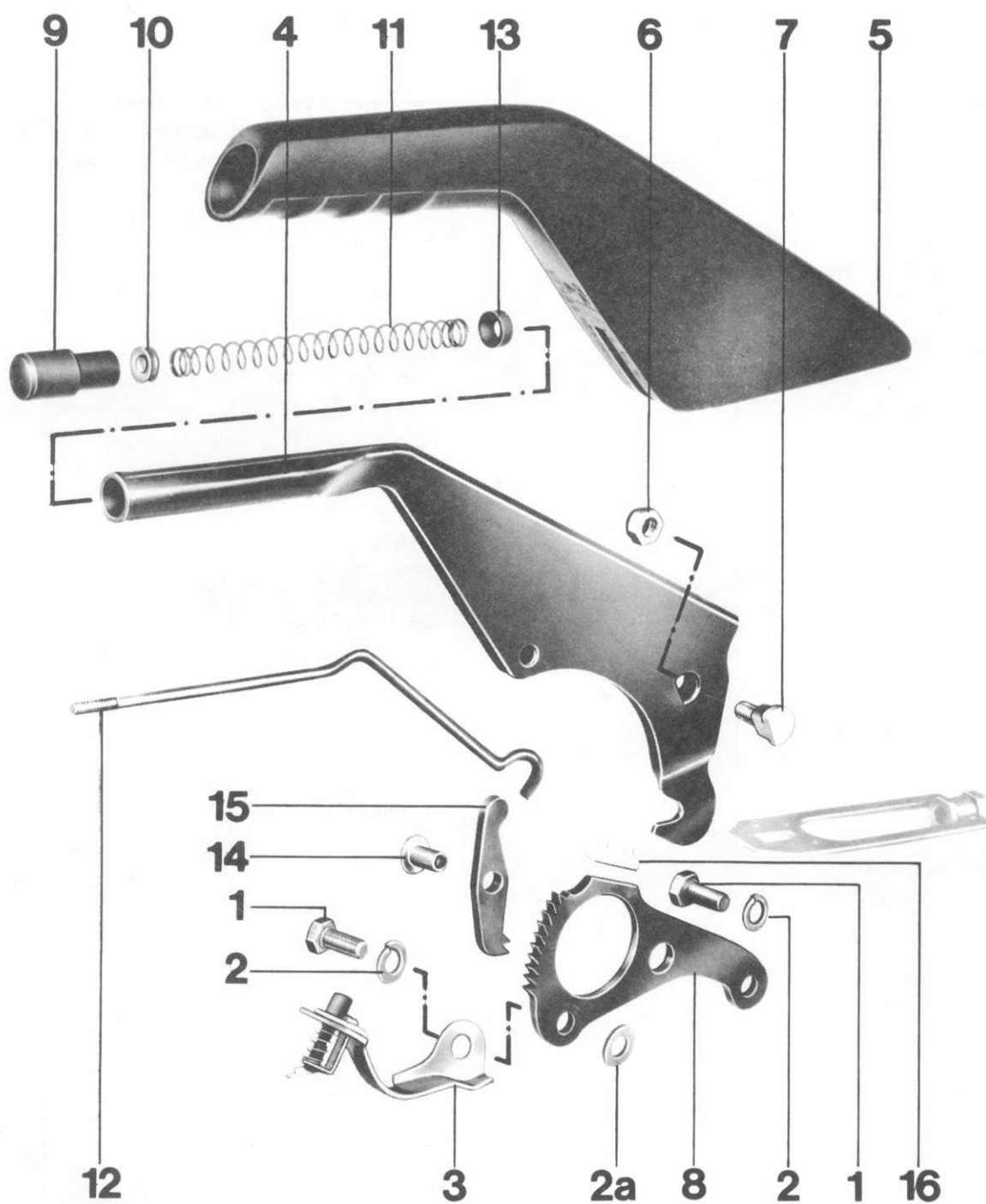
## Checking brake disc thickness

Measure brake disc thickness in approx.  
8 places within the braking surface using  
a micrometer.



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## DISASSEMBLING AND ASSEMBLING PARKING BRAKE LEVER



No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Bolt	2		Torque: 25 Nm (18 ftlb)	Sometimes a washer is used to align parking brake lever
2	Lock washer	2		Replace if necessary	
2a	Washer	1		Only used in some cases	
3	Bracket for parking brake switch	1		Switch must respond before first catch; align bracket if necessary	
4	Parking brake lever	1			
5	Sleeve	1		Paste on sides	
6	Lock nut	1		Replace if necessary. Torque: 23 Nm (17 ftlb)	
7	Bearing shaft	1			
8	Toothed element	1			
9	Push button	1		Lock with Loctite 221	
10	Plastic washer	1			
11	Spring	1			
12	Push rod	1			
13	Guide sleeve	1			
14	Rivet	1		Rivet that pawl still moves easily	
15	Pawl	1			
16	Stop	1			



## DISASSEMBLING AND ASSEMBLING PARKING BRAKE LEVER

## Disassembling

1. Remove parking brake lever/parking brake cable trim. Unscrew mounting bolts and take out complete parking brake lever.
2. Pull off sleeve forward from parking brake lever (pasted on sides of lever — loosen first).
3. Remove bearing shaft and move out locking element.
4. Unscrew push button (locked with Loctite). Take off washer, spring and guide sleeve toward front and push rod toward rear.

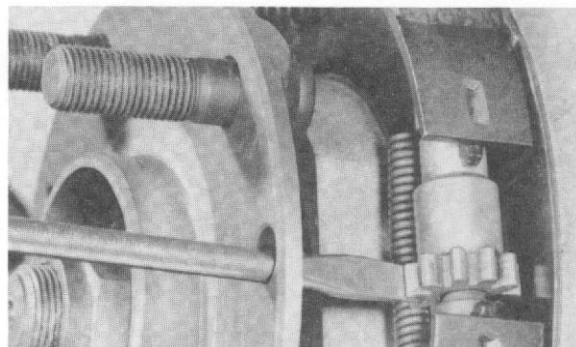
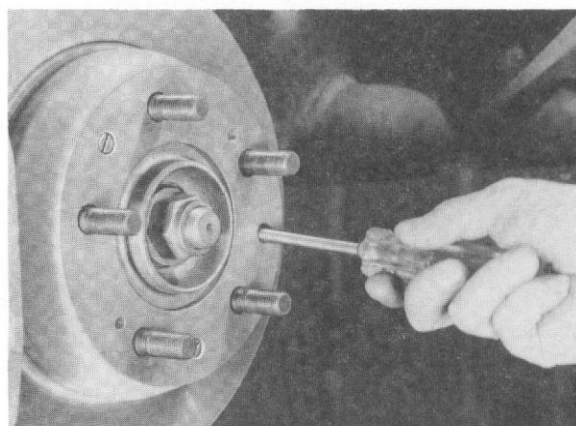
## Assembling

1. Lubricate all sliding and bearing surfaces with multi-purpose grease.
2. Pawl must move easily even after riveting. Lock push button with Loctite No. 221.
3. Install parking brake lever and check function of contact switch. It should respind before the first catch. If necessary, adjust switch holding bracket.

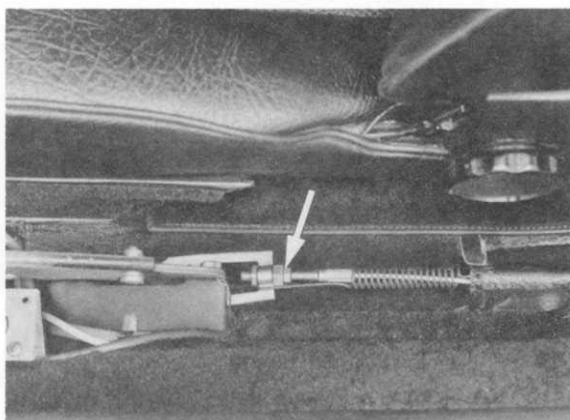
## Checking and Adjusting Parking Brake

The parking brake has to be adjusted, if with medium force the parking brake lever can be pulled up more than 2 teeth without any braking effect.

1. Jack up car and remove rear wheels.
2. Release parking brake and push back rear wheel disc brake pads until the discs can be turned easily.
3. Loosen adjusting nut on spreader lock until cable is without tension.
4. Insert a screwdriver through the hole in the brake disk and turn the adjusting device until it is no longer possible to turn the wheel. Then turn back the adjusting device until it is possible to turn the wheel freely, then turn back a further 2 notches (undo).



5. Pull up parking brake lever 2 teeth and turn adjusting nut that the wheels can just be turned by hand (with 4 teeth the wheels must be stopped).



6. Release parking brake lever and check, whether wheels turn easily.
7. Lock adjusting nuts.

## TIGHTENING TORQUES FOR BRAKES, HYDRAULIC PARTS

Location	Description	Thread	Torque Nm (ftlb)
Brake unit to bulkhead	Hex nut	M 8 DIN 934	23 (17)
Brake line to master cylinder, brake hoses, brake booster, T-distributor and hydraulic unit. Connecting line to four-piston fixed caliper	Union nut	M 10 x 1	12 (9)
Brake hoses to sliding caliper	Brake hose	M 10 x 1	14 (10)
Brake hose to floating caliper	Brake hose	M 10 x 1	14 (10)
Brake hose to floating and four-piston fixed calipers	Hollow screw	M 10 x 1	16.5 (13)
Brake hose, rear, to four-piston fixed caliper	Brake hose	M 10 x 1	14 (10)
Locknut to pressure rod (brake unit)	Hex nut	M 10 DIN 934	35 (26)
Bleeder screws in sliding and floating calipers	Bleeder screw	M 7	3.5 to 5.0 (2.5 to 3.6)
Bleeder screw in four-piston fixed caliper	Bleeder screw	M 10	8 - 12 (6 - 9)

Location	Description	Thread	Torque Nm (ftlb)
Master cylinder to vacuum booster	Hex nut	M 8 DIN 934	23 (17)
Stoplamp switch to master cylinder	Stoplamp switch	M 10 x 1 tapered	15 + 4 (11 + 3)
Regulator to wheel arch	Hex bolt	M 8	23 (17)
Screw-in regulator to master cylinder or hydraulic unit	Screw-in regulator	M 10 x 1	14 (10)
Hydraulic unit bracket to wheel arch	Hex nut	M 8	23 (17)
Hydraulic unit to hydraulic unit bracket	Hex bolt	M 6	10 (7)
T-distributor to bracket	Hex bolt	M 6	10 (7)
Housing (caliper) to bracket	Guide pin	M 9	15 - 20 (11 - 15)

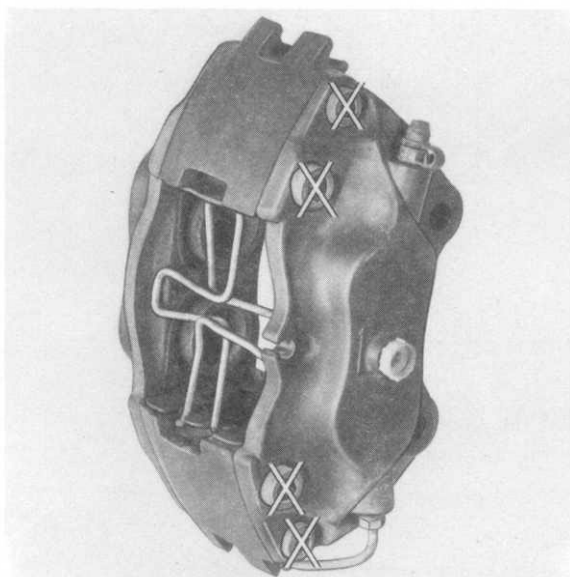
## Notes on brake system from 1986 models on

### Assembly instructions

**The two halves of the brake caliper must not be separated.**

The piston sealing rings, dirt scraper rings and spring plates can be changed while the fixed caliper is assembled.

To remove the spring plates, heat the retaining screws with a hot-air blower to approx. 150°C; this is because the screws are inserted with a locking agent. Do not re-use the screws. Coat the threads of the new screws lightly with Loctite 270. When installing the brake pistons, use Unisilikon TK 44 N 2 brake cylinder paste (this also applies to **earlier types of brake caliper** if repairs become necessary). Unisilikon paste is available as a spare part, available as a spare part (part number 000.043.117.00).



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**X = Never unscrew and retighten these screws**

So that correct brake caliper position can be checked with the brake pads installed, the fixed calipers have an arrow mark above the Porsche logo to indicate the correct direction of brake disk rotation.



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For modifications to front-wheel fixed brake calipers and notes on replacement, refer to Pages 47-04 / 47-05.

## Modifications to four-piston fixed calipers

### Modification I

From 1987 models\* on, the pistons in the front wheel fixed brake calipers were revised in design to minimize wear and optimize efficiency. The rear-wheel fixed calipers remained unchanged ( $\varnothing$  30/28 mm).

#### Modification

Piston diameter increased from 42/36 mm to 44/36 mm.

#### Note

Pistons for the four-piston fixed calipers on the 928 S have no chamfered areas (recesses). This also applies to the 42 mm diameter front pistons on 1986 model cars, despite some information published to the contrary.

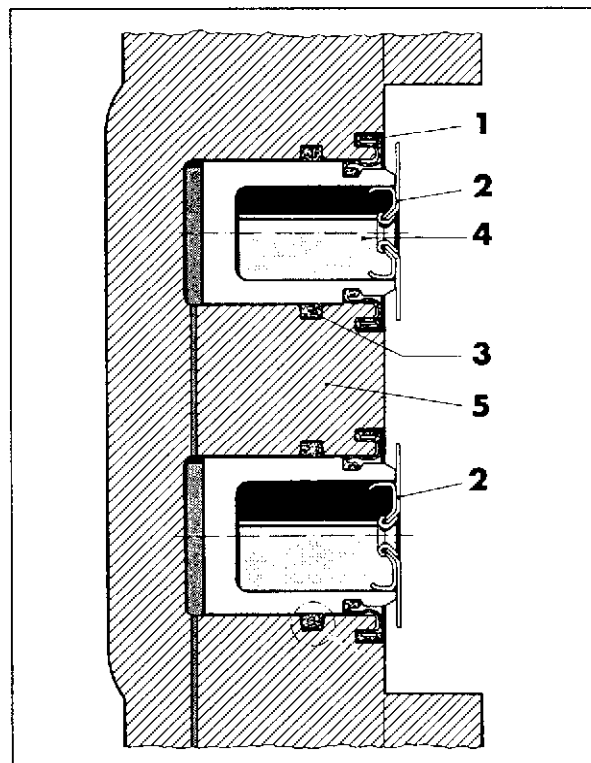
#### Replacement

The front wheel brake calipers with 44/36 mm diameter pistons can be retrofitted **as a pair only** to 1986 model cars. It is forbidden to mix the 36/42 mm diameter and 36/44 mm diameter brake calipers on the same car.

### Modification II

During the 1989 model year, the front and rear wheel brake piston seals were modified. A change was made from a scraper ring to a protective cap version.

#### Modified version.

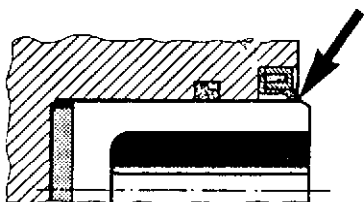


- 1 Dust protection cap
- 2 Damper plate
- 3 Rubber seal (rectangular-section ring)
- 4 Piston
- 5 Brake caliper housing

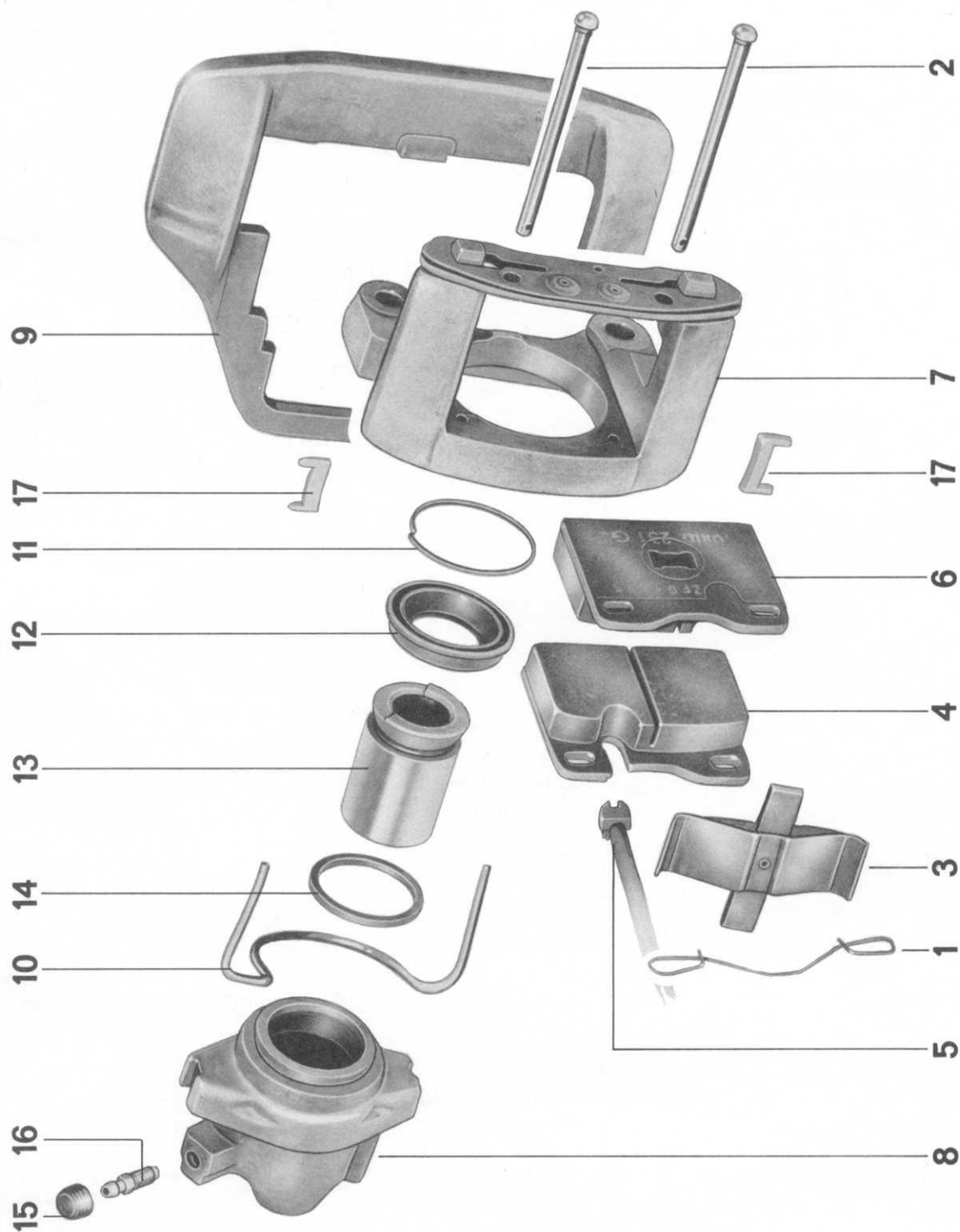
\* Some cars in the 1987 model year (for the USA, Canada, Australia und Arab countries) continued to be fitted with brake calipers with 42/36 mm diameter pistons.

**Previous version**

The scraper ring made a sliding-contact seal with the piston surface.

**Replacement**

Make sure that the two brake calipers on an axle are both of the same pattern.





No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Lock	1		Replace if necessary	New models have lock wire with wire guide
2	Retaining pin	2		Replace if necessary	
3	Cross spring	1		Replace if necessary	
4	Inner brake pad	1		Check, replacing if necessary. Wear limit: 2 mm. It is better to mount pad after installation of brake caliper	
5	Warning contact	1		Replace if wire core is ground through	
6	Outer brake pad	1		Check, replacing if necessary. Wear limit: 2 mm. It is better to mount pad after installation of brake caliper	
7	Mounting frame	1		Position slides correctly	
8	Brake cylinder	1	Drive off of floating frame with plastic hammer. Place piece of wood in caliper frame		
9	Floating frame	1			
10	Guide spring	1		Don't mix up left and right springs	
11	Clamp	1		Position correctly	
12	Dust cap	1		Replace	
13	Piston	1	Press out of cylinder with compressed air. Support piston on piece of wood. Danger!	Use brake cylinder paste. Adjust piston position with 20° gauge	

No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
14	Seal	1	Remove with a plastic rod	Replace, install with brake cylinder paste	
15	Dust cap	1			
16	Bleeder screw	1			
17	Slide	2		Replace, if necessary	

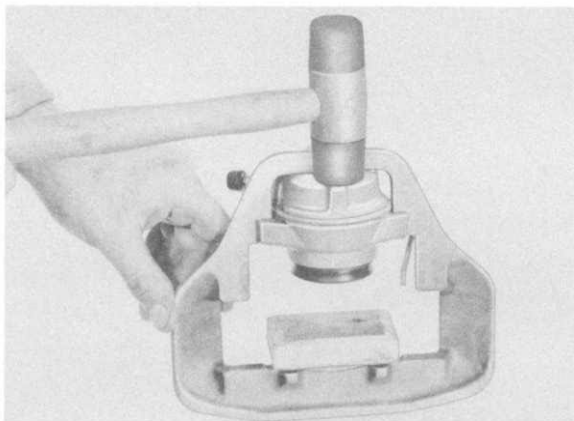
## DISASSEMBLING AND ASSEMBLING FLOATING FRAME CALIPER

## Disassembling

1. Press caliper frame off of mounting frame.



2. Drive brake cylinder off of caliper frame with a plastic hammer applied at different points all around. Place a piece of wood in caliper frame to prevent damage.



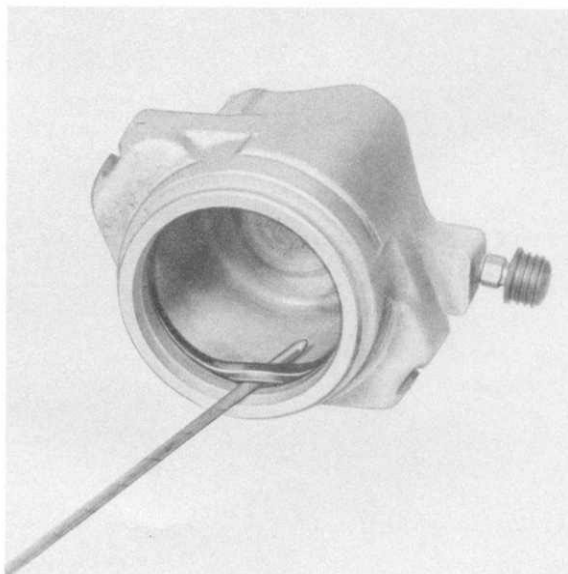
3. Press piston out of cylinder with compressed air.

## Warning

Support piston on piece of wood.

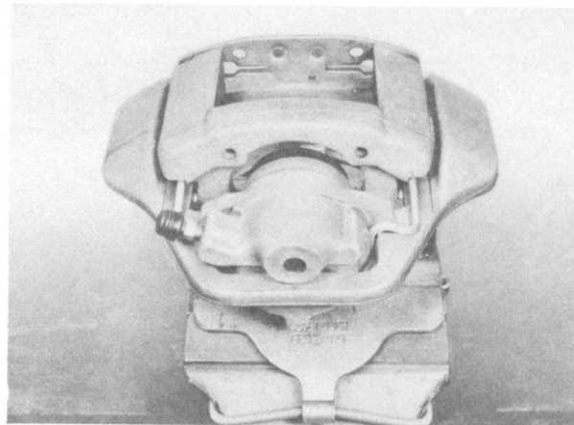
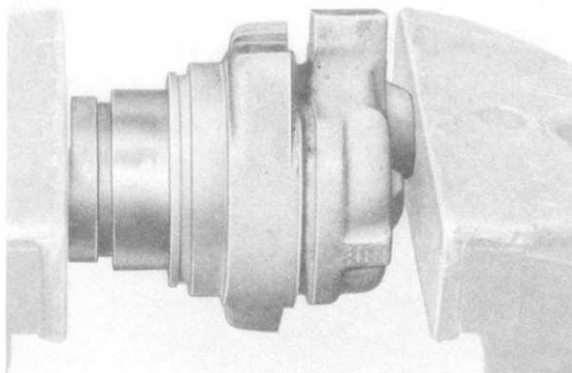


4. Remove seal with a plastic rod.



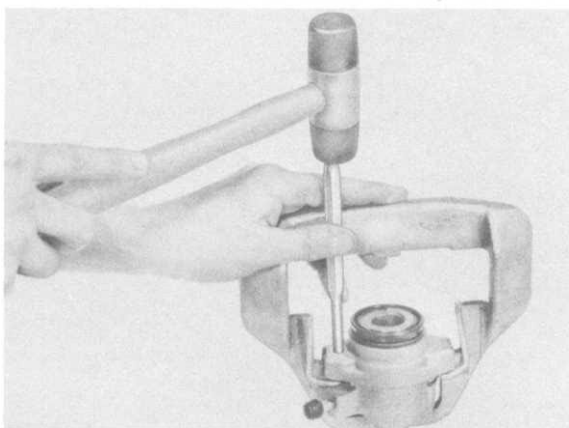
## Assembling

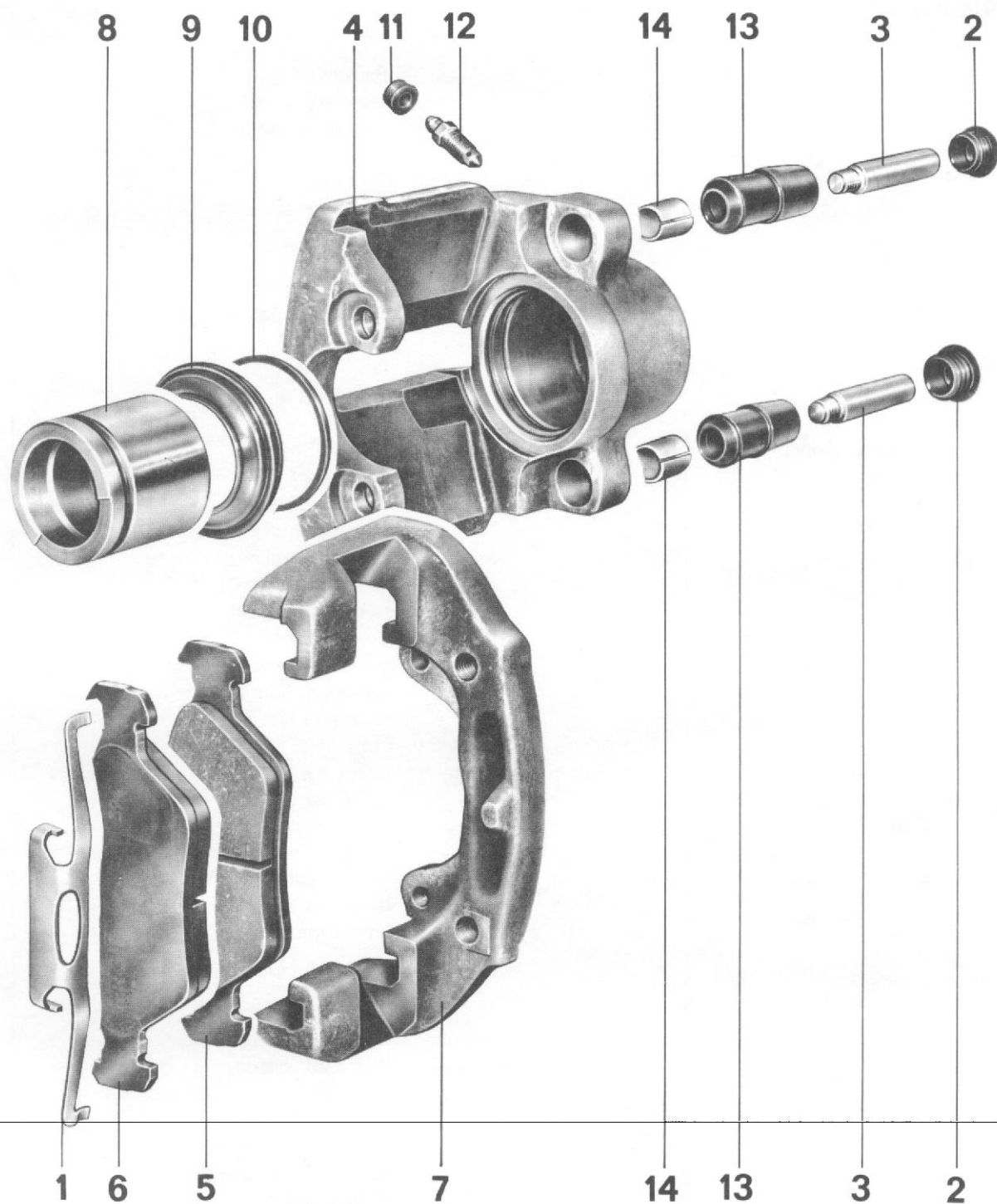
1. Apply a very thin coat of brake cylinder paste to cylinder bore, piston and seal. Press piston into cylinder in approximately correct position ( $20^{\circ}$  chamfer).
3. Install mounting frame. Be careful not to damage slides.



2. Drive brake cylinder with guide spring on to caliper frame with a soft mandrel applied at points all around.

4. Make final  $20^{\circ}$  adjustment of piston with piston turning pliers (see page 46 - 4).





Brake hose installation changed during 1983 model year. Brake hose mounted on modified fist caliper connection with a hollow union bolt from this time on to guarantee correct installed position.

No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Housing retaining spring	1		Replace, if necessary. Make sure of correct fit	
2	Plug	2		Replace, if necessary	
3	Guide pin	2		Replace, if necessary. Tighten to specified torque (15—20 Nm/ 11—14 ftlb)	
4	Housing (caliper)	1		Note 20° piston position. If necessary, correct with piston pliers. Set back (milled) surface faces down to brake disc inlet side. Reference point is edge on bottom of housing (page 47 - 11)	
5	Brake pad, inner (with riveted retaining clip)	1	Pull out of piston	Check, replacing if necessary. Wear limit 2 mm	
6	Brake pad, outer	1		Check, replacing if necessary. Wear limit 2 mm	
7	Holder	1			
8	Piston	1	Press out of housing with compressed air. Use piece of wood - danger!	Use brake cyl. paste. Watch 20° piston position	
9	Dust cover	1		Replace; make sure sealing lips fit correctly in housing and piston groove. See instructions	

No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
10	Seal	1	Remove with a plastic rod	Replace, install with brake cylinder paste	
11	Dust cap	1			
12	Bleeder valve	1			
13	Damper sleeve	2		Replace when torn, brittle or swollen rubber	Page 47 - 12
14	Slide	2		Replace if necessary	Page 47 - 12

## DISASSEMBLING AND ASSEMBLING FLOATING CALIPER

## Disassembling

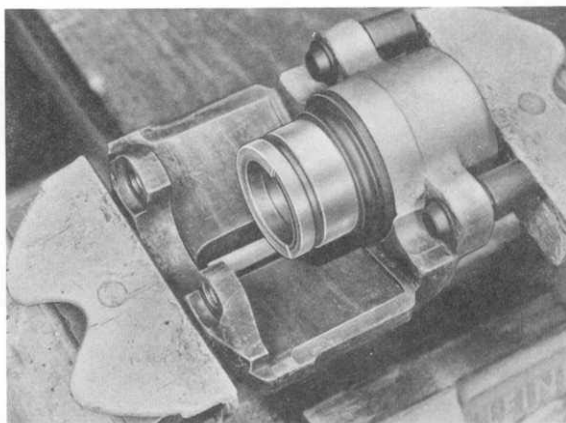
1. Remove housing retaining spring. Pull plugs out of guides. Remove guide pins.
  2. Remove housing. Take outer brake pad off of holder. Pull inner brake pad out of piston.
  3. Support piston firmly on a piece of wood and press out of housing with compressed air. Press out piston only halfway at first and take sealing lip of dust cover out of piston groove.
  4. Remove seal with a plastic needle.
2. Push dust cover on inside of piston so far that large diameter sealing lip (arrow) extends over the piston.



3. Press sealing lip of dust cover into housing groove with piston in approximately correct position ( $20^\circ$  set back surface). Make sure that seal fits properly around its entire periphery.

## Assembling

1. Apply a very thin coat of brake cylinder paste on cylinder bore, piston and seal.

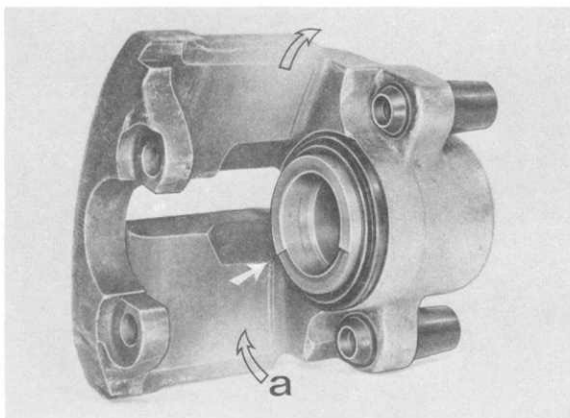




4. Press piston into housing slowly. Small diameter sealing lip should settle in groove of piston.



5. Adjust 20° piston position precisely with the piston pliers. Set back surface of piston faces down to brake disc inlet side.  
A reference point is the edge on bottom of housing (see arrow).  
Arrow a = brake disc inlet side.



6. Replace damaged dampers and guides.
7. Bolt holder to housing. Tighten guide pins to specified torque. Insert brake pads and housing retaining springs.

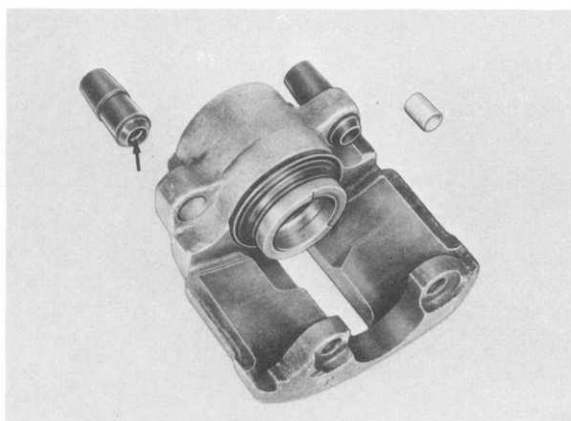
## REPLACING DAMPERS AND SLIDES

## Removing

1. Separate housing from holder. Pull piston end brake pad out of piston.
2. Press out damper in direction of brake hose connection. Make sure that bearing surface in housing is not damaged.

## Installing

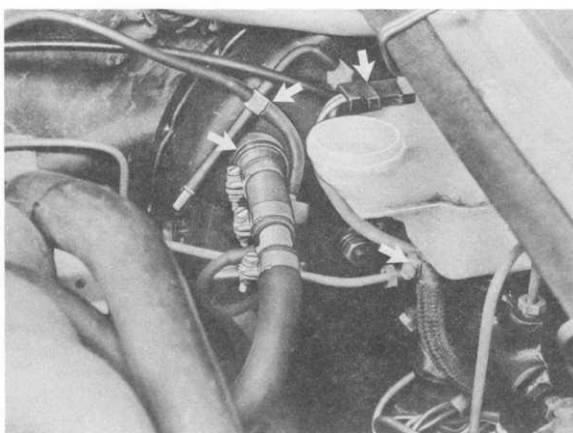
1. Coat damper with brake cylinder paste.
2. Insert damper in housing from the brake hose connection side. Then guide slide from piston side into damper so far, that it is positioned between the lips provided for this purpose (arrow = visible lip).



## REMOVING AND INSTALLING BRAKE MASTER CYLINDER

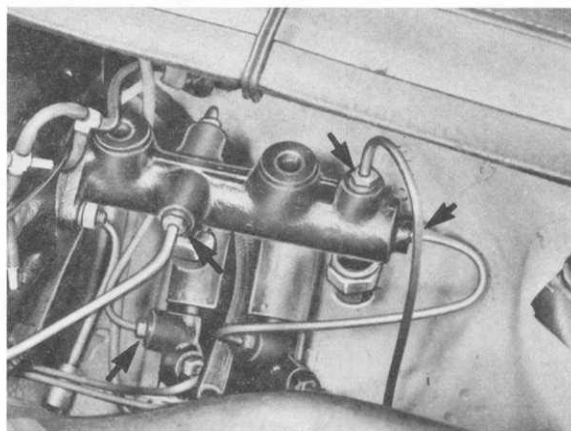
## Removing

1. Remove intake hoses and air cleaner upper section.
2. Drain both chambers of brake fluid reservoir by pumping out brake fluid via pertinent bleeder screws depending on brake circuit division.  
Diagonal brake circuit division up to 1983 models. Axle brake circuit division since 1984 models.  
Identification: stepped master cylinder and screw-in brake pressure regulator (see point 5).  
Identification: stepped master cylinder and screw-in brake pressure regulator (see point 5).
3. Detach vacuum hose with check valve at brake booster.  
Pull off vacuum line on branch, plug for warning device and hose for clutch control.



4. Pull brake fluid reservoir out of master cylinder from above. If applicable, pull off plugs on hydraulic stop light switches.

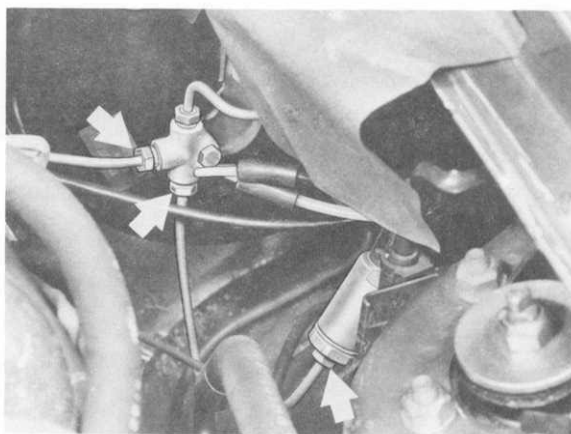
5. Detach brake lines.  
Up to 1983 models.



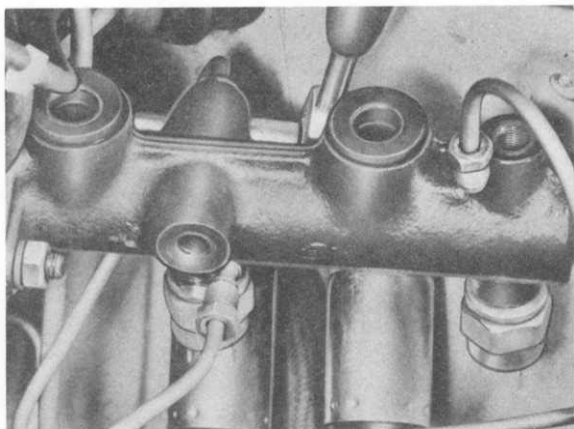
Since 1984 models

## Note:

Counterhold on hexagon of regulator when unscrewing rear axle brake line on screw-in brake pressure regulator. Screw-in regulator of cars with ABS is installed on hydraulic unit.



6. Remove the master brake cylinder at its flange with a 1/4-inch ratchet, a 13 mm socket wrench insert and a suitable extension. Take out the master brake cylinder.

**Note**

On right-hand drive cars, the windshield washer filler pipe must also be removed. Take it out at the same time as the master brake cylinder.

**Installing**

1. Renew the O-ring between the master brake cylinder and the brake booster, or else a loss of vacuum may occur.
2. Install the master brake cylinder and connect up the brake pipes.
3. Press the fluid reservoir into the sealing plugs in the master brake cylinder. Use new sealing plugs each time the fluid reservoir is removed. When pressing in, the reservoir must pass 2 detents before firm seating can be guaranteed.

**Note**

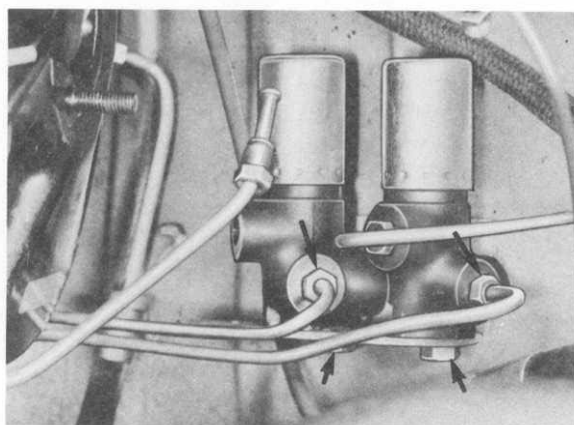
Use only brake fluid or brake cylinder paste as an aid to installation. Substances containing mineral oil will destroy the rubber elements in the brake system and cause brake failure. In the case of stepped brake master cylinders, there is a washer under the front sealing plug (intermediate piston brake circuit).

4. Bleed the brake/clutch with the filling and bleeding device. Check for leaks and for correct operation.

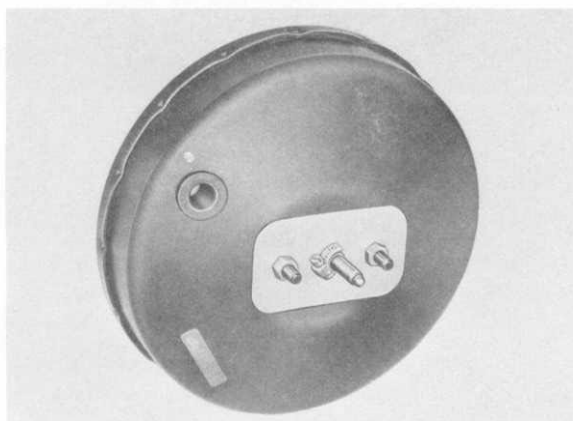
## REMOVING AND INSTALLING BRAKE BOOSTER

## R e m o v i n g

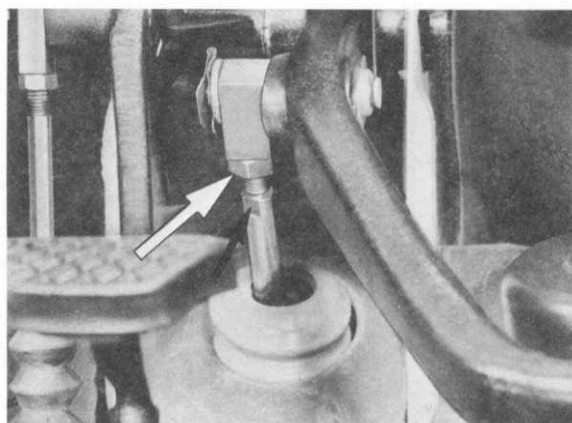
1. Remove master cylinder (see page 47 - 13)
2. Remove brake pressure regulator from wheel arch (only cars earlier than model year 84).



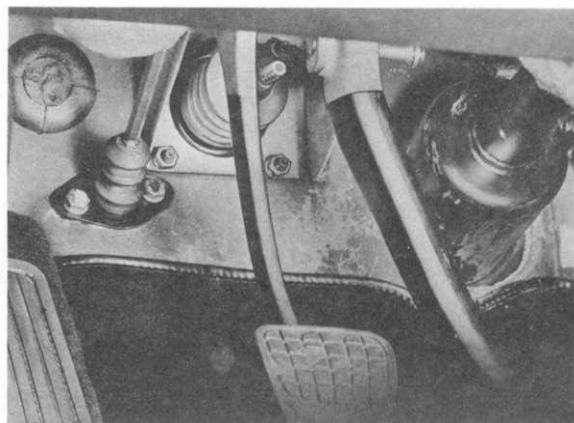
3. Depress brake pedal fully and using a hose clamp, fix pressure rod for master cylinder in this position. Place a strip of 2 mm sheet beneath clamp.



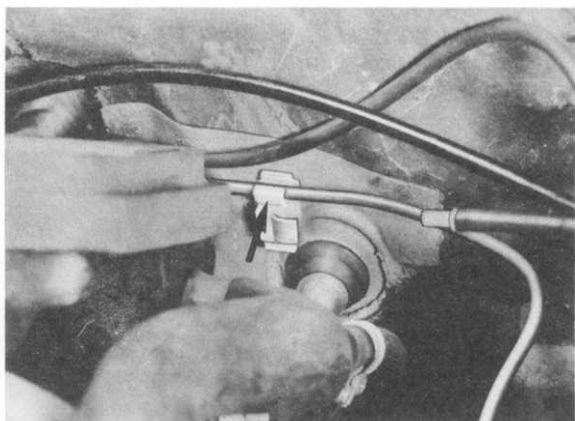
4. So that brake pressure rod (piston rod) protrudes as little as possible toward the footwell from the booster, adjust adapter, depress brake pedal again and correct position of hose clamp. Remove adapter.



5. Remove cover and unscrew mounting nuts of brake booster.



6. If necessary, unclip brake line from right-hand front wheel from its holder on bulkhead and carefully push toward engine. Position hose for clutch release cylinder and electric cables so that they do not obstruct during removal.



3. Install brake pressure regulator and master cylinder. Always renew seal ring between brake booster and master cylinder. Mount brake pressure rod with adapter on brake pedal. Adjust pressure rod play and check setting of mechanical stoplamp switch, if fitted (page 46 - 10a).

4. Bleed brakes/clutch with charging and bleeding equipment. Check for leaks and correct operation.

7. Remove brake booster. It may be necessary to make space by removing the lower section of the air filter to allow passage of a 10" brake booster.

### Installing

1. Renew seal ring between bulkhead and brake booster if damaged. The 10" boosters are fitted with 2 mm seals, or 1 mm seals as of model year 85. Use a 4 mm seal or two 2 mm seals for 9" boosters.

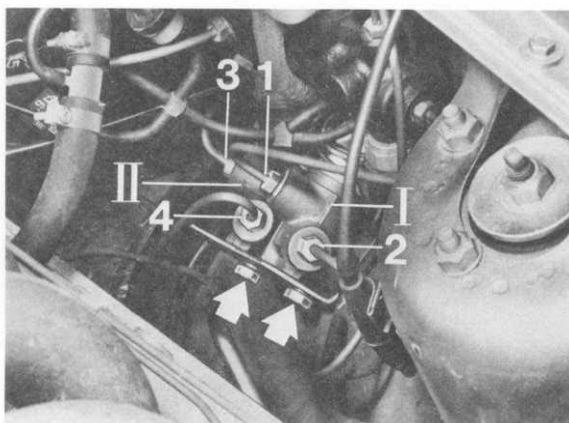
2. Install brake booster and tighten securing nuts. Check that the cover over the control housing is correctly seated.

## REMOVING AND INSTALLING BRAKE PRESSURE REGULATOR

## Regulator on Wheel House

## Removing

1. Remove intake hoses and air cleaner upper section.
2. Drain both chambers of brake fluid tank by pumping out brake fluid through bleeder valves of front and rear wheel brake calipers (diagonal brake circuit division).
3. Detach brake lines. Remove brake pressure regulator after unscrewing mounting bolt(s).



- I Regulator for right rear wheel  
 II Regulator for left rear wheel

- 1 – Inlet of intermediate piston brake circuit  
 2 – Outlet to right rear wheel  
 3 – Inlet of push rod brake circuit  
 4 – Outlet to left rear wheel

## Installing

1. Check brake pressure regulator/car application on page 47 - 18.
2. Install brake pressure regulators. The mounting plate has a retaining tab for each brake pressure regulator to guarantee correct installed position and prevention of turning when tightening bolts.
3. Connect brake lines. Bleed brakes.

## Note

If applicable, cancel the brake circuit failure indicator lamp by disconnecting the battery (ground wire on body).

Screw-in Regulator  
(since 1984 models)

## Arrangement

Cars with ABS: connect h screwed in hydraulic unit.

Cars without ABS: screwed in master cylinder (intermediate piston circuit).

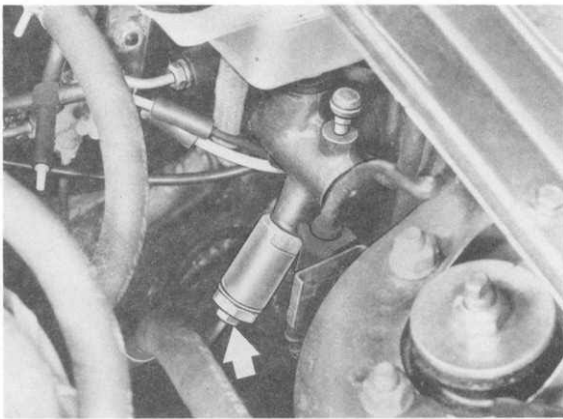
## Removing

1. Remove left intake hose.

2. Unscrew brake line on brake pressure regulator, counterholding on hexagon of regulator.

Note:

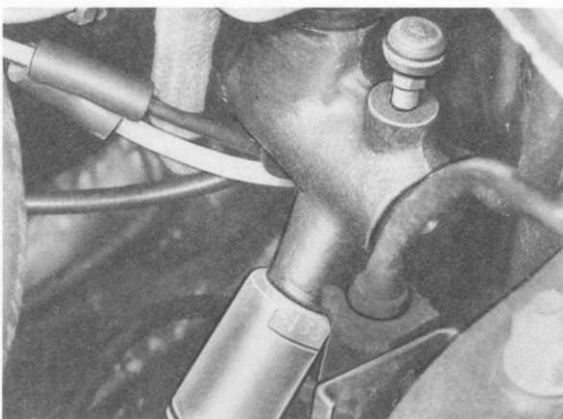
Place cloths underneath to avoid damage from escaping brake fluid.



Installing

1. Screw in brake pressure regulator. Mount brake line on brake pressure regulator while counterholding on the hexagon.
2. Bleed brakes (begin at bleeder valve of master cyl.).

3. Disconnect brake pressure regulator on brake master cylinder or hydraulic unit, never turning on the hexagon. Plug open connection with a plug.





## BRAKING-FORCE REGULATORS - INSTALLATION OVERVIEW

Braking-Force Regulators Until End of Model Year 83

(Diagonal braking circuits/2 regulators per vehicle)

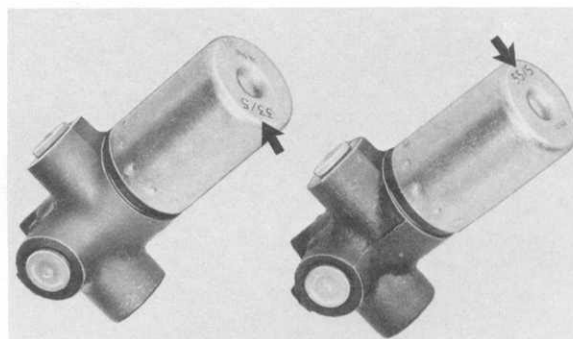
	9" Brake Boosters		10" Brake Boosters	
	previously installed	replace by	previously installed	replace by
Switchover pressure in bar	55	33	33	33
Part No.	(-----) discontinued	928.355.083.02	(928.355.083.01) discontinued	928.355.083.02
Identification (color + switchover pressure)	Painted black	Painted black green dot in center of cap	Painted blue*	Painted black, green dot in center of cap
Switchover pressure & reduction factor (stamped on cap)	55/5	33/5	33/5	33/5
Remarks	When replacing only use 928.355.083.02 as a pair. Under no circumstances may 33 and 55 bar regulators be used together in a car.		When replacing only use 928.355.083.02 as a pair. Under no circumstances may 928.355.083.01 and 928.355.083.02 regulators be used together in a car.	

Switchover pressure and reduction factors stamped on cap.

55 or 33 = switchover pressure (bar)

5 = reduction factor 0.46

\* For a brief period, brake pressure regulators painted black and marked only with a blue dot were installed. Note switchover pressure on cap.



Braking - Force Regulators, 84 ModelsOnward

(stage-type tandem master cylinder, separate brake circuits for each axle, 1 screw-in regulator per car)

Installed in	Part No.	Switchover pressure
84 models	928.355.305.00	33 bar
85 models	928.355.305.01	33 bar
86 models onward (with four-piston fixed-caliper brakes)	951.355.305.00	<u>18 bar</u>

## Installation:

Cars with ABS: Screwed into port h of hydraulic unit.

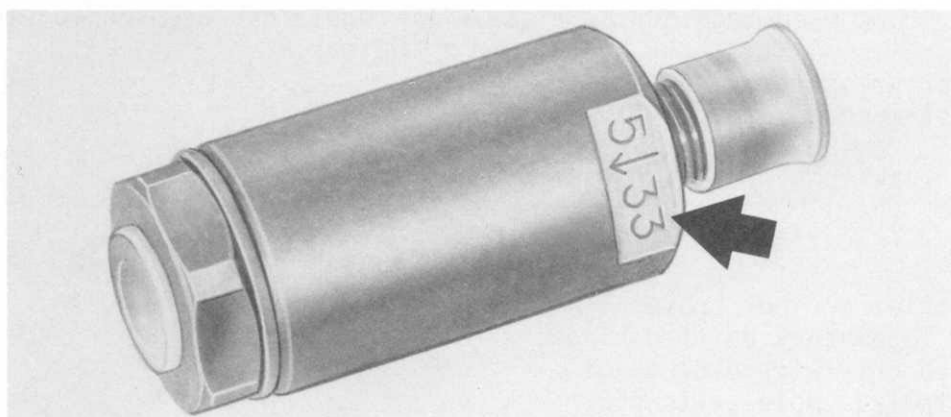
Cars without ABS: Screwed into master cylinder (inter-piston circuit).

## Identification / Remarks

Switchover pressure and reduction factor stamped on regulator.

33 or 18 = switchover pressure (bar)    5 = reduction factor 0.46

It is essential to ensure that the appropriate parts are installed. Under no circumstances may braking-force regulators with different reduction factors (e.g. 3 = 0.3) be installed.



## INSPECTING BRAKING-FORCE REGULATOR

## General

A braking-force regulator is integrated in the brake lines to the left-hand and right-hand rear wheels (diagonal braking circuits). This version was retained until the end of model year 1983. From model year 1984 onward, only one braking-force regulator is installed for both rear wheels (separate braking circuits for each axle). This regulator is smaller and lighter. It is screwed directly into the modified master cylinder or into the hydraulic unit of vehicles with ABS (screw-in regulator).

The braking-force regulators have a permanently set switchover pressure of 18, 33 or 55 bar (see overview, page 47 - 18a/18b). Until pressure rises to the switchover point, the same overpressure is applied to the input and output sides of the braking-force regulator. As the pressure on the input side rises further, the output overpressure (rear-axle overpressure) is reduced.

To check the braking-force regulators of diagonally-split braking circuits, the pressure which is not reduced (front axle) and the reduced pressure (rear axle) must be read simultaneously on manometers installed independently in the separate circuits.

To check the braking-force regulator (screw-in regulator) of brakes with separate circuits for each axle, the pressure which is not reduced (front axle) and the reduced pressure (rear axle) must be read simultaneously on independent manometers in the separate circuits.

## Preparation

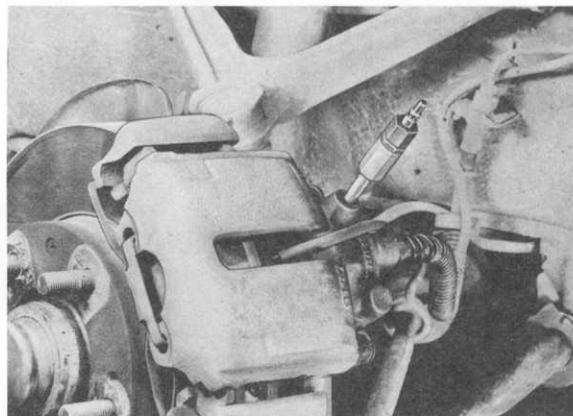
1. Connect brake calipers concerned and pressure tester by screwing test adapters into holes for bleeder valves in brake calipers.

Diagonally-split  
Brake Circuits

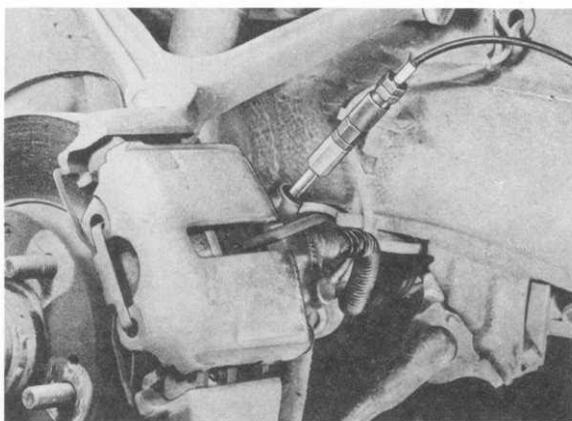
Test connections for braking-force regulator of left-hand rear wheel: on the left behind and on the right in front of the right-hand rear wheel:  
rear right and front left

Separate Braking  
Circuits for Each  
Axle (84 models onward)

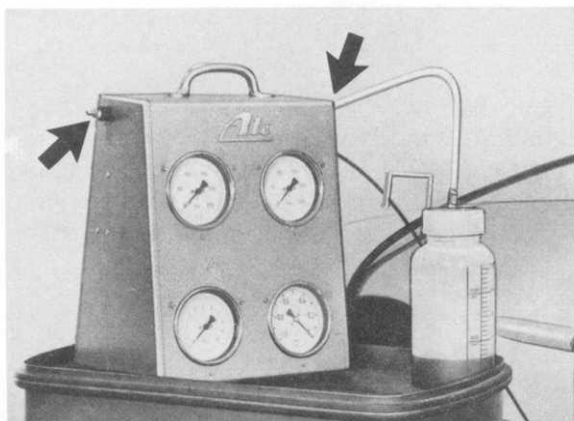
Test connections for the screw-in regulator:  
front axle left or right and  
rear axle left or right.



2. Connect line from tester (miniature coupling) to test adapter.



3. Bleed test lines and manometers of pressure tester.



4. Check switchover pressure of braking-force regulator installed in car (18, 33 or 55 bar). Before testing, check against table (page 47 - 18a/18b) to ensure that correct regulator is installed.

### Test I

Build up input overpressure (shown on manometer) of front brake caliper (unregulated wheel) in accordance with table. Read output overpressure on manometer of rear brake caliper (regulated wheel) (specified reading, see table below).

#### Note :

If the input overpressure (unregulated wheel) is inadvertently exceeded, do not reduce pressure to adjust. Pressure must be built up again from 0 bar (also applies for test II).

### Test II

Increase input overpressure (shown on manometer) of front brake caliper (unregulated wheel) to 100 bar. Read output overpressure on manometer of rear brake caliper (regulated wheel).

Test	Switch-over pressure of brake regulator	Input over-pressure (front axle)	Output over-pressure (rear axle)
Regulator at wheel arch			
I	55 bar	70 bar	62 $\pm$ 3 bar
	33 bar	48 bar	40 $\pm$ 3 bar
II	55 bar	100 bar	75 $\pm$ 5 bar
	33 bar	100 bar	64 $\pm$ 5 bar
Screw-in regulator			
I	33 bar	48 bar	40 $\pm$ 2 bar
	18 bar	33 bar	25 $\pm$ 2 bar
II	33 bar	100 bar	64 $\pm$ 3 bar
	18 bar	100 bar	55 $\pm$ 3 bar

### A d j u s t m e n t

- 1.If the measured values do not correspond to those stated in the table or if the pressure in the regulated circuit increases while the force exerted on the brake pedal remains constant, renew the braking-force regulator. When replacing, see note on page 47 - 18a/18b.
  - 2.After testing and removal of the equipment, bleed the brake system.
  - 3.Reset the brake circuit failure warning by disconnecting the battery (ground lead to body).
-

## Changing the brake fluid / bleeding the brakes

### General

To ensure fast and efficient servicing, it is recommended to use a filling and bleeding device. The procedures described below were carried out with a Teves unit. For a detailed description of the unit, refer to the operating manual of the unit.

### Important notes

Bleed both bleeder valves of each wheel of the four-piston fixed caliper brake.

When changing the brake fluid, also drain some brake fluid from the bleeder valve of the clutch slave cylinder.

Use only fresh DOT 4 brake fluid.

**Observe change intervals and brake fluid grade.**

Total brake fluid change quantity: 1 liter.

Change quantity per wheel: approx. 250 c.c.

**On vehicles up to end of MY '92**, the brake fluid must be replaced **every 2 years** as a minimum.

**As of MY '93**, the brake fluid change interval has been **increased to 3 years** - along with the use of special DOT 4 brake fluid.

**The 3-year change interval is valid as of MY '93, but only in conjunction with the use of the special Porsche brake fluid. The brake fluid is available under Part No. 000.043.202.04.**

Container contents: 5 liters (as of May, 1992).

This special brake fluid may also be used on pre-MY '93 vehicles. However, the **two-year** fluid change interval will remain valid for those vehicles.

### Brake fluid

The new brake fluid - Part No.

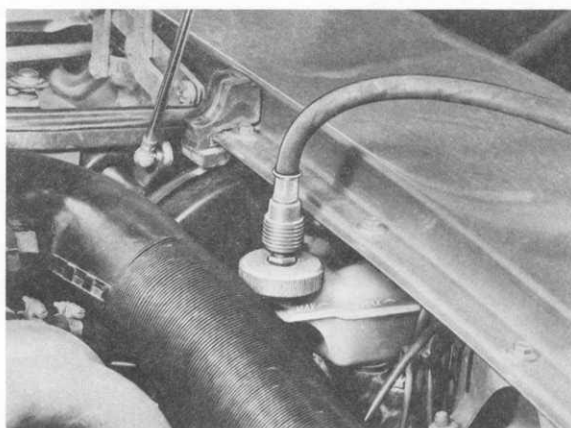
000.043.202.04 - offers superior properties. Compared to the brake fluid specified previously, its main features are **further reduction of water absorption and increased wet and dry boiling points.**

**Note on water absorption:** Water contents of only 2% in the brake fluid will cause the boiling point to drop by approx. 60 deg.C.

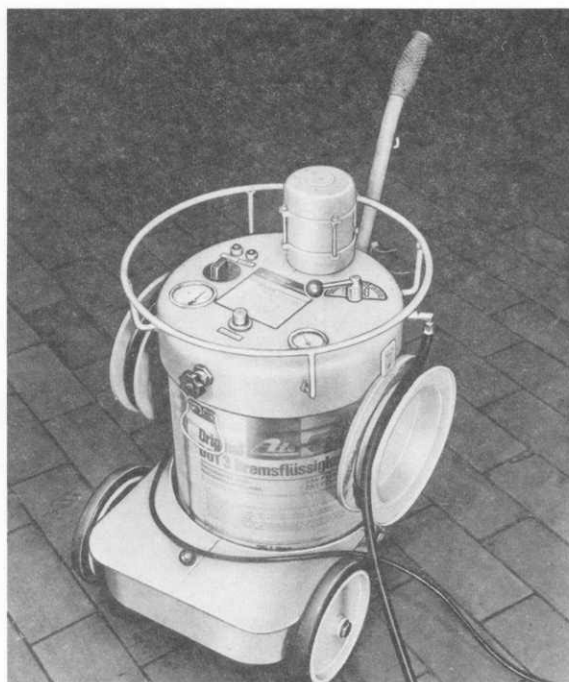
As of MY '93, only the new brake fluid may be used when topping up the reservoir. Any mixture of former brake fluid with new brake fluid causes the safety margin of the fluid to be narrowed down unnecessarily. Both the former and the new brake fluid are of amber color.

### Procedure for bleeding and changing the fluid

1. Top up reservoir with fresh brake fluid up to upper edge. Take out strainer insert.
2. Connect bleeder flange to reservoir and fit quick coupling of filler hose to the nipple on the bleeder flange.



3. Switch on bleeder. Move selection control lever to filling and bleeding position.



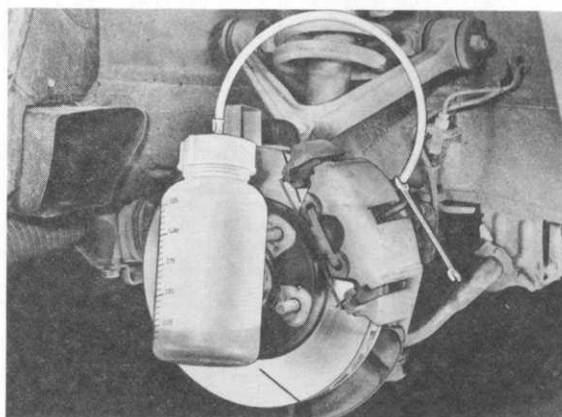
4. Open each bleeder valve until escaping brake fluid is without air bubbles.

#### Note

First bleed the clutch, if the brake master cylinder or brake fluid tank had been removed.

The stepped brake master cylinder (since 1984 models) has a bleeder valve for the intermediate piston brake circuit (rear axle brake circuit), see point 6.

5. Use a bottle to catch the escaping brake fluid for accurate inspection regarding cleanliness, air bubbles and determination of brake fluid consumption.



6. Operate the brake pedal firmly several times during bleeding procedures and with the bleeder valves open, in order to remove all air bubbles in the brake master cylinder.  
If there is a bleeder valve on the master cylinder, begin bleeding of brakes on this valve.

#### Note

There is no difference in bleeding procedures for cars with ABS.

7. It is recommended to perform a low Pressure leak test after finishing the bleeding/brake fluid change procedures. This, of course, requires that the bleeding adapters and filling hose are connected 100 % tight. All bleeder valves of the system must be closed. Keep the selection control lever at "filling and bleeding" and read pressure on the operating pressure gauge.



8. Now set lever to leak test. The pressure value displayed on the operating pressure gauge must not drop during the next 5 minutes.

There is a leak in the brake or clutch system, if pressure does drop during the test time.



9. Install dust caps on bleeder valves. Draw off brake fluid in tank, which is higher than the MAX mark. Install strainer and screw on brake fluid tank cap.



## TECHNICAL DATA

Steering	Rack-and-pinion type with tie rods and hydraulic assistance (power steering)
Steering wheel dia.	380 mm/15 in.
Steering wheel ratio at center	17.75 : 1
Turning circle dia. (wall-to-wall)	11.5 m/37.7 ft
Turning circle dia. (curb-to-curb)	9.6 m/31.5 ft
Steering wheel turns from lock to lock	3.13

---

## STEERING TORQUE SPECIFICATIONS

Location	Description	Threads	Material	Torque Nm (ftlb)
Steering gear to engine carrier	Self-locking nut	VM 10	5	46 (33)
Tie rod to steering arm	Self-locking nut	VM 12 x 1.5	8	65 (47)
Universal joint to steering gear	Self-locking nut	VM 8	8	28 (20)
Tie rod to ball joint	Nut	M 14 x 1.5	04	45 (33)
Steering tie rod to rack	Tie rod	M 16 x 1.5	16 Mn Cr 5	150 (108)
Universal joints to steering and intermediate shafts	Self-locking nut	VM 8	8	28 (20)
Pressure and return lines to steering gear	Hollow bolt	M 14 x 1.5		30 (22)
Steering wheel to steering shaft	Nut	M 18 x 1.5	8	50 (36)
Stabilizer clamp to side member	Bolt	M 10	8.8	46 (33)
Pulley to power steering pump	Self-locking nut	M 14 x 1.5	8	50 (36)
Steering protective tube to body	Bolt	M 6 with 4 mm socket		9.7 (7)
		M 6 with 5 mm socket		12 (9)
Suction hose nipple to power pump	Hollow bolt	M 18 x 1.5	C 35	60 (43)

## Replacing the steering in case of accident damage

### A. General

Accidents or driving conditions similar to accidents may cause various types of damage to steering gears. If the outside of the steering gear is undamaged, tracing of damage is sometimes difficult and requires considerable effort. This, however, constitutes an incalculable risk for the safety of the vehicle as it may lead to steering failure.

Due to the fact that a comprehensive check of all steering gear components requires considerable effort and is therefore not normally justifiable or even impossible to be carried out with standard shop equipment, the condition of other components that are easier to be checked must be considered as a replacement solution.

The following guidelines (item B) should be observed to decide if the steering gear of an accident vehicle requires replacement or may be used as it is.

### B. Assessing the Condition of the Steering System of an Accident Vehicle

The steering gear may remain on the car if all the following conditions are met:

- No visible damage to front-axle components such as wheels, king pins, control arms, steering arms, tie rods, to frontaxle crossmember, steering shaft, as well as to the suspension mountings at the body.
- No inadmissible increase of torque and no binding or stiffness when the steering gear is turned from lock to lock. When moving the steering from lock to lock, the front wheels must be off the ground (front axle raised) and the engine must be stopped (no drive to power steering pump).
- Admissible suspension alignment tolerances must not be exceeded.

The steering box must be replaced or exchanged if any of the following points apply:

- Damage to steering gear is visible or can be felt
- Burning damage (e.g. bellows of steering burnt)

- **Permanent deformation or cracking of:**

Steering gear mounts

Tie rods

Steering arms

King pins

Control arms

Front-axle crossmember (engine mounts)

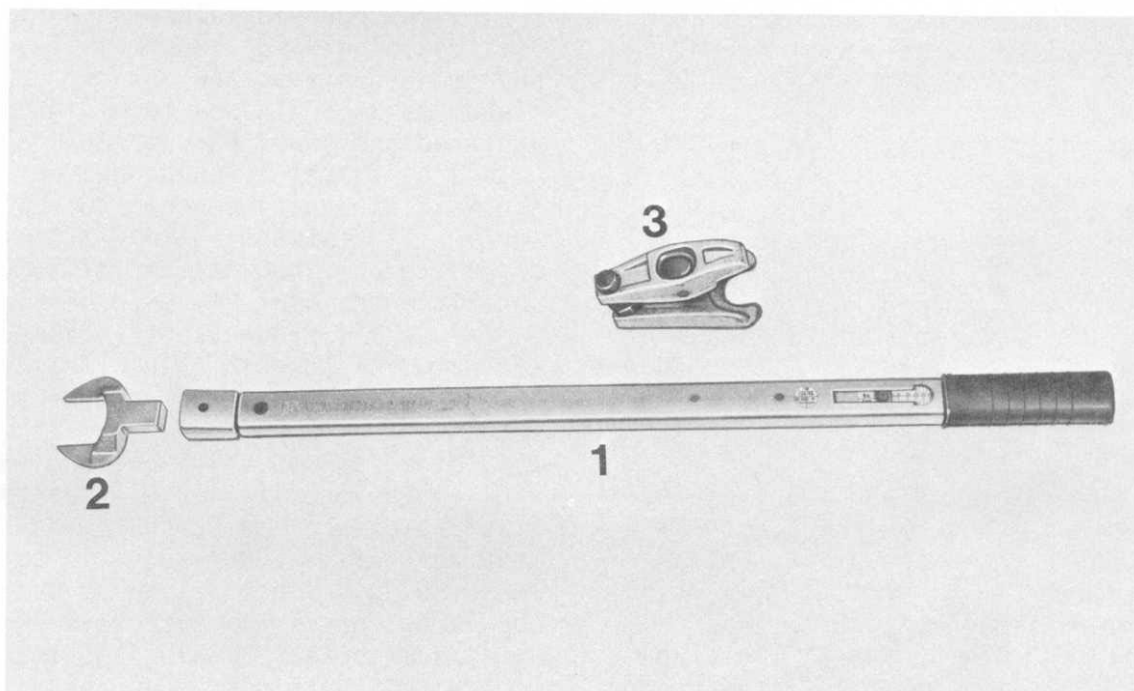
If the above criteria are **not** sufficient for a decision, it is recommended to exchange or replace the steering gear.

### **C. Exceptional regulations / order processing**

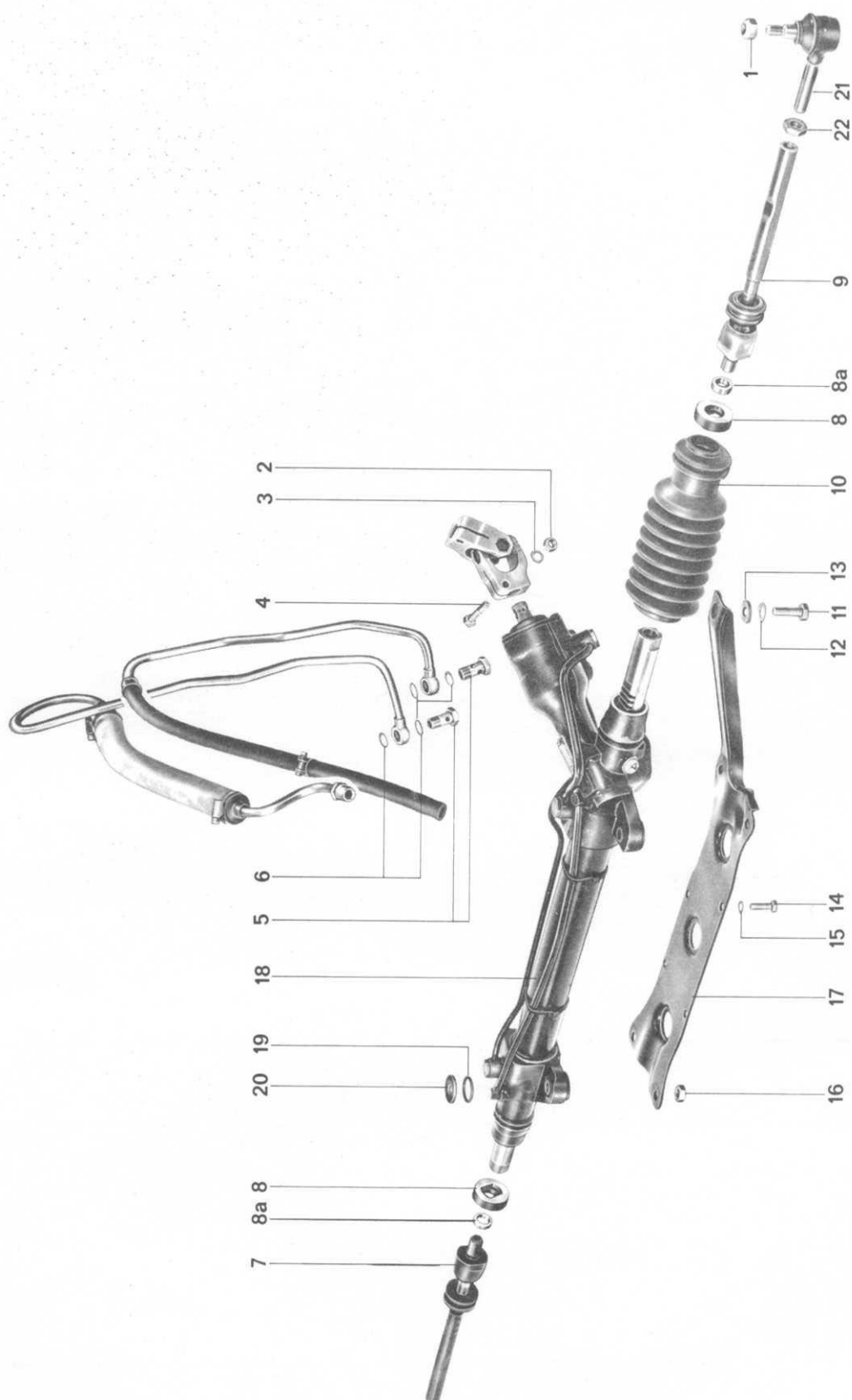
If the **steering gear replacement proposed** by the shop is refused by the customer or insurance company for financial reasons, an expert or, if this is not possible in foreign countries, the importer should be consulted (to be charged to the refusing party). If a decision is made against the above guidelines, it is recommended to file a note to this effect and have it signed by the expert.

**Power steering gears with no visible outside damage** that require replacement can be supplied on an exchange basis.

## TOOLS



No.	Description	Special Tool	Remarks
1	Torque wrench (Stahlwille 730 R/20 or Hazet 6292-1 CT)	9183	e. g. Nexus 168-1
2	Wrench socket		
3	Tie rod puller		



No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Self-locking nut	2		Replace. Tighten to specified torque	Watch position of universal joint Page 48 - 6
2	Self-locking nut	1		Replace. Torque: 28 Nm/20 ftlb	
3	Washer	1		Replace if necessary	
4	Setscrew	1			
5	Hollow bolt	2		Tighten to specified torque	
6	Seal	4		Replace	
7	Tie rod assembly	1		Torque: 150 Nm/108 ftlb. Tighten while holding rack and use torque wrench with special tool 9183	
8	Stop	2		Note arrangement	
8a	Spacer	2		Note arrangement	
9	Tie rod	1		Torque: 150 Nm/108 ftlb. Tighten while holding rack and use torque wrench with special tool 9183	
10	Dust boot	2		Check, replacing if necessary	
11	Bolt	1			
12	Washer	1		Replace if necessary	
13	Washer	1			
14	Bolt	4			
15	Washer	4		Replace if necessary	

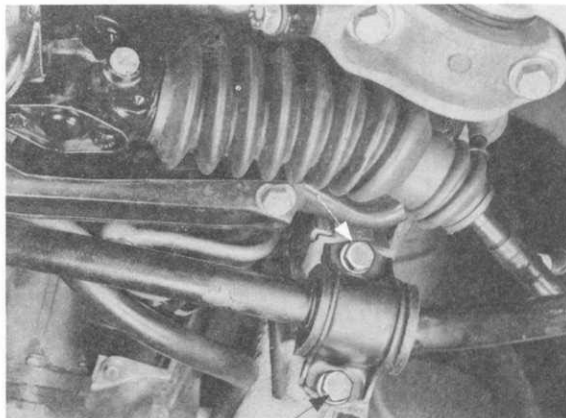
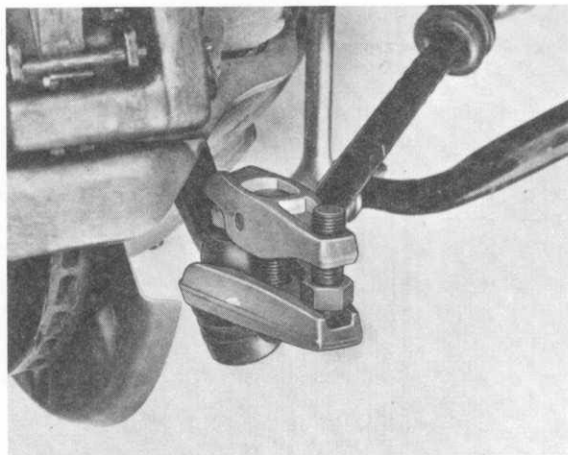
No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
16	Self-locking nut	4		Replace. Tighten to specified torque	
17	Reinforcement plate	1			
18	Steering gear	1		Run out rack ends completely and coat with VW steering gear lube AOF 086 000	Note position of universal joint Page 48 - 6
19	O-ring	4		Replace if necessary. Position correctly	Not for new steering gears with bushings in mounting bosses
20	Washer	4			Not for new steering gears with bushings in mounting bosses
21	Tie rod end	1		Screw into tie rod 18 to 19 turns	
22	Nut	1			



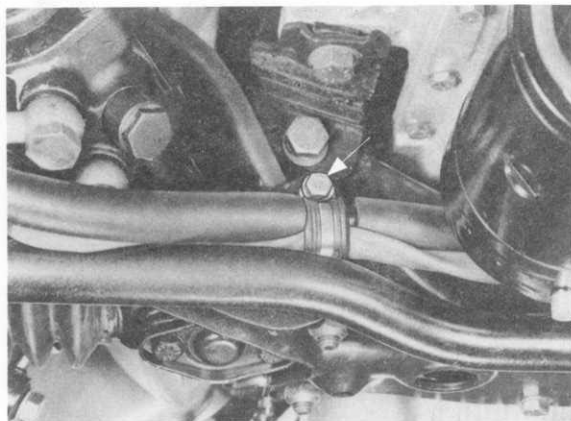
## REMOVING AND INSTALLING STEERING GEAR

## Removing

1. Draw hydraulic fluid out of tank.
2. Press out tie rods with a standard extractor.



3. Pull back hose strap with harness after removal of screw on side.



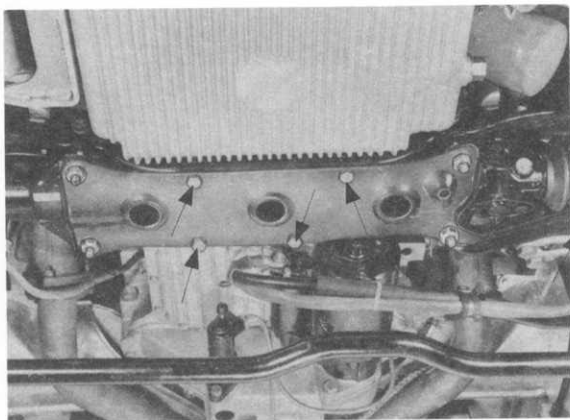
4. Remove bolts from stabilizer mounts. Let stabilizer hang down.

5. Unscrew pressure line and return line at steering gear.

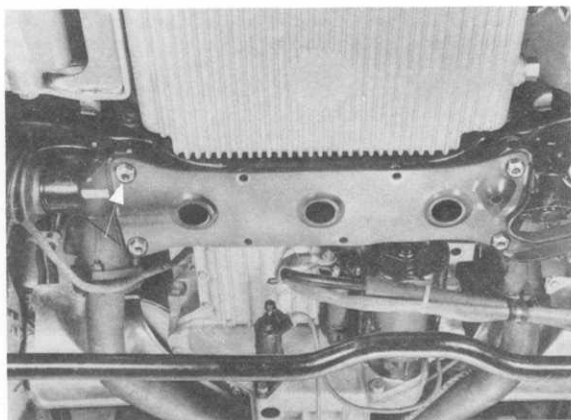


- 1 - Pressure line
- 2 - Return line

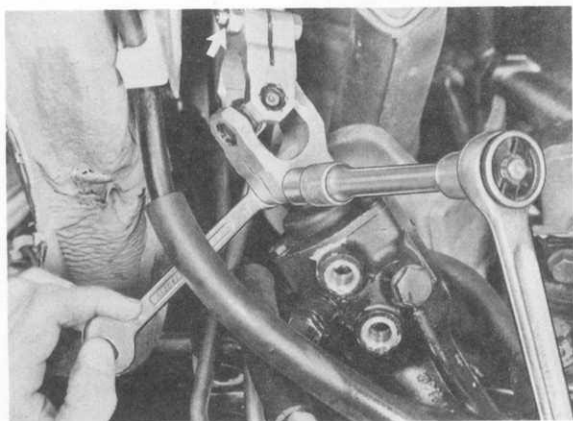
6. Remove five bolts from reinforcement plate on engine carrier.



7. Loosen four self-locking nuts of steering gear, but do not remove them.



8. Remove bolts on universal joint. Push universal joint in direction of steering intermediate shaft.



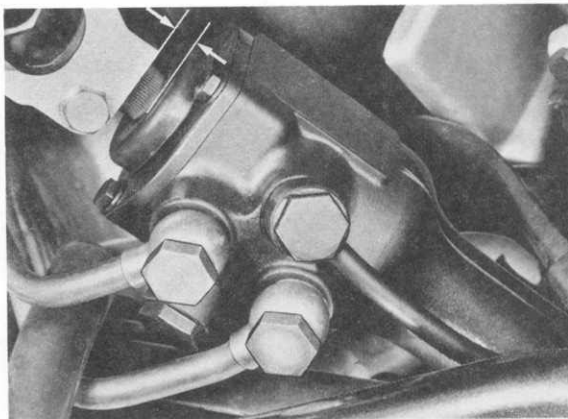
9. Now remove the four mounting nuts and take steering gear out of studs on engine carrier.

### Installing

1. Slide universal joint on to steering gear in correct position (steering wheel and steering gear in center position). Nuts on steering should only be screwed on slightly (facilitates assembly).
2. Mount steering gear. Produce 8 mm clearance between steering gear and universal joint with gauge 9208. Tighten mounting bolts for universal joint to 28 Nm.

### Note

On cars with a longer universal joint the clearance will definitely be less than 8 mm after inserting clamping bolt on the steering gear. In this case it is important to make sure that there is only a small gap between the steering gear and universal joint.



3. Fill system with hydraulic fluid, bleed and check for leaks as well as correct operation (see page 48 - 9)
4. If necessary (with new parts), adjust toe. **In conjunction with this matter**, remember that there are different steering stop versions (see text below). As of Model Year 1986, the tie rod was changed as well. **Be sure to observe this difference when replacing parts (also refer to page 40 - 17).**

### Steering stop versions

The steering stop has also been changed because of changes on the steering gear (rack deep-bore drilled and 15 mm longer, smaller diameter on ends of rack).

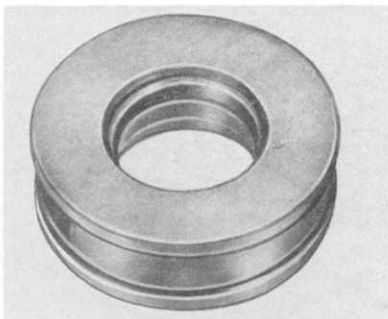
#### Stop of Changed Version

Part No. 928.347.329.03 or

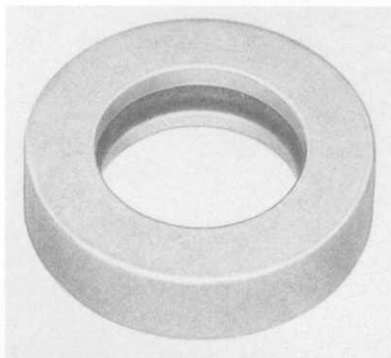
#### Present Version

Part No. 928.347.329.04

Stop 928.347.329.03 is no longer available for replacements. See cross reference **survey on page 48 - 6 b.**



928.347.329.03 (rubber / metal)



928.347.329.04 (aluminium)

#### Stop of Old Version

Part No. 928 347.329.00

- opening on one side with two surfaces in conjunction with spacer, Part No. 928.347.331.00



**Cross Reference Survey:**

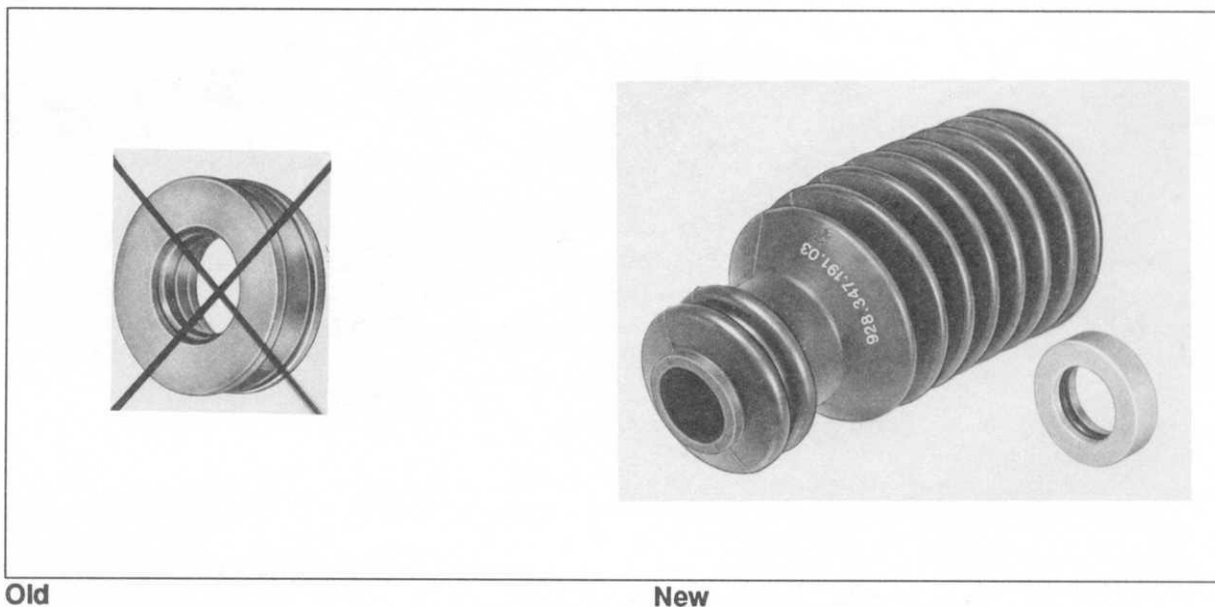
Steering Gear Version Identification	Steering Gear (LHD only)	Stop Part No. (left and right)	Spacer Part No.
1. Old version Rack <b>795 mm</b> long Rack end dia. <b>left 26 mm,</b> <b>right 25 mm</b>	928.347.010.22	928.347.329.00	928.347.331.00
2. Interim version Rack <b>795 mm</b> long Rack end dia. <b>left 26 mm</b> <b>right 23 mm</b>	928.347.010.22	928.347.329.00	928.347.331.00
3. New/current version Rack length <b>810 mm</b> Rack end <b>dia. left and right 23 mm</b>	(928.347.010.24) (928.347.010.26) <b>928.347.010.27*</b>	928.347.329.03 bzw. 928.347.329.04 see text below	none

The steering gears with Part No. 928.347.010.22 (former version and interim solution) are no longer available. They should be replaced with the new/current version.

The steering gears of the new version 928.347.010.24 and 928.347.010.26 indicated in brackets have since been deleted as well (status as of December, 1994).

**All former steering gear versions are to be replaced with the current version, 928.347.010.27.**

The elastic steering stop, 928.347.329.03, for left and right sides is replaced by a solid steering stop, 928.347.329.04, for improvement in quality. At the same time it was necessary to replace the dust cover, 928.347.191.02, with a new version dust cover having a supporting lip, Part No. 928.347.191.03.

**Instructions for Repair Sector:**

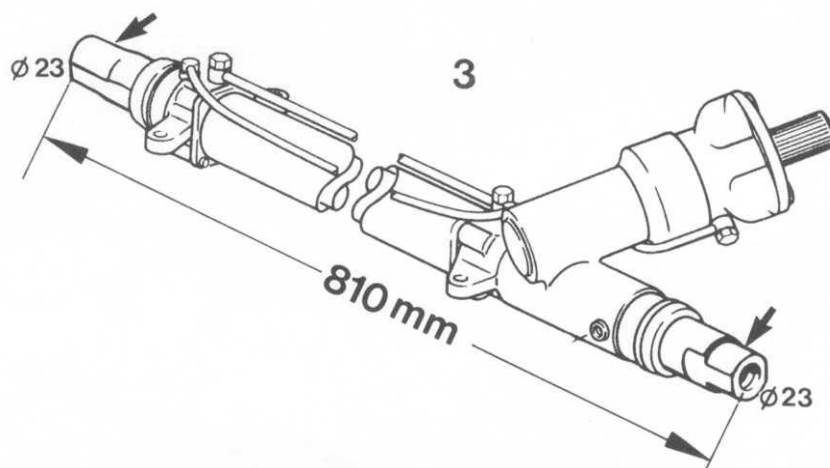
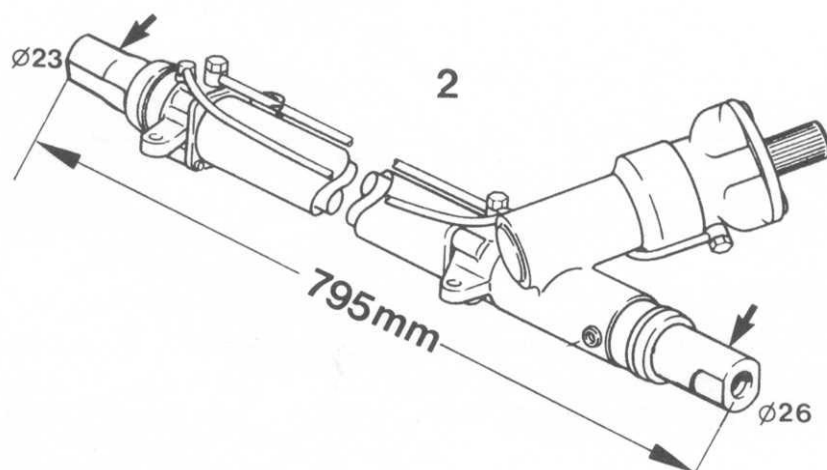
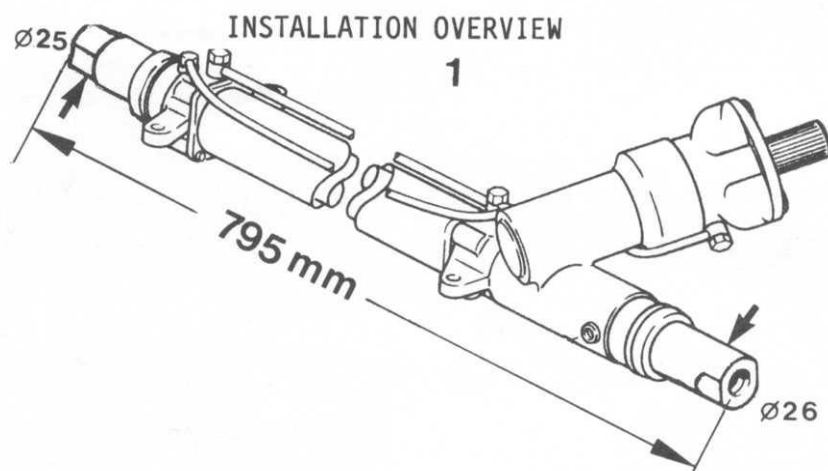
Only the new steering stop 928.347.329.04 and the new bellows 928.347.191.03 are supplied for steering gear 928.347.010.24. The bellows 928.347.191.03 and the steering stop 928.347.329.04 are also applicable to steering gears 928.347.010.26 / 928.347.010.27 (as of MY '91 or 928 GTS).

The new steering stop may only be installed together with the new dust cover.

When installing a solid stop for the first time, stops and dust covers must be replaced on both sides.

The new version dust cover can also be installed together with the old version elastic stop.

See cross reference survey on page 48 - 6d.

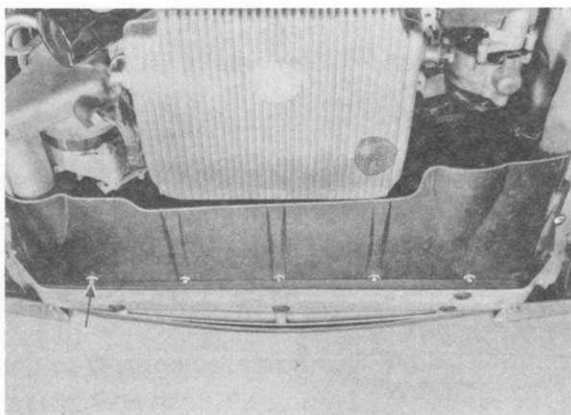


928.347.329.03 et  
928.347.329.04 (page 48 - 6 c)

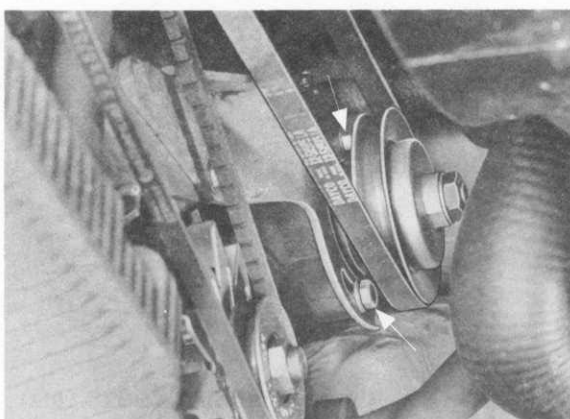
## REMOVING AND INSTALLING POWER STEERING PUMP

## Removing

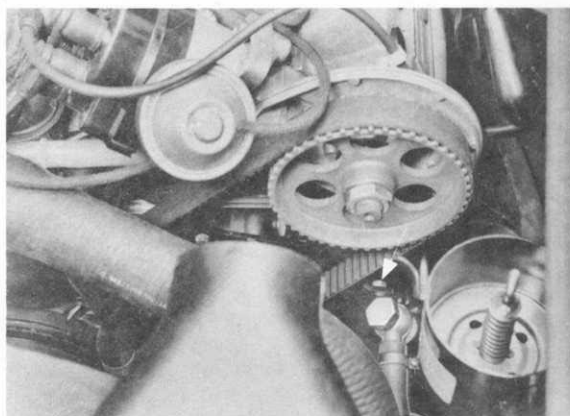
1. Detach intake hose to air cleaner on left side.  
Draw hydraulic fluid out of reservoir.
2. Remove splash shield.



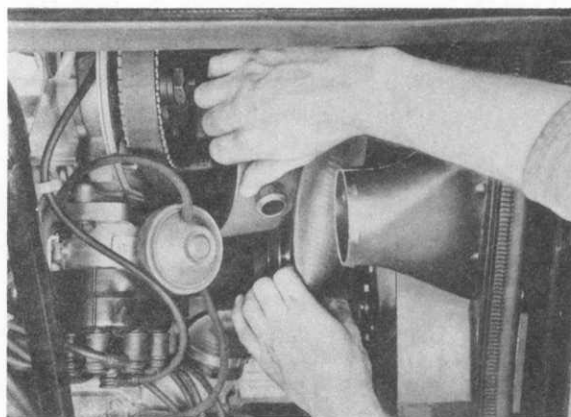
3. Loosen front bolts on power steering pump a little.



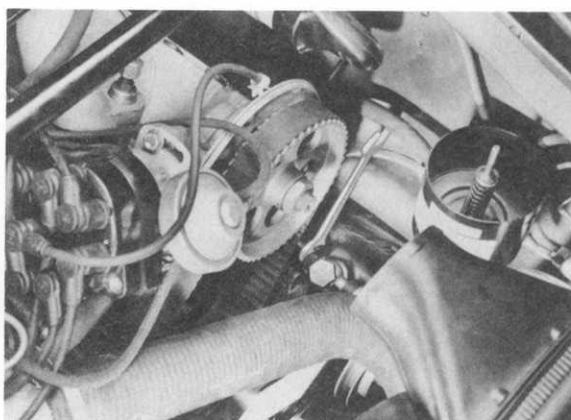
4. Remove rear bolt from power steering pump.



5. Remove v-belt.
6. Take off left upper section of drive belt cover to facilitate procedures.

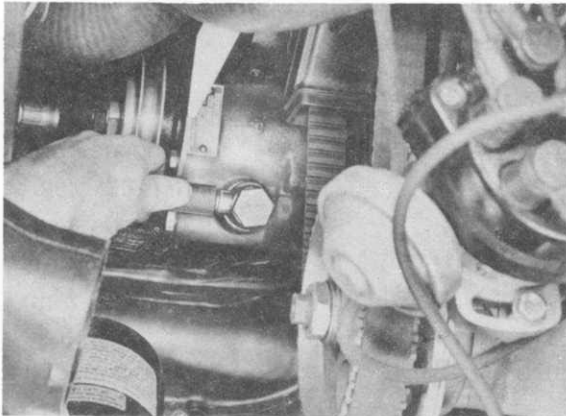


7. Detach pressure hose.

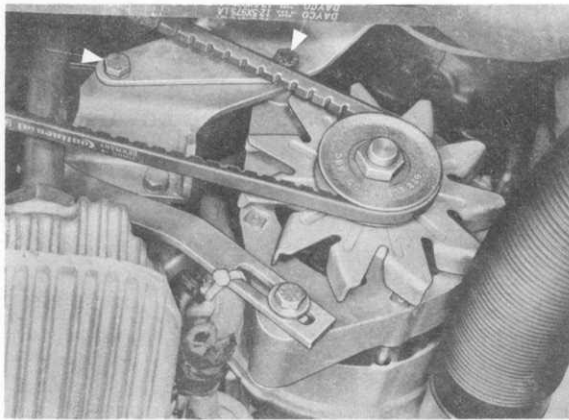




8. Remove suction hose after loosening clamp.



9. Remove bolts on front holder of power steering pump.



### Installing

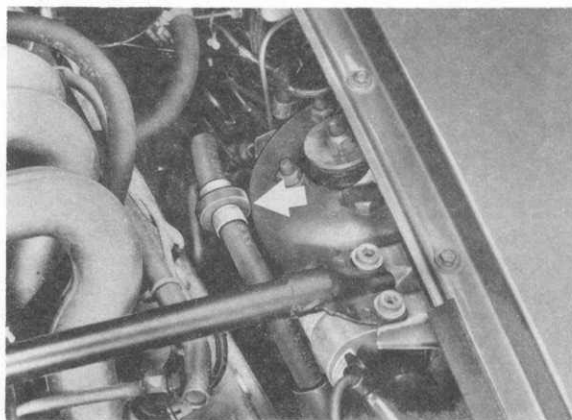
1. Tighten two bolts on front holder; only insert rear one (belt tightness).
2. Install pressure hose so that in installed position the protective ring (arrow) rests on spring strut mount. (Installed position: install drive belt, do not finish installation yet because of point 3.)  
Pressure hoses in initially manufactured cars had an asbestos sleeve.

Install this pressure hose leaving not more than 25 mm between inner wheel well and hose.

### Note :

If hose is routed too close to exhaust manifold, the hose could come loose from its holder and cause failure of the power steering.

Asbestos protected hoses are no longer available for replacements.



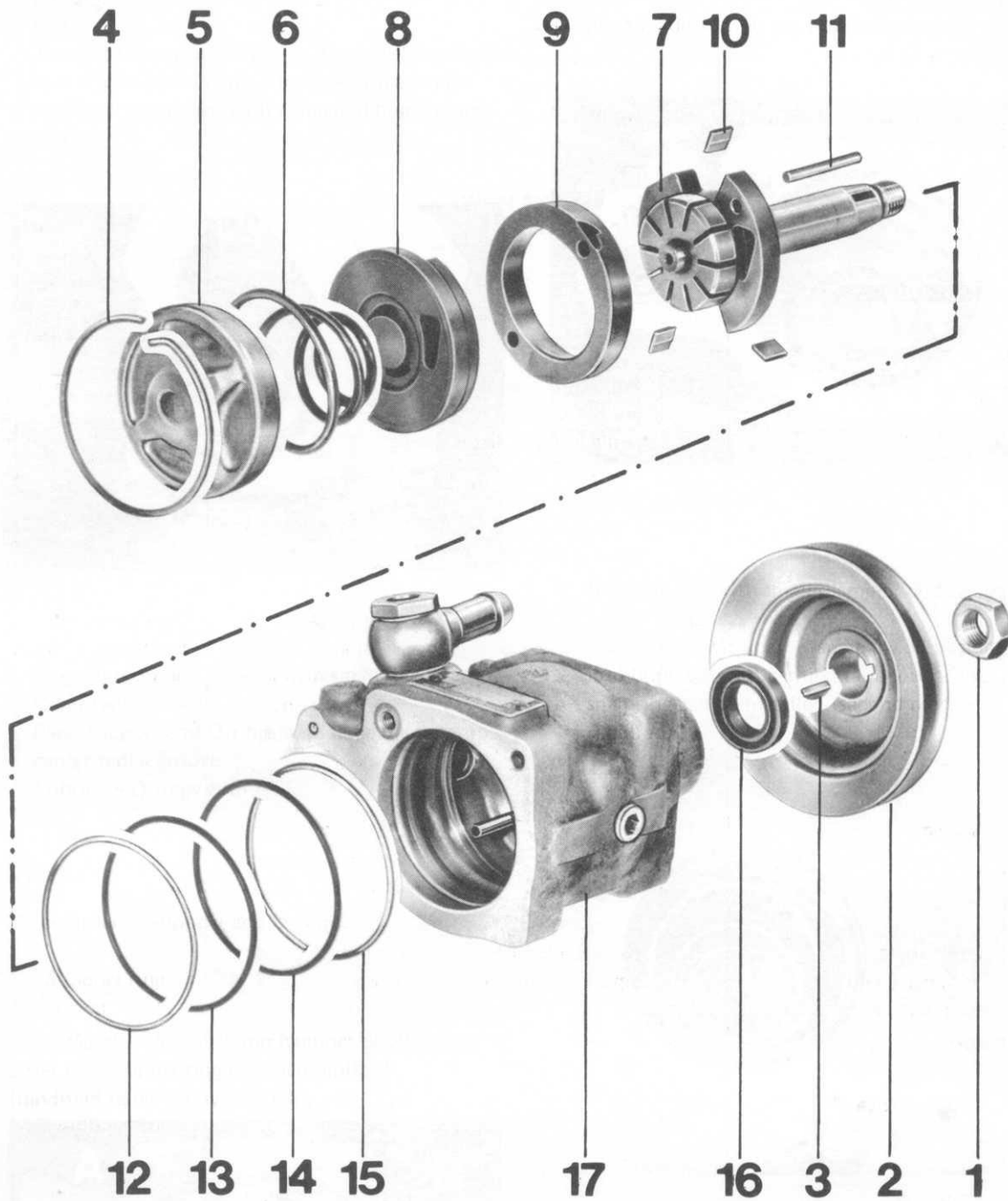
3. Install upper section of drive belt cover.
4. Install suction hose.
5. Install belt and adjust to remove tension. Also check tightness of alternator belt (slight corrections could be made).
6. Bolt on splash shield. Add hydraulic fluid. Bleed steering system. Check for leaks and operation.

### Note :

Make sure that no hydraulic fluid is spilled on alternator belt while disassembling and assembling.



## REPLACING SEALS FOR ALUMINUM POWER STEERING PUMP



## Note:

Body of power steering pump is made of aluminum as of 1981 models to reduce weight. Worn seals can be replaced on these aluminum power steering pumps, but pump has to be disassembled.

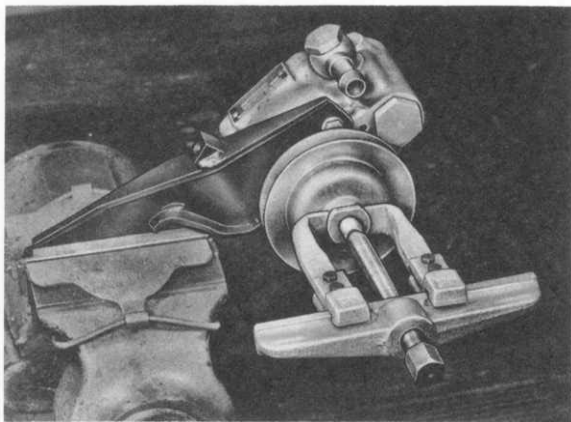
No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Self-locking nut M 14 x 1.5	1	Hold on pulley with open-end wrench	Replace if necessary. Torque: 50 Nm (36 ftlb)	
2	Pulley	1	Use standard puller, e. g. Kukko 20/1		
3	Woodruff key	1		Replace if necessary	
4	Hook snap ring	1	Pull out of radial groove with pliers, while holding down cap no. 5 to prevent it from popping up and causing injury		
5	Cap	1		Bevel faces inside of pump. Only press on far enough that hook snap ring can be installed	Don't cant cap when removing and installing
6	Spring	1		Position correctly; large diameter end faces cap	see assembly instructions
7	Drive shaft with drive end face plate and rotor	1	Knock out with a plastic hammer	Install face plate in correct position	
8	Cap end face plate	1		Position correctly	
9	Cam ring	1		Position correctly	
10	Pump impeller	10		Position correctly, must move easily in rotor	
11	Dowel pin	2		Insert in power steering pump body	

No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
12	Support ring, large dia.	1	Remove with plastic needle or air pressure	Replace — watching out for different diameters and installed positions	p. 48-8g, point 5
13	O-ring, large dia.	1			
14	O-ring, small dia.	1			
15	Support ring, small dia.	1			
16	Shaft seal	1	Lift out being careful not to damage bearing surface	Pack space between both sealing lips with multi-purpose grease. Don't damage sealing lips on groove in drive shaft (cover up)	See disassembling power steering pump, point 2 p. 48-8g, point 5
17	Aluminum body	1			

## REPLACING SEALS FOR ALUMINUM POWER STEERING PUMP

## Disassembling Power Steering Pump

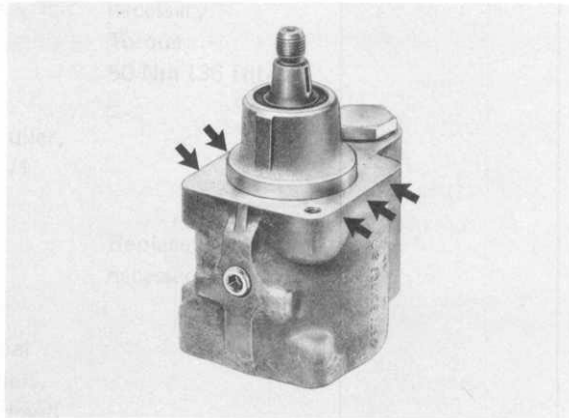
1. Use a standard puller (e. g. Kukko 20/1) to take pulley and woodruff key off removed pump.



2. Remove front bracket on power pump.

## Note :

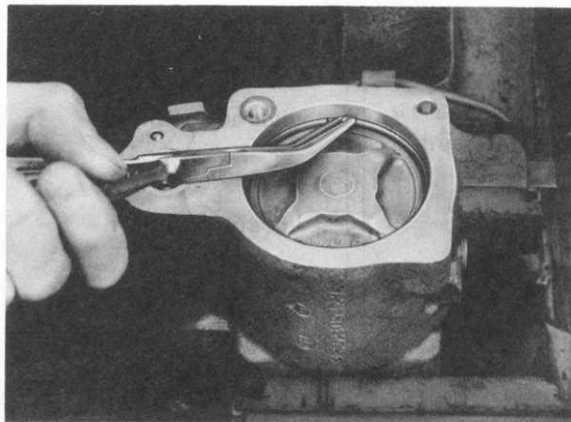
Pump may only be clamped in a vise on the marked surfaces (arrows) when replacing seals. Always use soft jaws in vise and keep clamping force as low as possible.



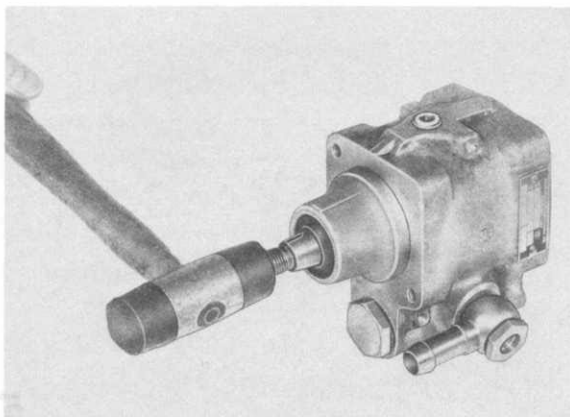
3. Pull hook snap ring out of radial groove with pliers. Press down on cover during this step to prevent snap ring from popping up and causing injury. Do not cant cover while removing, to prevent damage to the sealing surface.

## Note :

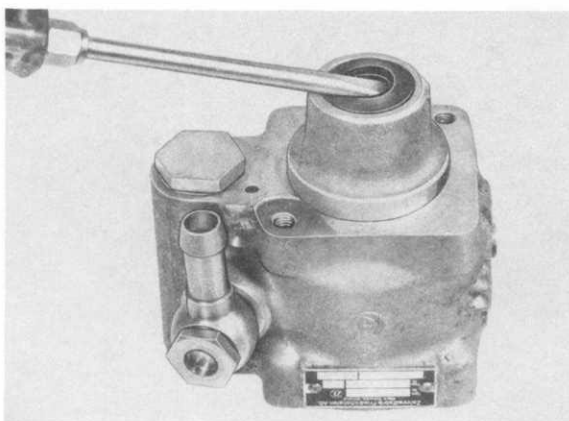
Loosen a canted cover by removing deposits in cylinder opening and tapp lightly with a plastic hammer. If necessary, remove cover together with rotor set and face plates (step 4).



4. Drive out drive shaft with face plates and rotor set by tapping with plastic hammer.



5. Lift out shaft seal, being careful not to damage bearing surface and bearing sleeve. Remove support ring and O-ring in radial grooves of body (use plastic needle or air pressure).



### Inspecting Components

Clean parts with a cleaning fluid and check visually.

#### Checking Points:

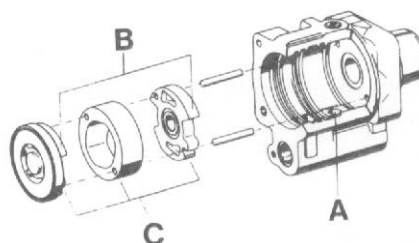
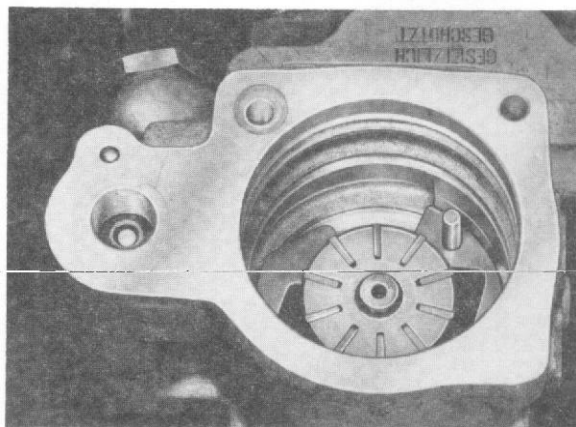
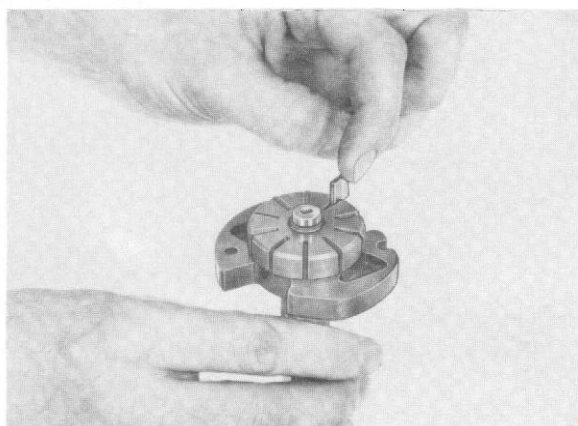
- Drive shaft: bearing surface of shaft seal and bearing sleeve (for wear). Threads, taper and groove for woodruff key.
- Bores for dowel pins in body (for wear).
- Bearing sleeve.
- Bearing surfaces and radial grooves of seals. Bores in body.
- Sealing surface of cover.
- Connection threads for pressure line.
- Rotor set:  
Cam ring (cam surface — seizure marks, wear) and rotor (guide slots — wear).  
Pump impellers (seizure marks and wear especially on round bearing surface and guiding surfaces on sides).
- Face plates (seizure marks and wear on face surfaces).

## Assembling Power Steering Pump

## Note:

Lubricate all parts lightly with ATF before installing.

1. Insert dowel pins in body.
2. Install ten impellers in slots of rotor so that their polished and round outer surfaces face the cam ring.  
Make sure impellers move easily.



3. Install drive shaft, face plate and rotor assembly in body. Slide face plate on dowel pins with wide element opposite valve bore.

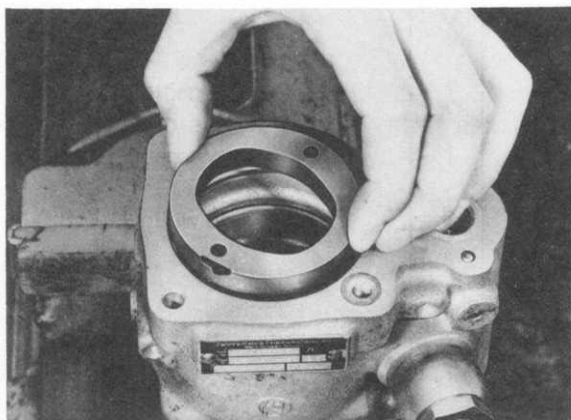
A = Valve bore

B = Wide side of face plates opposite valve bore

C = Slots in both face plates and cam ring aligned

4. Install cam ring. Cast arrow in cam ring circumference indicates pump driving direction. Since the pump turns clockwise, arrow must be on cover end.

There are elongated holes for the dowel pins in the cam ring and face plate. Elongated hole in cam ring must be aligned with elongated hole in face plate.



5. Place support and O-rings with small diameter in lower radial groove.  
Place support and O-rings with large diameter in center radial groove.  
Lubricate O-rings with ATF.

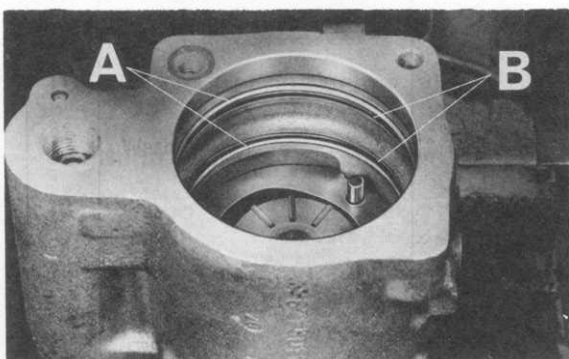
#### Note :

Check order of support and O-rings.

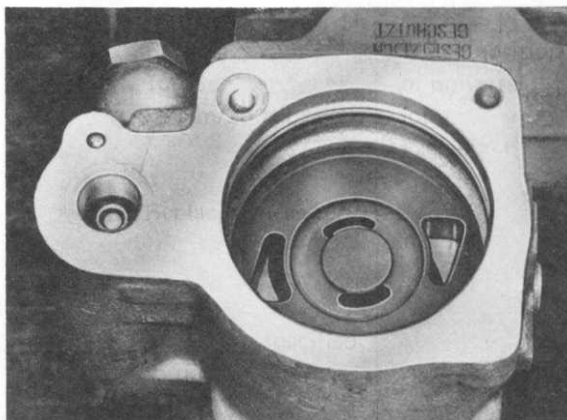
A = Support ring

B = O-ring

Since March, 1983 or Pump Number 866201 the cover end support ring has been omitted (modified radial groove in case).

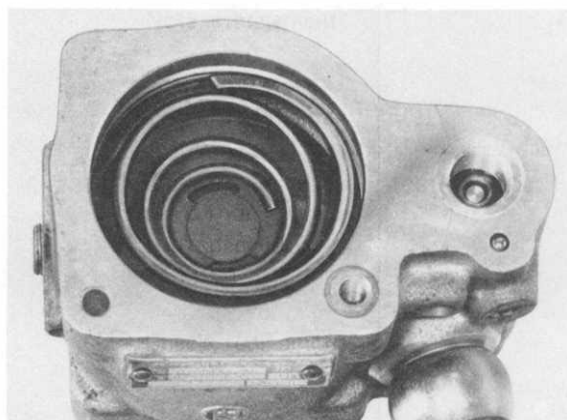


6. Press face plate on to rotor set. Dowel pins must engage in bores provided for this purpose. Slot must be aligned with slots in cam ring and face plate (wide section opposite valve bore).



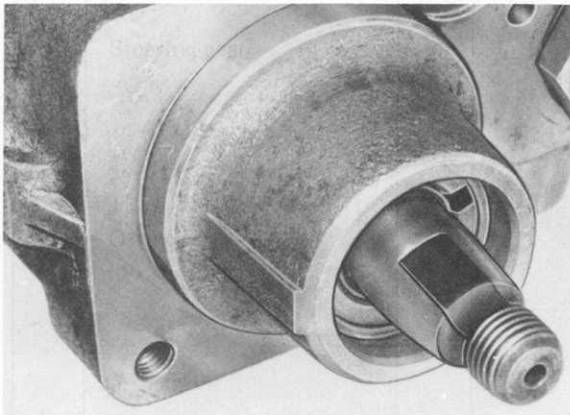
7. Install spring with small diameter end facing face plate.

Press cover (with bevel facing inside of pump) into body without canting far enough, that hook snap ring can be installed (second mechanic required).

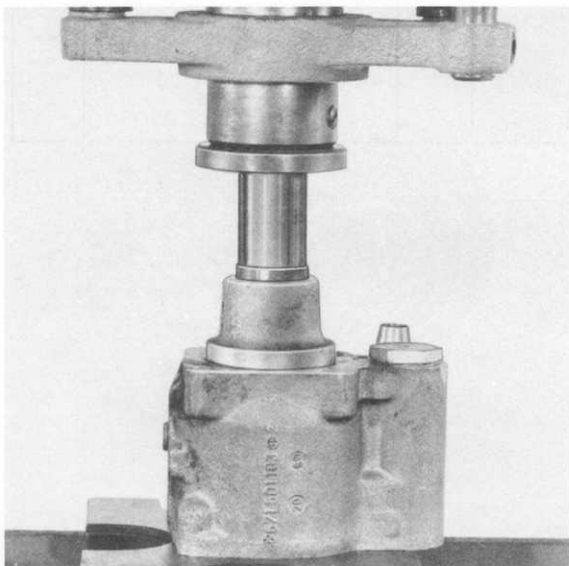


8. Pack multi-purpose grease in shaft seal between both sealing lips and install seal on drive shaft.

Use a suitable sleeve or cover woodruff key groove with a narrow strip of tape to avoid damaging shaft seal on groove.



9. Press on shaft seal against stop with a suitable mandrel.



10. Install front bracket. Install woodruff key and pulley. Tighten self-locking hexagon nut to 50 Nm (36 ftlb).

11. Install power pump. Fill and bleed steering system.  
Check pump operation and for leaks.



## Checking and adjusting the rack-and-pinion power steering

### General

Defects in the power steering arise as the result of a lack of oil in the hydraulic system. Because of the high oil pressure which builds up in the hydraulic circuit, even small leaks may lead to a loss of fluid, damaging the servo pump.

Rumbling noises from the steering as it is turned or foam in the fluid reservoir indicate low oil level and / or air in the system. Before refilling the reservoir, eliminate any leaks on the intake side or replace the defective component on the delivery side.

### Note:

**It is not permissible to repair or disassemble rack and pinion steering gear.** Repairs to servo pumps are impermissible, although the pumps can be resealed (page 48 - 8a).

Replacement steering gear and servo pumps are available on an exchange basis in a number of countries. In some cases, it may be possible to have the steering gear and the servo pump repaired by a main service agent in countries without exchange facilities.

### Checking drive belt tension

Tension is correct when light thumb pressure applied at a point midway between the two pulleys deflects the belt by approx. 10 mm.

### Checking steering system for leaks (visual check)

With the engine running, turn steering wheel to full lock and keep it in this position. This causes the maximum possible line pressure to be built up.

Check all line connections for leaks in this position and retighten if required.

Run this check for max. 10 seconds. If checks are made for a longer interval, allow for a short break approx. every 10 seconds.



### Checking fluid level of power steering

1. Pull off or unscrew cap of hydraulic fluid reservoir.

#### Note

Reservoir is mounted on wheel housing in Engine compartment. The reservoir installed in cars earlier than model year 83 has a fluid-level mark (version A).

As of model year 83, a modified reservoir is installed with a dipstick mounted on the cap (version B).

2. Start engine and allow to idle. With version A, the fluid level should be at the mark stamped on the reservoir. With version , wipe dipstick, screw cap down and remove. The fluid level must be between the two marks. If necessary, top up with ATF DEXRON II D.



Version A



Version B

### Bleeding steering system

1. To refill the entire system after installing new steering equipment or lines or after a heavy loss of hydraulic fluid, start engine briefly and switch off again immediately after starting. Repeat this process several times. This will cause the fluid level in the reservoir to drop quickly: keep the level up to the max. mark by continuously adding fluid. Do not allow the reservoir to empty.
2. Continue the process described in point 1 until the fluid level in the reservoir stops dropping, then restart engine and allow to idle.

3. Quickly turn steering wheel several times from lock to lock, to drive all air out of the cylinders (when end position of piston is reached, do not pull harder on steering wheel than required to turn steering; avoid building up unnecessary pressure at this stage).
4. Observe fluid level during this process and, if level continues to drop, keep adding fluid until the level in the reservoir remains constant and air bubbles cease to rise in the hydraulic fluid when the steering wheel is turned.
5. When the engine is stopped, the level of fluid in the reservoir should not rise by more than 10 mm.

**Note:**

If the difference between fluid levels with engine stopped and engine running is more than 10 mm, there is too much air trapped in the hydraulic fluid.

## TOOLS

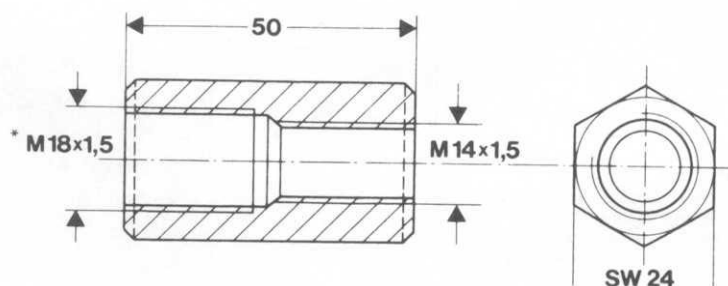
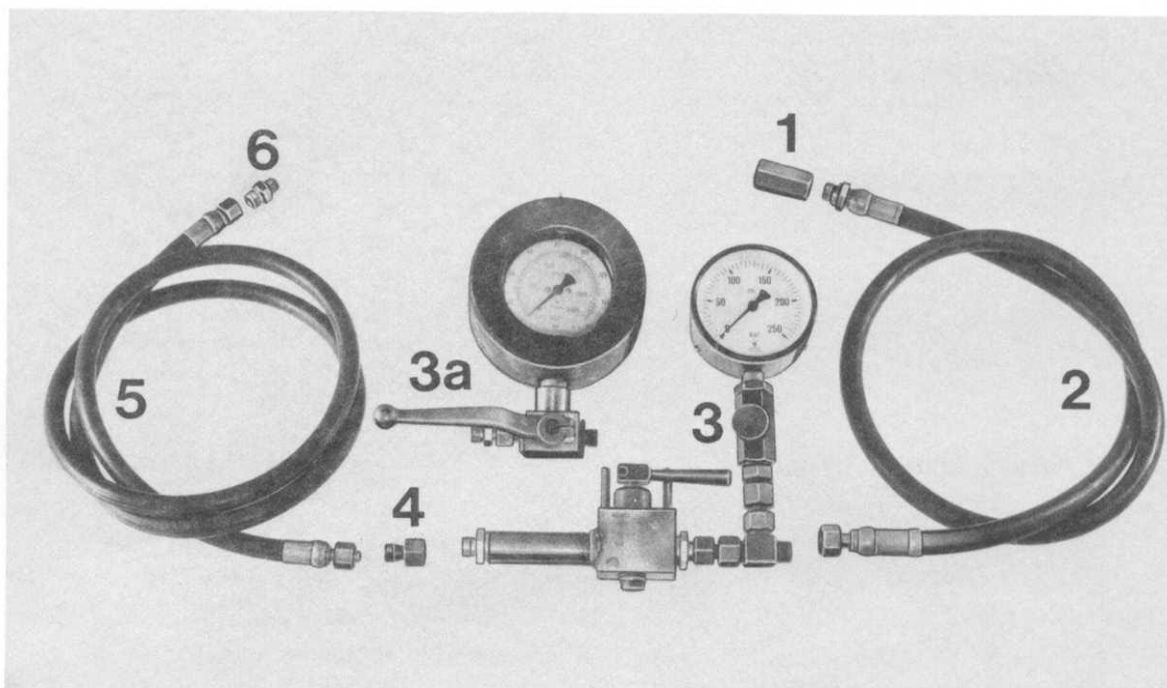
## Note:

All parts (1 through 6) can be used for 928 and 944 cars.

Pressure gauge is connected between pressure line and steering gear (944: between power pump and pressure line).

If old pressure gauge no. 3 (see below) is used, make sure high pressure hoses no. 2 and no. 5 are connected on pressure gauge in correct position (opposite sides as for 944).

Connection of high pressure hoses on pressure gauge no. 3 a, on the other hand, can be made on any side.



TOOL TABLE – PAGE 48 - 10

\* Threads will be M 18 x 1.5 or M 16 x 1.5 depending on pressure gauge version (see Tool Table).

## TOOLS

No.	Description	Special Tool	Remarks
1	Adapter	V.A.G. 1402	For pressure gauge 3: local manufacture (see sketch, page 48 - 9). For pressure gauge 3 a: local manufacture, deviates from sketch. Threads not M 18 x 1.5 (for gauge no. 3) but <u>M 16 x 1.5</u> .
2	High pressure hose up to 200 bar, 1.5 meters long		Standard, for gauge no. 3: M 18 x 1.5 and sealing head on one end and M 18 x 1.5 with flat seal on other end. for gauge no. 3 a: M 16 x 1.5 with sealing head on one end and M 16 x 1.5 with flat seal on other end.
3	Pressure gauge 0 — 250 bar		Old version, no longer available.
3a	Pressure gauge 0 — 160 bar		Order No. Z 401 103 WE from: Volkswagenwerk AG KD - Gerätevertrieb Wolfsburg Tel.: 05361/9-25431
4	Adapter (not required for press. gauge 3 a)		Standard, M 18 x 1.5 and M 16 x 1.5
5	High pressure hose up to 200 bar, 2.0 meters long		Standard, M 16 x 1.5 and sealing head on both ends
6	Connector		Standard, M 16 x 1.5 with sealing head on one end and M 14 x 1.5 with flat seal on other end

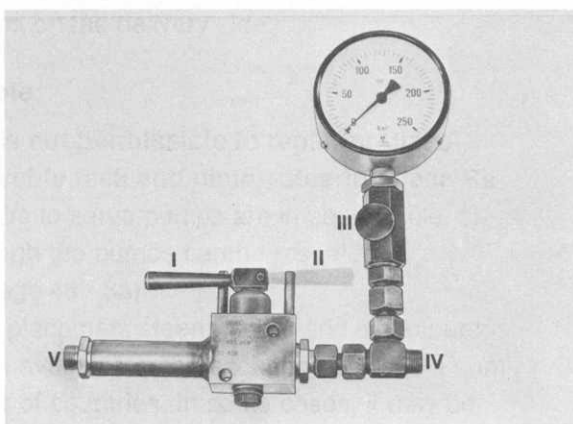
## CHECKING HYDRAULIC FUNCTION OF STEERING (PRESSURE TEST)

### General Information

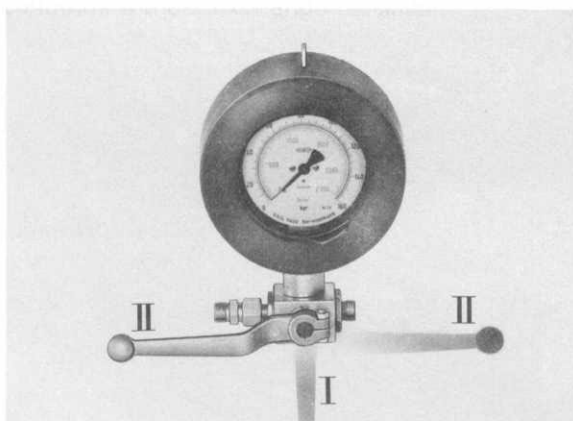
Tester (pressure gauge) is installed between pressure line and steering gear (rotary piston valve).  
Make sure of correct installed position when using old pressure gauge.

Connections and lever positions are marked with numbers for better understanding of the following instructions.

### Old Version



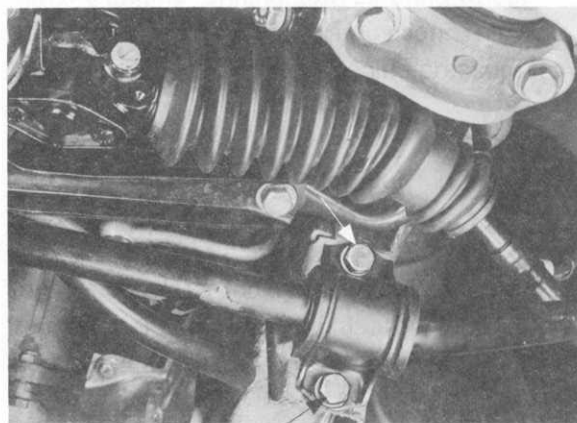
V.A.G. 1402



- I — Shut-off valve open
- II — Shut-off valve closed
- III — Damping orifice
- IV — From pressure line
- V — To steering gear

### Installing Pressure Gauge

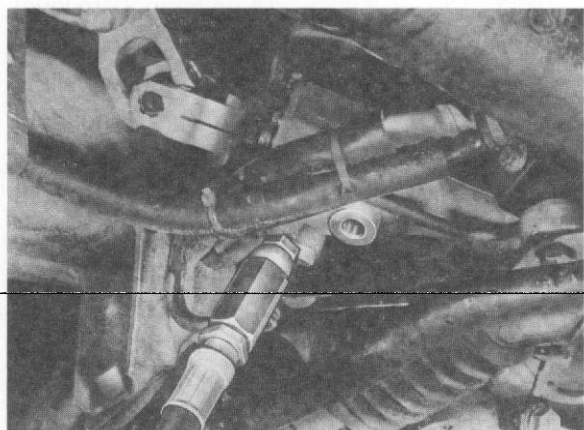
1. Unscrew bolts from stabilizer bearings and pull down stabilizer far enough that pressure line hollow bolt is accessible.



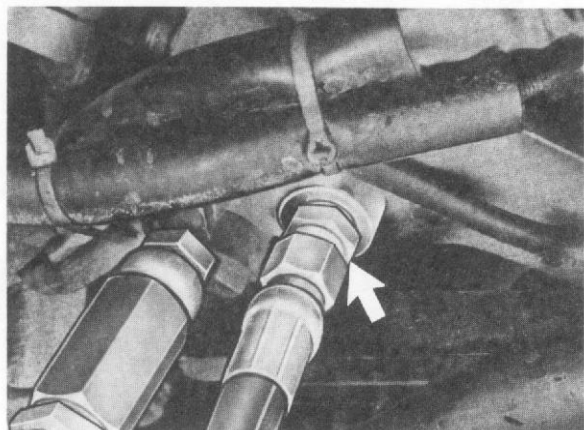
2. Detach pressure line at steering gear. Catch hydraulic fluid, but do not reuse.



3. Pull down pressure line, which does not require loosening mounting clamp of lines. Connect 1.5 meter long high pressure hose no. 2 to pressure line using the hollow bolt and adapter no. 1 (seals required: 2 x 14 x 18 and 1 x 18 x 22 or 1 x 16 x 20).



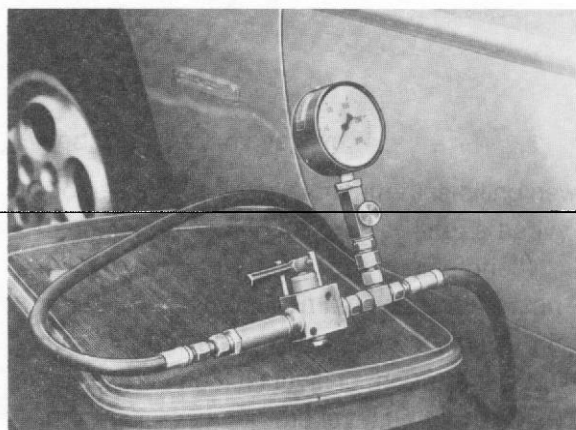
4. Screw connector with high pressure hose no. 5 on steering gear (seal required: 14 x 18).



5. Mount pressure gauge between high pressure hoses and place on a base (e.g. toolbox) next to driver's door.

#### Note

Use adapter no. 4 for old version pressure gauge and connect high pressure hose no. 5 on connection V of pressure gauge.



6. Open shut-off valve of pressure gauge (lever position I), fill supply tank and bleed steering system (see page 48 - 8j).
7. Check delivery pressure of power steering pump and system pressure (page 48 - 13).

### Checking the delivery pressure of the power steering pump

1. With the engine running at idle, close shutoff valve (lever position II) and read off pressure. Open shutoff valve again at once.  
**Specification 68 to 82 bar** for power steering pump 928.347.431.04, 928.347.431.05 and 928.347.089.00.  
**Specification 110 to 110 bar** for power steering pump 928.347.089.01 (as of MY '91)  
**Identification:** Nameplate on pump. Part No. and pressure specification are indicated on the nameplate.

#### Note

To limit wear, the shutoff valve should not be closed for more than 5 seconds. In the case of pressure gauge version 3a, select lever position II right or II left according to the way that high-pressure hoses are connected to the pressure gauge. (No reading is possible if lever position II is incorrect).

2. If specifications are not reached or exceeded, replace pump.

### Checking Delivery Pressure of Power Pump

1. Run engine at idle speed. Shut-off valve must be open (lever position I).
2. Turn steering wheel to left and right full lock and read off fluid pressure at pressure gauge.  
**Specification 68 to 82 bar** for power steering pump 928.347.431.04, 928.347.431.05 and 928.347.089.00.  
**Specification 110 to 110 bar** for power steering pump 928.347.089.01 (as of MY '91).  
**Identification:** Nameplate on pump. Part No. and pressure specification are indicated on the nameplate.

#### Note

It is not sufficient to make sure that the steering stop limiter becomes effective. The reset force of the rotary piston valve must also be overcome. Force required at steering wheel: approx. 100 N (10 kPa).

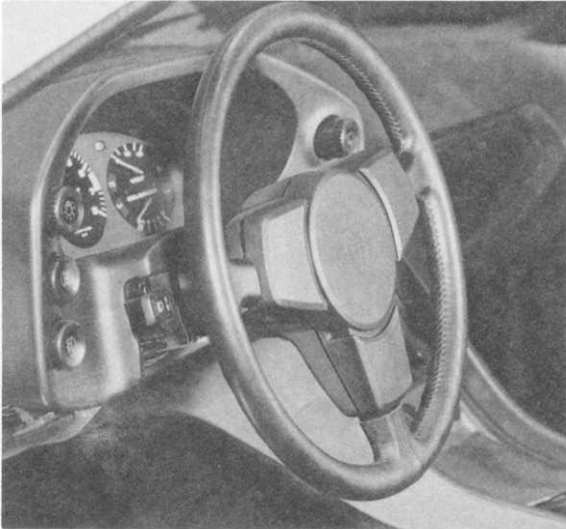
3. Replace steering gear assembly, if specified value is not reached at left/or right locks (excessive leak oil flow).



## REMOVING AND INSTALLING STEERING WHEEL

### Removing

1. Pull impact pad off of steering wheel and take off horn wires.



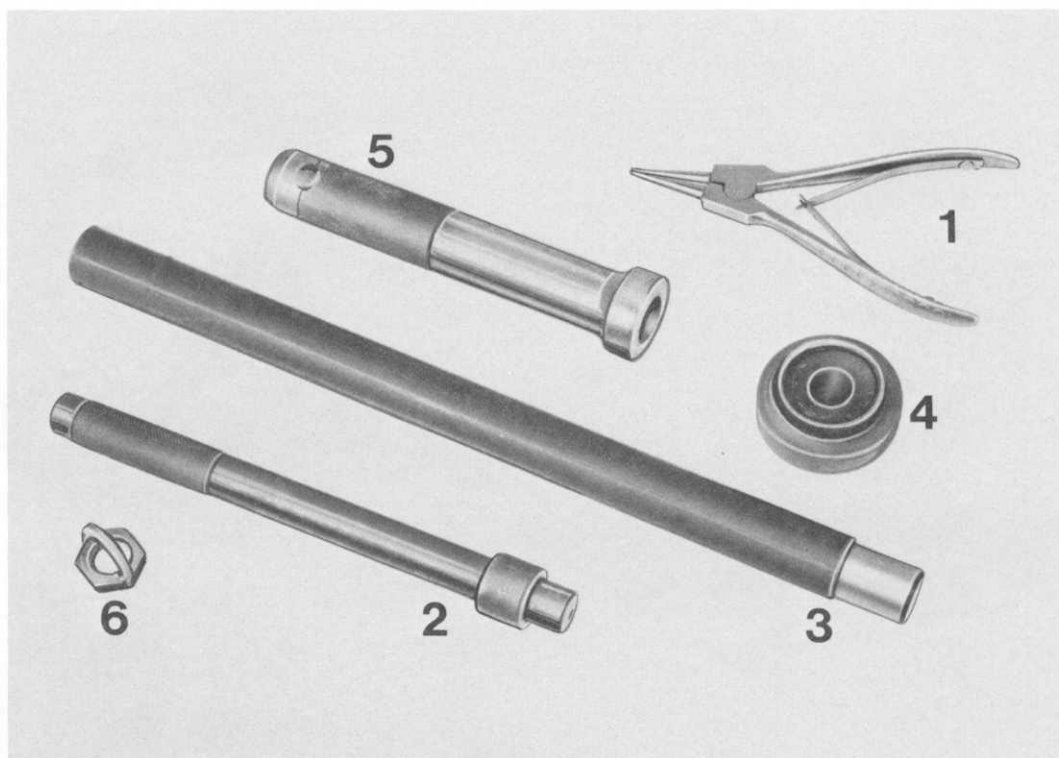
2. Mark position of steering wheel to steering shaft for reinstalling.
3. Unscrew nut and remove steering wheel and washer.



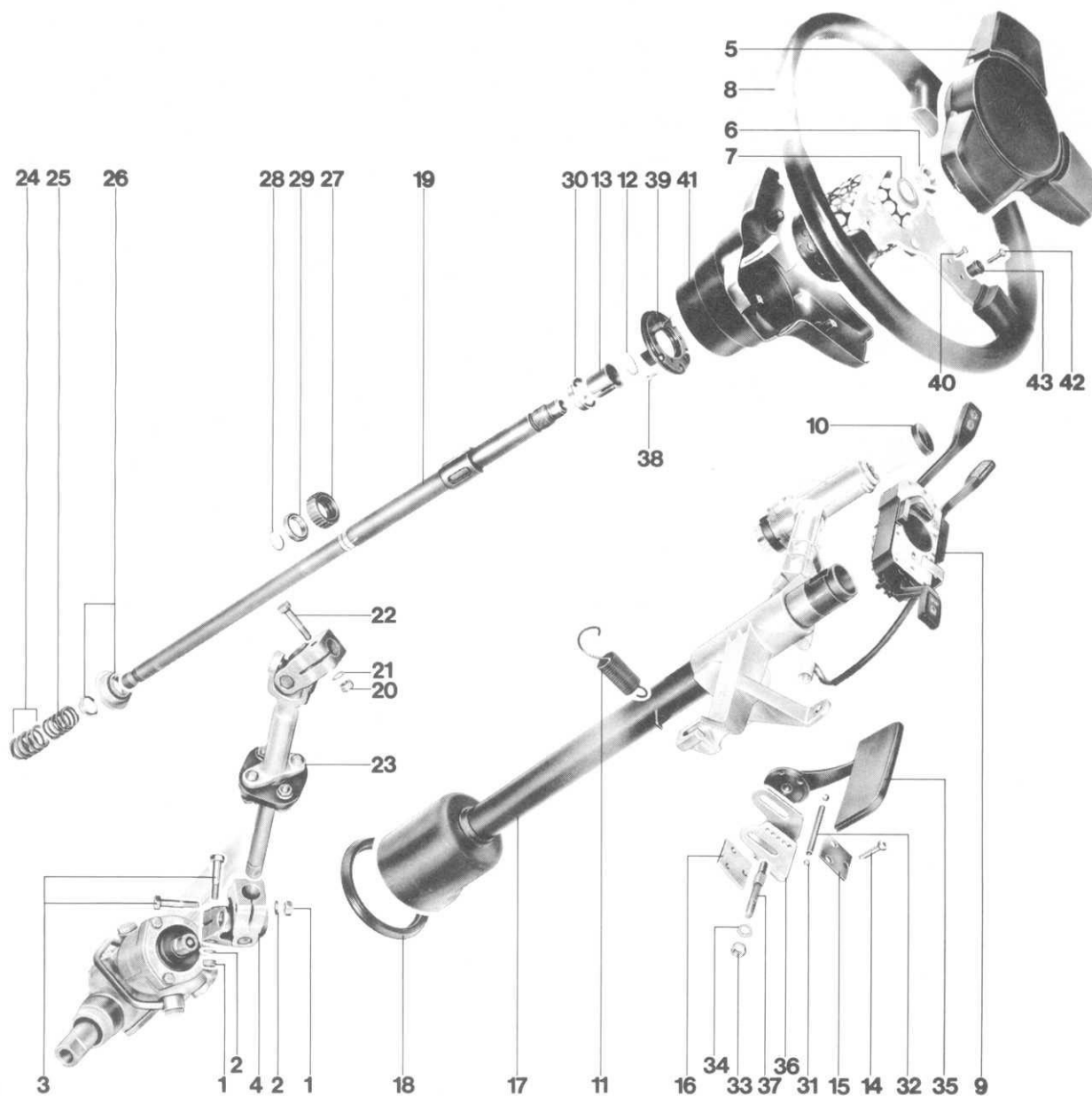
### Installing

1. Install steering wheel with road wheels pointing straight ahead or according to disassembly mark in such a manner, that steering wheel spokes are horizontal.
2. Install hexagon nut with spring washer and tighten to specified torque.
3. Mount horn wires on impact pad and press impact pad on to retaining pins.
4. Check function of horns and direction indicator switch.

## TOOLS



No.	Description	Special Tool	Remarks
1	Circlip pliers		Standard tool
2	Mandrel	VW 295	
3	Mandrel	VW 214 f/20	
4	Pressure pad	VW 433	
5	Sleeve	30 - 21	
6	Locally made tool		Half of an approx. 4 mm thick washer welded on steering wheel mounting nut (M 18 x 1.5 hexagon nut)



No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
1	Self-locking nut	2		Replace, torque: 28 Nm (20 ftlb)	Watch installed position of universal joint no. 4, see page 48 - 23
2	Washer	2		Replace if necessary	
3	Setscrew	2			
4	Universal joint	1		Produce 8 mm gap for short version with tool 9208 (page 48 - 23). Check for damage	
5	Pad	1			Remove tool 9132 immediately after installing steering wheel
6	Nut M 18 x 1.5	1		Torque: 50 Nm (36 ftlb)	
7	Washer	1		Replace if necessary	
8	Steering wheel	1		Steering wheel spokes horizontal with steering gear in center position (centered with tool 9132)	
9	Steering column switch	1	Unscrew mounting bolt	Align with cover	Different torque depending on type of screw (see point 6 of installing)
10	Rubber cover	1			
11	Spring	1			
12	Circlip	1			
13	Support	1			
14	Screw	3			
15	Spacer 2 mm thick	1			

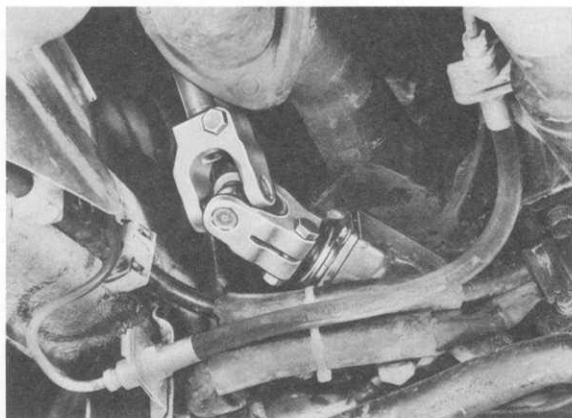
No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
16	Washer	X		6 mm (one thick 4 mm and one thin 2 mm) for leather or 4 mm (one thick 4 mm) for leatherette	
17	Steering tube with steering lock	1			
18	Seal	1		Replace if necessary; position correctly	
19	Steering shaft	1		Adjust axial play to 0.5 . . . 1.0 mm	
20	Self-locking nut	1		Replace, torque: 28 Nm (20 ftlb)	Axial play of intermediate shaft will be changed as soon as steering shaft/intermediate shaft conn. is disconnected
21	Washer	1		Replace if necessary	
22	Setscrew	1			
23	Intermediate steering shaft	1			Changed from steel to forged aluminum to save weight
24	Shim	X		Set: four 1.5 mm and one 0.5 mm thick shims	See repair manual for adjusting steering shaft axial play
25	Spring	1			
26	Steering shaft mount, lower, with support	1		Install with sleeve 30 - 21	
(27)	Sleeve	1			Deleted in 1981 models, no longer available as replacement, if necessary install old steering shaft without mount
(28)	Snap ring	1			
(29)	Steering shaft mount center	1			

No.	Description	Qty.	Note When:		Special Instructions
			Removing	Installing	
30	Steering shaft mount, upper	1	Drive out with a suitable pipe	Drive in with VW 433	
31	Ball	2			
32	Spring	1			
33	Self-locking nut	1			
34	Washer	1			
35	Adjusting lever	1			
36	Bracket	1			
37	Stud	1			
38	Screw M 3.5 x 10	3			Same part as no. 40
39	Contact ring	1		Position correctly	
40	Screw M 3.5 x 10	3			Same part as no. 38
41	Hub trim	1			
42	Bolt	3			
43	Insulator	3		Replace if necessary	

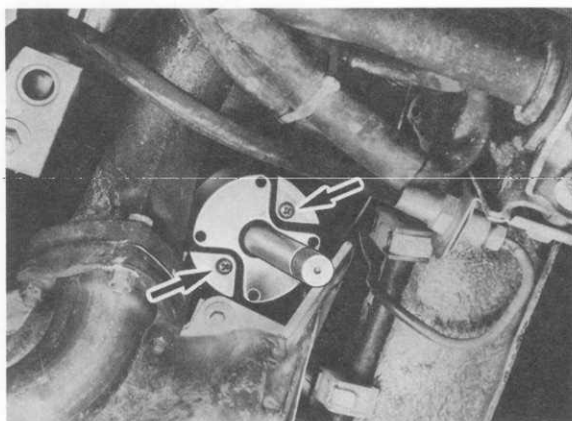
## REMOVING AND INSTALLING STEERING TUBE

## Removing

1. Remove universal joint after unscrewing two hexagon head setscrews.



2. If applicable, take off cover on steering intermediate shaft.

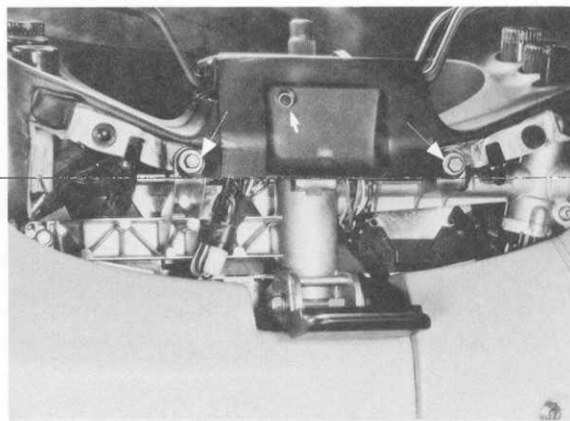


3. Disconnect battery ground wire at body. If car has electric seats, move them completely back to make assembly work easier.

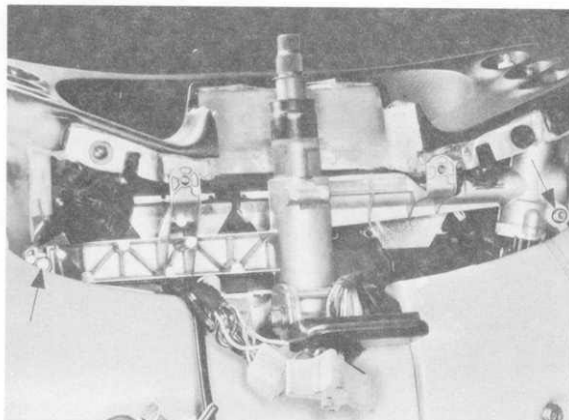
4. Pull off impact pad on steering wheel and remove horn wires. Mark position of steering wheel on steering shaft. Unscrew hexagon nut and take off steering wheel with washer.



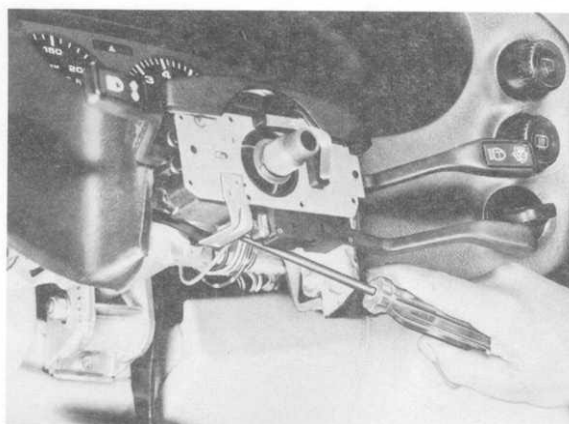
5. Unscrew cover underneath instrument cowl (not on older models) and cover underneath steering column switch.



6. Unscrew mounting bolts for instrument cowl.



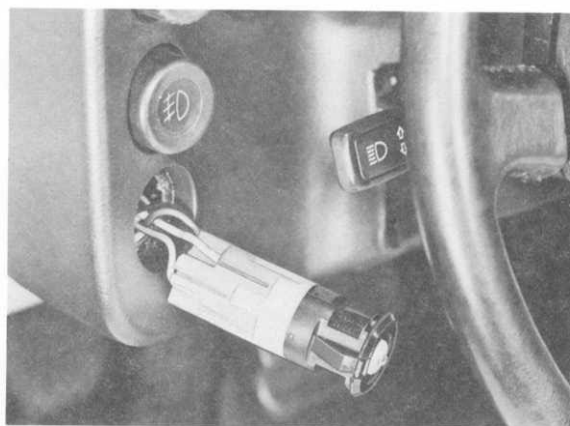
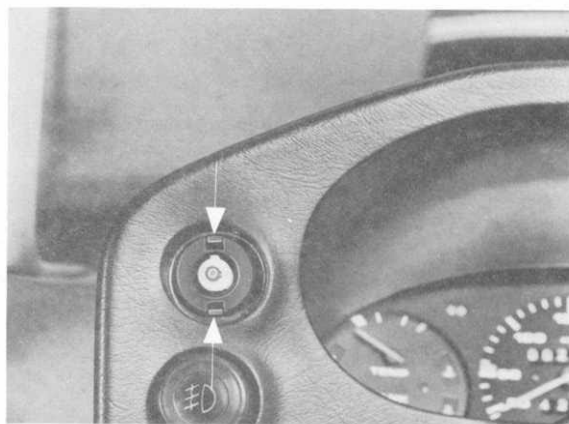
7. Unscrew mounting bolt for steering column switch.



8. Remove steering column switch after disconnecting plug connector and pulling off plug. Lift instrument cowl for this purpose.



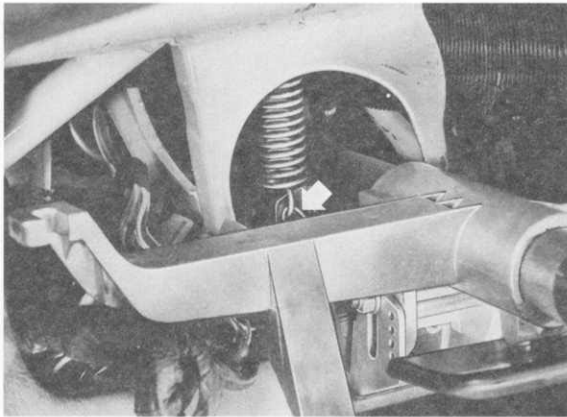
9. Remove 5 switches in instrument cowl by pulling off switch knobs, compressing both spring clips of each switch, pulling out switches and pulling off plugs. Remove rubber cover (ignition lock cover).



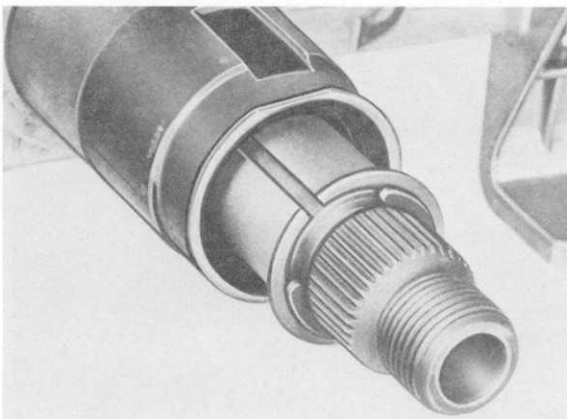
10. Pull plugs out of plug guides on back of instrument cowl (printed circuit) and lift off instrument cowl. Mark plugs for reinstallation.



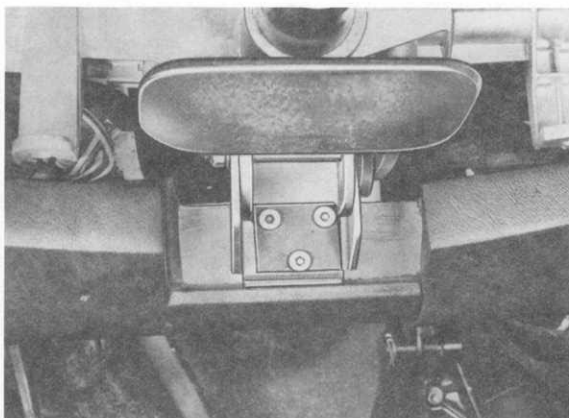
11. Pull off plugs on ignition switch. Disconnect spring for steering wheel height control with a piece of suitable wire.



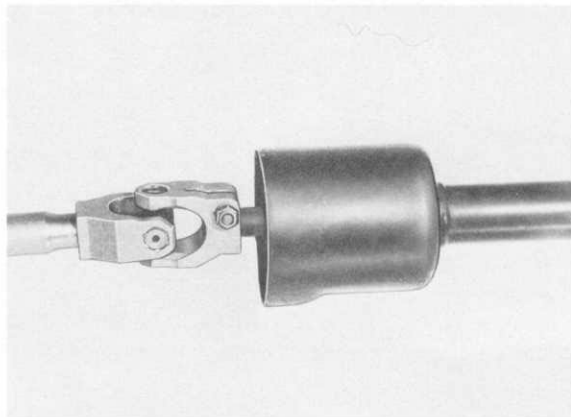
12. Remove circlip and support on steering shaft.



13. Unscrew mounting bolts on steering tube bracket.



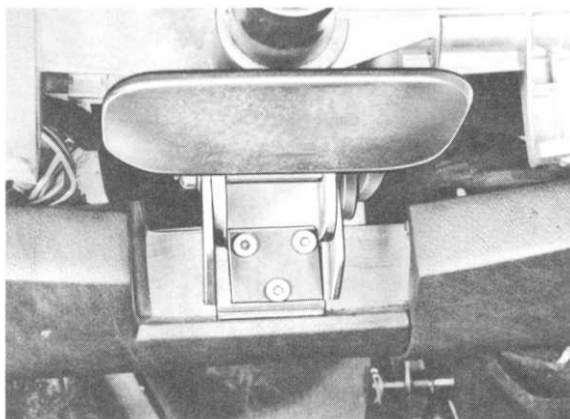
14. Move up steering tube combined with steering and intermediate shafts. To prevent seizure of intermediate shaft on firewall while moving up, keep to the following procedures. Pull up steering tube slightly and then push down the now accessible steering and intermediate shafts in the steering tube against the stop on the steering shaft mount. Push down very carefully to prevent changing sit of mount.



#### Installing

1. Insert seal in firewall in correct position. Coat pertinent area and seal with tire assembly paste to make installation of steering tube easier.
2. Install steering tube with steering and intermediate shafts in car.  
Preparations:  
Circlip and support of steering shaft removed, steering shaft pushed down in steering tube, intermediate shaft pushed through firewall. Slide up steering shaft again before moving steering tube into firewall. Install support and steering wheel mounting nut temporarily instead of the circlip.

3. Mount steering tube with appropriate spacers, see pages 48 - 17 and 18. Only tighten the socket head bolts finger tight.



4. Attach spring for steering wheel height control. Install circlip on steering shaft. Connect plugs on ignition switch.

5. Install steering column switch and instrument cowl. Tighten mounting bolts of cowl.

6. Align instrument cowl (horizontal position and equal distance to instrument panel on left and right sides). Then tighten 3 mounting bolts of steering tube to specified torque.

M 6 x 25 socket head bolt  
 with 4 mm socket: 9.7 Nm (7 ftlb)  
 with 5 mm socket: 12.0 Nm (9 ftlb)

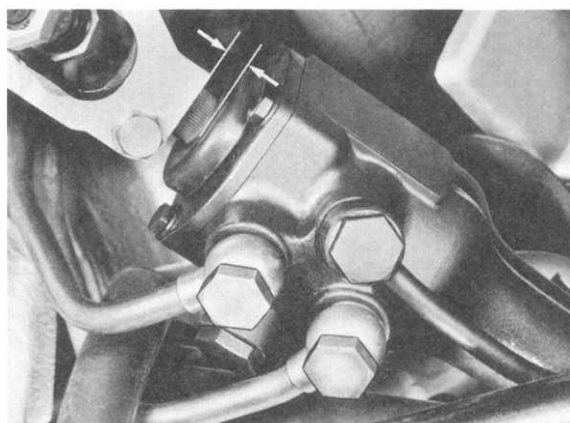
7. Align steering column switch and tighten mounting bolt. Screw on cover(s). Connect battery ground wire.

8. If applicable, mount cover on intermediate shaft.

Install universal joint between steering and intermediate shafts. First slide up universal joint on intermediate shaft fully (facilitates installation). Produce 8 mm gap between steering gear and universal joint with Special Tool 9208. Tighten universal joint mounting bolts to 28 Nm (20 ftlb).

#### Note

For cars with a longer universal joint the gap will definitely be less than 8 mm after installing clamping bolt on the steering gear. In this case only make sure that there is a small gap between the steering gear and universal joint. The steering gear might have to be lowered to install the long universal joint.



9. Install steering wheel so that its spokes are horizontal when road wheels are pointing straight ahead or by mark made during removal operations.

Install mounting nut with washer and torque to 50 Nm (36 ftlb).

If necessary, correct position of steering wheel after test drive (not positioned horizontally before removal and slightly different universal joint position).

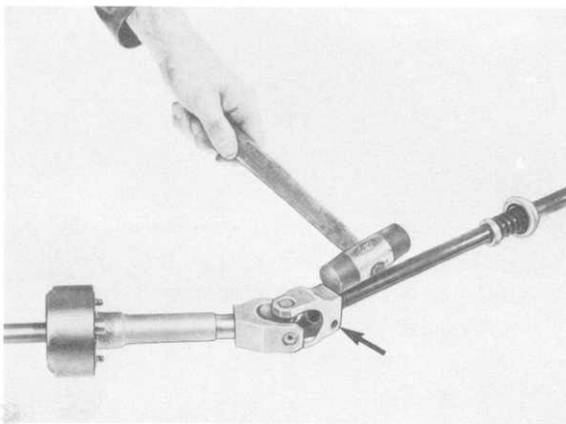
10. Check function of electrical system and pertinent parts.

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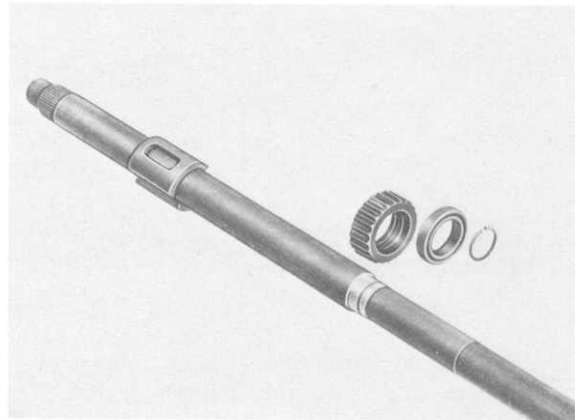
## REMOVING AND INSTALLING STEERING SHAFT / STEERING SHAFT BEARINGS ADJUSTING AXIAL PLAY OF STEERING SHAFT

### Removing

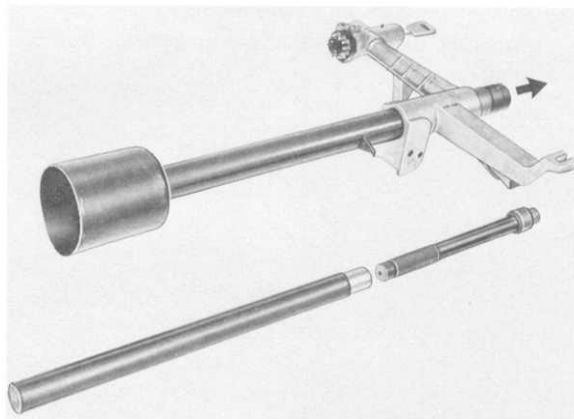
1. Pull intermediate and steering shafts down out of steering tube quickly (circlip and support removed, steering wheel lock unlocked). This will also remove the lower steering shaft bearing.
2. Disconnect intermediate shaft on steering shaft after removing setscrew (arrow). Be careful not to damage the aluminum universal joint (use plastic hammer). Remove lower steering shaft bearing, spring and shims (if applicable) on steering shaft.



3. If steering shaft has three bearings (also refer to page 48 - 18), only remove the center bearing when damaged (must run easily) since replacement parts are no longer available. If necessary, install a steering shaft designed for three bearings without the center bearing.

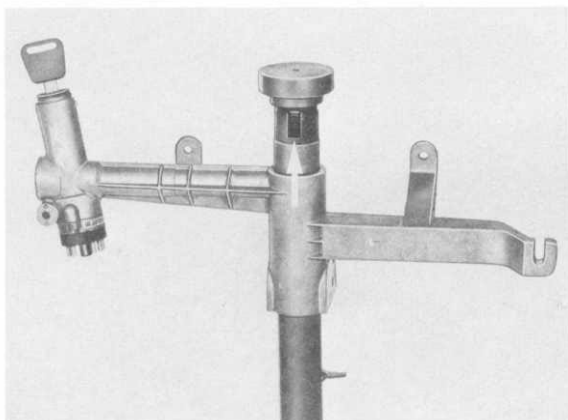


4. Drive upper steering shaft bearing out of outer tube with a suitable piece of pipe.

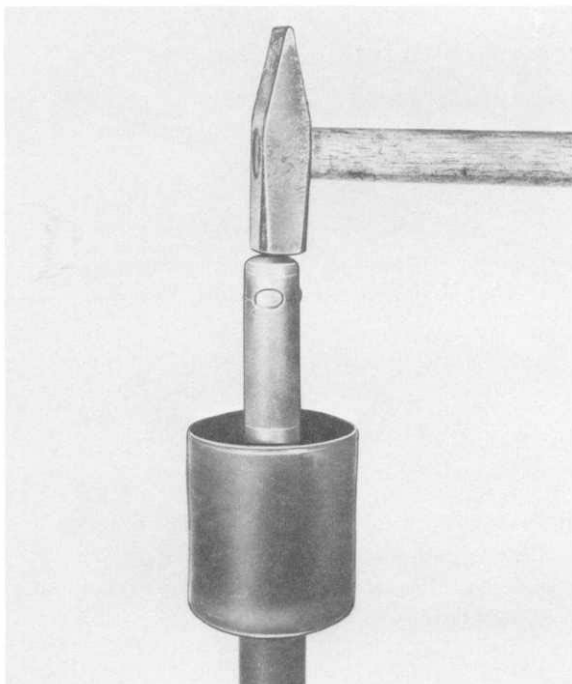


### Installing/Adjusting Axial Play

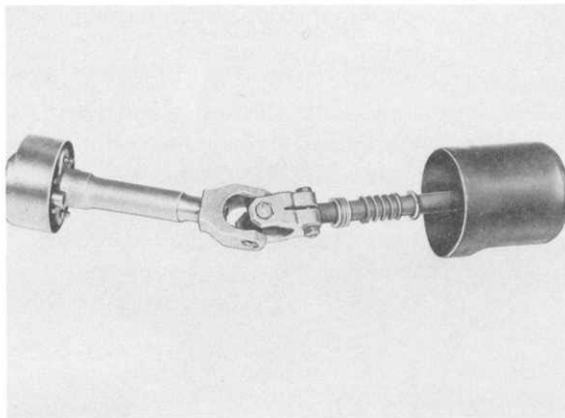
1. Drive or press in upper steering shaft bearing flush with Special Tool VW 433. Surface on bearing collar faces opening for steering column switch (arrow).



2. Move steering shaft into outer tube from below. If steering shaft still has three bearings, coat inside of outer tube as well as sleeve of center bearing with a multi-purpose grease for this operation.
3. Drive lower steering shaft bearing into steering protective tube against stop with Special Tool 30 - 21.

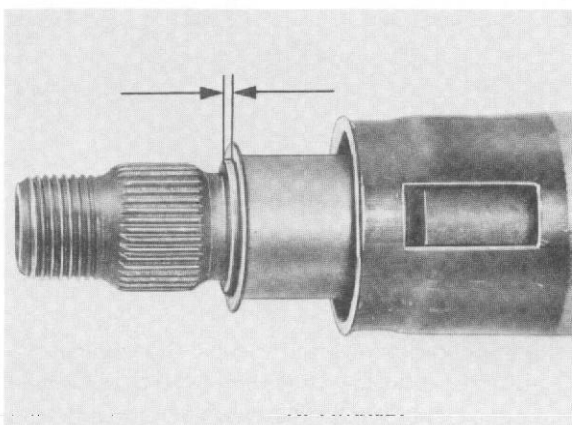
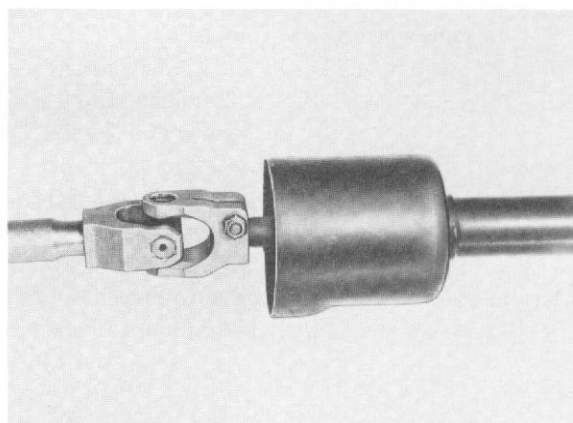
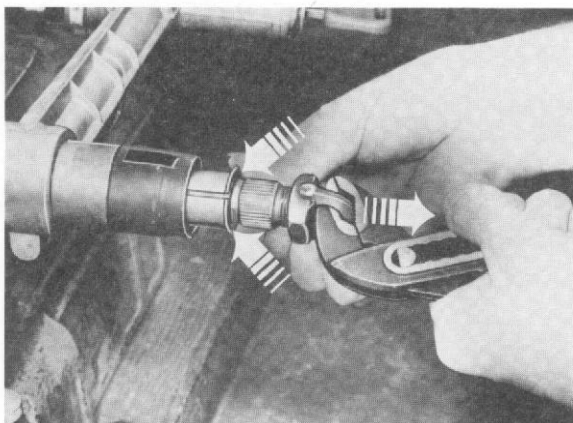


4. Move steering shaft down out of steering tube partially (at most up to stop of shaft on lower bearing). Install support, spring and shims (basic set: 4 x 1.5 mm and 1 x 0.5 mm) on steering shaft. Mount intermediate shaft on steering shaft. Before tightening the self-locking hexagon nut, push down (in direction of steering) intermediate shaft on steering shaft all the way against stop of setscrew on opening of steering shaft.



5. Clamp steering tube in a vise on the steering lock housing. Slide steering shaft into steering tube completely. Mount support and screw on locally made tool.
6. Check steering shaft axial play. Pull up steering shaft far enough so that spring is definitely against block (force approx. 30 kp/66 lb). In this state press support firmly against inner race of upper steering shaft bearing (with help of a tool if necessary). If necessary, center steering shaft slightly while support is being pushed down. The distance between edge of groove and support should be 0.5 mm (equals axial play). Check with help of a second mechanic and a 0.5 mm thick shim or a feeler gauge blade.

Adjusting value: 0.5 mm  
Nominal value: 0.5 – 1 mm



**7. a) Axial Play (Distance) Correct:**

Move intermediate and steering shafts out of steering tube far enough so that the setscrew is accessible.

Tighten self-locking hexagon nut to 28 Nm (20 ftlb).

**7. b) Axial Play (Distance) Excessive:**

Move intermediate shaft on steering shaft in direction of steering wheel until the axial play is correct.

Torque hexagon nut to 28 Nm (20 ftlb).

If the steering shaft opening is not sufficient for adjustment, use a larger shim set (6.5 mm basic set).

**7. c) Insufficient or No Axial Play (Insufficient Distance or Support Positioned Above Edge of Groove):**

Use smaller shim set (6.5 mm basic set).

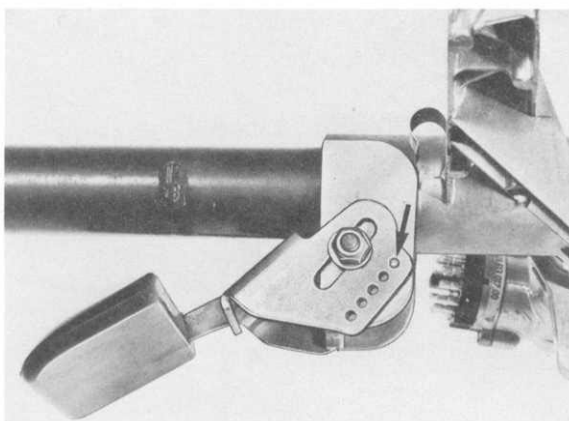
**8.** After finishing adjustments always make sure that washer and nut still have a locking effect. Recheck axial play after tightening the self-locking hexagon nut to 28 Nm (20 ftlb).

**9.** Install support and circlip. Install steering wheel and check easy movement of steering shaft and locking effect of steering wheel lock.

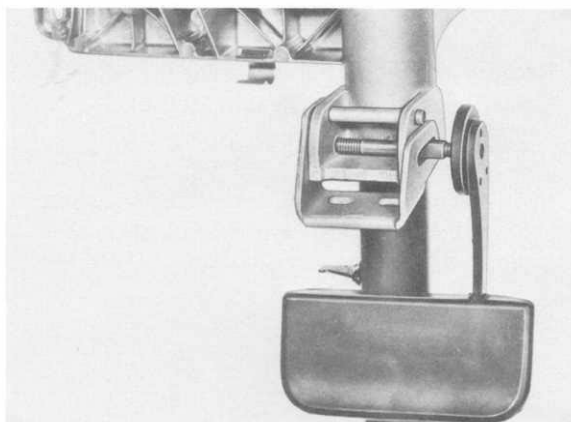
## DISASSEMBLING AND ASSEMBLING STEERING WHEEL HEIGHT CONTROL

## Disassembling

1. Move steering wheel height control lever to release position.  
Remove balls and spring. Make sure that a cloth is held above the area of the balls (to prevent injury) and catch the first ball after turning the bracket.



2. Unscrew self-locking hexagon nut. Move out control lever with stud and take off bracket.

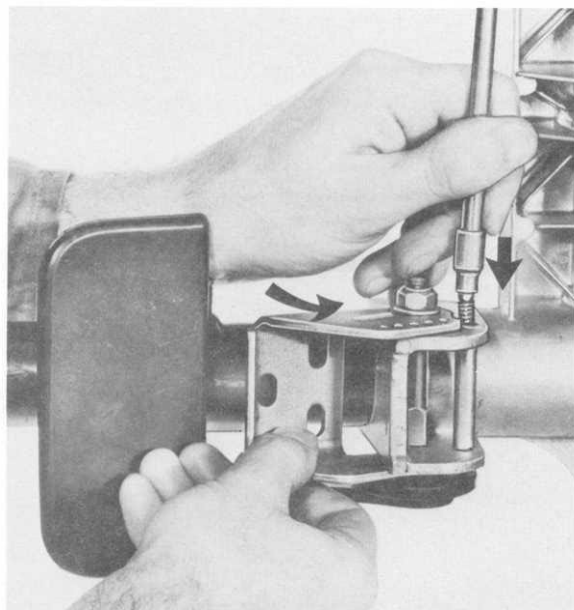


## Assembling

1. Screw stud in control lever. Threaded part must protrude slightly (arrow).



2. Mount bracket on steering tube. Give sliding surfaces a thin coat of Optimoly HT paste. Insert control lever with stud and screw in mounting nut. Only screw in mounting nut finger tight.
3. Install balls and springs. First install one ball with spring. Then apply second ball with spring, using a suitable piece of pipe or a socket wrench, until the bracket can be turned on the balls. Balls must engage in one of the 5 holes in the bracket.

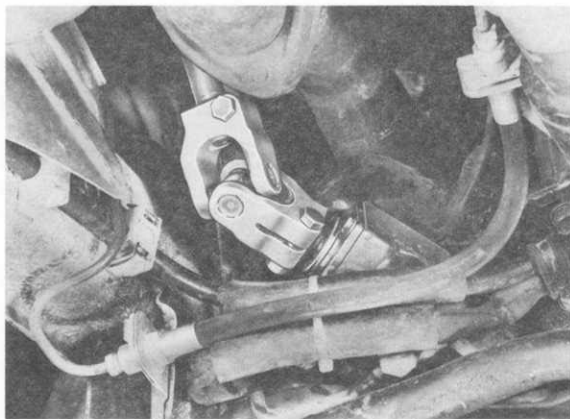


4. Tighten mounting nut of control lever so that the locking position is reached with a medium amount of force. When more force is applied, it should be possible to turn the control lever further in locking direction.



## REPLACING UPPER STEERING SHAFT BEARING

1. Remove universal joint after unscrewing two hexagon head setscrews.

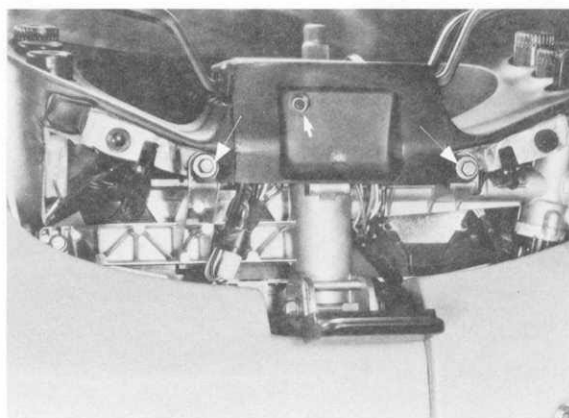


2. Disconnect battery ground wire at body. If car has electric seats, move them back completely to make work easier.

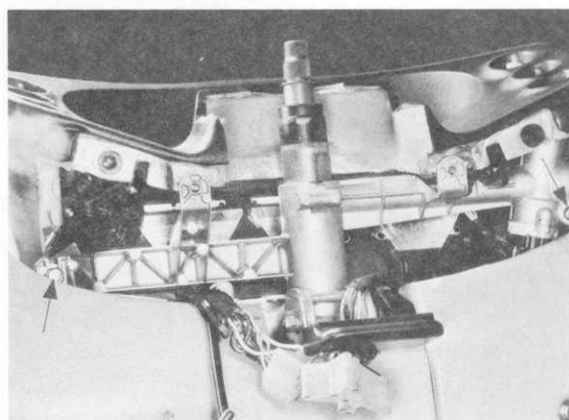
3. Pull off impact pad on steering wheel and remove horn wires. Mark position of steering wheel on steering shaft. Unscrew hexagon nut and remove steering wheel with washer.



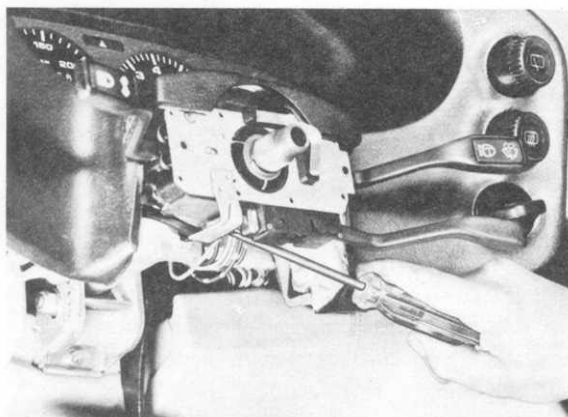
4. Unscrew cover underneath instrument cowl (not on older models) and cover underneath steering column switch.



5. Unscrew mounting bolts for instrument cowl.



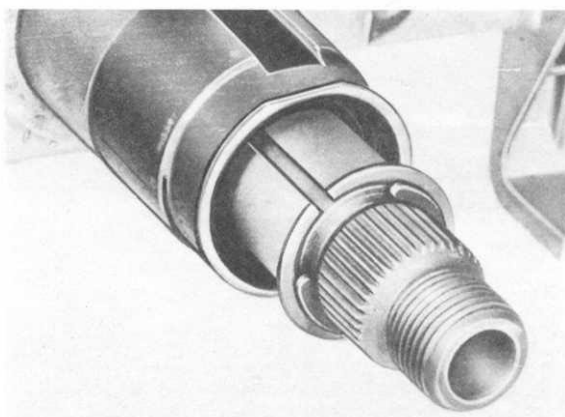
6. Unscrew mounting bolt for steering column switch.



7. Remove steering column switch after disconnecting plug connector and pulling off plugs, lifting instrument cowl for this.

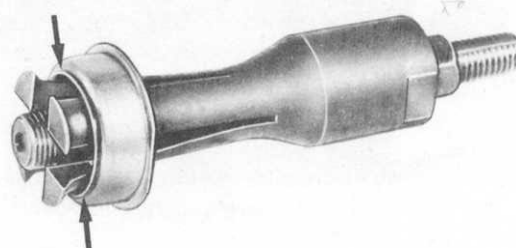


8. Remove circlip and support on steering shaft.

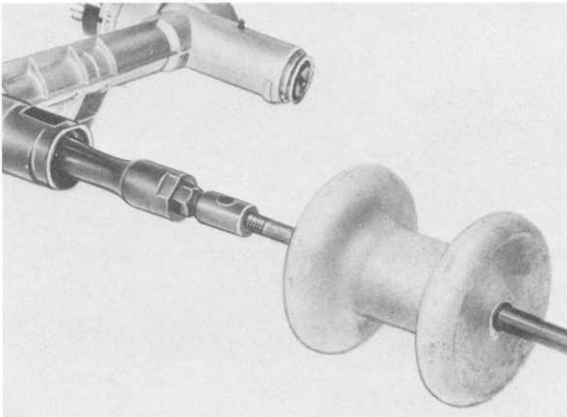


9. Unlock steering lock and push steering shaft into steering protective tube far enough so that intermediate shaft in engine compartment rests on camshaft housing.

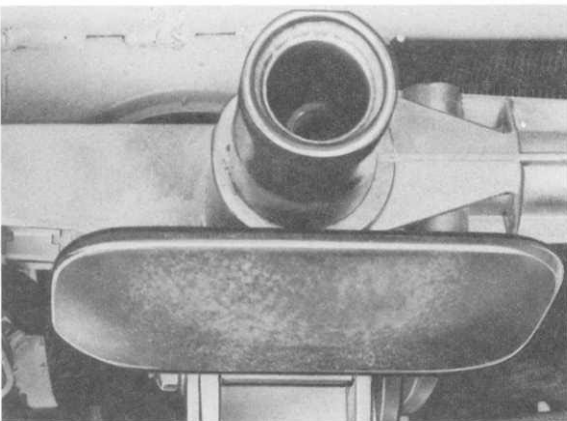
10. Apply a standard internal-claw puller, e. g. puller 62 - 020 from Schrem in Giengen, in upper steering shaft bearing. Spread puller enough so that bearing inner race is not pulled out of bearing outer race while driving out bearing (arrow), since otherwise the balls would fall down into the steering tube.



11. Connect Special Tool VW 771 with internal-claw puller and drive out upper steering shaft bearing.



12. Drive in new steering shaft bearing flush with Special Tool VW 433. Surface on bearing collar must face up because of steering column switch guide tab.



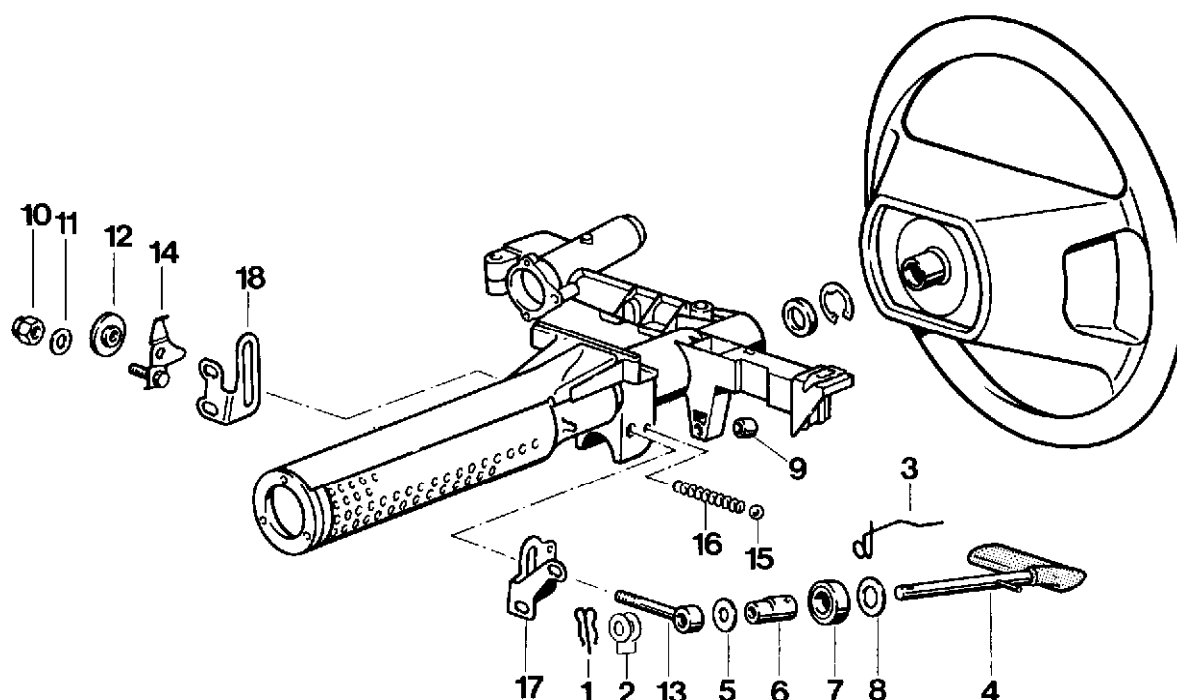
13. Pull or push up steering shaft in steering tube. Check axial play of steering shaft, see page 48 - 25.  
If there is no axial play, it must be adjusted since otherwise the new bearing could be destroyed in a short time. Install support and circlip.

14. Install steering column switch and covers. Connect battery ground wire.

15. Install universal joint between steering and intermediate shafts. If necessary, adjust 8 mm gap (see page 48 - 23).

16. Install steering wheel so that its spokes are horizontal when road wheels point straight ahead or according to mark made before removing.  
Install mounting nut with washer and torque to 50 Nm (36 ftlb).  
If necessary (not positioned horizontally before removing and slightly different universal joint position), correct steering wheel position after test drive.

## Dismantling and assembling steering wheel height adjuster of airbag vehicles

**Dismantling and assembling steering wheel height adjuster of airbag vehicles**

976-48

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Spring clip	1		if not present, retrofit to modified steering wheel height adjuster (p. 48 - 40 ). Affected parts: No. 1, 2, 4 and 6.
2	Spring washer	2		
3	Spring	1		always fit a new spring, making sure it is not bent when fitting
4	Adjuster lever	1		fit modified version only (p. 48 - 40).
5	Washer with small inside dia.	1		
6	Eccentric	1		fit modified version only
7	Needle-roller bearing	1		replace if required
8	Washer with large inside dia.	1		
9	Bushing	1		replace if required. Coat inside with multi-purpose grease.
10	Lock nut	1		replace if required. After adjustment, tighten setting nut (No. 12).
11	Washer	1		
12	Setting nut	1		Adjust (p. 48 - 39 )
13	Through bolt	1		
14	Drag lever	1		
15	Ball	1		
16	Thrust spring	1		
17	Left-hand console	1		
18	Right-hand console	1		

## Dismantling and assembling instructions

### Important notes

If the scope of assembly deviates from the following instructions, the safety requirements for the operation of vehicles with airbag equipment must be observed.

Example: Removing the airbag steering wheel, working on the contact unit (steering column switch) etc.

### Safety requirements

Test and assembly operations must only be carried out by qualified personnel.

Before working on the airbag system or on adjacent components that entail a risk of live components getting near the airbag system, the following safety requirements must be observed at all times:

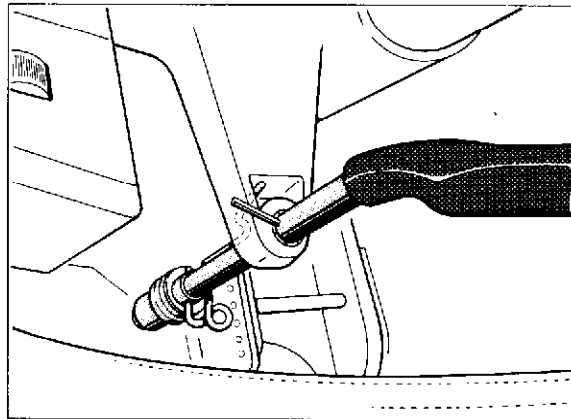
1. Switch off ignition.
2. Disconnect and cover negative battery terminal.

After the battery has been disconnected, assembly operations or other jobs that require the use of a hammer or similar tools must only be performed after a waiting time of 20 minutes has elapsed. This is required to ensure that the power supply to the airbag system is interrupted and to make sure the airbag is not triggered inadvertently.

For further safety requirements, refer to Repair Group 68.

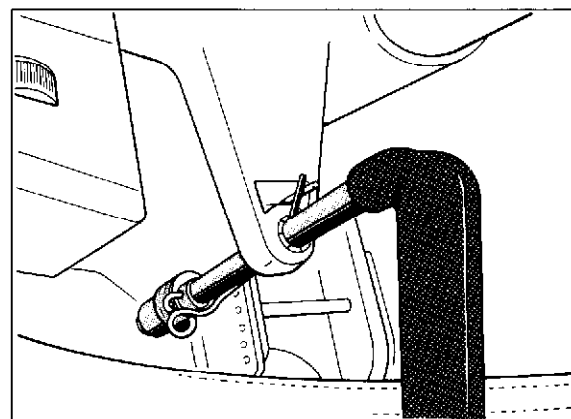
### Adjuster lever positions

Adjusting mechanism of steering wheel height adjuster closed.



977 - 48

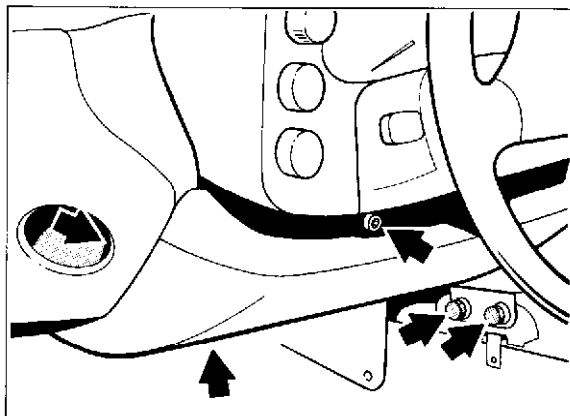
Adjusting mechanism of steering wheel height adjuster open.



978-48

## Dismantling

1. Remove knee protector strip. The fastening screws and nuts (arrows) are accessible after removal of the center console cover and of the air outlet nozzle.



979-48

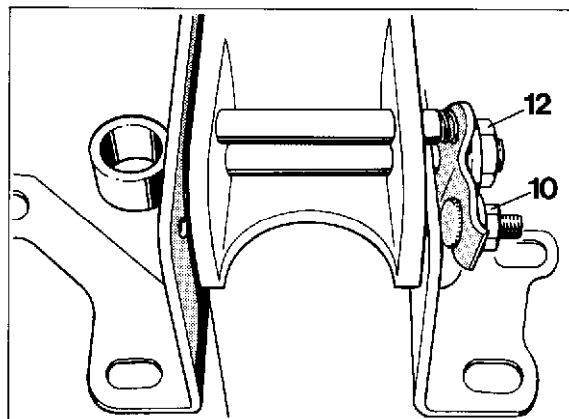
## Note

If the steering wheel height adjuster is modified to the new version, assembly may be started from item 2 immediately after removal of the knee protector strip (e.g. if the adjuster lever/through bolt union is disconnected). This means that adjuster mechanism items No. 10 to 18 (page 48 - 34) do not have to be dismantled any further.

2. Turn adjuster lever of height adjuster to the open position. For dismantling sequence, refer to explosion drawing on page 48 - 34.

## Assembly

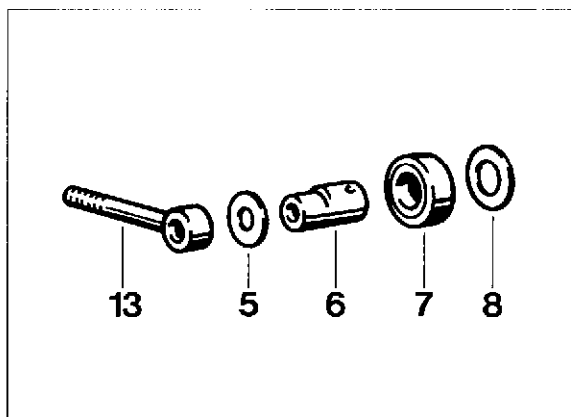
1. If required, fit parts No. 10 to No. 18 (p. 48 - 34).
2. For further assembly or fitting, use only the parts applicable as of MY '92 (modified version with spring clip).  
For identification of the relevant parts, refer to page 48 - 40.
3. Undo lock nut (No. 10). Open setting nut (No. 12) by a minimum amount. If parts – No. 10 to No. 18 – had not been removed, mark previous position of the setting nut (No. 12).



980-48



4. Insert eccentric (No. 6) with small washer (No. 5) and large washer (No. 8) as well as needle-roller bearing (No. 7) into through bolt (No. 13). Use multi-purpose grease.



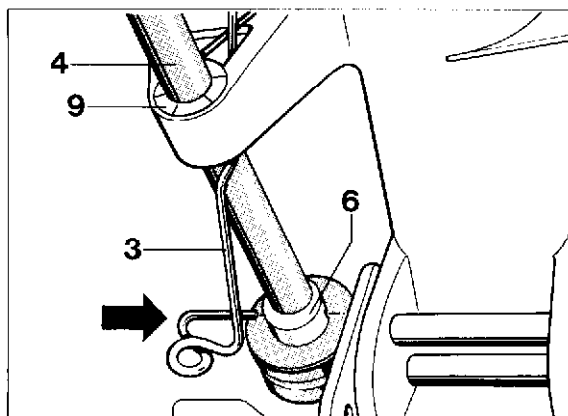
983-48

5. Place pilot bushing (No. 9) into the column tube.

Insert adjuster lever (No. 4) in open position (lever points straight down) into pilot bushing (Nr. 9) and into eccentric (No. 6). **The wider side of the eccentric must face down.**

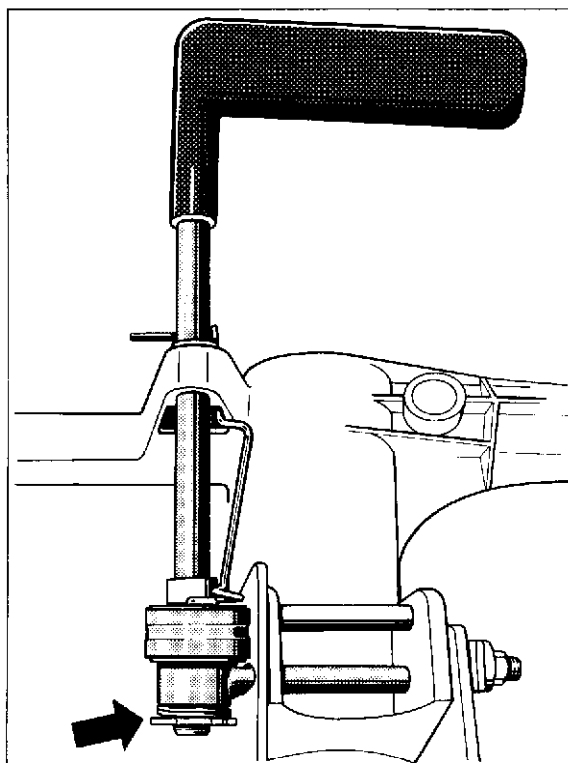
If required, turn eccentric accordingly.

Place a new spring (No. 3) into the described position (holes in eccentric and adjuster lever mate up with each other).



981-48

6. Install spring washers (2 pc.) and spring clip.

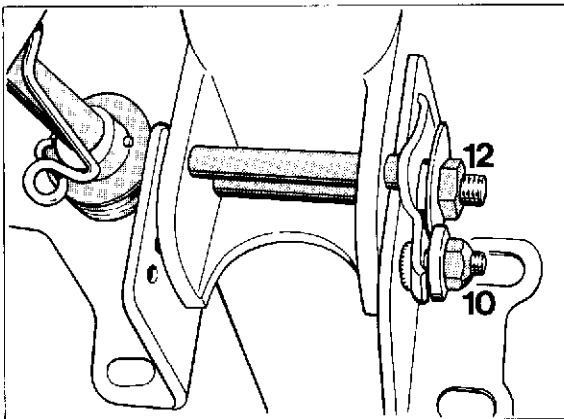


986-48

7. Adjust setting nut (No. 12) of the through bolt carefully.

Proceed as follows: Tighten setting nut until both the steering wheel height adjuster operates perfectly in the open position and the clamping action at the adjuster mechanism is fully operative in the closed position.

Following careful adjustment, tighten the lock nut (No. 10). This causes the setting nut (No. 12) to be locked.



982-48

8. Check operation of the steering wheel height adjuster repeatedly and fit the corresponding parts (knee protector strip etc.).

## Modifications to the steering wheel height adjuster

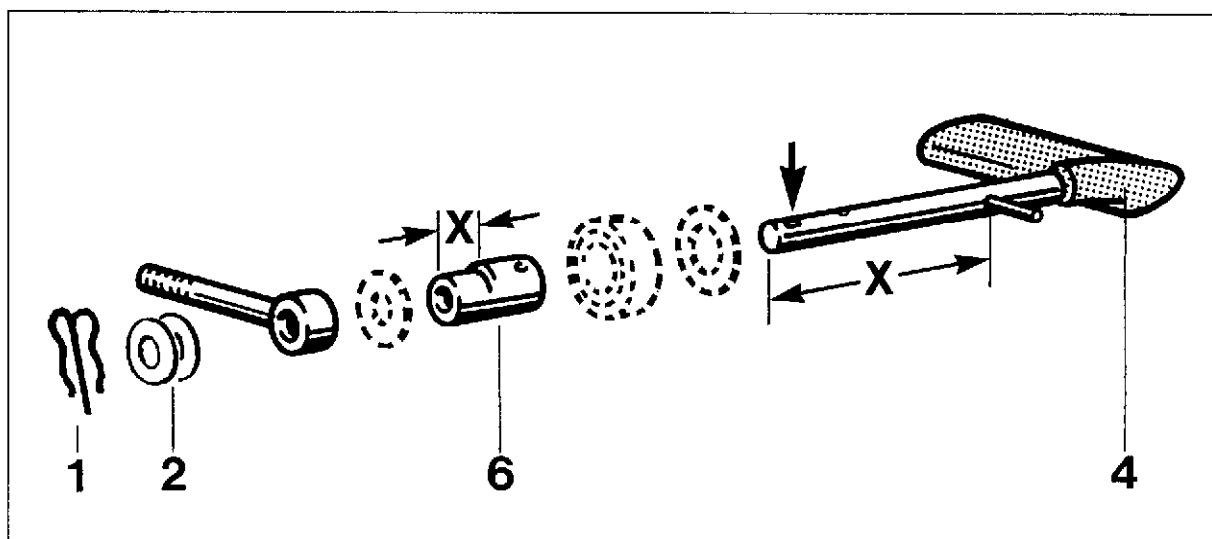
As of MY '92, axial locking of the operating level (No. 4) was improved by a spring clip (No. 1). This has entailed modification of the operating lever (No. 4) and of the eccentric (No. 6). The spring clip (No. 1) and two spring washers (No. 2) were newly introduced.

**In case of repairs, the modified design should also be adopted for vehicles prior to MY '92 equipped with airbag.**

Required parts: New lever, new eccentric, two spring washers and one spring clip.

### Parts identification

No.	Designation	Original version	Modified version
4	<b>Adjuster lever</b> dimension x $\approx$	without hole at end 106 mm	with hole at end (arrow) 111 mm
6	<b>Eccentric</b> Total length Dimension x =	36.0 + 1.0 mm 14.5 + 0.2 mm	34.5 + 1.0 mm 13.0 + 0.2 mm



488-48

## Adjustment specification for Keylock cable

### General

Vehicles with automatic transmissions for the USA and Canada have been equipped with the Keylock safety system as of the 1993 model year.

Keylock has been installed in vehicles with automatic transmission world-wide as of the 1994 model year. With this system, the ignition key can be pulled out **only** if the selector lever was moved to position P beforehand. This ensures that the vehicle does not move off unintentionally.

The selector lever remains locked until the ignition key is inserted again and the ignition lock is turned to position 1 (terminal X).

The blocking function is activated and deactivated via a cable between the ignition lock and the selector lever lock.

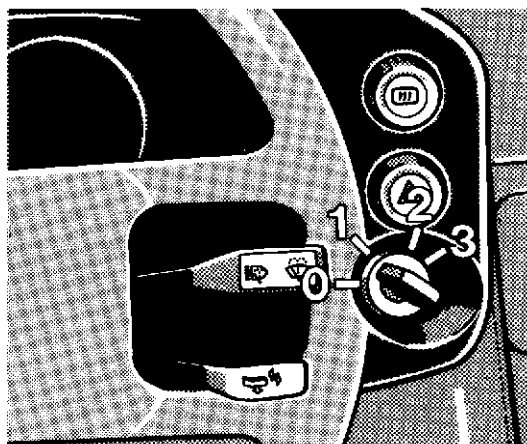
The vehicle cannot be moved without the ignition key, as the engaged parking lock prevents the drive wheels from turning.

### Fit the Keylock cable on the steering lock

Screw in the Keylock cable No. 37 (see Page 48-42) **only** with the steering lock in position "2" (ignition on). **Then move the selector lever to position "P" and subsequently turn the steering lock to position "0".**

### Note

The cable adjustment has to be corrected (see Page 48-42) if the ignition lock cannot be turned to position "0".



BA-928/30

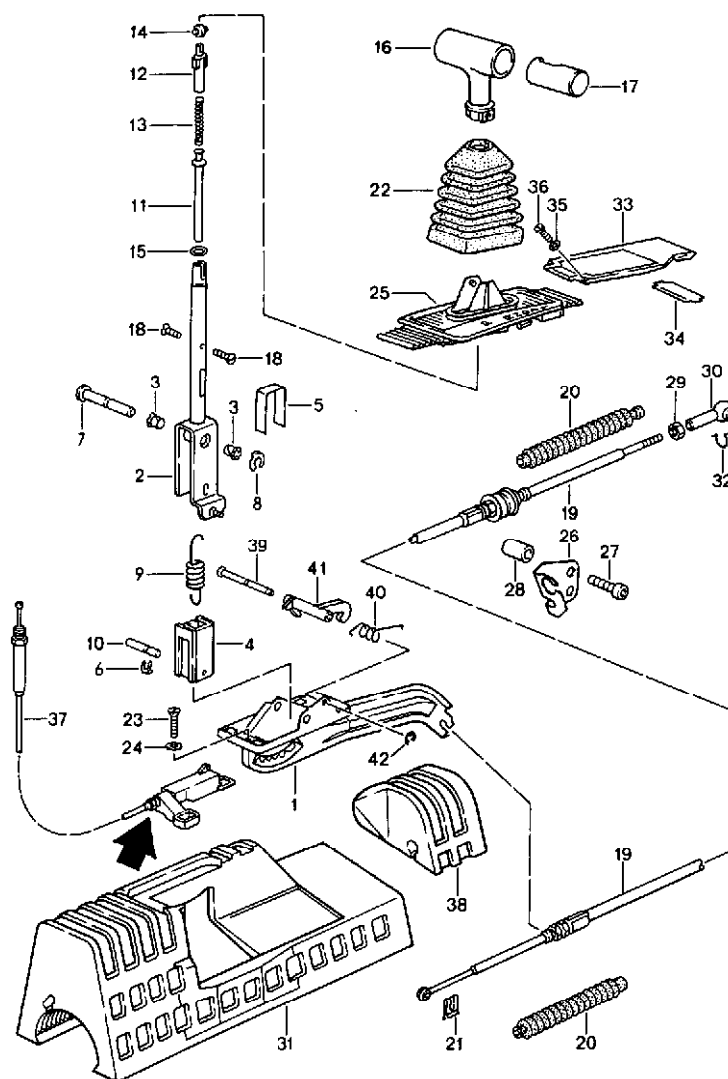
## Adjustment and testing specification for Keylock cable

Move the selector lever to position "P". Turn the ignition key to position 2 (ignition on).

**Unscrew** the adjusting screw (arrow) until the ignition key can no longer be turned to position 0 (stop).

Carefully **screw in** the adjusting screw until the ignition lock can be locked again (using greater force).

**Then screw in** the adjusting screw by an **additional** approx. 1/2 turn = 0.5 mm. After this step, it must be possible to turn the ignition key to position 0 (stop) and pull it out only if the selector lever is in position "P".



7/01/06

Refer to Repair Group 87 for removal and installation of heater, blower and air distribution housing, as well as disassembly and assembly of heater.

Several points will not apply to cars without an air conditioner.

## SPECIFICATIONS FOR AIR CONDITIONER

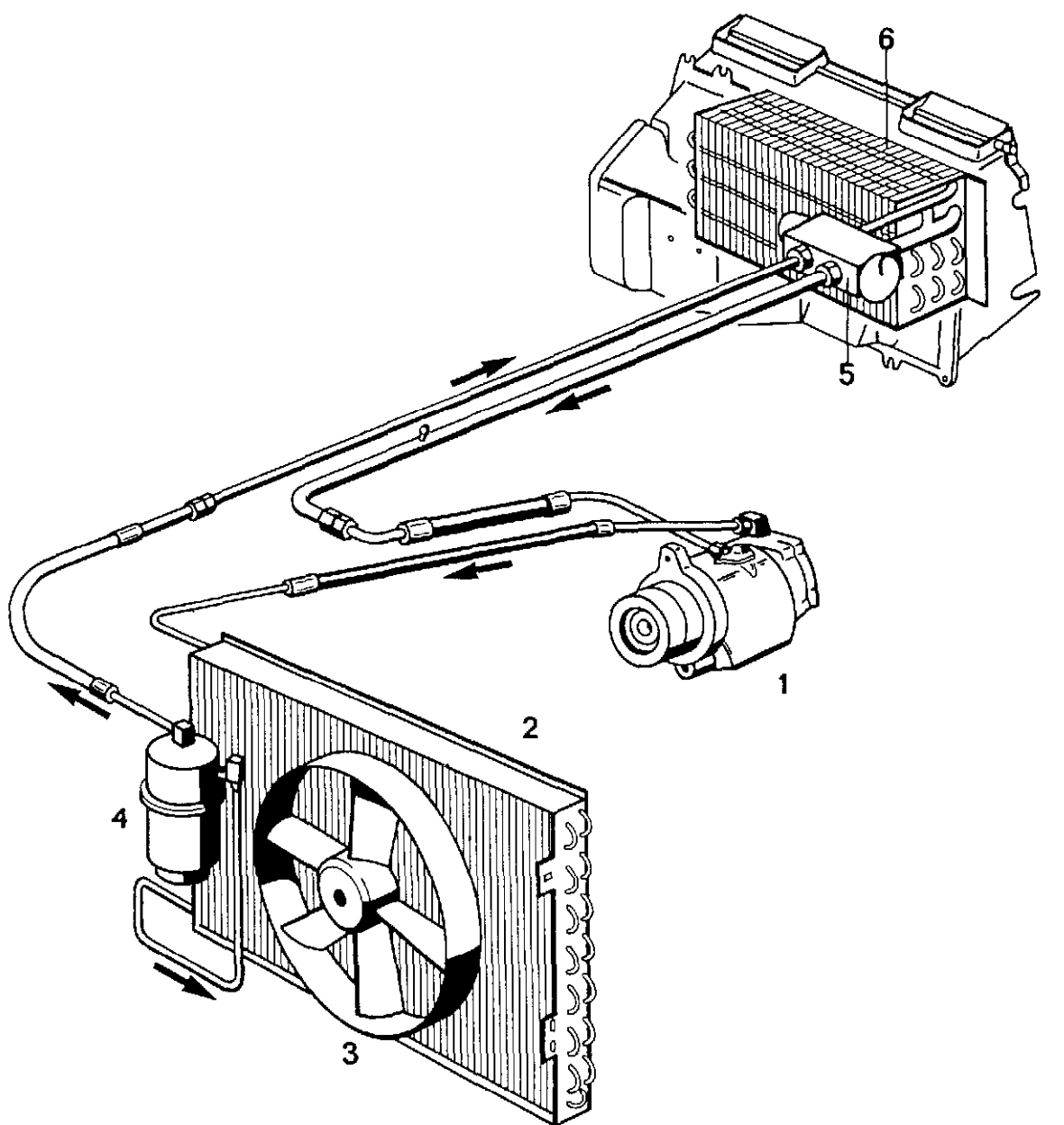
Refrigerant capacity	950 grams/33,5 ounces of R 12
Refrigerant oil in compressor	350 cm <sup>3</sup> /12 ounces of Suniso No. 5 GS or Texaco Cappela "E" or similar
Power requirement of compressor clutch	approx. 50 watts
Seal on receiver-drier	Seal ruptures at $117 \pm 3^{\circ}\text{C}/242 \pm 5^{\circ}\text{F}$ = a pressure of approx. 45 bar/640 psi
Relief valve on compressor	Valve opens at pressure of 31 to 35 bar/ 440 to 500 psi = temperature of $95$ to $105^{\circ}\text{C}/$ $203$ to $221^{\circ}\text{F}$

## TIGHTENING TORQUES - AIR CONDITIONER

Location	Description	Threads	Material	Torque Nm (ft lb)
Pressure line to expansion valve	Coupling	5/8"x 18 UNF	28 K	14 - 20 (10 - 14)
Pressure line to receiver-drier	Coupling	5/8"x 18 UNF	28 K	14 - 20 (10 - 14)
Hose to compressor/ condenser	Coupling	3/4"x 16 UNF	28 K	33 - 39 (24 - 28)
Hose to suction line/ compressor	Coupling	7/8"x 14	28 K	36 - 42 (26 - 30)
Suction line to expansion valve	Coupling	7/8"x 18	28 K	36 - 42 (26 - 30)

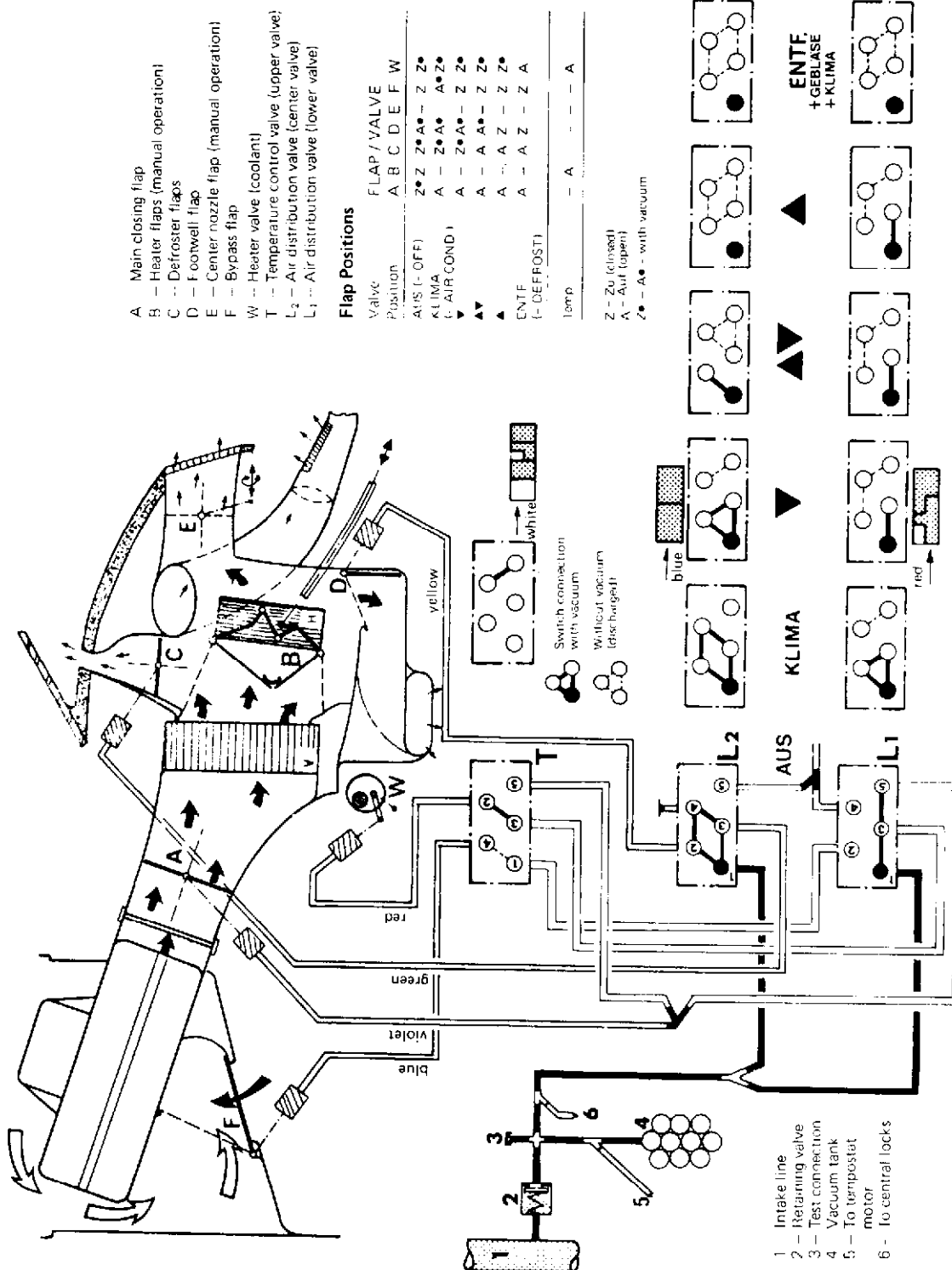


## REFRIGERANT SYSTEM LAYOUT



- 1 - Compressor
- 2 - Condenser
- 3 - Fan
- 4 - Receiver-drier
- 5 - Expansion valve
- 6 - Evaporator

## VACUUM SYSTEM LAYOUT



## Safety regulations for handling the refrigerant R12

The used refrigerant R12 is known as a safety refrigerant. In other words, this refrigerant is non-combustible, non-explosive, non-toxic, non-irritating, odorless and tasteless. Nevertheless, you should observe the following points:

1. Any contact with fluid or gaseous refrigerants must be avoided. Affected skin areas must be treated like frost injuries; wash off immediately with cold water and then consult a physician. Protective goggles must be worn to protect the eyes. If refrigerant should nevertheless enter the eye, consult a physician immediately. Rubber gloves must be worn to protect hands.
2. When performing repairs on the air-conditioning system, the refrigerant must be siphoned off from the system and the refrigerant cleaned. Refrigerant must not be allowed to enter the environment, because it attacks the earth's ozone layer.
3. Welding must not be performed on parts of the closed air-conditioning system or close to it under any circumstances. Irrespective of whether the system is filled with refrigerant or not, a very high pressure is produced by heating which can lead to damage to the system or even to an explosion. R 12 is completely non-toxic at normal temperatures, but decomposes into hydrogen chloride and fluorocarbon. These decomposition products contain, among other things, chlorine and phosgene. Corresponding care must be taken because these products are damaging to health.
4. Refrigerant bottles must not be thrown and must not be exposed to the sun or other heat sources for a long period in filled condition. The maximum permissible temperature of a filled refrigerant bottle must not exceed 45 °C.

## Characteristics of the refrigerant R 12

Trade designation: Frigen R 12, Freon R 12

Chemical designation:  $\text{CCl}_2\text{F}_2$  (Dichlorfluor-methane) or  $\text{CF}_2\text{Cl}_2$  (Difluordichlormethane)

R 12 is colorless, odorless, non-toxic, non-combustible and heavier than air.

Boiling point:  $-30^\circ\text{C}$  at atmospheric pressure.  
At higher pressure, R 12 is also still fluid at higher temperatures (e.g. in the pressure bottle).

### Chemical behavior with respect to other substances

1. R 12 does not attack most metals, particularly iron, copper, brass and aluminum, but lead may react with R 12 under certain circumstances. For this reason, lead is not used in refrigeration engineering.
2. Many plastics are decomposed by R12. Seals and closures etc. made of plastic must be used only if they have been specially recommended by the refrigerant companies.
3. R 12 dissolves oil. The special refrigerating oil required for lubricating the compressor circulates in the refrigerant circuit. Additives or contaminations in the oil enter into chemical reactions with R 12: consequently, only oils suitable for the refrigerant R 12 must be used.

4. Moisture in the refrigerant leads to decomposition of the refrigerant oil and to icing of the expansion valve. For this reason, dismantled lines and assemblies and test instruments must be sealed immediately after use in order to keep out air humidity and dirt particles.

## Flushing the air-conditioning system with refrigerant R 12

If humidity has entered the system during assembly of the air-conditioning system or as result of replacement of individual parts, the following procedure must be followed when refilling the system:

1. Connect the service unit.

2. Evacuate.

3. Fill approx. 500 g refrigerant.

4. Switch on the air-conditioning system and allow the compressor to run for approx. 1 min. Ensure that valves 6 and 7 are closed on the service unit.

5. Syphon off the refrigerant.

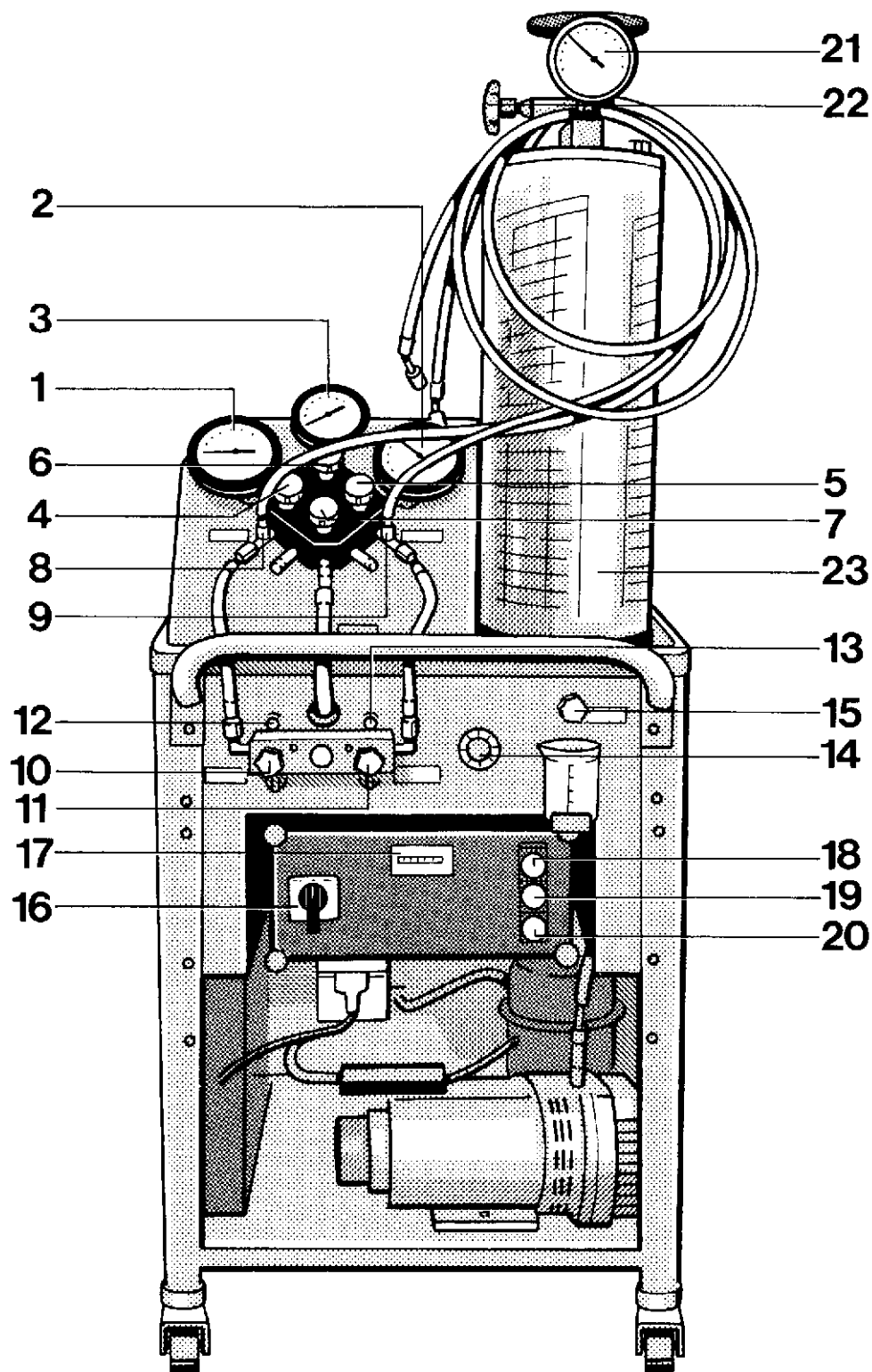
6. Fit new fluid reservoir.

7. Evacuate.

8. Fill

## Installation work on the air-conditioning system

Service unit SECU



303-87

- 1 - Pressure gauge, low-pressure
- 2 - Pressure gauge, high-pressure
- 3 - Torrmeter
- 4 - Shut-off valve, low pressure (blue)
- 5 - Shut-off valve, high-pressure (red)
- 6 - Shut-off valve, torrmeter (black)
- 7 - Shut-off valve, vacuum pump (yellow)
- 8 - Connection piece, low-pressure
- 9 - Connection piece, high-pressure
- 10 - Shut-off valve, refrigerant inlet
- 11 - Shut-off valve; refrigerant outlet
- 12 - Connectiong piece, refrigerant inlet (from refrigerant botttle)
- 13 - Connection piece, refrigerant outlet (to refrigerant bottle)
- 14 - Moisture indicator
- 15 - Drain valve, refrigerating oil
- 16 - Main switch
- 17 - Operating hours counter
- 18 - Pilot lamp, yellow
- 19 - Pilot lamp, red
- 20 - Pilot lamp, green
- 21 - Pressure gauge, filling cylinder
- 22 - Shut-off valve, filling cylinder
- 23 - Filling cylinder with weight scale

## Installation work with intervention in the refrigerant system

The contents of the air-conditioning system must be disposed of in accordance with the relevant regulations before all work on the air-conditioning system which necessitates opening of the refrigerant system. The safety regulations must also be observed.

Dirt and moisture must be kept out of the piping system of the air-conditioning system. Extreme cleanliness must therefore be observed for all work. No parts of the system must be cleaned inside with hot steam under any circumstances. Only nitrogen must be used for cleaning.

When replacing a component, all openings must be sealed with a suitable stopper.

### General work sequence

1. Syphon off refrigerant.
2. Remove faulty parts.
3. Evacuate.
4. Check system for leaks.
5. Flush with refrigerant.
6. Syphon off system again.
7. Evacuate.
8. Fill.

### Note

Pay attention to sealing rings when disconnecting or connecting the hose connections.



### Syphoning off refrigerant

1. Connect the service unit to the system.

#### Note

Check on the fluid reservoir whether the sight glass is still transparent. If the sight glass is discolored brown on the inside, the refrigerant should be pre-filtered by a cleaning drier installed inbetween in the extraction hose. In this case, syphon off via the high-pressure side only.

2. Open the low-pressure shut-off valve (4), high pressure shut-off valve (5) and refrigerant inlet shut-off valve (8).

3. Turn the main switch (16) fully to the right. The green pilot lamp lights up.

#### Note

The syphoning-off operation takes place automatically. The unit is switched off when all refrigerant has been syphoned out of the circuit. The red pilot lamp then lights up.

4. Close shut-off valves 4, 5 and 8.
5. Open the refrigerating oil drain cock (15) and drain off syphoned-off refrigerating oil.
6. Determine the volume of the refrigerating oil.

#### Note

Do not use syphoned-off refrigerating oil again.

7. Fill in new refrigerating oil (syphoned-off volume + 10 cm<sup>3</sup>)

### Filling with refrigerating oil

1. Unscrew the red hose on the service unit at connection piece 9 and hold in the container with new refrigerating oil.
2. Switch on the vacuum pump.
3. Open the shut-off valves for low pressure (4) and vacuum pump (7).

#### Note

Refrigerating oil is now sucked into the system via the high-pressure side.

4. After filling the system with the refrigerating oil, close the shut-off valves and switch off the vacuum pump.

**Evacuating the air-conditioning system**

1. Syphon off any existing pressure.
2. Switch on the vacuum pump (turn the main switch to the left).
3. Open the shut-off valves for low pressure (4), high pressure (5), torrmeter (6) and vacuum pump (7).
4. Leave the vacuum pump switched on for at least 15 min.
5. Close shut-off valves 6 and 7 at a pressure of approx. 0.1 bar (absolute)
6. Switch off the vacuum pump.

**Note**

If the vacuum cannot be reached or can be reached only after a very long time or if the pressure increases to over 0.2 bar (absolute) approx. 10 minutes after switching off the pump, the circuit possesses a leak and must be sealed.

**Flushing the air-conditioning system****Note**

Flushing the air-conditioning system serves the purpose of drying the circuit.

1. Evacuate.
2. Open the shut-off valves for high pressure (5) and the refrigerant outlet (11).
3. Allow refrigerant to flow in until a pressure of approx. 2 bar (absolute) is indicated.
4. Close shut-off valves 5 and 11.
5. Shut-off refrigerant again.
6. Evacuate.

## Filling the air-conditioning system

### Note

The air-conditioning system must be evacuated and filled. There must be sufficient refrigerant in the filling cylinder. Top up if necessary.

1. All valves on the service unit must be closed.
2. A pressure of approx. 7 bar is required to fill the system. If the pressure is lower, the pressure can be increased by cleaning the refrigerant (refer to Page 87 - 16g). If the pressure is higher than 10 bar (end of the weight scale), the pressure in the filling cylinder can be lowered by opening the shut-off valve 22.

### Note

The pressure increases by approx. 1.5 bar in 10 minutes.

3. In accordance with the value read off on pressure gauge 21, adjust the rotary scale of the filling cylinder so that the value specified on the top edge of the scale stops over the sight glass.

### Note

It must be noted that the rotary scale is designed for use of different refrigerants. The refrigerant designations are specified at the bottom scale edge.

Only the scales for R12 are applicable for vehicle air-conditioning systems.

4. Set the required refrigerant quantity on the filling cylinder with the rubber ring (difference with respect to the refrigerant level in the filling cylinder).
5. Open the shut-off valves for high pressure (5) and the refrigerant outlet (11).
6. Observe the fluid level in the sight glass of the filling cylinder. Close shut-off valves 11 and 5 when the fluid level has reached the setting ring.
7. Check the refrigerating output (refer to Page 87-116).
8. Disconnect filling hoses at compressor.
9. Screw protective caps onto the valves.

## Topping up the air-conditioning system

### Note

There is not sufficient refrigerant in the system if gas bubbles are visible in the sight glass of the fluid reservoir when the air-conditioning system is switched on.

1. Syphon off the fluid from the air-conditioning system.
2. Determine the volume of the refrigerating oil which is syphoned off as well.
3. Fill system with new refrigerating oil.
4. Evacuate.
5. Check system for leaks.
6. Fill with prescribed filling quantity.

## Filling the service unit with refrigerant

1. Connect the refrigerant bottle with the refrigerant inlet connection piece (12).
2. Open the valve on the refrigerant bottle and shut-off valve 10.
3. Switch on the service unit with the main switch (16). The green pilot lamp lights up.
4. If there is sufficient refrigerant in the service unit, close the bottle valve. The system switches off automatically when the refrigerant has been syphoned off up to the bottle valve.
5. Close the refrigerant inlet shut-off valve (10).

## Empty the service unit

### Note

If the filling cylinder is full of refrigerant and it is necessary to syphon off more refrigerant, the clean refrigerant can be filled into a refrigerant bottle. Pay attention to the maximum filling weight. **The refrigerant bottle must not be overfilled.**

1. Connect the refrigerant bottle with the refrigerant outlet connection piece (13).
2. Increase the pressure in the filling cylinder to approx. 8 bar by cleaning the refrigerant.
3. Open the bottle valve and refrigerant outlet shut-off valve (11).
4. After completing emptying, close the bottle valve and shut-off valve.

### Note

Do not empty the filling cylinder completely, otherwise moisture may enter the service unit.

## Cleaning the refrigerant

### Note

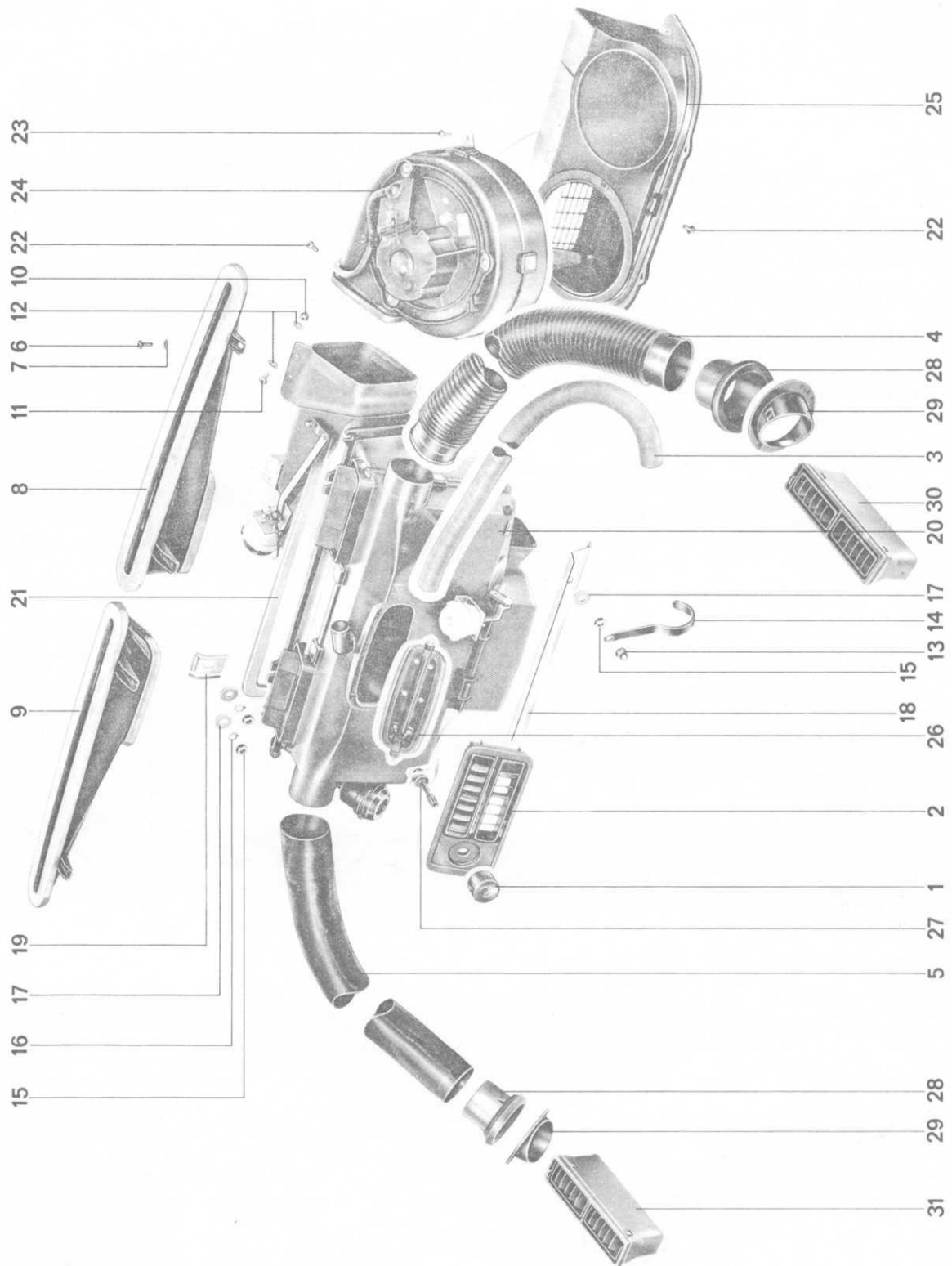
If the syphoned-off refrigerant is heavily contaminated, it must be pumped through the filter systems several times.

The cleaning condition can be seen at the moisture indicator (14).

1. Open the filling cylinder shut-off valve (22).
2. Switch on the service unit. The green pilot lamp lights up.
3. After cleaning the refrigerant (condition shown by the moisture indicator), close the shut-off valve).

### Note

The unit switches off automatically when all refrigerant has been pumped into the filling cylinder (red pilot lamp lights up). The pressure in the filling cylinder increases.



No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Knob	1			
2	Center vent	1	Don't break off mounting pins		
3	Connecting hose to glove box	1		Replace, if necessary	
4	Connecting hose between instrument panel/side vent and heater/air cond.	1		Replace, if necessary	
5	Connecting hose between instrument panel/side vent and heater/air cond.	1		Replace, if necessary	
6	Screw 4, 2 x 9, 5	4			
7	Washer	4			
8	Defroster vent, right	1			
9	Defroster vent, left	1			
10	Self-locking nut	2		Replace, if necessary	
11	Screw 5 x 20	2			
12	Washer	4			
13	Cap nut	2			
14	Cable holder	1			
15	Nut	6			
16	Lockwasher	4			
17	Washer	6			
18	Reinforcement	1			
19	Retaining plate	2			
20	Heater/air cond.	1			

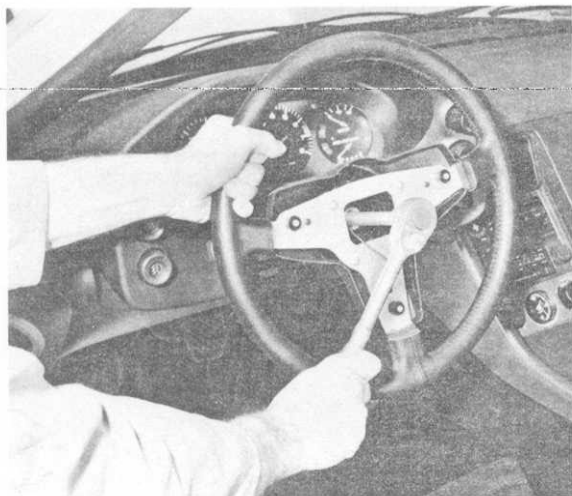
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
21	Seal	1		Paste on body	
22	Screw	2			
23	Screw	1			
24	Blower	1			
25	Air distribution housing	1		In addition to seal, also use non-hardening sealant	
26	Shut-off flap	1			
27	Blower switch shaft	1			
28	Adapter for air duct	2			
29	Escutcheon	2			
30	Side vent, right	1			
31	Side vent, left	1			



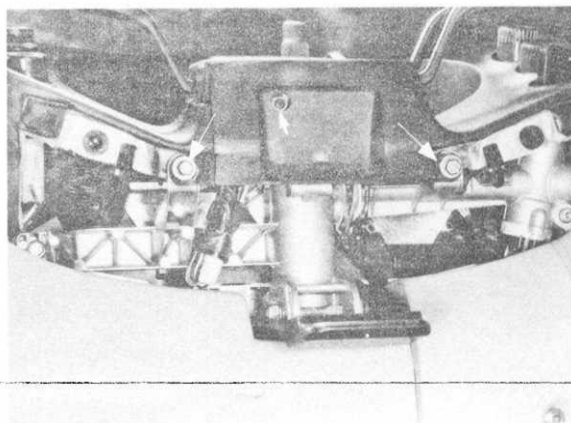
## REMOVING AND INSTALLING HEATER/AIR CONDITIONER

### Removing

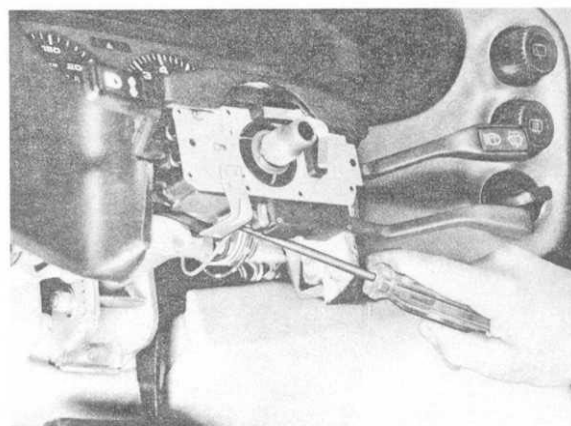
1. Discharge air conditioner.
2. Disconnect battery ground strap from body. If car has electric seats, run back seats all the way to facilitate work.
3. Pull off impact pad from steering wheel and remove horn wires. Mark position of steering wheel to steering shaft. Unscrew nut and take off steering wheel with washer.



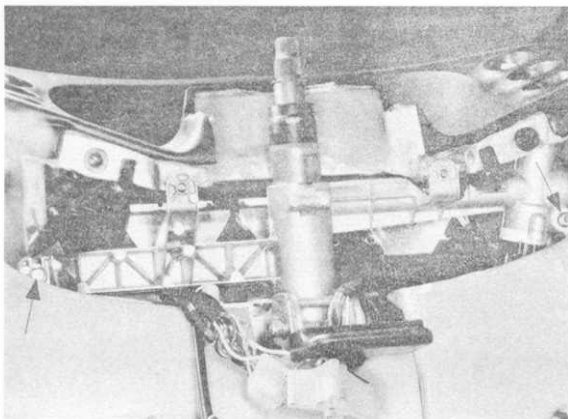
4. Remove cover underneath instrument cowl (only on new models) and cover underneath steering column switch.



5. Loosen mounting screw for steering column switch.



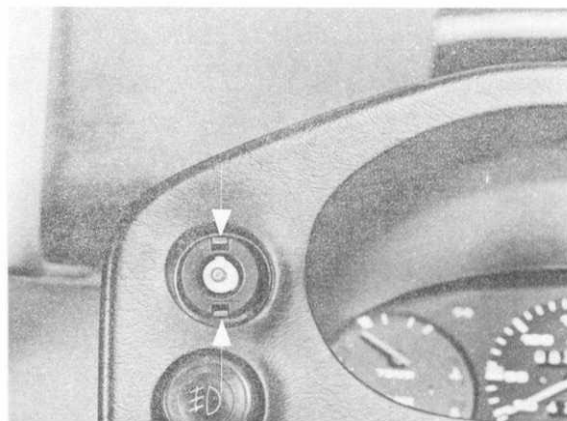
6. Remove instrument cowl mounting screws.



7. Lift instrument cowl, pull off plugs and remove steering column switch.

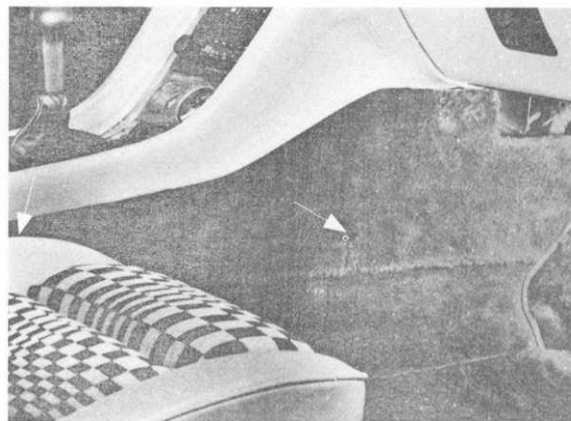


8. Remove 5 switches from instrument cowl by pulling off switch knobs, compressing spring clips, pulling out switches and pulling off plugs.



9. Pull out plugs from receptacles on back of instrument cowl (printed circuit) and lift off instrument cowl. Mark plugs for reinstallation.

10. Remove kick plate at accelerator pedal. Detach side trim panels from center console. Remove carpet sections and insulation sheets.

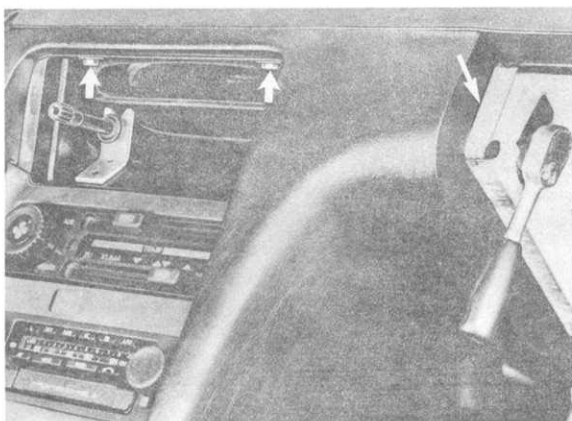


11. Take off tray and glove box. Remove shift lever knob and dust cover.

12. Pull off rotary knob for center vent. Pull out center vent without twisting or turning (danger of breaking off mounting pins).



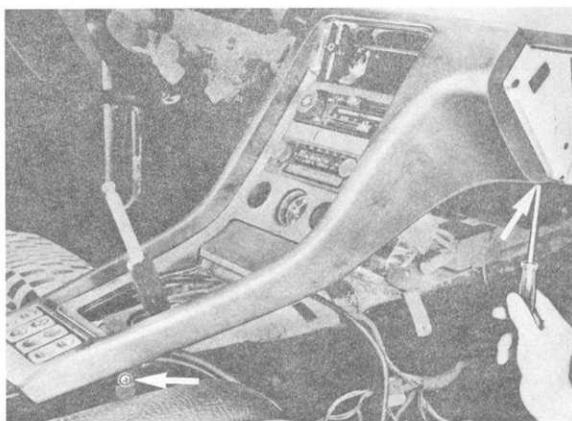
13. Remove center console mounting screws in recess of center nozzle and right mounting screw in glove box opening.



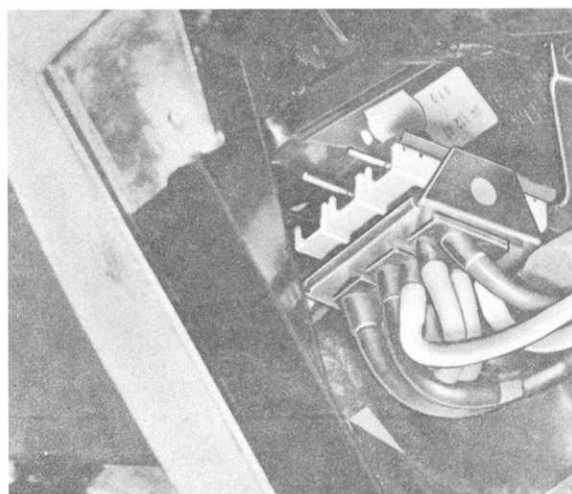
14. Remove remaining center console mounting screws on frame tunnel at left and right sides as well as on instrument panel. Remove radio mounting nut on holder (not applicable to plug-in version).

Disconnect or pull off following plug connectors or plugs.

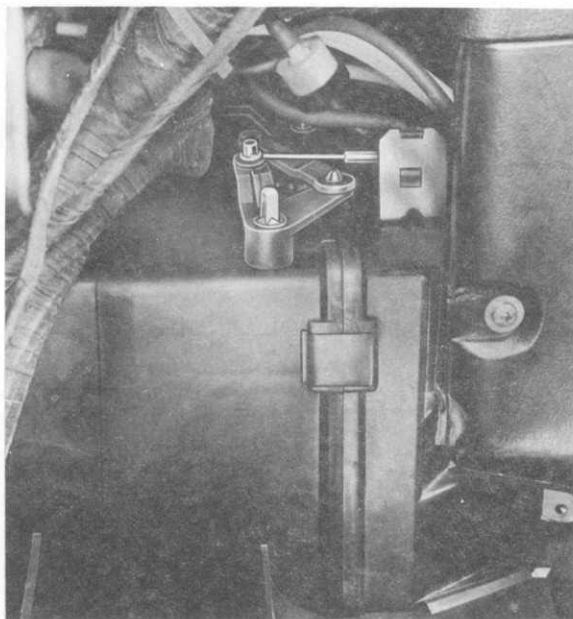
Emergency flasher light switch, ashtray, radio, clock, seat belt light (double indicator lamp), heater/fresh air control switch, central warning panel (check buttons on new models), blower switch, power windows, electric sun roof.



15. Disconnect vacuum lines from control switch by disengaging spring clips and pulling off adapter.



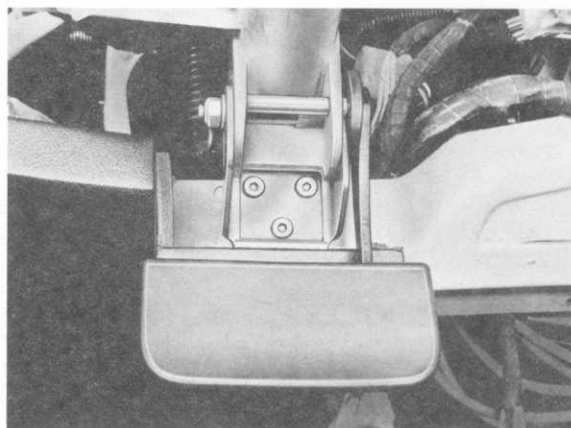
16. Disconnect cable from heater flaps on heater/air conditioner unit.



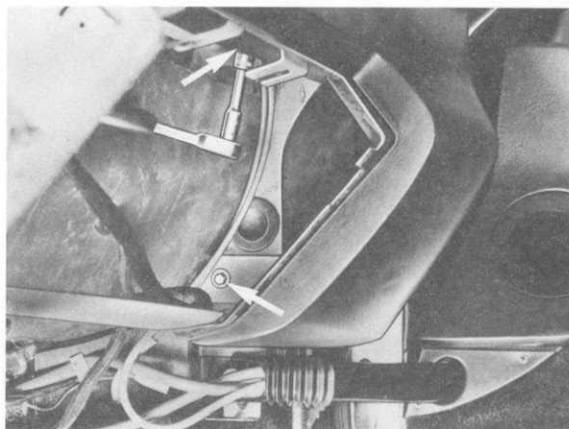
17. Pull out cable for heater flaps, which is routed between instrument panel and heater/air conditioner, and lift off center console.

18. Unscrew holder from control unit for tempostat cruise control and receiver of radio, and tilt off to the right side.

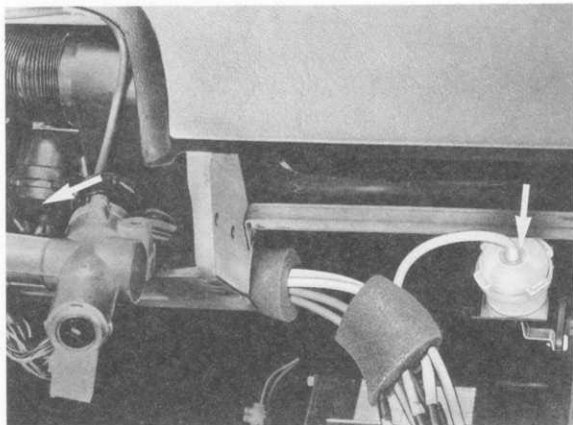
19. Disconnect steering protection tube from instrument panel (3 fillister head screws).



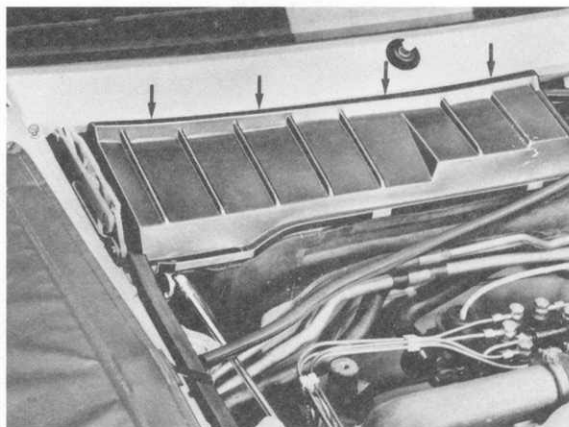
20. Unscrew mounting screws of instrument panel (2 each on left and right sides). Pull off hoses for side ventilation. Remove hose clips (holding vacuum hoses).



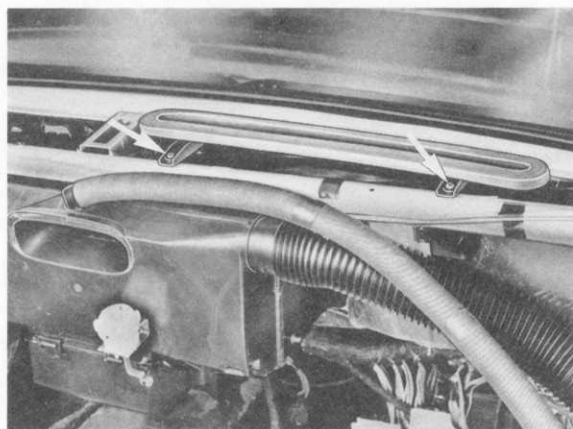
21. Pull off yellow and green vacuum hoses from vacuum boxes of footwell flap and defroster flaps. Remove instrument panel.



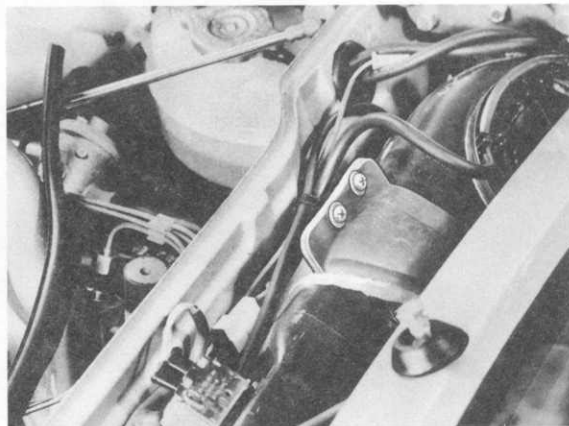
23. Remove cover over blower.



22. Remove connecting hoses between side nozzles/glove box nozzle and heater/air conditioner. Remove defroster nozzles.

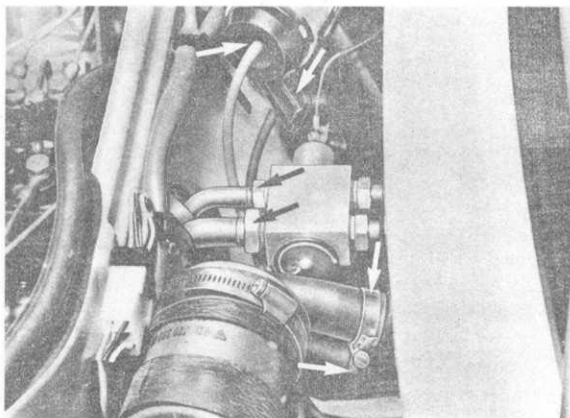


24. Remove two screws on rubber connector between blower and heater/air conditioner. Pull off wires from temperature switch.



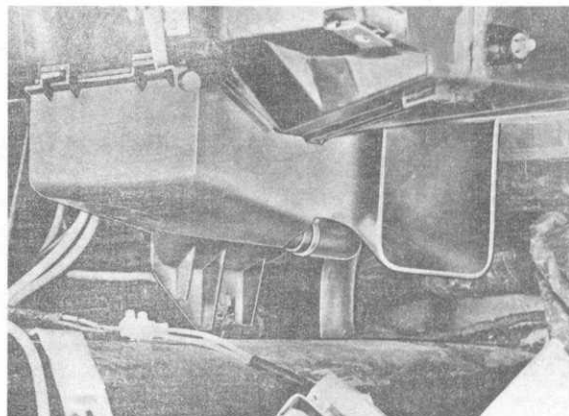


25. Pry off wiper linkage from wiper motor (facilitates assembly). Pull off plugs from resistor block/safety switch and vacuum hose (violet) from vacuum unit of main shut-off flap. Unscrew and plug low pressure and high pressure lines on expansion valve for air conditioner. Detach coolant hoses from heat exchanger.

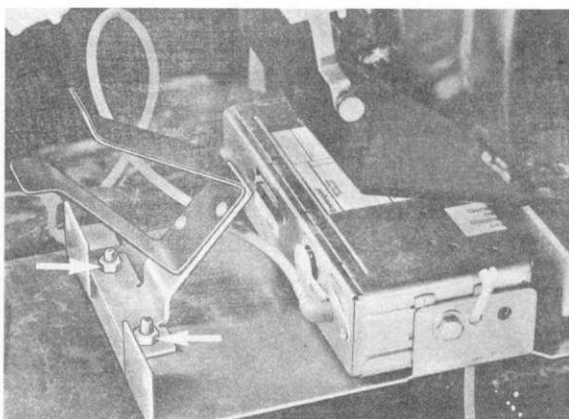
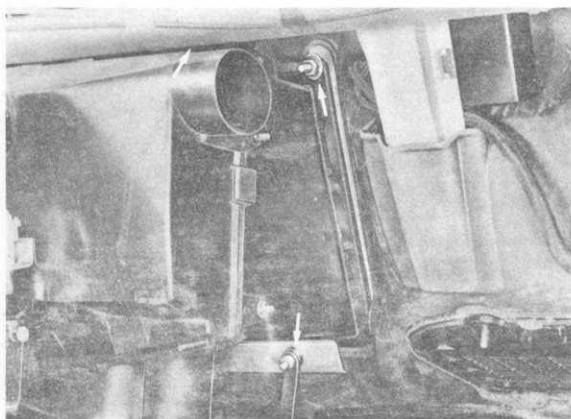


### Installing

1. Replace O-rings on air conditioner. Install air conditioner, center and tighten screws.
2. Install water drain hose on footwell housing. Tighten hose clamp.

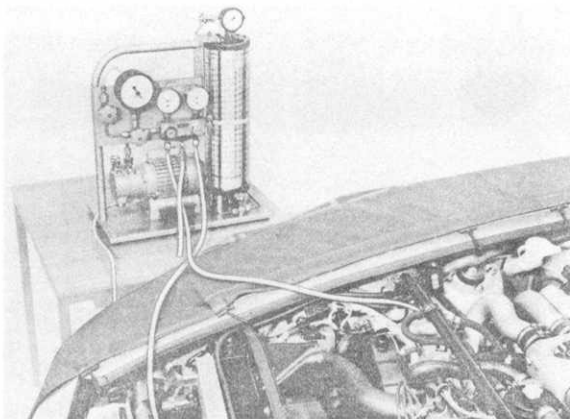


26. Remove mounting nuts from heater/air conditioner. Pull off water drain hose. Lift out heater/air conditioner.

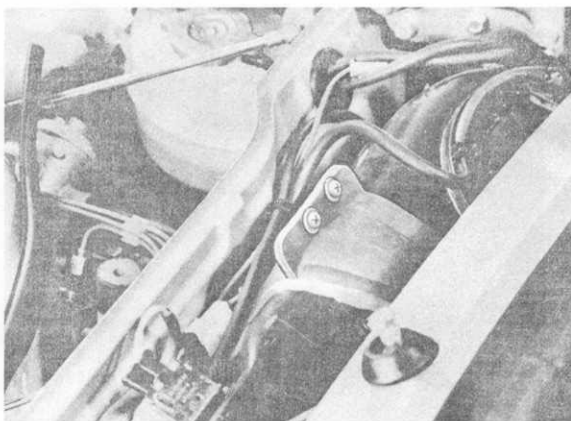


4. Connect lines on expansion valve, coolant hoses, vacuum hose of main shut-off flap, plugs on resistor block/safety switch and wires on temperature switch. Connect wiper linkage.

5. Connect service unit. Quick flush air conditioner.



6. Install rubber connector between blower and heater/air conditioner with a suitable adhesive, e.g. Loctite Super Bonder 414.



7. Install cover over blower.

8. Attach connecting hoses for side and glove box ventilation on heater/air conditioner. Install defroster vents.

9. Install instrument panel. Attach connecting hoses for side ventilation.

10. Install steering protective tube on instrument panel. Do not yet tighten the three socket head screws.

11. Connect yellow hose for vacuum unit of footwell flap, green hose for vacuum unit of defroster flap and fasten vacuum hoses on instrument panel with clips.

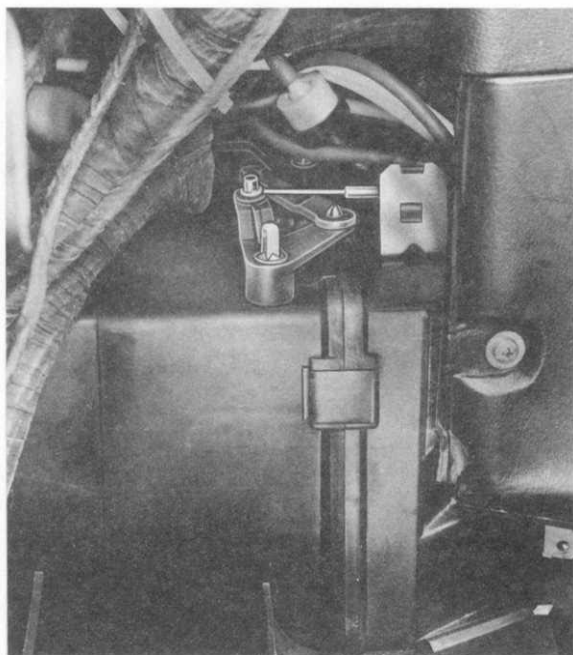
12. Install center console on frame tunnel. Push in cable for heater flaps between instrument panel and heater/air conditioner. Mount vacuum hoses on control switch.

13. Connect power seats and radio, or install.



14. Tighten center console screws, starting at center nozzle/instrument panel.

15. Attach cables for heater flaps.



16. Install shift lever knob with dust cover. For new version (large opening in shift lever area) first mount dust cover with shift lever knob on frame. Push shift lever knob on to shift lever. Engage frame on center console.

17. Install center nozzle and rotary knob. Charge air conditioner.

18. Install instrument cowl (incl. steering column switch and covers). When installing switches, be careful not to mix up plugs for front fog light and tail fog light switches! Plug with black/violet wire belongs to front fog light switch. Align instrument cowl with instrument panel and tighten mounting screws (3 fillister head screws) of steering protective tube.

19. Mount electric wires on holder of tempostat control with clips.

20. Connect battery. If applicable, insulate glove box light wires. Check function of heater, fresh air supply, air conditioner and electric system. Add coolant for engine cooling system.

21. Install side trim panels on center console and tread protection plate at height of accelerator pedal. Install floor carpets and insulation sheets. Install steering wheel.

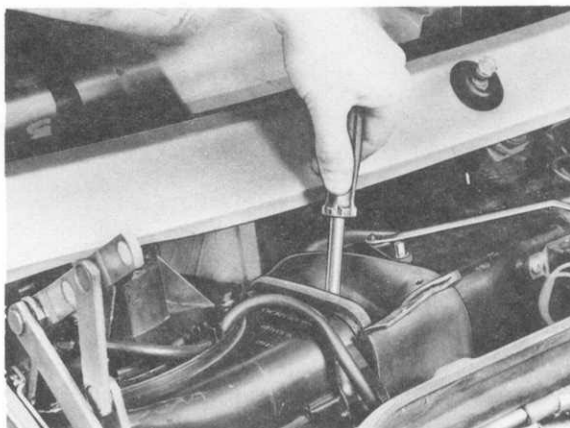
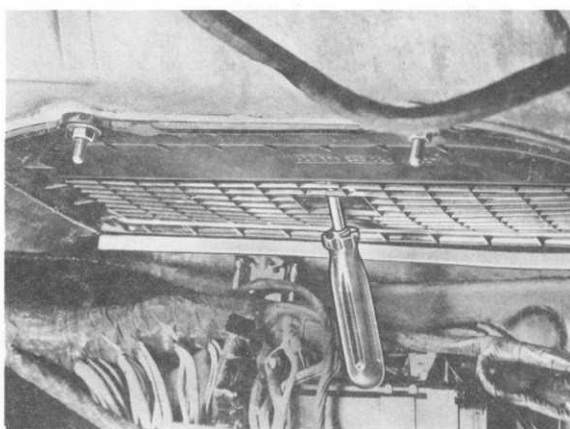
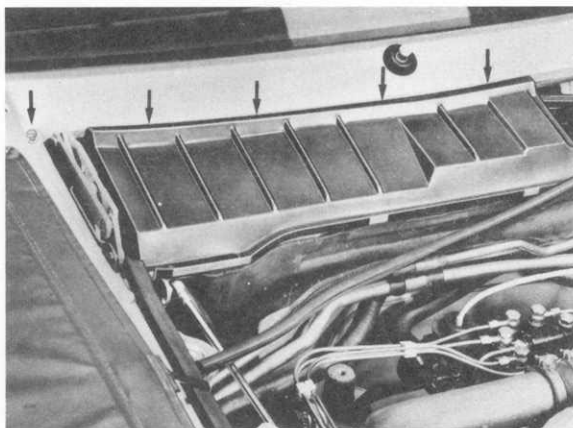
22. Install glove box. Fit and adjust lid. Install tray.



## REMOVING AND INSTALLING BLOWER

### Removing

1. Pull off ignition key. Mark position of engine hood and remove engine hood.
2. Take off right windshield wiper arm.
3. Remove cover above blower. Unscrew mounting screws from apron outer section on fenders of left and right sides.
4. Open rubber connector between blower and heater/air conditioner. Don't pull off rubber connector from heater/air conditioner (sealed).
5. Disconnect blower wire harness at plug connector.
6. Remove three mounting screws from blower.
  - a) To accomplish this, open flap of intake housing (move control switch lever to "AIR COND. "). Unscrew mounting screw with a screwdriver inserted through open flap. Cars without an air conditioner have a hole in the intake housing, which is sealed with a plug.
  - b) Unscrew screw on inside of blower housing and screw on outside of blower housing.



4. Switch on the air-conditioning system, motor speed approx. 2000 rpm. Open the filling valve 2 and low-pressure valve 7.
5. Observe the sight glass in the fluid reservoir. The filling operation is complete if no gas bubbles are formed.

**Note**

Valves 6 and 7 must never be opened simultaneously when the compressor is running.

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### Flushing the air-conditioning system with refrigerant R 12

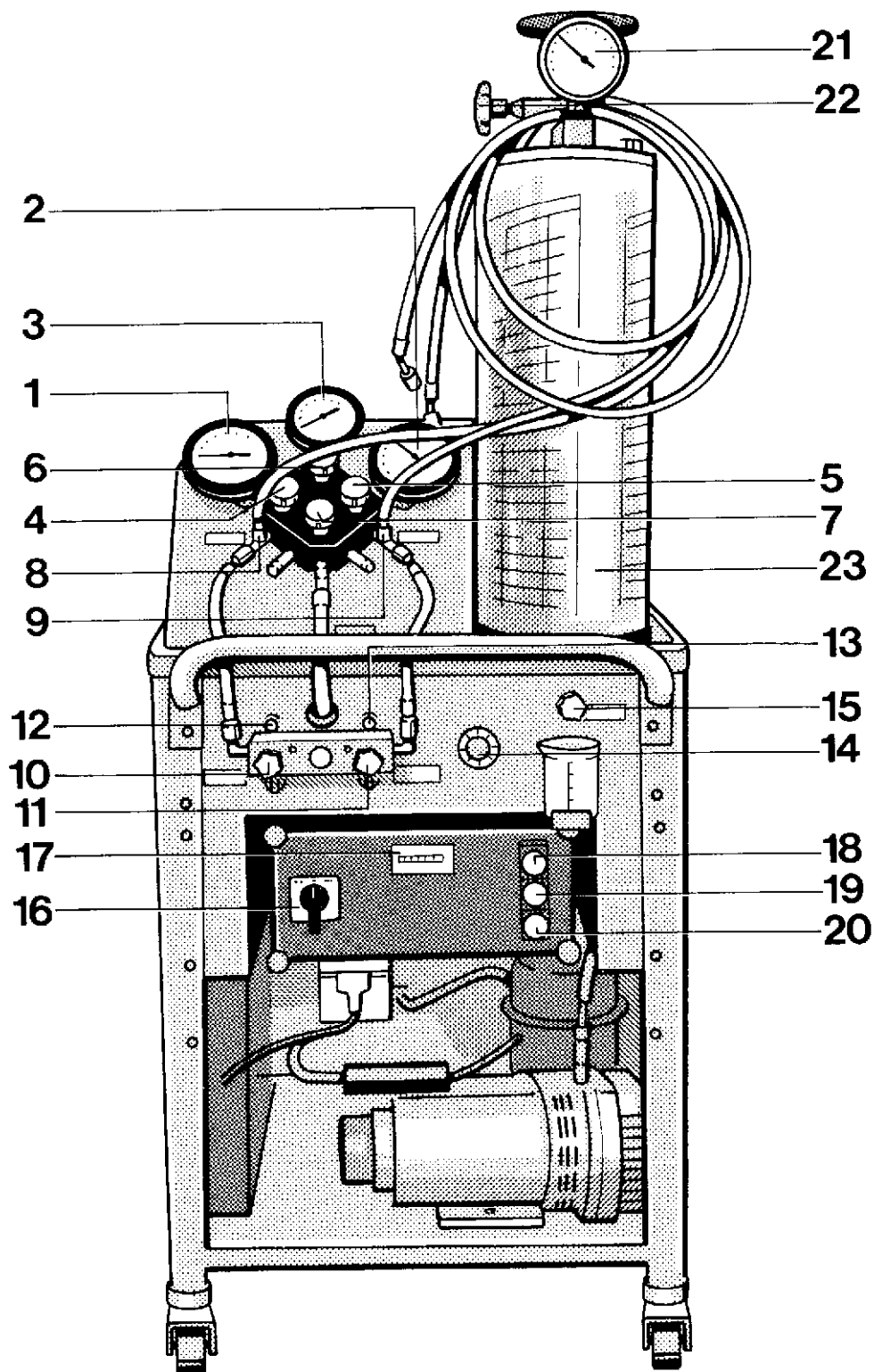
If humidity has entered the system during assembly of the air-conditioning system or as result of replacement of individual parts, the following procedure must be followed when refilling the system:

1. Connect the service unit.
2. Evacuate.
3. Fill approx. 500 g refrigerant.
4. Switch on the air-conditioning system and allow the compressor to run for approx. 1 min. Ensure that valves 6 and 7 are closed on the service unit.

5. Syphon off the refrigerant.
6. Fit new fluid reservoir.
7. Evacuate.
8. Fill

## Installation work on the air-conditioning system

Service unit SECU



303-87

- 1 - Pressure gauge, low-pressure
- 2 - Pressure gauge, high-pressure
- 3 - Torrmeter
- 4 - Shut-off valve, low pressure (blue)
- 5 - Shut-off valve, high-pressure (red)
- 6 - Shut-off valve, torrmeter (black)
- 7 - Shut-off valve, vacuum pump (yellow)
- 8 - Connection piece, low-pressure
- 9 - Connection piece, high-pressure
- 10 - Shut-off valve, refrigerant inlet
- 11 - Shut-off valve; refrigerant outlet
- 12 - Connectiong piece, refrigerant inlet (from refrigerant bottle)
- 13 - Connection piece, refrigerant outlet (to refrigerant bottle)
- 14 - Moisture indicator
- 15 - Drain valve, refrigerating oil
- 16 - Main switch
- 17 - Operating hours counter
- 18 - Pilot lamp, yellow
- 19 - Pilot lamp, red
- 20 - Pilot lamp, green
- 21 - Pressure gauge, filling cylinder
- 22 - Shut-off valve, filling cylinder
- 23 - Filling cylinder with weight scale

## Installation work with intervention in the refrigerant system

The contents of the air-conditioning system must be disposed of in accordance with the relevant regulations before all work on the air-conditioning system which necessitates opening of the refrigerant system. The safety regulations must also be observed.

Dirt and moisture must be kept out of the piping system of the air-conditioning system. Extreme cleanliness must therefore be observed for all work. No parts of the system must be cleaned inside with hot steam under any circumstances. Only nitrogen must be used for cleaning.

When replacing a component, all openings must be sealed with a suitable stopper.

### General work sequence

1. Syphon off refrigerant.
2. Remove faulty parts.
3. Evacuate.
4. Check system for leaks.
5. Flush with refrigerant.
6. Syphon off system again.
7. Evacuate.
8. Fill.

### Note

Pay attention to sealing rings when disconnecting or connecting the hose connections.

### Syphoning off refrigerant

1. Connect the service unit to the system.

#### Note

Check on the fluid reservoir whether the sight glass is still transparent. If the sight glass is discolored brown on the inside, the refrigerant should be pre-filtered by a cleaning drier installed inbetween in the extraction hose. In this case, syphon off via the high-pressure side only.

2. Open the low-pressure shut-off valve (4), high pressure shut-off valve (5) and refrigerant inlet shut-off valve (8).
3. Turn the main switch (16) fully to the right. The green pilot lamp lights up.

#### Note

The syphoning-off operation takes place automatically. The unit is switched off when all refrigerant has been syphoned out of the circuit. The red pilot lamp then lights up.

4. Close shut-off valves 4, 5 and 8.
5. Open the refrigerating oil drain cock (15) and drain off syphoned-off refrigerating oil.
6. Determine the volume of the refrigerating oil.

#### Note

Do not use syphoned-off refrigerating oil again.

7. Fill in new refrigerating oil (syphoned-off volume + 10 cm<sup>3</sup>)

### Filling with refrigerating oil

1. Unscrew the red hose on the service unit at connection piece 9 and hold in the container with new refrigerating oil.
2. Switch on the vacuum pump.
3. Open the shut-off valves for low pressure (4) and vacuum pump (7).

#### Note

Refrigerating oil is now sucked into the system via the high-pressure side.

4. After filling the system with the refrigerating oil, close the shut-off valves and switch off the vacuum pump.

### Evacuating the air-conditioning system

1. Syphon off any existing pressure.
2. Switch on the vacuum pump (turn the main switch to the left).
3. Open the shut-off valves for low pressure (4), high pressure (5), torrmeter (6) and vacuum pump (7).
4. Leave the vacuum pump switched on for at least 15 min.
5. Close shut-off valves 6 and 7 at a pressure of approx. 0.1 bar (absolute)
6. Switch off the vacuum pump.

#### Note

If the vacuum cannot be reached or can be reached only after a very long time or if the pressure increases to over 0.2 bar (absolute) approx. 10 minutes after switching off the pump, the circuit possesses a leak and must be sealed.

### Flushing the air-conditioning system

#### Note

Flushing the air-conditioning system serves the purpose of drying the circuit.

1. Evacuate.
2. Open the shut-off valves for high pressure (5) and the refrigerant outlet (11).
3. Allow refrigerant to flow in until a pressure of approx. 2 bar (absolute) is indicated.
4. Close shut-off valves 5 and 11.
5. Shut-off refrigerant again.
6. Evacuate.

## Filling the air-conditioning system

### Note

The air-conditioning system must be evacuated and filled. There must be sufficient refrigerant in the filling cylinder. Top up if necessary.

1. All valves on the service unit must be closed.
2. A pressure of approx. 7 bar is required to fill the system. If the pressure is lower, the pressure can be increased by cleaning the refrigerant (refer to Page 87 - 16g). If the pressure is higher than 10 bar (end of the weight scale), the pressure in the filling cylinder can be lowered by opening the shut-off valve 22.
4. Set the required refrigerant quantity on the filling cylinder with the rubber ring (difference with respect to the refrigerant level in the filling cylinder).
5. Open the shut-off valves for high pressure (5) and the refrigerant outlet (11).
6. Observe the fluid level in the sight glass of the filling cylinder. Close shut-off valves 11 and 5 when the fluid level has reached the setting ring.
7. Check the refrigerating output (refer to Page 87-116).
8. Disconnect filling hoses at compressor.
9. Screw protective caps onto the valves.

### Note

The pressure increases by approx. 1.5 bar in 10 minutes.

3. In accordance with the value read off on pressure gauge 21, adjust the rotary scale of the filling cylinder so that the value specified on the top edge of the scale stops over the sight glass.

### Note

It must be noted that the rotary scale is designed for use of different refrigerants. The refrigerant designations are specified at the bottom scale edge.

Only the scales for R12 are applicable for vehicle air-conditioning systems.



## Topping up the air-conditioning system

### Note

There is not sufficient refrigerant in the system if gas bubbles are visible in the sight glass of the fluid reservoir when the air-conditioning system is switched on.

1. Syphon off the fluid from the air-conditioning system.
2. Determine the volume of the refrigerating oil which is syphoned off as well.
3. Fill system with new refrigerating oil.
4. Evacuate.
5. Check system for leaks.
6. Fill with prescribed filling quantity.

## Filling the service unit with refrigerant

1. Connect the refrigerant bottle with the refrigerant inlet connection piece (12).
2. Open the valve on the refrigerant bottle and shut-off valve 10.
3. Switch on the service unit with the main switch (16). The green pilot lamp lights up.
4. If there is sufficient refrigerant in the service unit, close the bottle valve. The system switches off automatically when the refrigerant has been syphoned off up to the bottle valve.
5. Close the refrigerant inlet shut-off valve (10).

## Empty the service unit

### Note

If the filling cylinder is full of refrigerant and it is necessary to syphon off more refrigerant, the clean refrigerant can be filled into a refrigerant bottle. Pay attention to the maximum filling weight. **The refrigerant bottle must not be overfilled.**

1. Connect the refrigerant bottle with the refrigerant outlet connection piece (13).
2. Increase the pressure in the filling cylinder to approx. 8 bar by cleaning the refrigerant.
3. Open the bottle valve and refrigerant outlet shut-off valve (11).
4. After completing emptying, close the bottle valve and shut-off valve.

### Note

Do not empty the filling cylinder completely, otherwise moisture may enter the service unit.

## Cleaning the refrigerant

### Note

If the syphoned-off refrigerant is heavily contaminated, it must be pumped through the filter systems several times.

The cleaning condition can be seen at the moisture indicator (14).

1. Open the filling cylinder shut-off valve (22).
2. Switch on the service unit. The green pilot lamp lights up.
3. After cleaning the refrigerant (condition shown by the moisture indicator), close the shut-off valve).

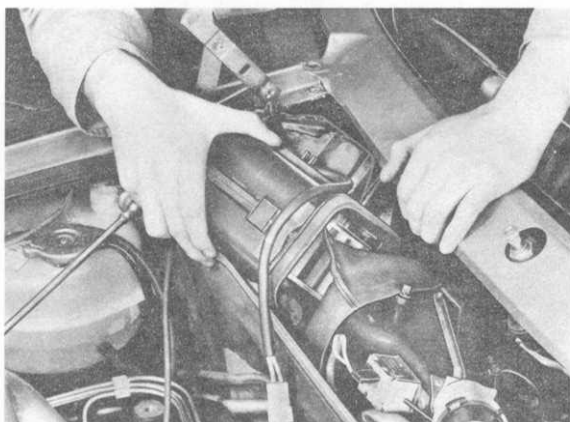
### Note

The unit switches off automatically when all refrigerant has been pumped into the filling cylinder (red pilot lamp lights up). The pressure in the filling cylinder increases.

7. Close main shut-off flap. Lift apron outer section. Lift out blower.

#### Note

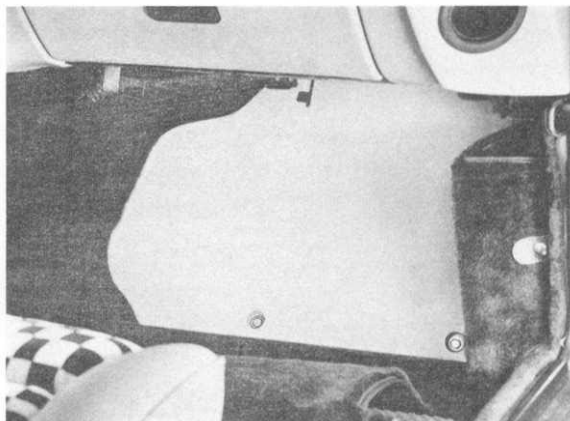
Be careful not to damage apron outer section.



## REMOVING AND INSTALLING AIR DISTRIBUTION HOUSING

### Removing

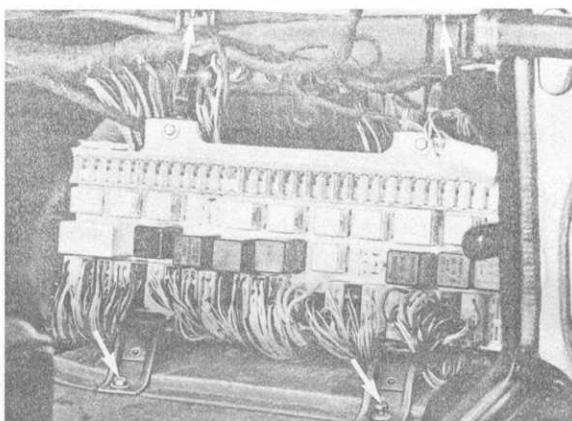
1. Disconnect battery ground.
2. Remove blower.
3. Disconnect vacuum hose from vacuum unit of control flap (only air conditioner) at connector of hoses.
4. Remove cover from central fuse/relay plate in footwell of passenger's side and tray.



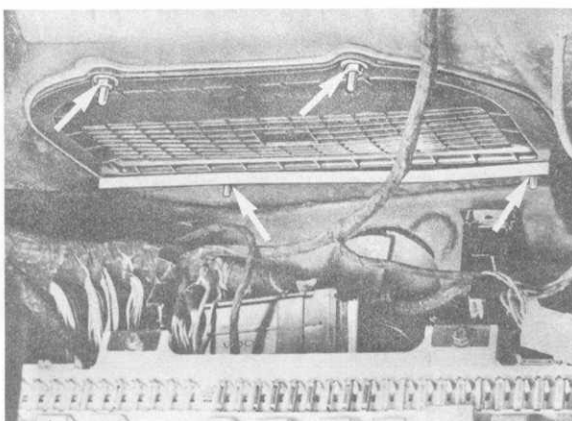
### Installing

Seal rubber connector between blower and heater/air conditioner with a suitable adhesive, e. g. Loctite Super Bonder 414.

5. Remove mounting nuts and screws from central fuse/relay plate. Lower central fuse/relay plate.

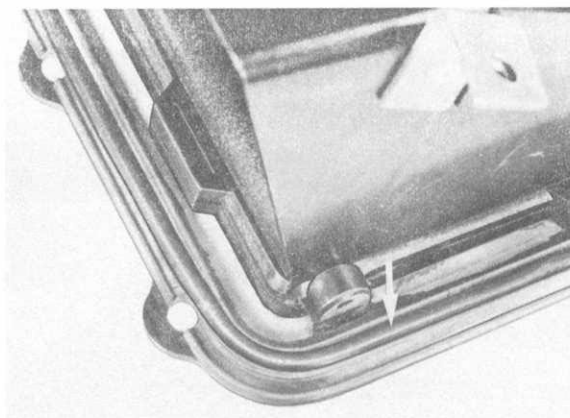


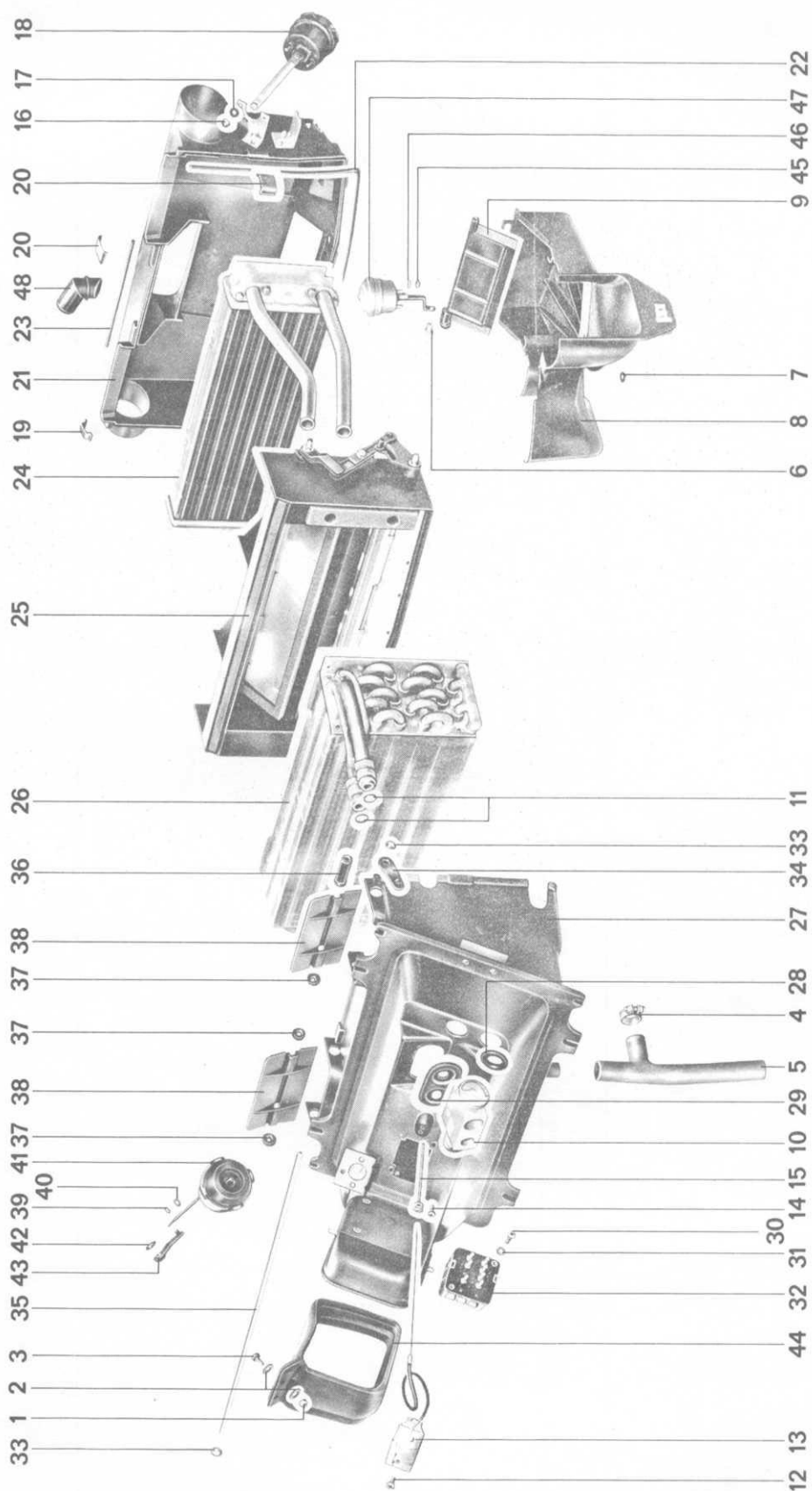
6. Lift out air distributor housing after removal of mounting nuts.



## Installing

To seal the air distributor housing, use a non-hardening caulking compound in addition to the gasket.





No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Self-locking nut	2		Replace, if necessary	
2	Washer	4			
3	Screw 5 x 20	2			
4	Hose clamp	1		Replace, if necessary	
5	Water drain hose	1		Check for damage and position correctly	
6	Pin	1			
7	Push nut	1		Replace	
8	Footwell housing	1			
9	Footwell flap	1			
10	Expansion valve	1		Replace all 4 O-rings	
11	O-ring	2		Replace	
12	Screw	2			
13	Temperature switch	1			
14	Screw	1			
15	Capillary guide tube	1			
16	Push nut	3		Replace (same as no. 39)	
17	Rubber washer	3			
18	Vacuum unit for defroster vents	1		Check operation	
19	Clamp	2		Replace, if necessary	

No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
20	Clip	8		Replace, if necessary	
21	Housing, rear	1			
22	Cord seal	1		Replace	
23	Cord seal	1		Replace	
24	Heater core	1			
25	Flap housing	1			
26	Evaporator core	1			
27	Housing, front	1			
28	Grommet (heater core)	2		Position correctly	
29	Grommet (evaporator core)	1		Position correctly	
30	Screw	2			
31	Washer	2			
32	Resistor block/safety switch	1			
33	Push nut	2		Replace (same as no. 42)	
34	Defroster flap lever	1		Same as no. 43	
35	Flap shaft	1			
36	Sleeve	1			
37	Bushing	3			
38	Defroster flap	2		Position correctly	
39	Push nut	2		Replace (same as no. 42)	

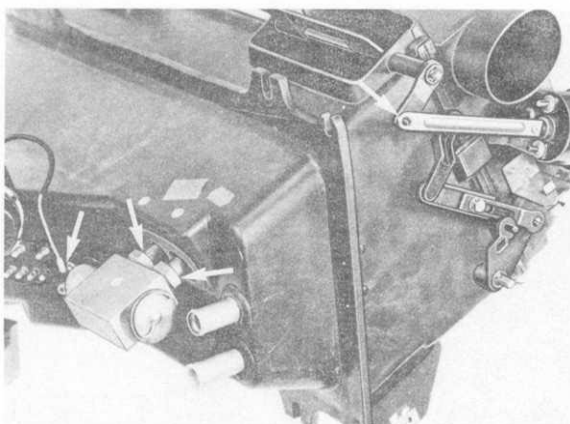
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
40	Rubber washer	3			
41	Vacuum unit for shut-off flap	1		Check operation	
42	Push nut	1		Replace (same as no. 33)	
43	Shut-off flap lever	1		Same as no. 34	
44	Rubber connector	1			
45	Push nut	3		Replace	
46	Rubber washer	3			
47	Vacuum unit for footwell flap	1			
48	Outlet neck	1			



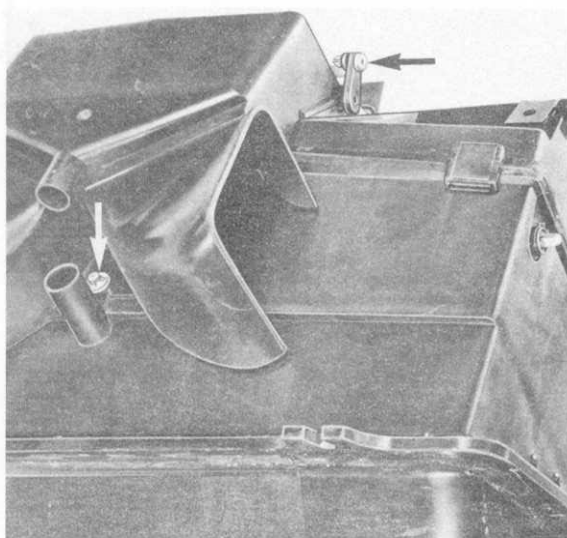
## DISASSEMBLING AND ASSEMBLING HEATER/EVAPORATOR

## Disassembling

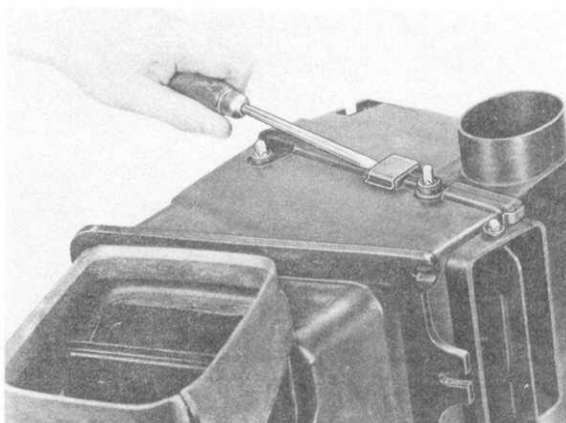
1. Take off expansion valve. Remove temperature switch and pull out capillary tube from guide tube carefully. Remove capillary tube. Disconnect vacuum unit from defroster flaps.



2. Remove pins on vacuum unit of footwell flap. Pry off push nut uniformly and remove footwell housing with footwell flap.



3. Pry off retaining clips and remove sealant from joint. Take apart heater/evaporator and remove interior parts.



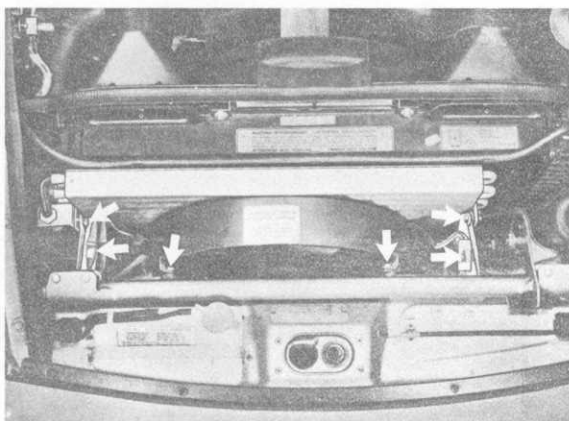
## Assembling

Seal joint between front housing and rear housing sections.

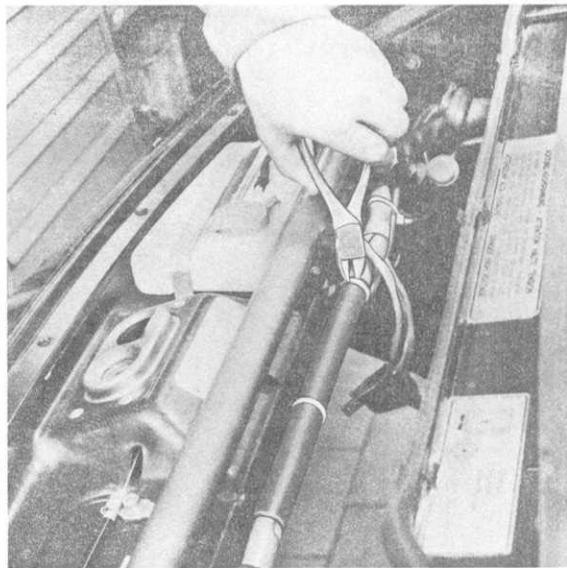
## REMOVING AND INSTALLING CONDENSER FAN

1. Remove air inlet grill.

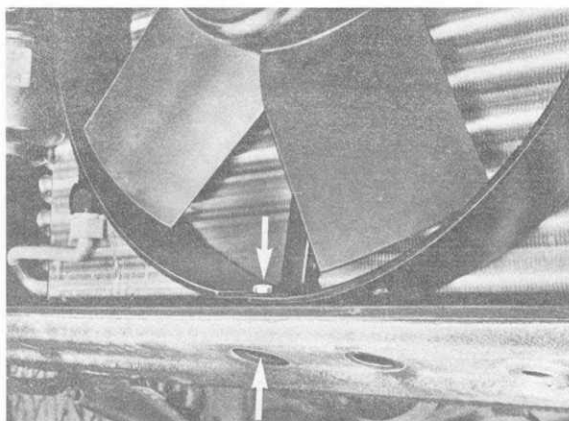
2. Pull off hose clamps on radiator. Disconnect wire plugs. Unscrew left and right brackets on condenser. Unscrew upper fan mountings.



4. Loosen wire harness on lock cross member and remove cover.



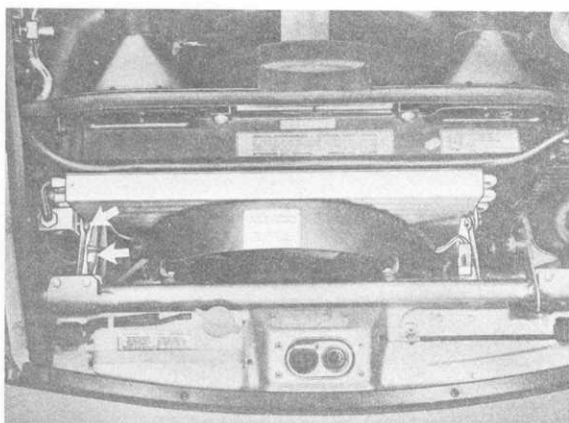
3. Unscrew lower mounting.



5. Pull out fan from top. Be careful not to damage fins of condenser.

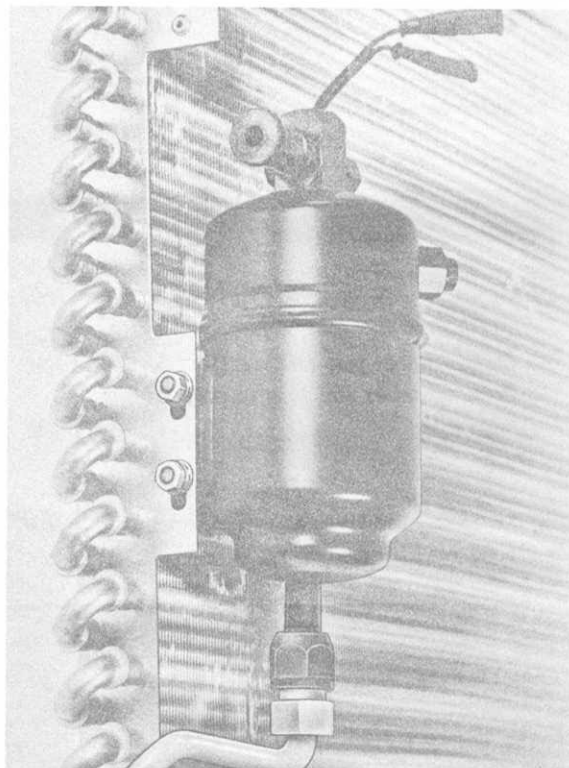
## REMOVING AND INSTALLING RECEIVER-DRIER

1. Discharge air conditioner.
2. Remove air inlet grill.
3. Remove upper and lower condenser fan mountings and push fan to one side.
4. Pull off wire plugs for temperature and low pressure switches. Unscrew right bracket for condenser.



5. Remove hose at top of receiver-drier.

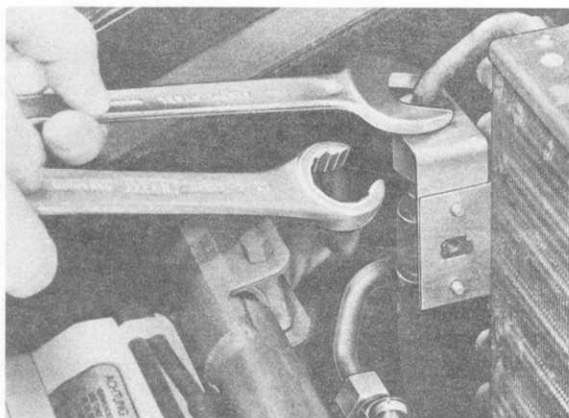
6. Remove receiver-drier.



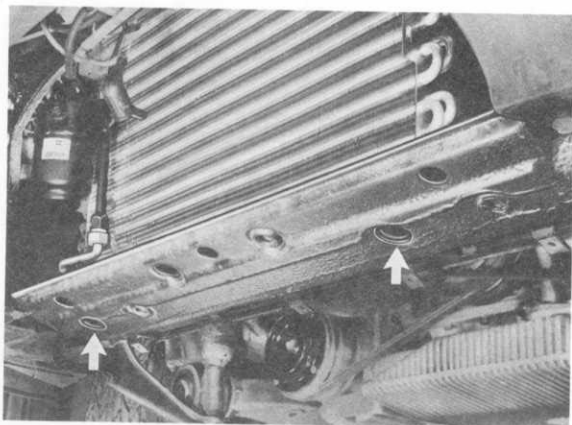
Install new receiver-drier and charge air conditioner.

## REMOVING AND INSTALLING CONDENSER

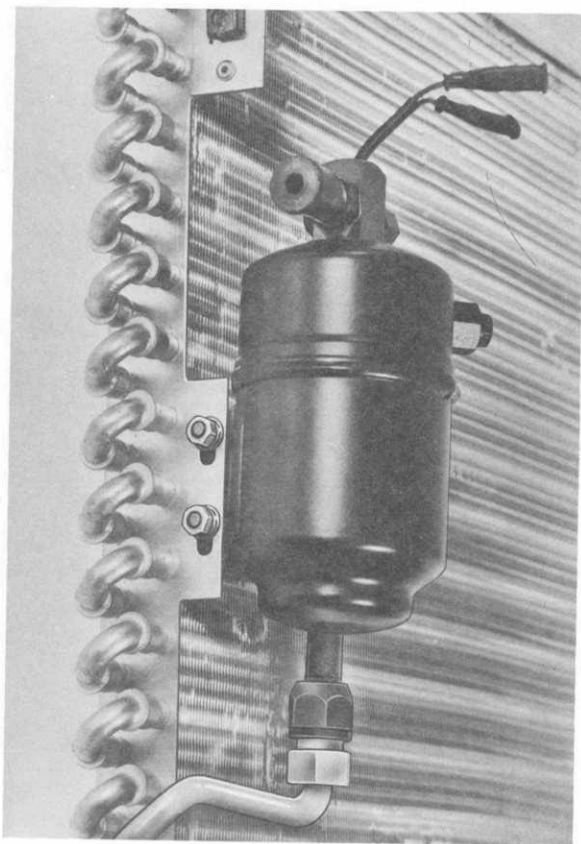
1. Discharge air conditioner.
2. Remove air inlet grill.
3. Remove condenser fan.
4. Loosen upper left and right brackets on lock cross member and turn to one side.
5. Remove hose lines at top of condenser and on receiver-drier.
6. Remove low pressure switch on receiver-drier.



7. Remove lower mounting screws on condenser. Pull out condenser with receiver-drier from above.



8. Take off receiver-drier.



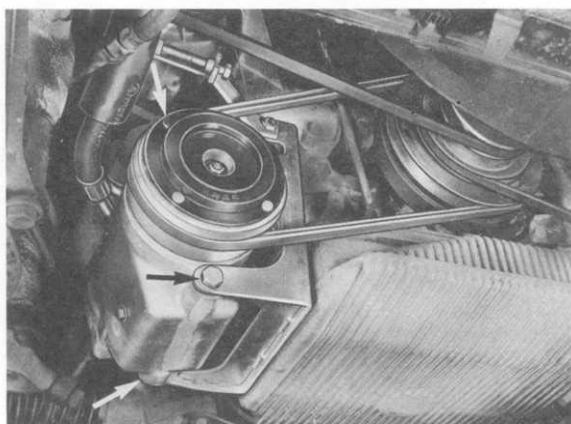
## REMOVING AND INSTALLING COMPRESSOR

## Removing

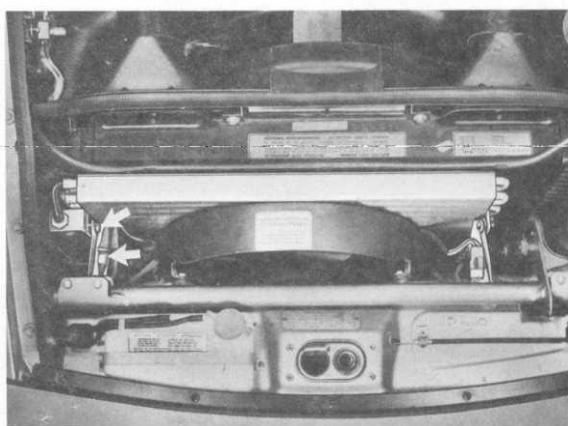
1. Discharge air conditioner.

2. Remove splash shield underneath radiator.

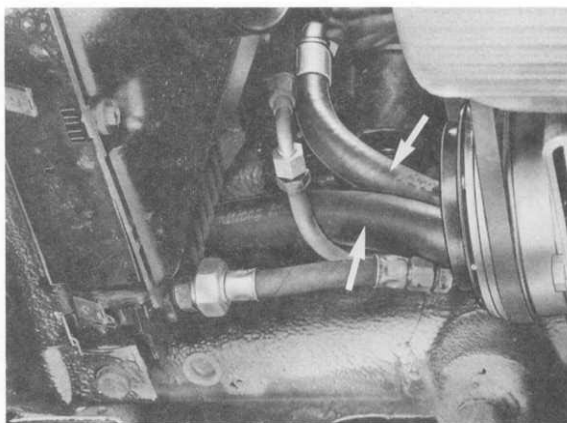
3. Loosen compressor and take off belt.



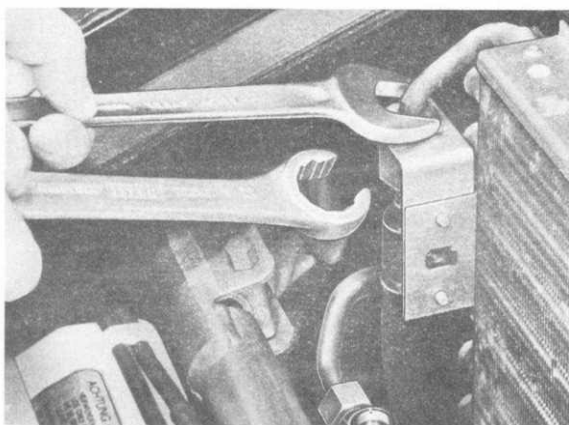
4. Remove holder from condenser at top right.



5. Disconnect hoses.



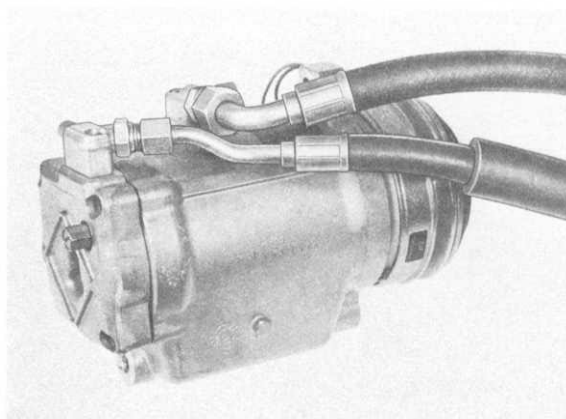
## Installing



6. Pull off wire plugs of magnetic clutch. Remove compressor mounting bolts and remove compressor with hoses.
7. Remove hoses and insert plugs in connections and lines.

New compressors are under pressure. Consequently unscrew plugs slowly until refrigerant is heard to have escaped. Remove plugs only after releasing pressure.

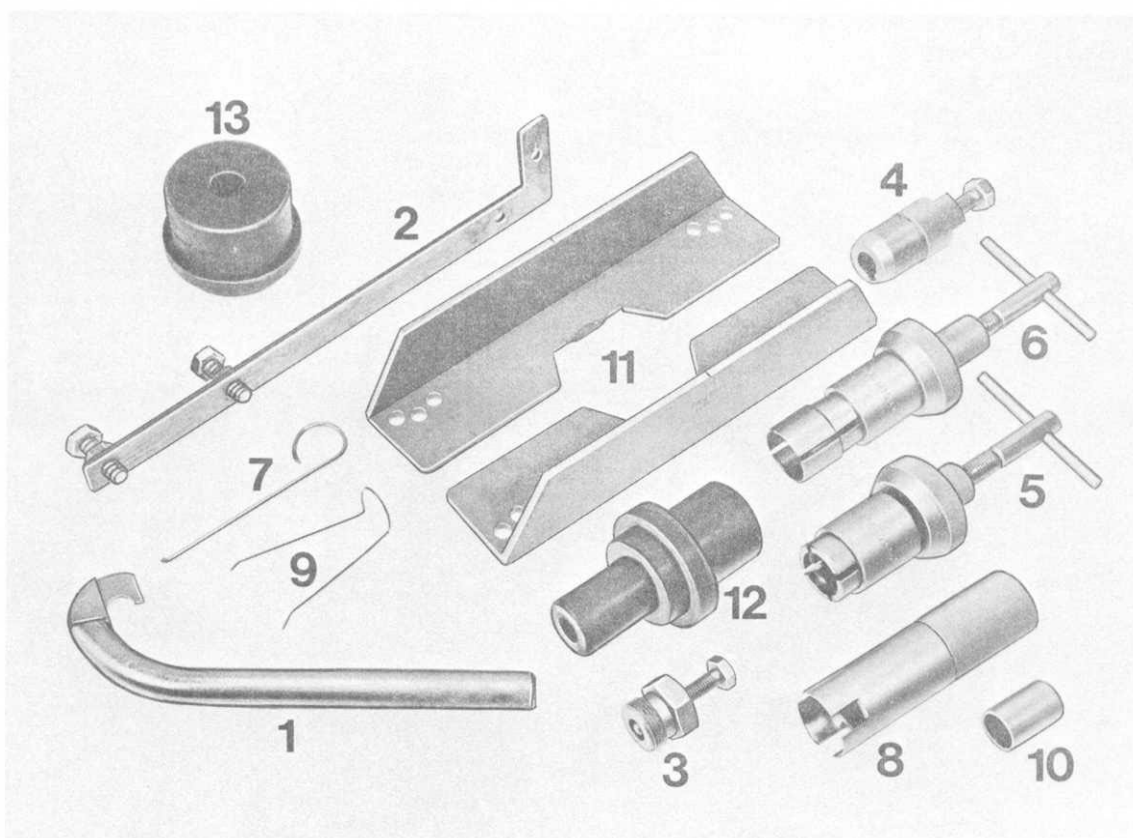
Install and tighten hoses prior to installation.



Charge air conditioner.

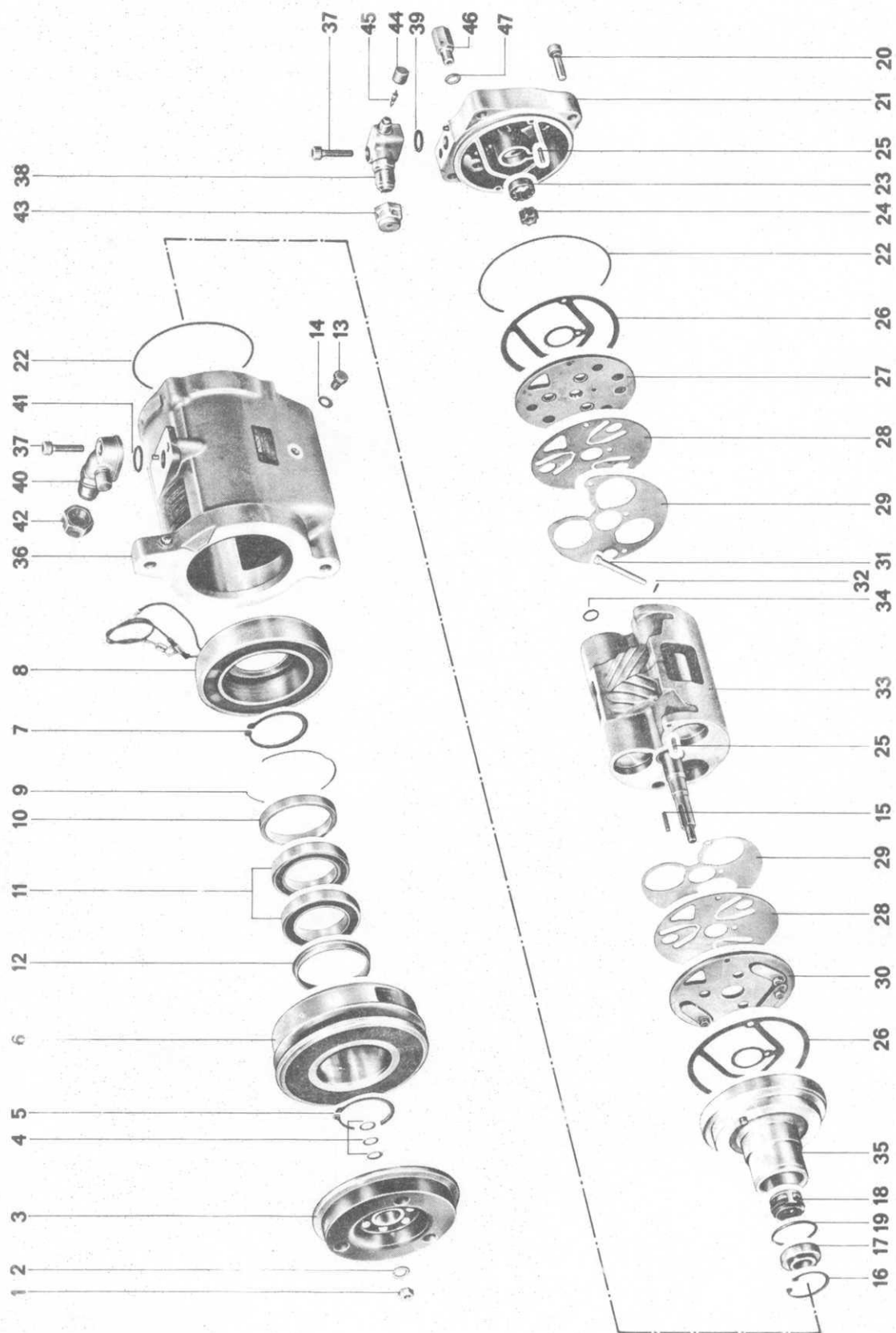


## TOOLS



No.	Description	Special Tool	Remarks
1	Holding wrench	95458-02070	Local manufacture from 924 Sankyo compressor
2	Holding wrench		
3	Puller	95456-03064	
4	Woodruff key puller	95456-21060	
5	Thrust washer puller	95456-03060	
6	Seal puller	95456-02060	
7	Oil pipe pulling hook		Local manufacture
8	Seal installer	95456-08010	Local manufacture
9	Thrust washer installer		
10	Thrust washer pad	95456-09010	For removing and installing bearing
11	Holding rails	VW 457/1	
12	Thrust pad	VW 195	
13	Thrust pad	VW 472/1	To remove bearing

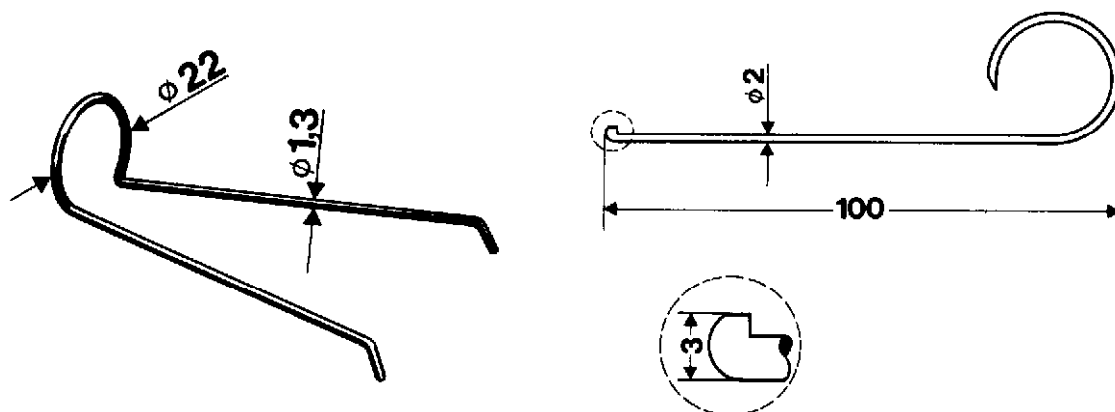




No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Nut	1		Tighten to 17 Nm (12 ft lb)	
2	Lockwasher	1			
3	Clutch plate	1		Check for damage	
4	Set of shims	1		Adjust play between pulley and coupling to 0.4 - 1.0 mm (0.016 - 0.040 in.)	
5	Circlip	1		Bevel faces shaft end	
6	Pulley	1		Replace pulley assembly with ball bearing, if friction surface is worn or oil splattered	
7	Circlip	1		Bevel faces shaft end	
8	Coil unit	1		3.7 ohm resistance	
9	Circlip	1			
10	Spacer	1			
11	Ball bearing	2			
12	Dust ring	1			
13	Oil filler plug	1		Tighten to 15 Nm (11 ft lb)	
14	Seal	1			
15	Woodruff key	1			
16	Circlip	1			

No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
17	Thrust washer	1		Don't damage sealing surfaces. Check for scratches, replacing both parts if necessary. Lubricate with refrigerant oil	
18	Seal	1			
19	O-ring	1			
20	Screw	4		Tighten to 26 Nm (19 ft lb)	
21	Housing cover, rear	1			
22	O-ring	2			
23	Oil pump outer race	1			
24	Oil pump inner race	1			
25	Dowel pin	4			
26	Valve plate gasket	2			
27	Valve plate, rear	1			
28	Suction valve	2			
29	Cylinder gasket	2			
30	Valve plate, front	1			
31	Oil suction tube	1			
32	O-ring	1			
33	Cylinder block	1			Must not be disassembled
34	O-ring	1			
35	Housing cover, front	1			
36	Housing	1			
37	Screw	2		Tighten to 19 Nm (14 ft lb)	
38	Discharge service valve	1			

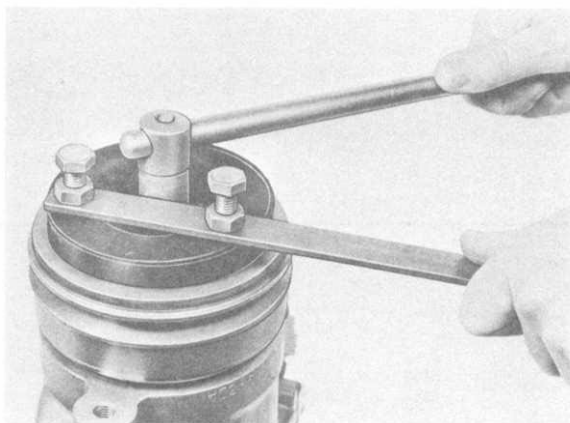
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
39	O-ring	1			
40	Suction service valve	1			
41	O-ring	1			
42	Cap, suction valve	1			
43	Cap, discharge valve	1			
44	Cap	2			
45	Valve core	2			
46	Safety valve	1			
47	Seal	1			



## DISASSEMBLING AND ASSEMBLING COMPRESSOR

## Removing and Installing Magnetic Clutch

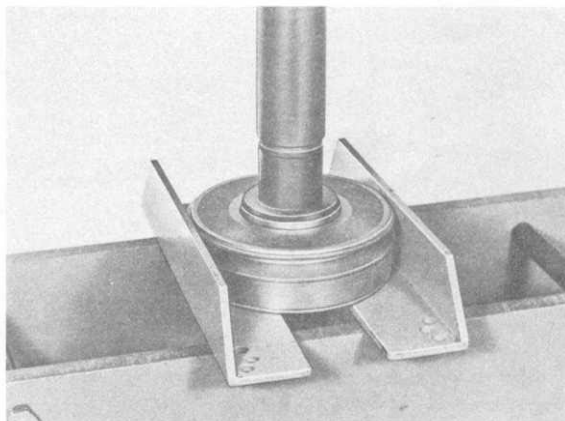
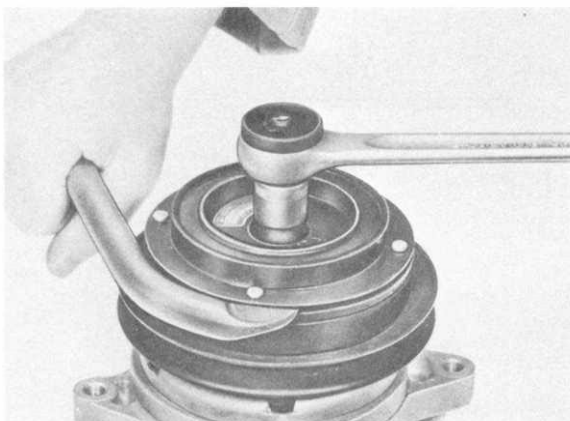
1. Counterhold with correct wrench depending on version to loosen or tighten mounting nut.



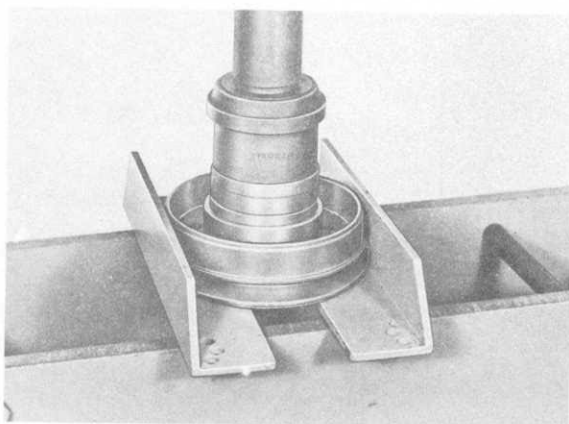
2. Remove clutch plate with puller.



3. Remove ball bearing.



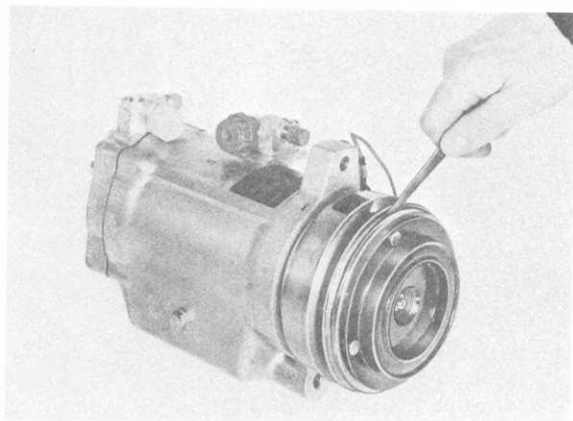
4. Install ball bearing.



If necessary, adjust play with set of shims.



5. Play between clutch plate and pulley is  
0.4 to 1.0 mm (0.016 to 0.040 in.).



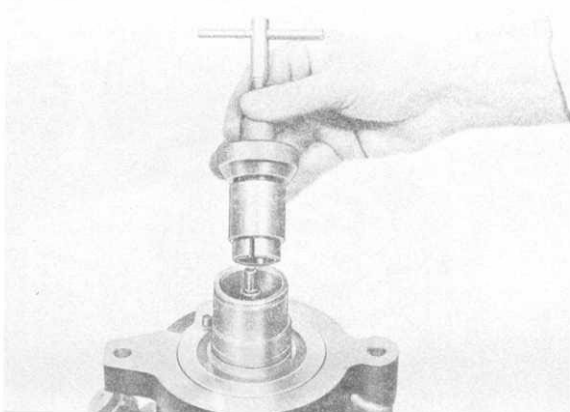
### Disassembling Compressor

#### Note

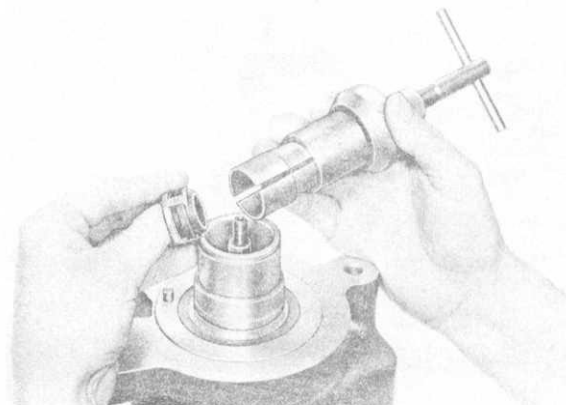
Remove any plugs from line connections to let residual gas escape.

1. Drain refrigerating oil (never reuse).
2. Remove woodruff key with woodruff key puller.

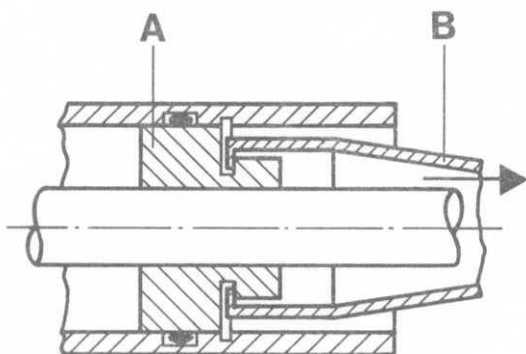
3. Pull out thrust washer with puller.



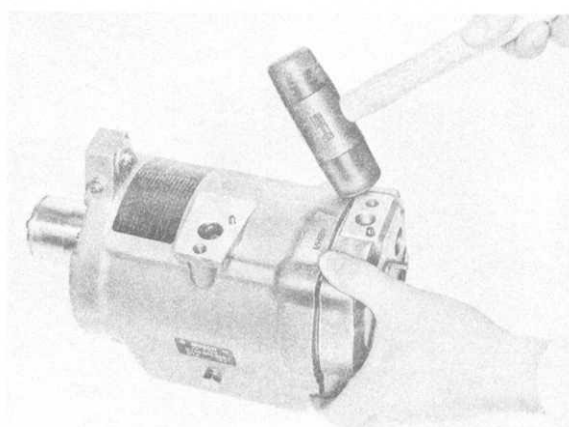
4. Remove seal with puller.



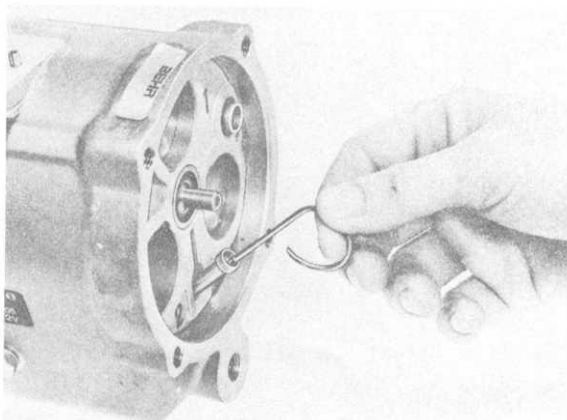
5. Remove mounting bolts from rear housing cover. Take off housing cover, applying light taps with a plastic hammer when necessary.



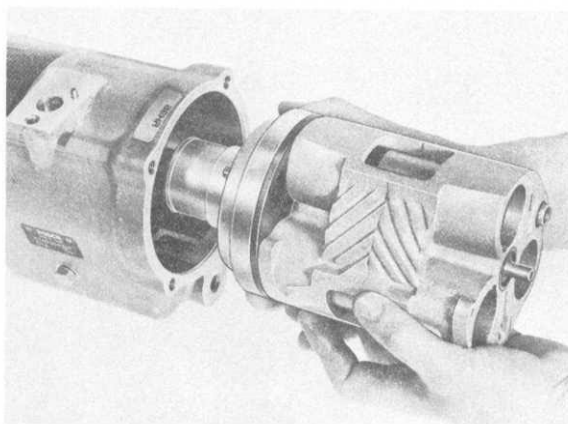
A - Thrust washer  
B - Puller



6. Pull out oil suction tube with pulling hook.



7. Remove cylinder block from housing.



#### Note

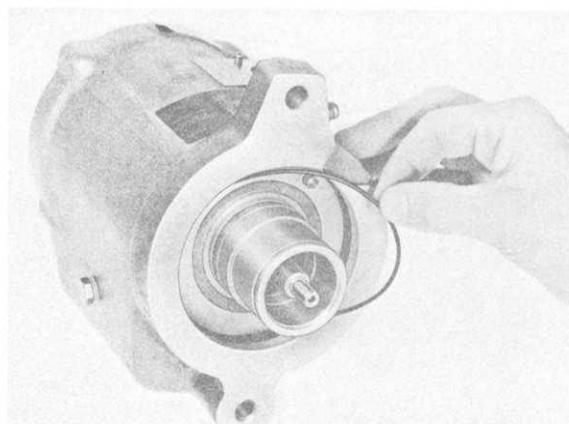
Never disassemble cylinder block!

### Assembling Compressor

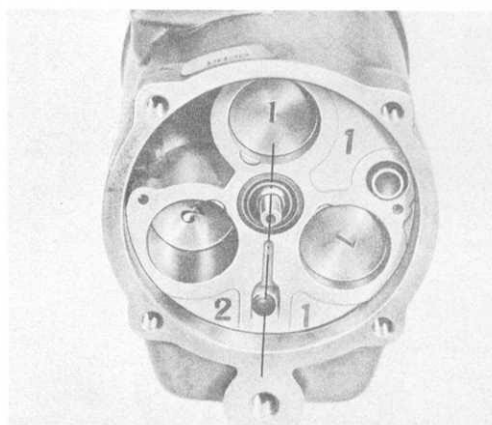
#### Note

Coat all gaskets and seals with clean refrigerating oil prior to installation.  
(See page 87 - 01 for types of oil.)

1. Place O-ring in front of housing and push in cylinder block.



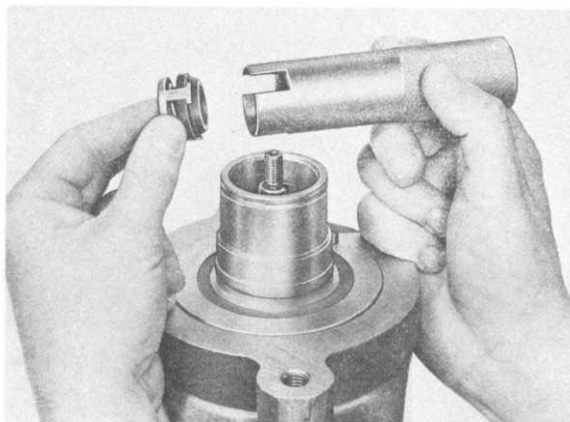
2. Align cylinder block so that bore of oil suction tube faces down.





3. Place seal in assembly tool and push on to input shaft.

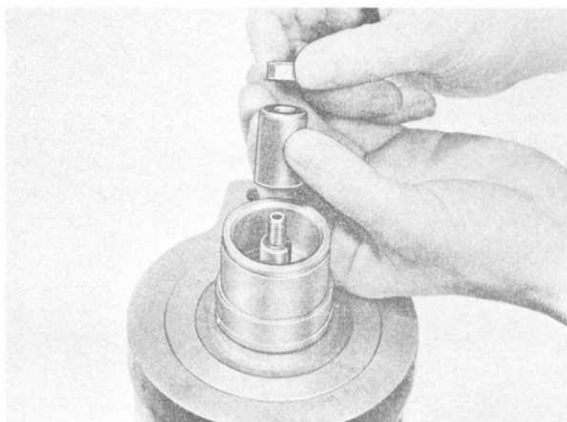
Turn seal on shaft with tool until seal engages.



4. Guide in thrust washer with assembly tool carefully.



5. Press in thrust washer with thrust pad and nut until groove for circlip is visible.



Insert circlip and take off thrust pad.

6. Install woodruff key by mounting clutch plate and driving in key.



## 7. Add refrigerant oil.

## Checking Volume of Oil in System

## 8. Turn assembled compressor with a torque wrench.

Torque must not exceed 17,5 Nm (12,5 ft lb).

## Note

After installation of compressor and charging the system, run compressor 15 minutes at idle speed with magnetic clutch applied.

There is no way of checking the oil level in the air conditioner compressor. The compressor of a newly installed air conditioner has a total oil volume of about 350 cc prior to initial operation. The refrigerant oil will be distributed throughout the system when operated for a while. The different parts will then have the following oil quantities:

Condenser	approx. 30 cc/1 ounce
Evaporator	approx. 60 cc/2 ounces
Receiver-drier and lines	approx. 10 cc/0,34 ounce
Remainder in compressor	approx. 250 cc/8 ounces

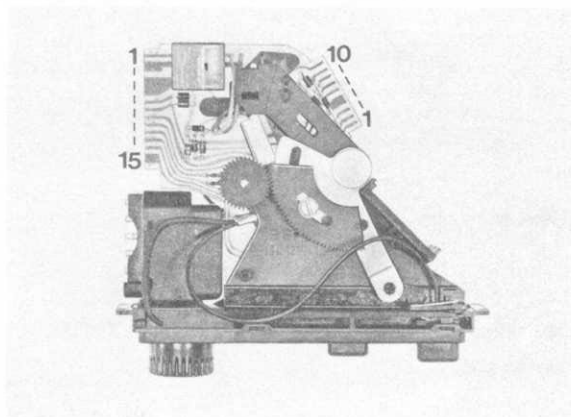
1. When replacing a condenser, evaporator, receiver-drier or lines, the amount of oil for the part concerned must be added to the system. To do this, remove compressor, unscrew oil drain plug and add refrigerant oil.

2. Prior to installation of a new compressor in an already used air conditioner, remove enough oil from the compressor so that the total oil volume will again be about 350 cc/2 ounces.

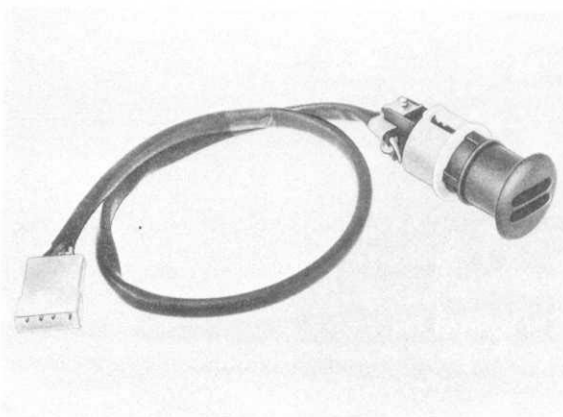
For example, if no other part is replaced besides the compressor, drain approx. 100 cc/3,4 ounces of oil from the new compressor.

## REGULATORS AND CONTROL UNIT OF AUTOMATIC AIR CONDITIONER

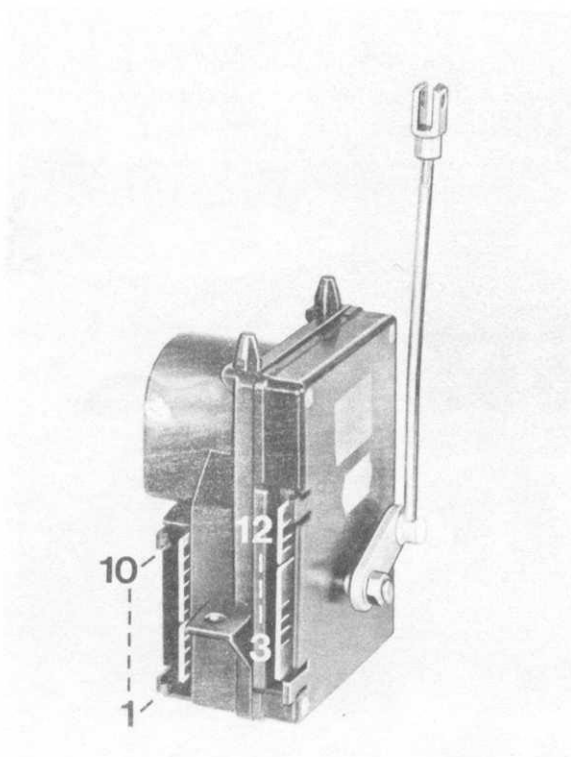
Control Switch (opened)



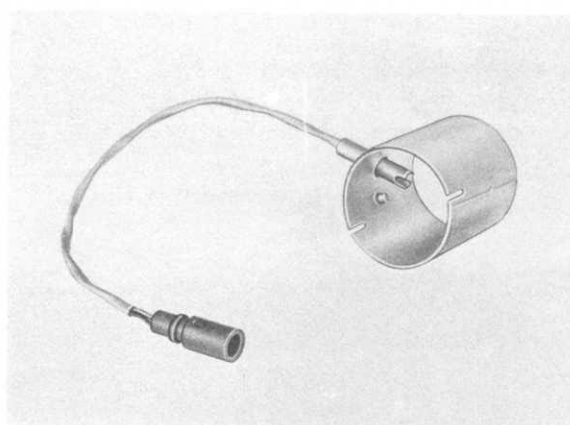
Inside Sensor



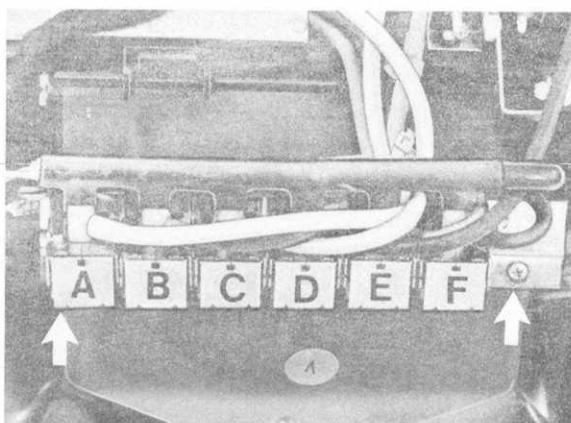
Control Unit



Outside Sensor



## Solenoid Valves



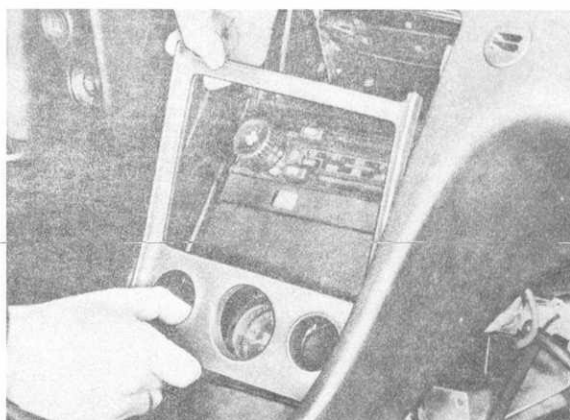
- A - Footwell flap (yellow)
- B - Defroster flap (green)
- C - Center nozzle stage I (orange)
- D - Center nozzle stage II (brown)
- E - Mixing flap and heating valve (red)
- F - Fresh air bypass flap (blue)

## Removing and Installing Control Switch

1. Pry out center vent with a putty knife.



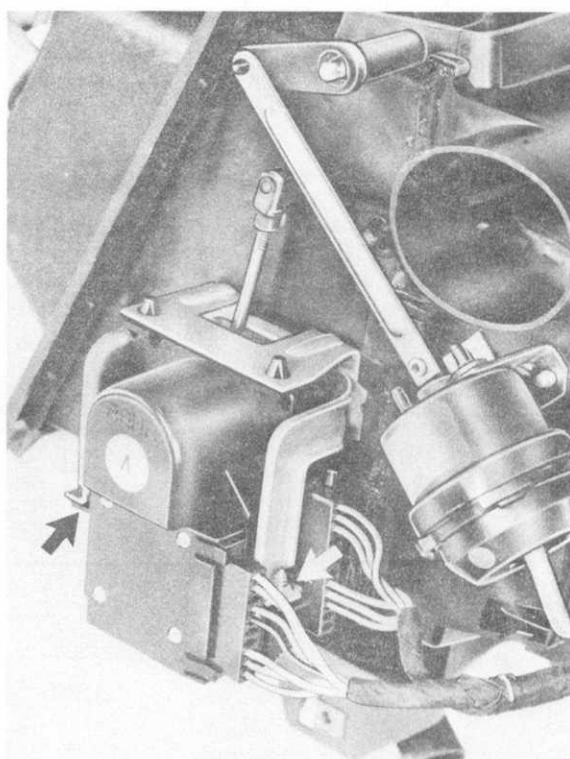
2. Pull off cover frame starting at top.



3. Loosen and remove control board (wires can remain connected).
4. Loosen and pull out control switch. Pull off plugs.

## Removing and Installing Control Unit

1. Pull off both plugs.
2. Unscrew front and rear mounting bolts. Pull out control unit downward and disconnect operating rod at bottom.

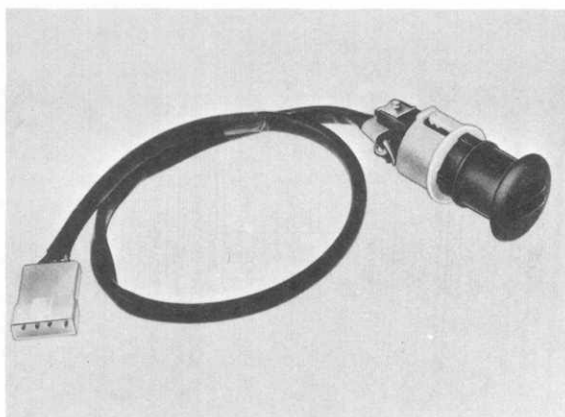
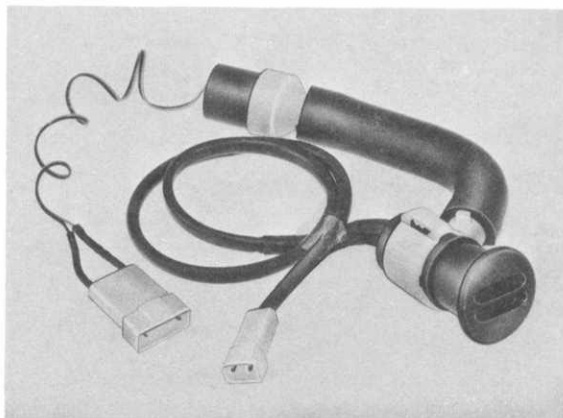


### Removing and Installing Inside Sensor

1. Remove control switch.
2. Remove tray and glove box.
3. Unscrew trim panels on left and right sides of center console.
4. Unscrew center console mounting screws on instrument panel and frame tunnel. Wires remain connected.
5. Lift center console far enough and pull back toward rear so that inside sensor is accessible.
6. Press out inside sensor from inside.

### Note

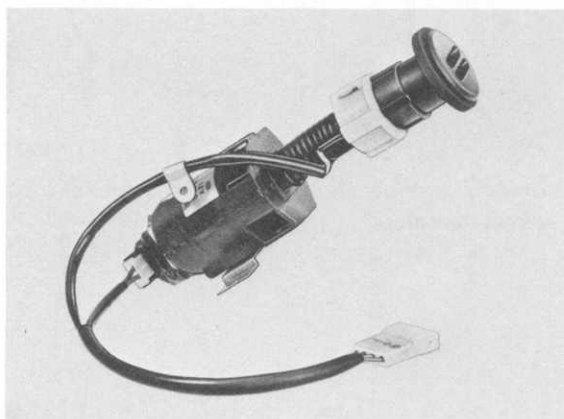
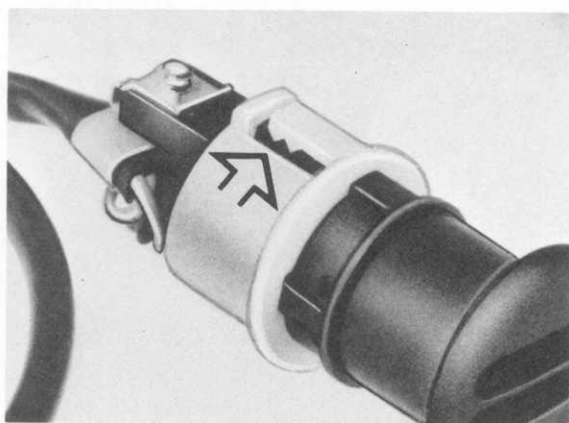
Some cars since standard production of 1980 models have an inside sensor with a separate blower.



This inside sensor is not available as a spare part. When installing a new inside sensor in these cars, the wires must be transferred in the multiple pin plug. Note colors of wires.

### Inside Sensor with Blower Beginning With February, 1981

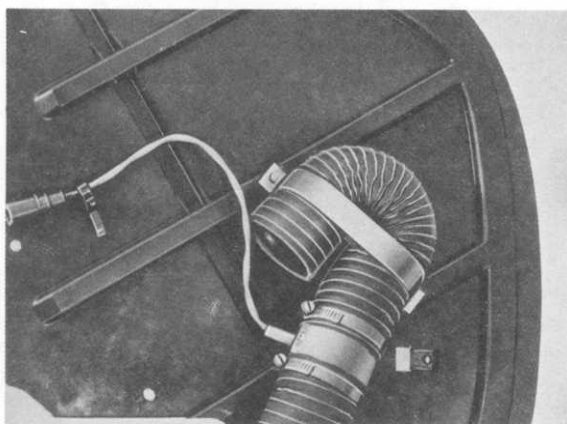
The mounting ring is pressed on and held in position by retaining tabs.



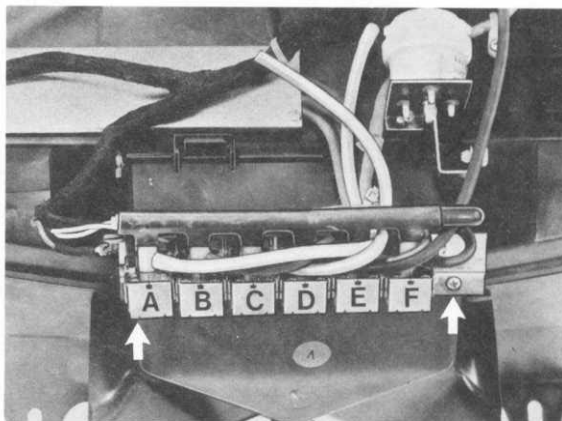
### Removing and Installing Outside Sensor

Outside sensor is located in fresh air hose of alternator.

1. Unscrew cover in front left wheel house.
2. Loosen hose straps on fresh air hoses and pull off of outside sensor housing. Disconnect plugs.



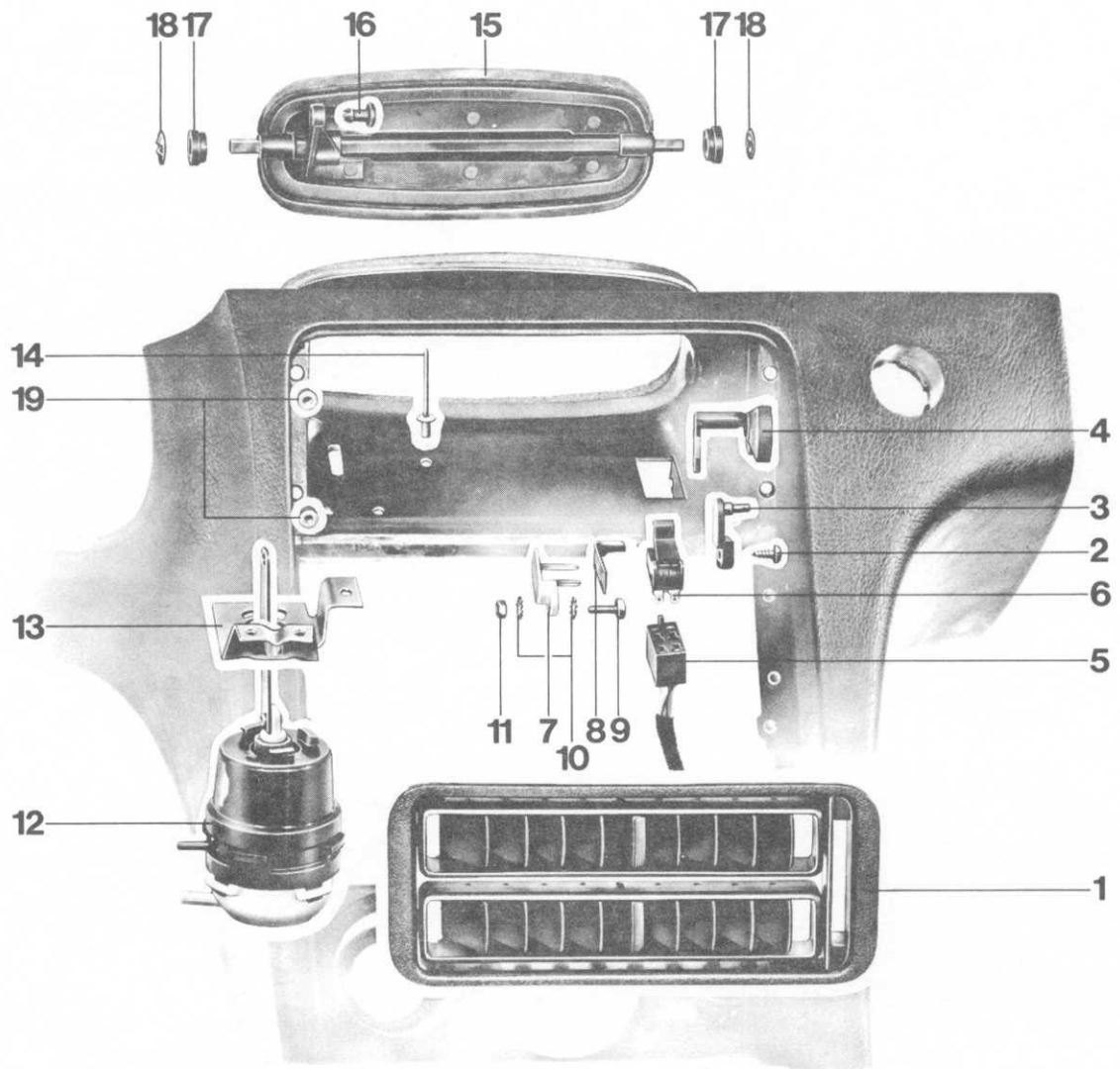
3. Unscrew valve carrier (2 screws).



4. Unscrew mounting bolt of valve being replaced and disconnect by moving up. Pull off vacuum line and electric wire.

### Removing and Installing Vacuum Servo Solenoid Valves

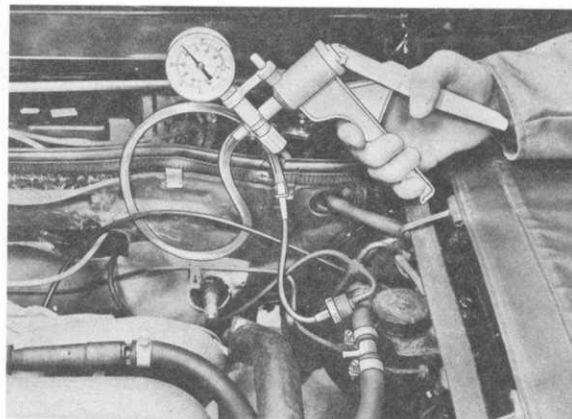
1. Remove tray.
2. Unscrew trim panels on left and right sides of center console.



No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Center vent	1			
2	Metal screw	1			
3	Mounting part	1			
4	Operating lever	1			
5	Plug	1			
6	Microswitch	1			
7	Microswitch holder	1			
8	Holder	1			
9	Bolt	1			
10	Lockwasher	2			
11	Nut	1			
12	Vacuum unit for center vent	1			
13	Holder	1			
14	Rivet	3			
15	Flap, center vent	1			
16	Pin	1			
17	Bushing	2			
18	Clip	2			
19	Grommet	4			

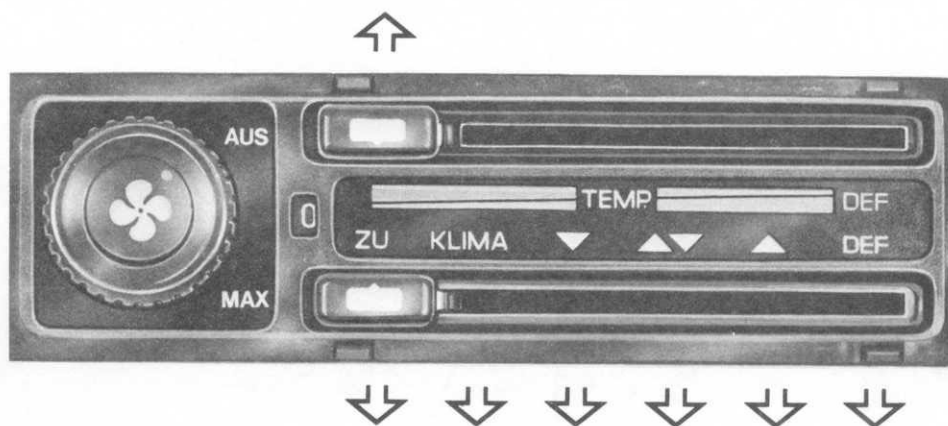


Check all functions of vacuum controlled flaps prior to installation of center console. For this purpose connect a vacuum hand pump in the suction line ahead of the check valve and build up a vacuum of about 400 mbar.

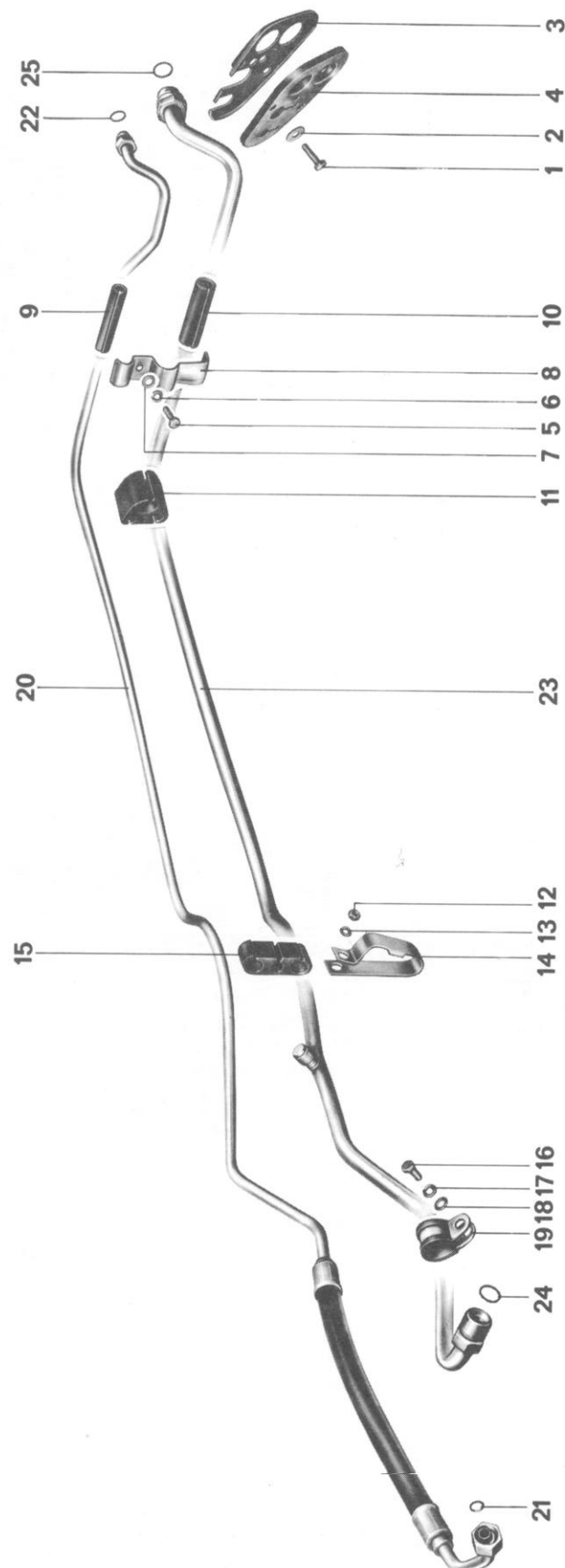


The relation of the slide position of the control switch to the positions of the flaps is shown in the table below.

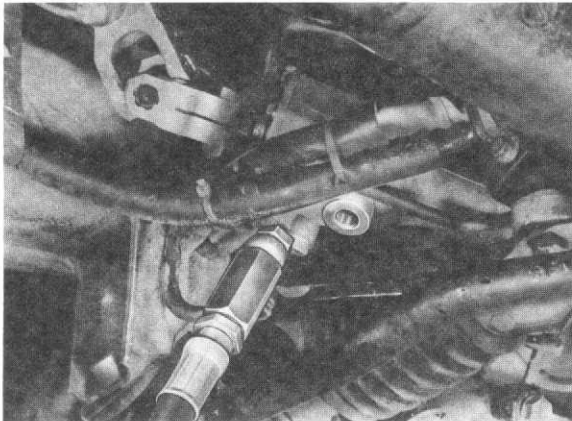
Heater remains switches off



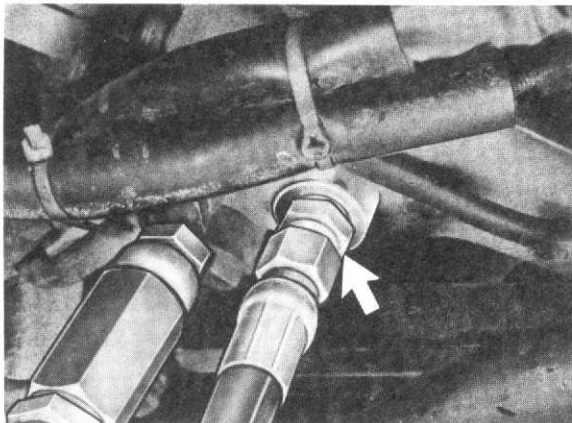
Blower switch in off position	off	on	—————→	max.
Main shut-off flap	off	on	—————→	
Defroster flap	off	————→	on	————→
Footwell flap	off	————→	off	————→
Bypass flap	off	on	off	————→
Heater valve	off	————→		on



3. Pull down pressure line, which does not require loosening mounting clamp of lines. Connect 1.5 meter long high pressure hose no. 2 to pressure line using the hollow bolt and adapter no. 1 (seals required: 2 x 14 x 18 and 1 x 18 x 22 or 1 x 16 x 20).



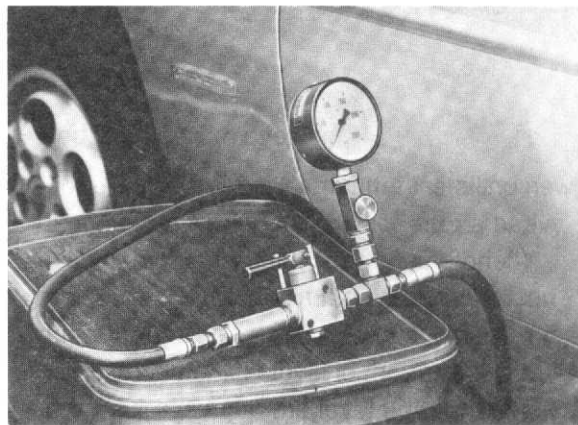
4. Screw connector with high pressure hose no. 5 on steering gear (seal required: 14 x 18).



5. Mount pressure gauge between high pressure hoses and place on a base (e.g. toolbox) next to driver's door.

#### Note

Use adapter no. 4 for old version pressure gauge and connect high pressure hose no. 5 on connection V of pressure gauge.

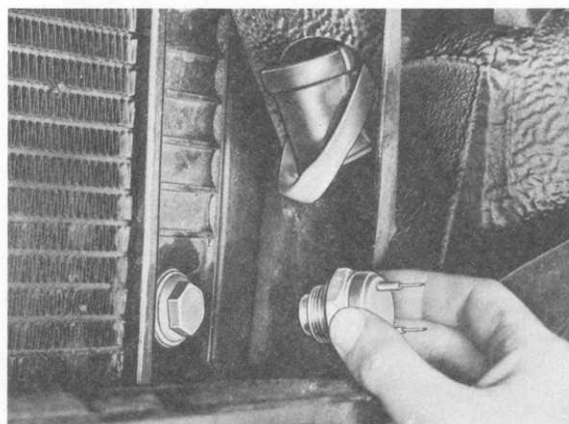


6. **Open shut-off value of pressure gauge (lever position I)**, fill supply tank and bleed steering system (see page 48 - 8j).
7. Check delivery pressure of power steering pump and system pressure (page 48 - 13).

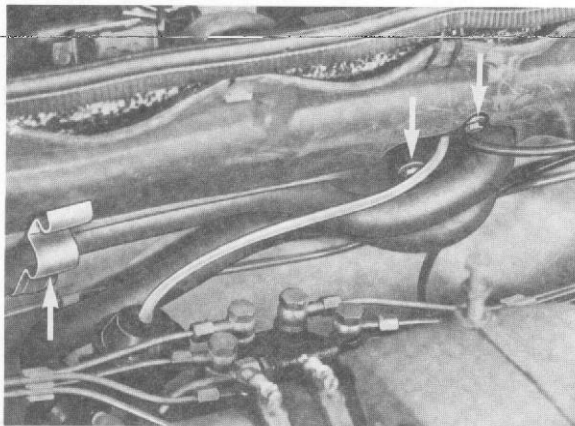
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
21	O-ring 7.5 x 1.8	1			
22	O-ring 7.5 x 1.8	1			
23	Suction line NW 13	1			
24	O-ring 14 x 1.8	1			
25	O-ring 14 x 1.8	1			

### Installing Pressure and Suction Lines

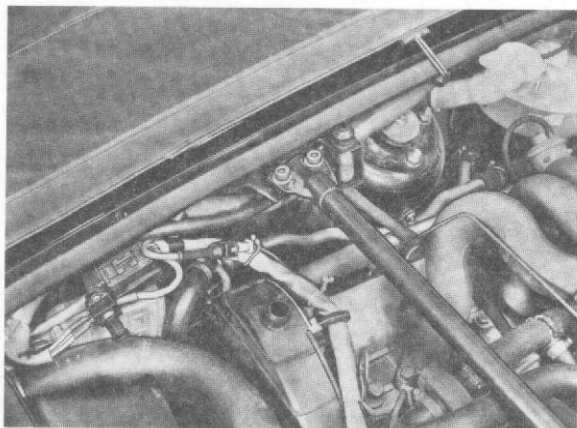
1. Take off engine cover.
2. Remove air cleaner.
3. Unscrew guard underneath radiator.
4. Drain coolant from radiator.
5. Unscrew air inlet grill.
6. Remove plug on radiator and screw in temperature switch (torque: 39 Nm or 3.9 kpm).  
Connect provided plug with protective sleeve.



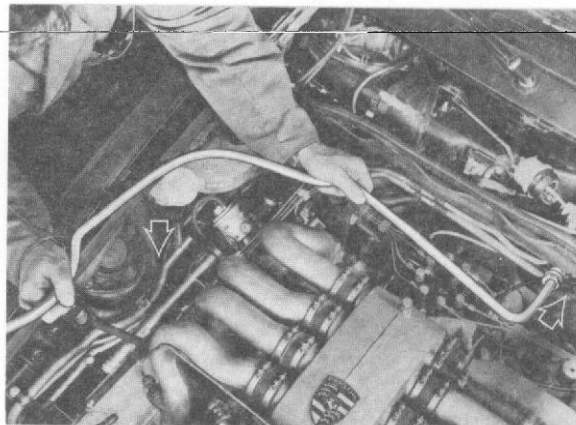
7. Unscrew cover for tread plate in firewall. Pull out vacuum hoses and heater hoses from tread plate. Unscrew holder for heater hose.



8. Unscrew front right radiator hose. Disconnect plug and plus terminal. Unscrew TCI control unit. Detach coolant hose at t-adaptor underneath cross member. Remove heater pipe with heater hose at firewall.



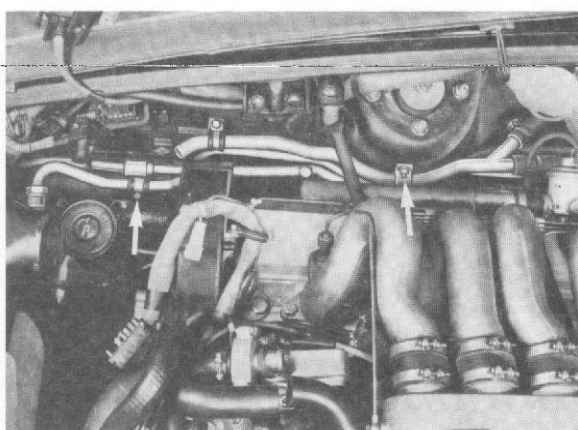
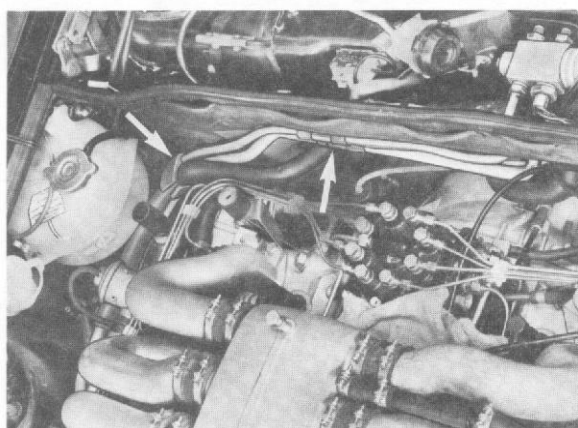
9. Guide large diameter suction line through opening in firewall with connection end facing expansion valve and then position between engine and right wheel housing.



10. Route pressure line in the same manner, whereby pressure line is mounted above suction line.
11. Insert tread plate behind firewall above both lines.
12. Connect lines on expansion valve. Hold expansion valve when tightening lines.

13. Position heater pipe line with hose above lines on wheel housing.

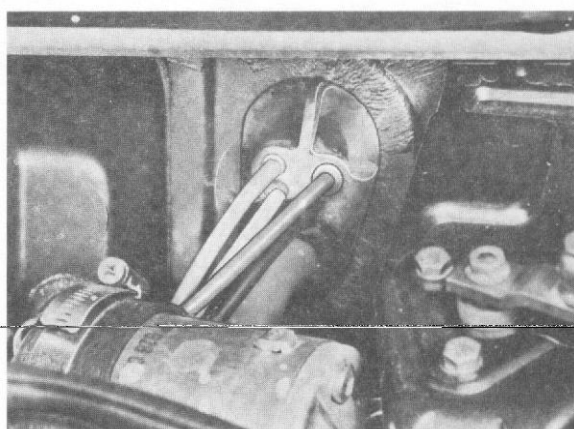
14. Place new mounting parts on lines and install nuts and screws. Align pipes and hoses, and tighten screws or nuts.



15. Connect cover behind firewall on tread plate. Insert and connect heater and vacuum hoses.

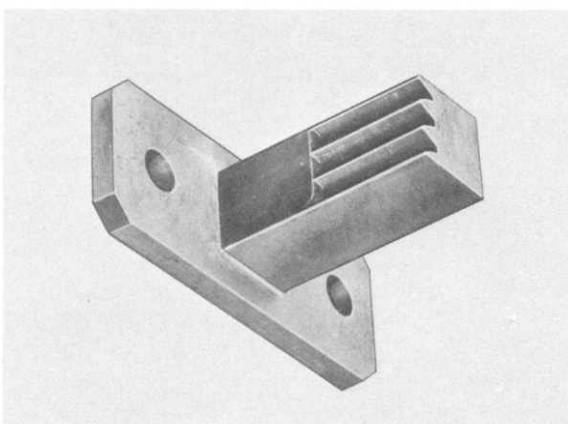
16. Screw on cover of tread plate.

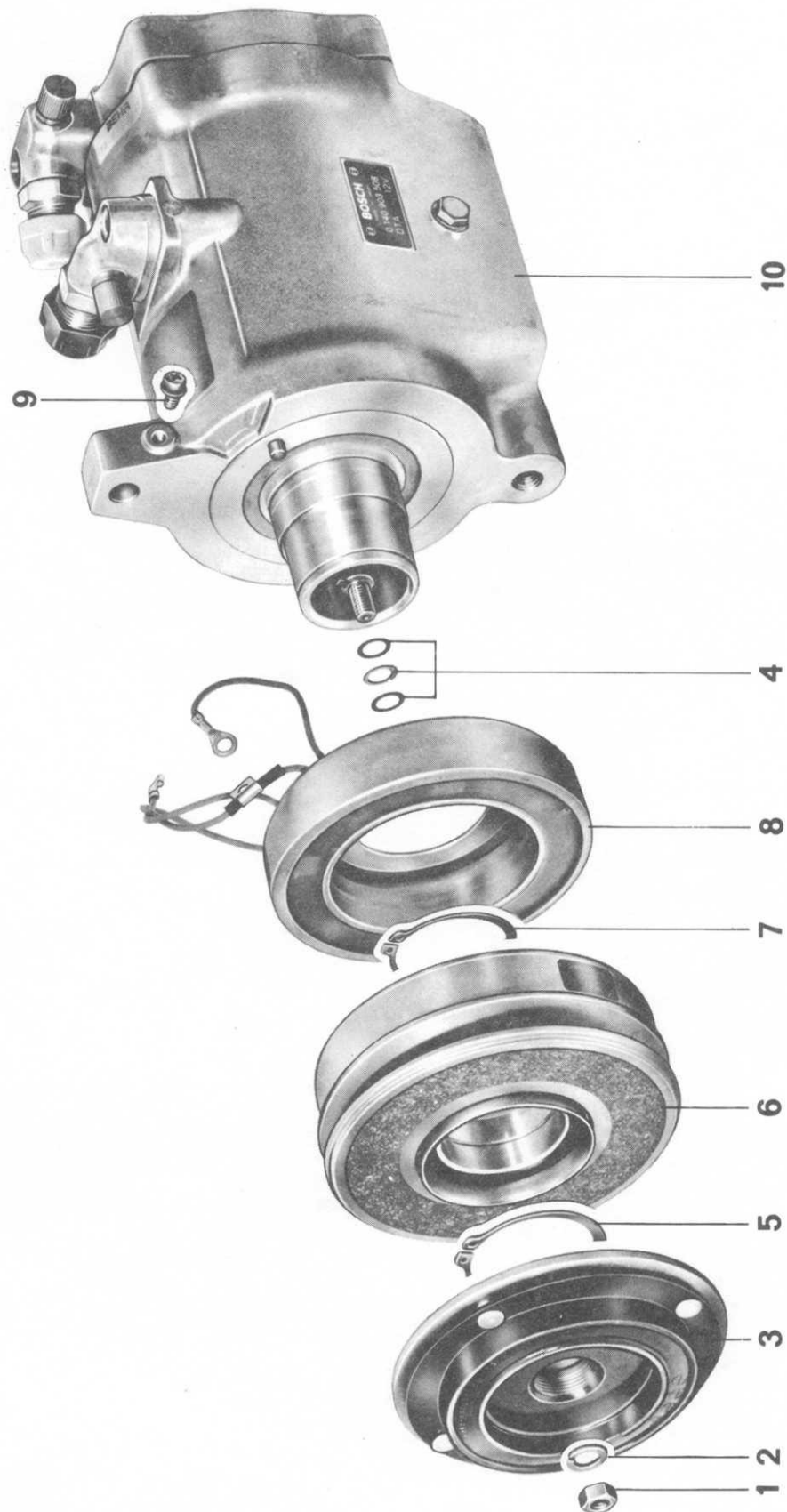
Insert new vacuum line for bypass flap in intake housing through grommet provided in partition and connect.



### Installing Pulley for Compressor

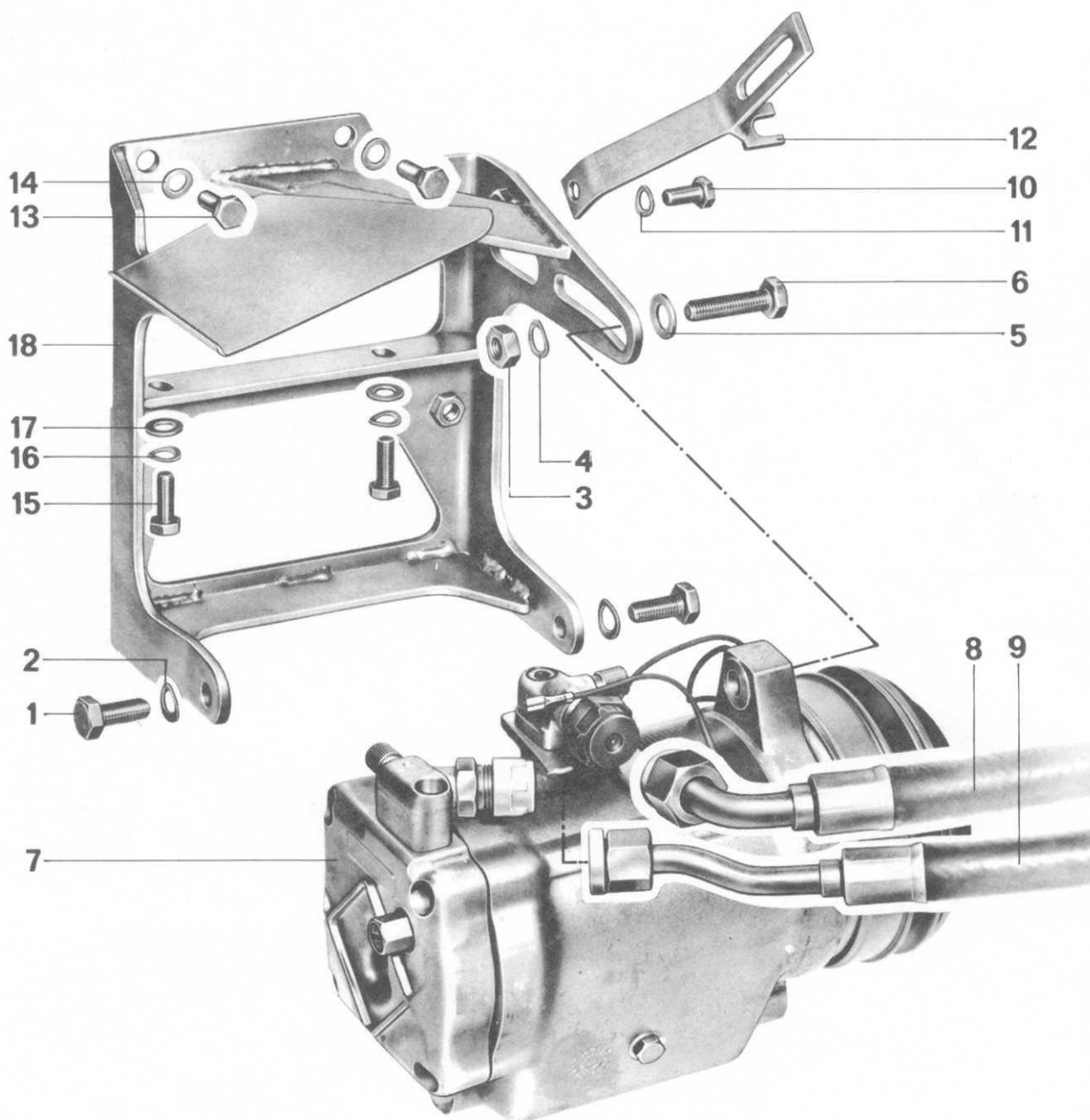
1. Remove belts from power steering pump, air pump and alternator.
2. Unscrew clutch operating cylinder (or cover for cars with automatic transmission) and install tool for holding flywheel with same screws.
3. Remove pulley. Install compressor pulley in place of spacer and tighten screws.
4. Reinstall operating cylinder or cover.







No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Nut M 8	1		Tighten to 17 Nm (1.7 kpm)	
2	Lockwasher	1			
3	Coupling	1			
4	Set of shims	1		Adjust play between pulley and coupling to 0,4 - 1,0 mm	
5	Circlip	1			
6	Pulley	1			
7	Circlip	1			
8	Coil unit	1			
9	Phillips screw	1			
10	Compressor	1			

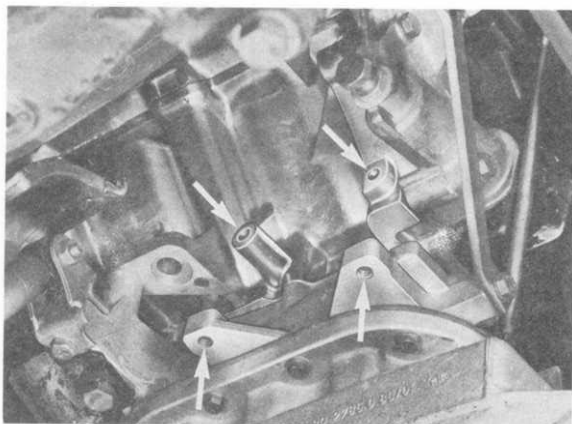


No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Bolt M 10 x 25	2			
2	Washer	2			
3	Nut M 10	1			
4	Washer	1			
5	Washer	1			
6	Bolt M 10 x 40	1			
7	Compressor	1			
8	Hose NW 13	1			
9	Hose NW 10	1			
10	Bolt M 8 x 22	1			
11	Washer	1			
12	Strut	1			
13	Bolt M 8 x 20	2			
14	Washer	2			
15	Bolt M 8 x 22	2			
16	Washer	2			
17	Washer	2			
18	Compressor console	1			

## Installing Compressor Console and Compressor

1. Remove air pump without air cleaner.

2. Bolt console at tapped holes provided for this purpose.



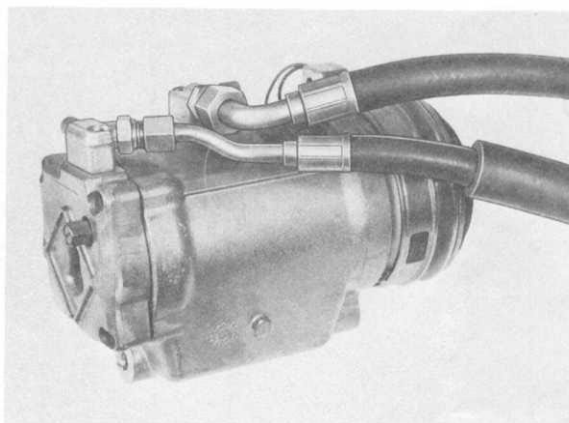
3. Replace air pump strut by shorter version.

4. Install air pump.

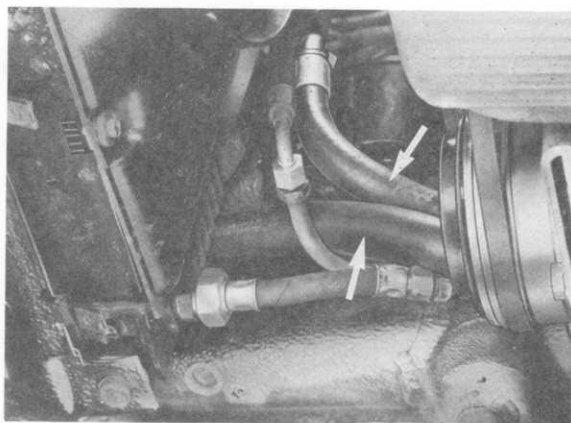
5. New compressor is under pressure!

Unscrew plugs on compressor slowly and listen for escaping refrigerant. Remove plugs only after releasing pressure.

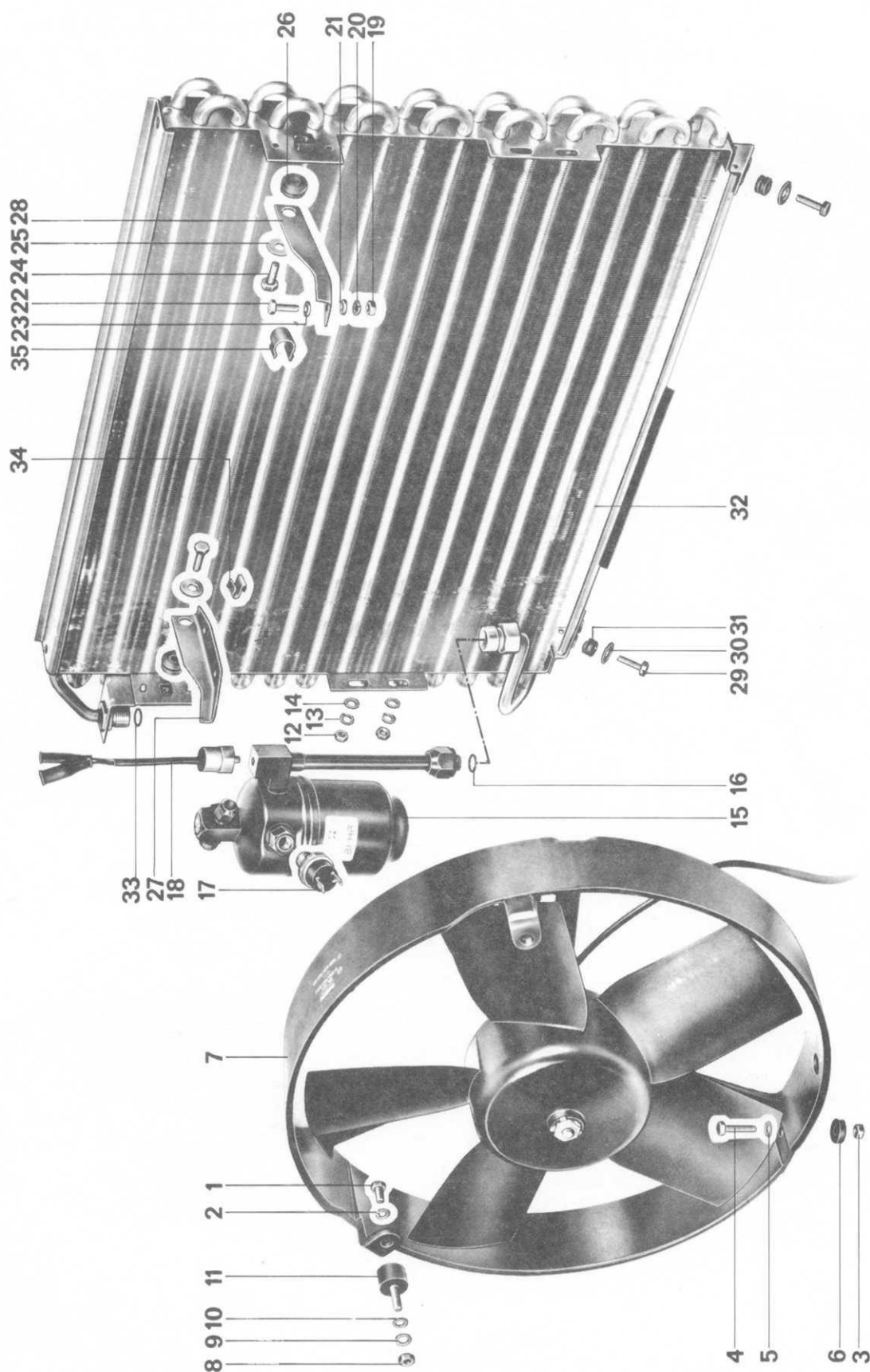
6. Connect and tighten hoses on compressor prior to installation.



7. Install compressor in console. Route hose on suction side up and connect on suction line. Route hose on pressure side toward front between wheel housing and radiator.



8. Install belts in order of compressor, alternator, air pump and power steering pump, and tighten.



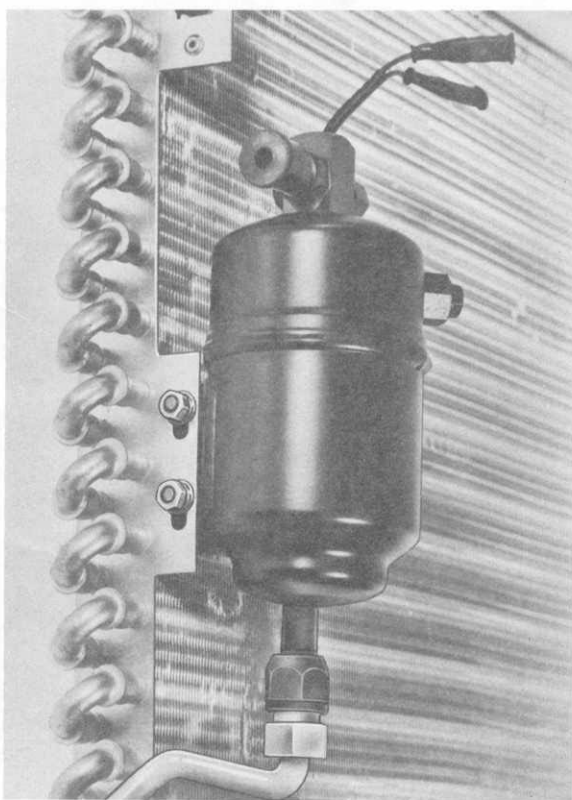
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Screw M 6 x 12	2			
2	Lockwasher	2			
3	Selflocking nut M 6	1		Tighten to 10 Nm (1.0 kpm)	
4	Screw M 6 x 25	1			
5	Washer	1			
6	Rubber washer	1			
7	Fan	1			
8	Nut M 6	2			
9	Lockwasher	2			
10	Washer	2			
11	Rubber pad	2			
12	Nut M 6	2			
13	Lockwasher	2			
14	Washer	2			
15	Tank	1			
16	O-ring 10.6 x 1.8	1			
17	Low pressure switch	1		Tighten to 18 Nm (1.8 kpm)	
18	Temperature sensor	1		Tighten to 4 Nm (0.4 kpm)	
19	Nut M 6	2			
20	Lockwasher	2			
21	Washer	2			
22	Screw M 6 x 16	2			

No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
23	Washer	2			
24	Screw M 6 x 20	2		Tighten to 8 Nm (0.8 kpm)	
25	Washer	2			
26	Rubber grommet	2			
27	Holder, right	1			
28	Holder, left	1			
29	Screw M 6 x 20	2			
30	Washer	2			
31	Rubber grommet	2			
32	Condenser	1			
33	O-ring 10,6 x 1.8	1			
34	Clamp, right	1			
35	Clamp, left	1			



## Installing Condenser and Fan

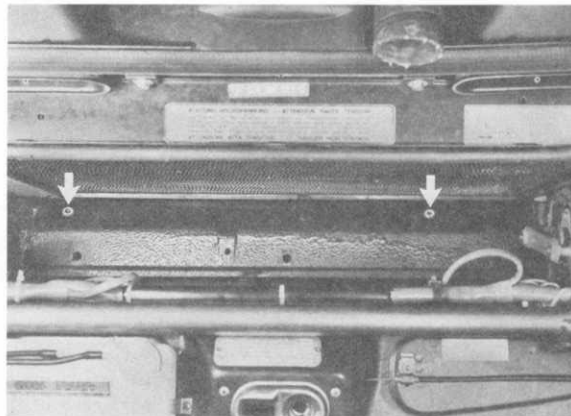
1. Install temperature switch on tank.
2. Connect condenser outlet with tank inlet and bolt tank.



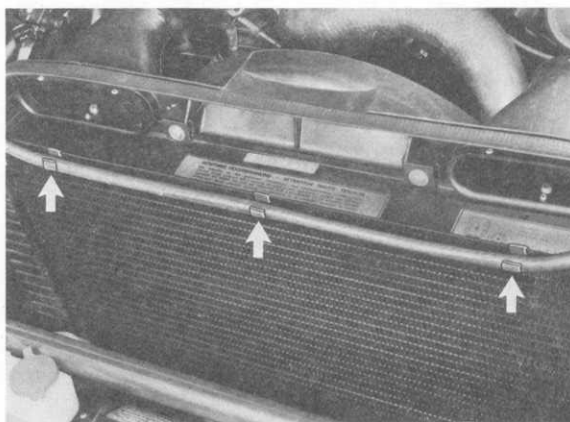
## Note

Be careful not to damage condenser plates!  
Straighten deformed plates with a plate comb.

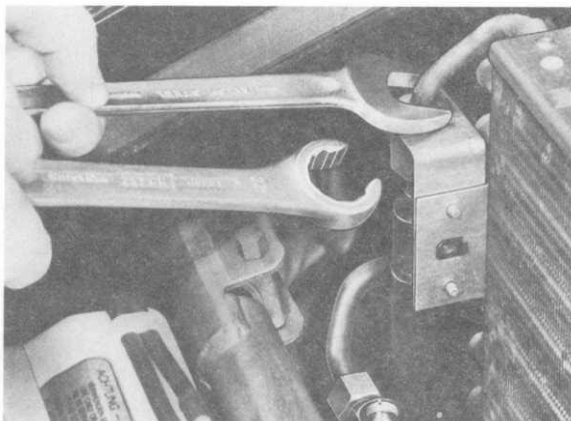
3. Install rubber grommets in holes provided in cross member.



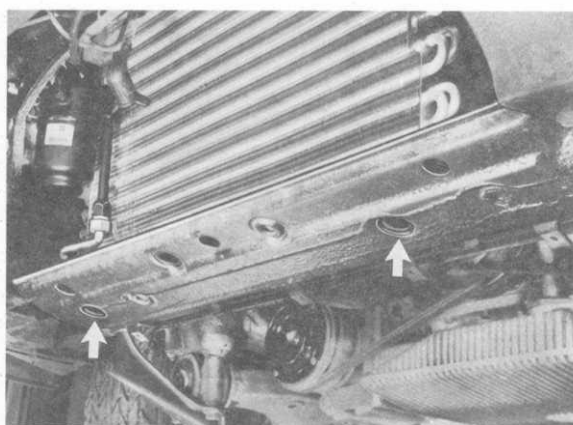
4. Pull off hose clamps on radiator.



5. Slide in condenser ahead of radiator. Connect tank with pressure line leading to expansion valve. Connect condenser inlet with hose leading to compressor.



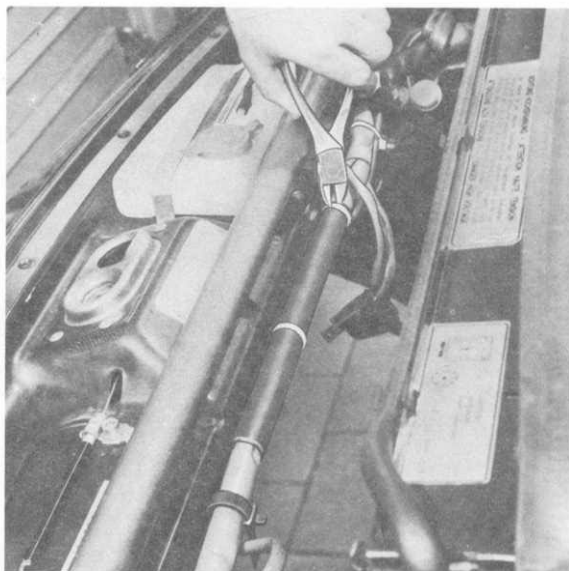
6. Bolt condenser from below.



7. Install low pressure switch (O-ring belongs to switch).

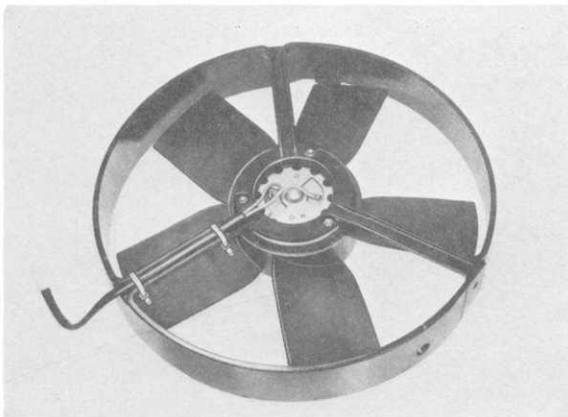


8. Loosen wire harness on lock cross member and take off cover.

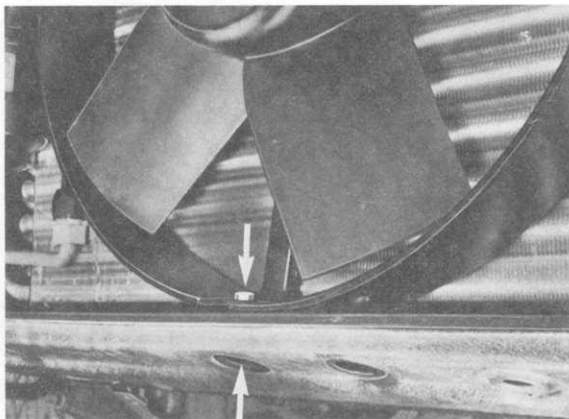


9. Screw rubber pad for fan on lock cross member.

10. Mount wire harness on fan housing with a strap.

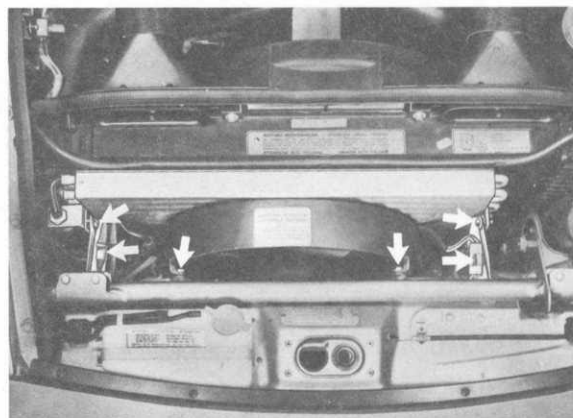


11. Install fan from above carefully, to prevent damaging the condenser plates.

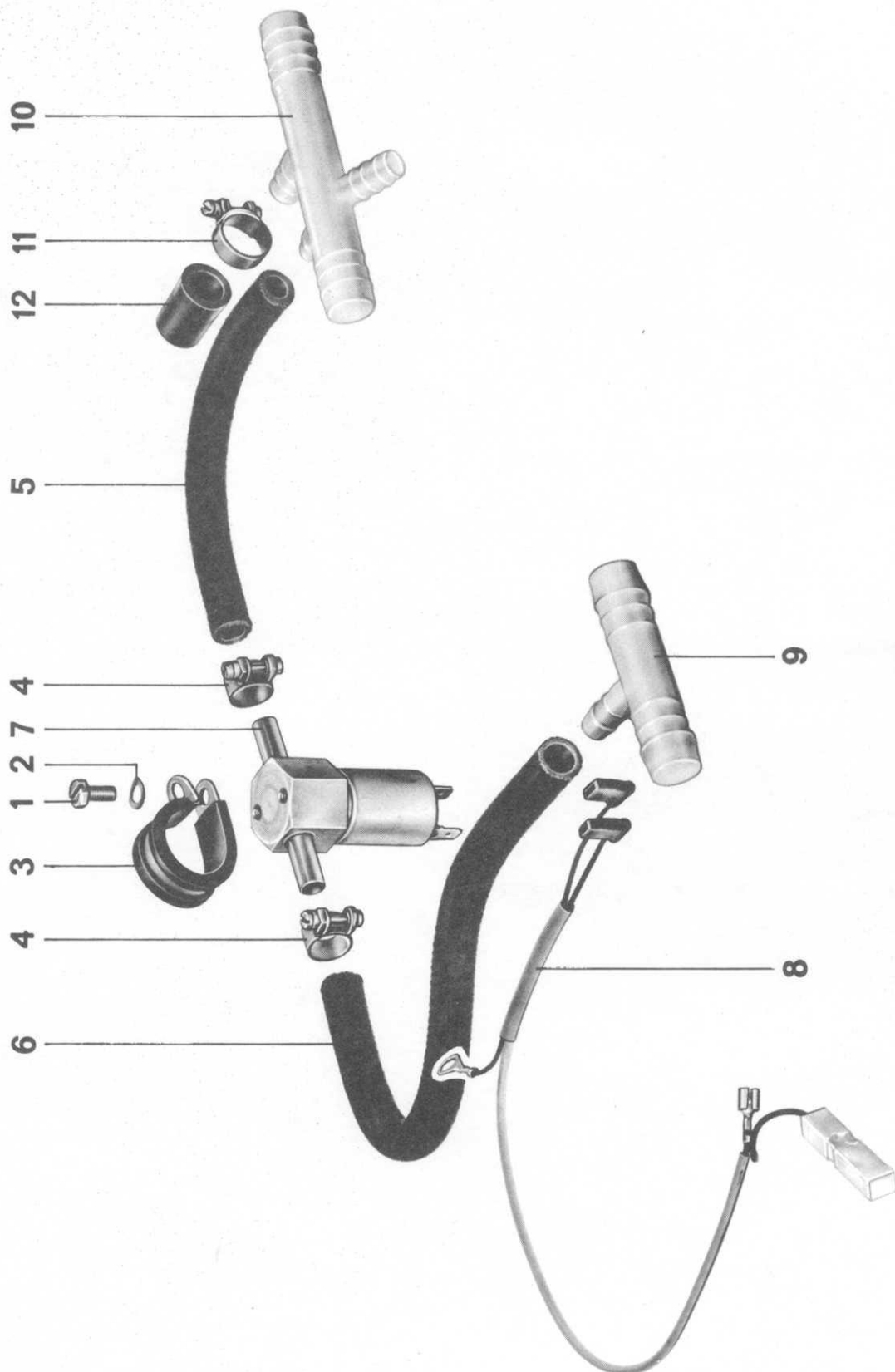


12. Bolt fan from below.

13. Bolt fan from above.  
Bolt condenser at top with left and right holders. Connect low pressure switch, temperature switch and fan with wire harness. Hold wire plugs on left and right sides with clamps.



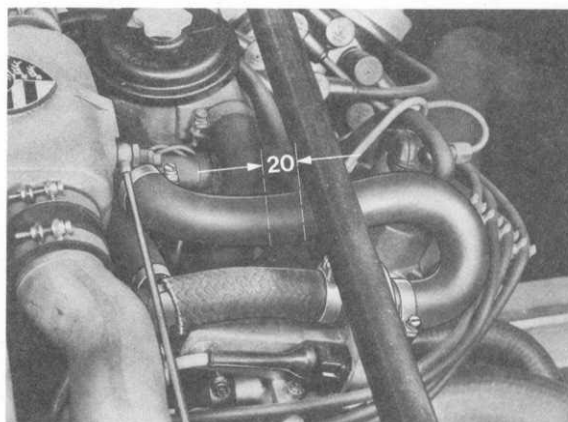
14. Secure wire harness and cover with straps.



No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Screw M 6 x 12	1			
2	Washer	1			
3	Clamp	1			
4	Clamp	2			
5	Hose 9.5 x 15.5 x 150	1			
6	Hose 9.5 x 15.5 x 290	1			
7	Electric air valve	1			
8	Wire harness	1			
9	T-adapter	1			
10	Branch	1			
11	Clamp	1			
12	Cap	1			

### Installing Electric Air Valve

1. Install cross member.
2. Mark hose between throttle bypass valve and intake branch, and unscrew. Cut out a piece about 20 mm long at marked position.

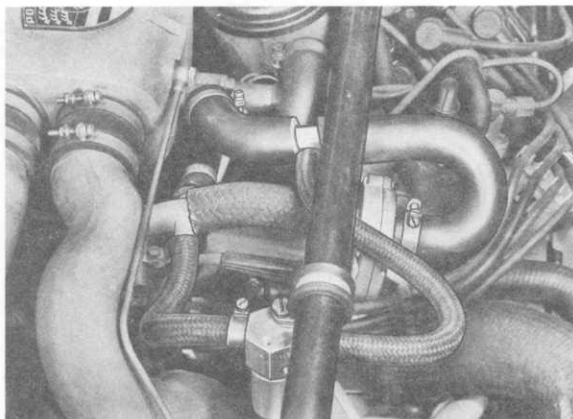


3. Remove hose with t-adapter between throttle bypass valve and air guide housing. Take off t-adapter and shorten long hose by about 30 mm.

4. Mount electric air valve on cross member.

5. Cut two hoses 9,5 x 15,5 to lengths of 150 and 250 mm.

6. Install hoses and connectors.



7. Install wire harness, connecting both angled plugs on electric air valve. Screw wire clip on engine with standard ground wire. Connect plug from engine wire harness and insulated plug with magnetic coupling.

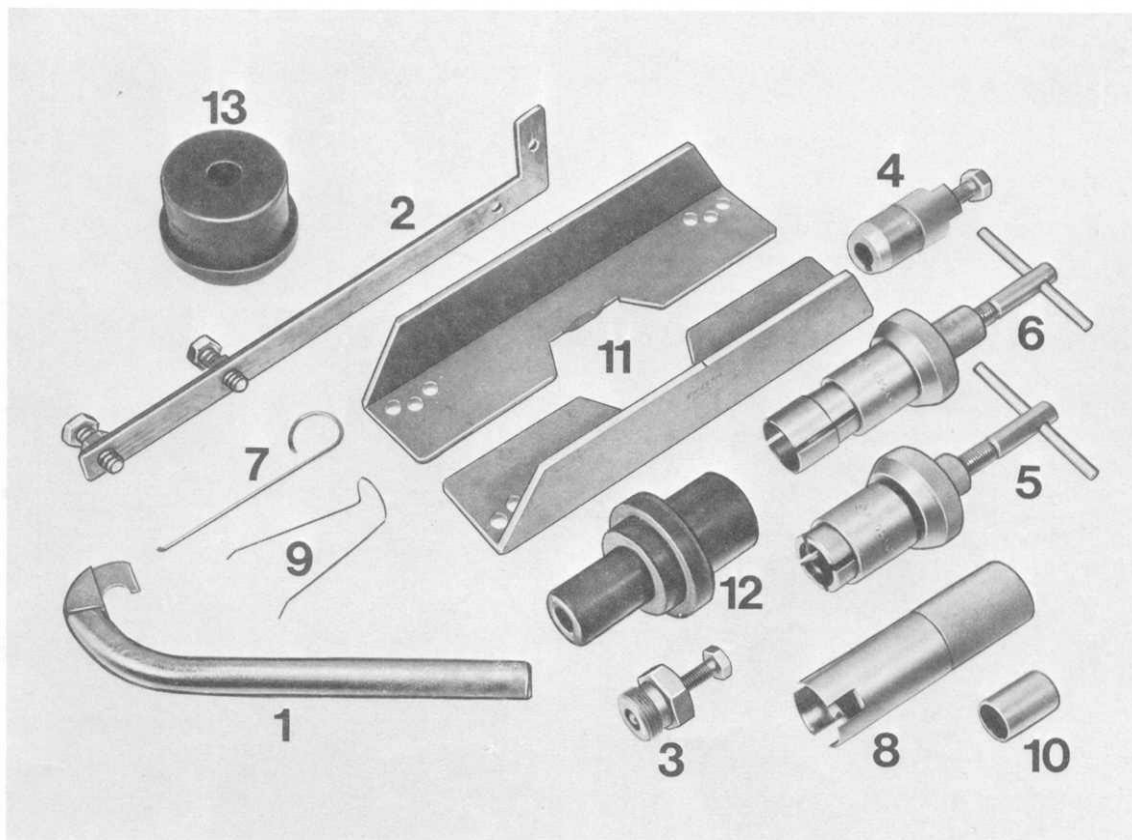
8. Install or tighten all removed or loosened parts.

Flush, drain and charge air conditioner according to instructions.

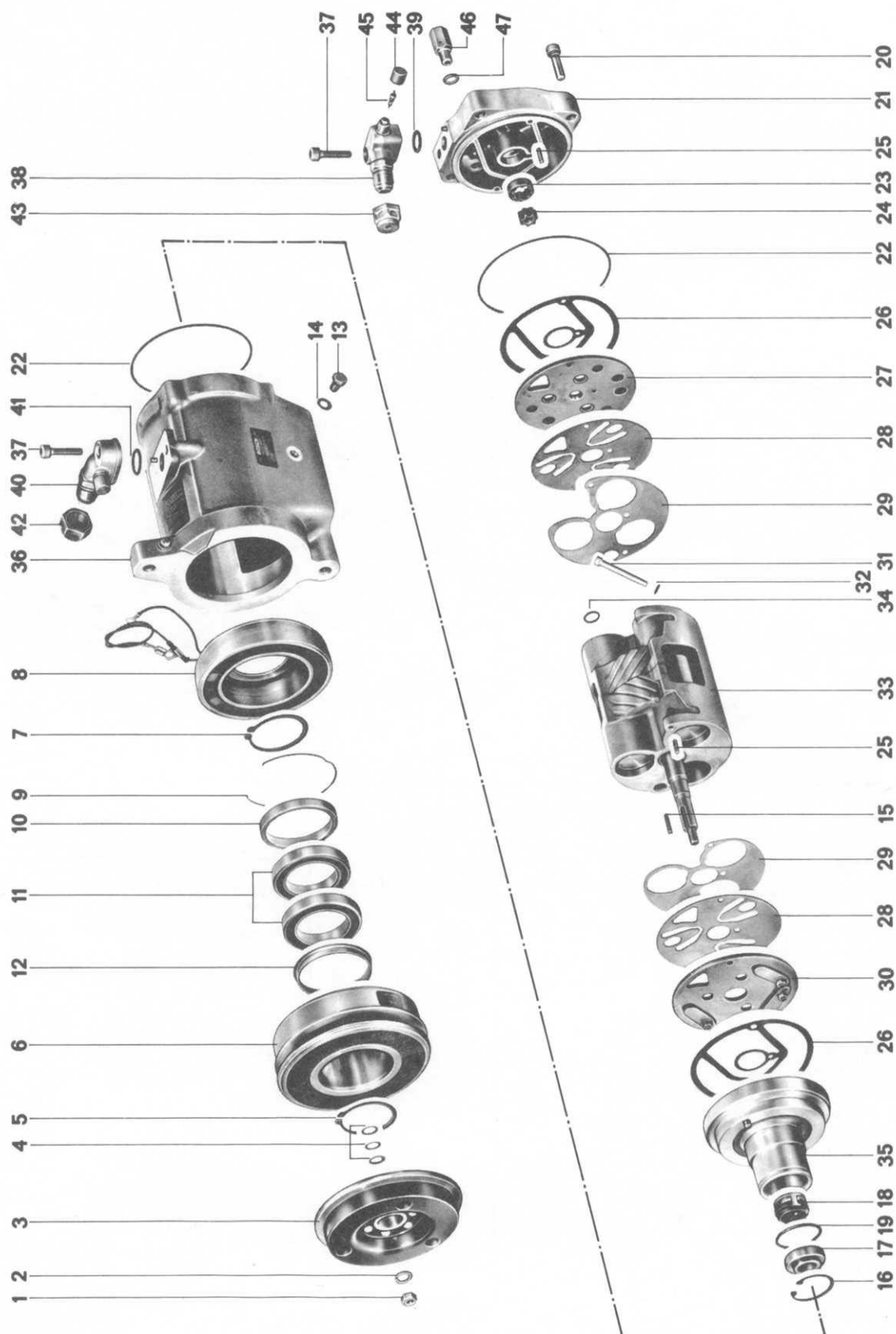
Let compressor run 15 minutes at idle speed with magnetic coupling operated.

Check air conditioner function and for leaks.

## TOOLS



No.	Description	Special Tool	Remarks
1	Holding wrench	95458-02070	Source of supply - see Workshop Hand-book Local manufacture from 924 Sankyo compressor
2	Holding wrench		
3	Puller	95458-03064	Local manufacture
4	Woodruff key puller	95456-21060	
5	Thrust washer puller	95456-03060	
6	Seal puller	95456-02060	
7	Oil pipe pulling hook		Local manufacture
8	Seal installer	95456-08010	
9	Thrust washer installer		Local manufacture
10	Thrust washer pad	95456-09010	
11	Holding rails	VW 457/1	For removing and installing bearing
12	Thrust pad	VW 195	To remove bearing
13	Thrust pad	VW 472/1	To remove bearing

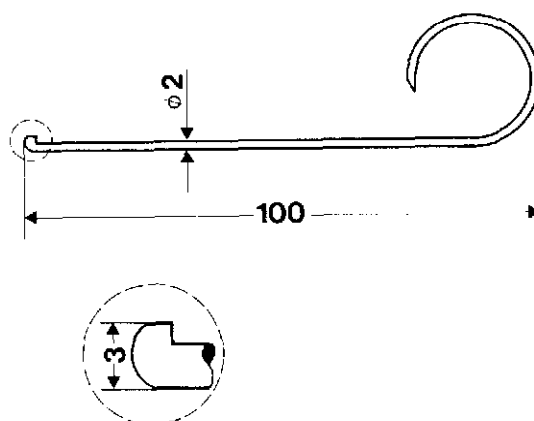
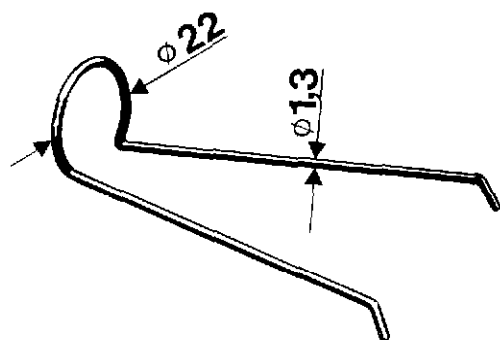




No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Nut	1		Tighten to 17 Nm (1.7 kpm)	
2	Lockwasher	1			
3	Coupling	1		Check for damage	
4	Set of shims	1		Adjust play between pulley and coupling to 0.4 - 1.0 mm	
5	Circlip	1		Bevel faces shaft end	
6	Pulley	1		Replace pulley assembly with ball bearing, if friction surface is worn or oil splattered	
7	Circlip	1		Bevel faces shaft end	
8	Coil unit	1		3.7 ohm resistance	
9	Circlip	1			
10	Spacer	1			
11	Ball bearing	2			
12	Dust ring	1			
13	Oil filler screw	1		Tighten to 15 Nm (1.5 kpm)	
14	Seal	1			
15	Woodruff key	1			
16	Circlip	1			

No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
17	Thrust washer	1		Don't damage sealing surfaces. Check for scratches, replacing both parts if necessary. Lubricate with refrigerating oil	
18	Seal	1			
19	O-ring	1			
20	Screw	4		Tighten to 26 Nm (2.6 kpm)	
21	Housing cover, rear	1			
22	O-ring	2			
23	Oil pump outer race	1			
24	Oil pump inner race	1			
25	Dowel pin	4			
26	Valve plate seal	2			
27	Valve plate, rear	1			
28	Suction valve	2			
29	Cylinder gasket	2			
30	Valve plate, front	1			
31	Oil suction tube	1			
32	O-ring	1			
33	Cylinder block	1			Must not be disassembled
34	O-ring	1			
35	Housing cover, front	1			
36	Housing	1			
37	Screw	2		Tighten to 19 Nm (1.9 kpm)	
38	Pressure connection	1			

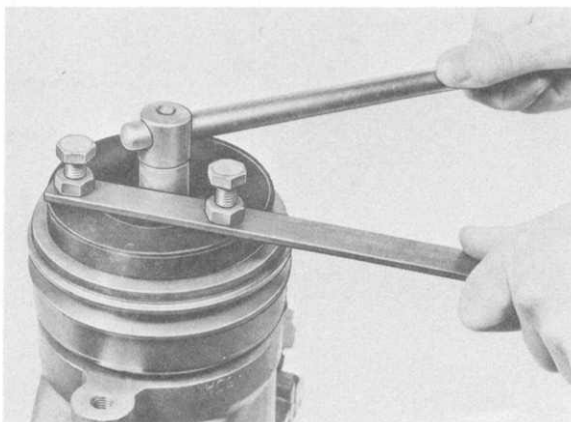
No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
39	O-ring	1			
40	Suction connection	1			
41	O-ring	1			
42	Plug, suction end	1			
43	Plug, pressure end	1			
44	Cap	2			
45	Spring valve	2			
46	Safety valve	1			
47	Seal	1			



## DISASSEMBLING AND ASSEMBLING COMPRESSOR

## Removing and Installing Magnetic Coupling

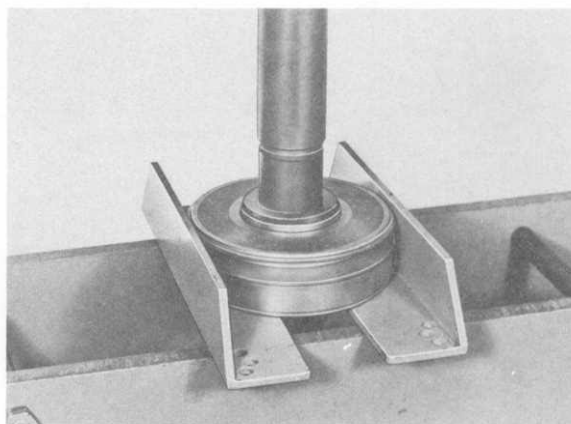
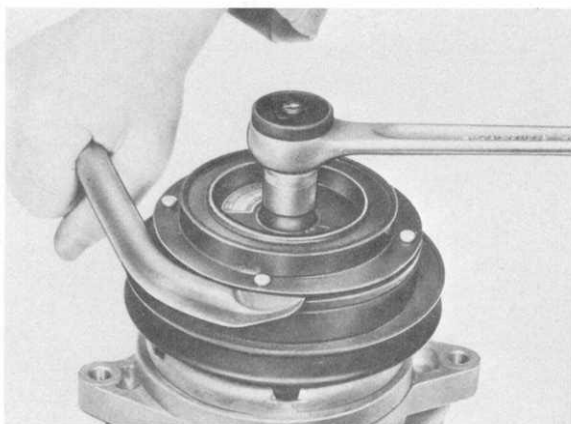
1. Counterhold with pertinent wrench depending on version to loosen or tighten mounting nut.



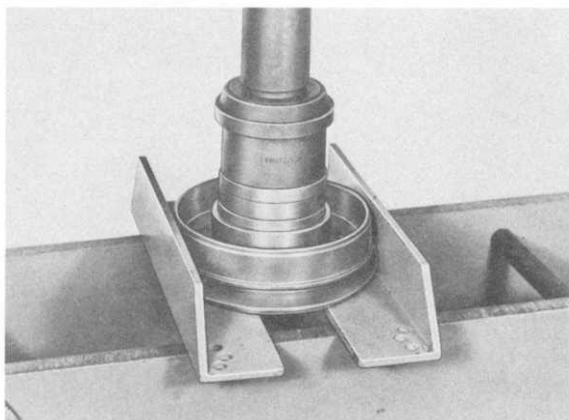
2. Remove coupling plate with puller.



3. Remove ball bearing.



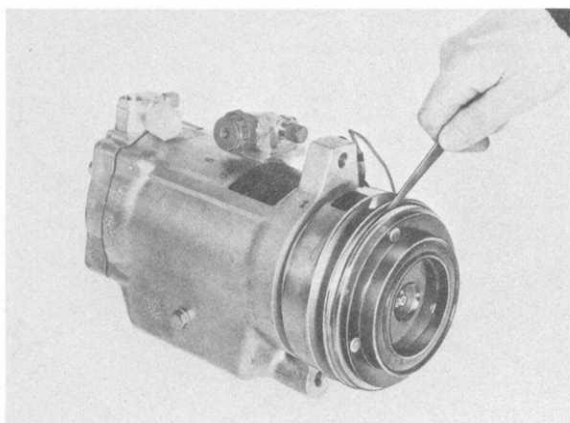
4. Install ball bearing.



If necessary, adjust play with set of shims.



5. Play between coupling plate and pulley is 0.4 to 1.0 mm.



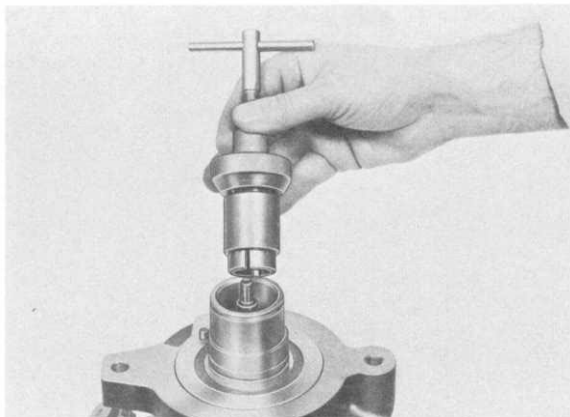
### Disassembling Compressor

#### Note

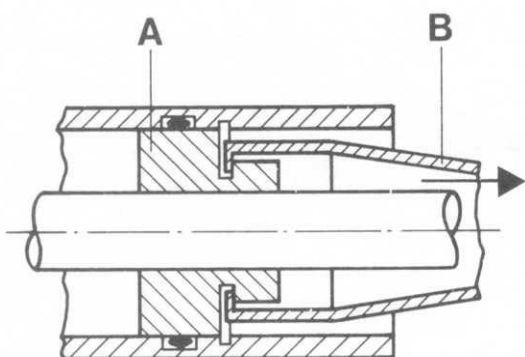
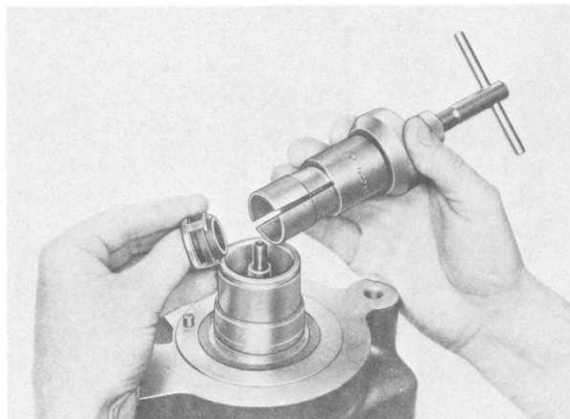
Remove any plugs from line connections to let residual gas escape.

1. Drain refrigerating oil (never reuse).
2. Remove woodruff key with woodruff key puller.

3. Pull out thrust washer with puller.



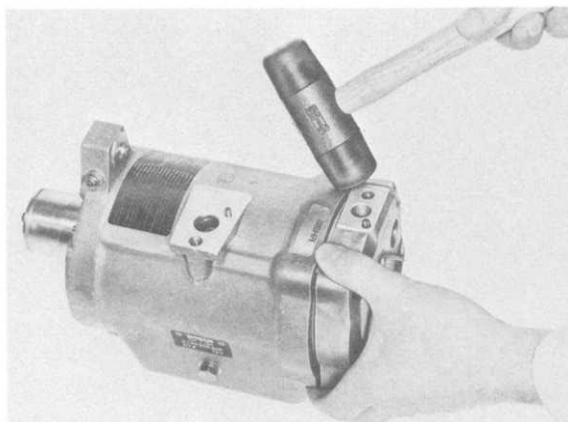
4. Remove seal with puller.



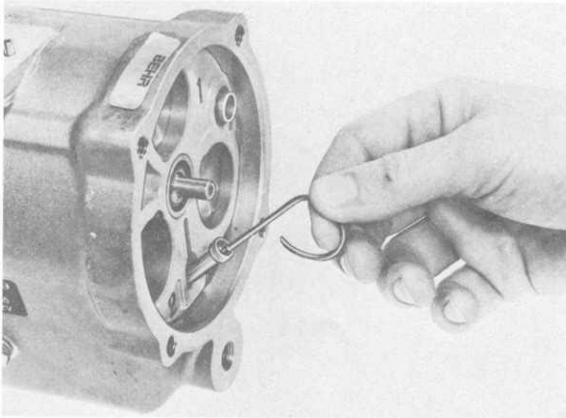
A - Thrust washer

B - Puller

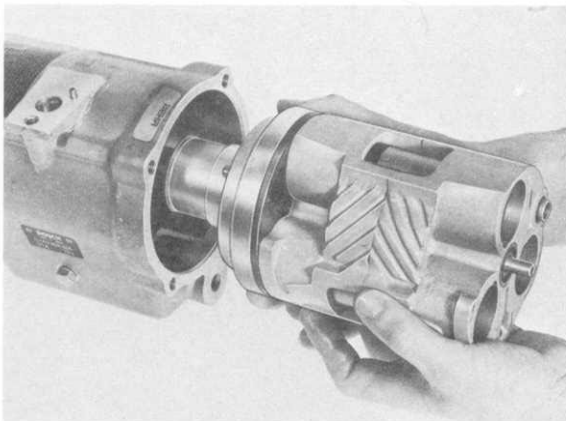
5. Unscrew mounting bolts from rear housing cover. Take off housing cover, applying light knocks with a plastic hammer when necessary.



6. Pull out oil suction tube with pulling hook.



7. Remove cylinder block from housing.



#### Note

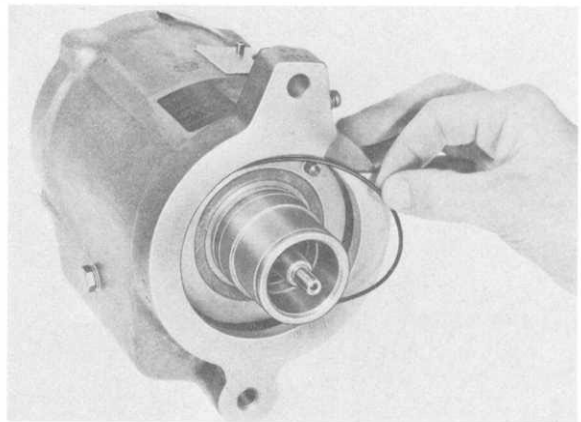
Never disassemble cylinder block!

### Assembling Compressor

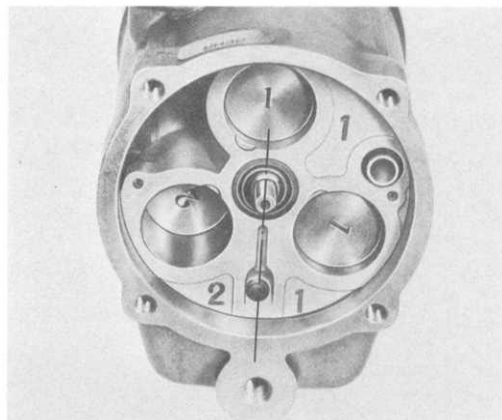
#### Note

Coat all gaskets and seals with clean refrigerating oil prior to installation.  
(See page 87 - 01 for types of oil).

1. Place O-ring in front of housing and push in cylinder block.



2. Align cylinder block that bore of oil suction tube faces down.

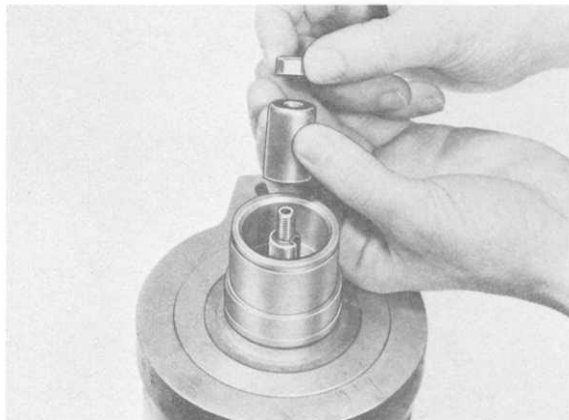


3. Place seal in assembly tool and push on to input shaft.

Turn seal on shaft with tool until seal engages.



5. Press in thrust washer with thrust pad and nut so far, until groove for circlip is visible.

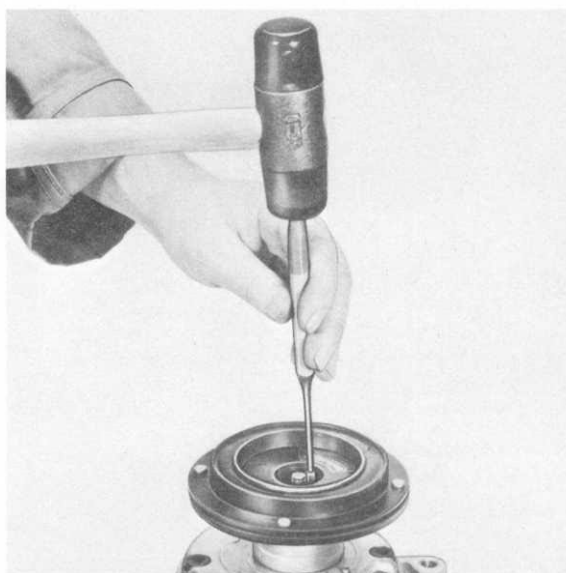


4. Guide in thrust washer with assembly tool carefully.



Insert circlip and take off thrust pad.

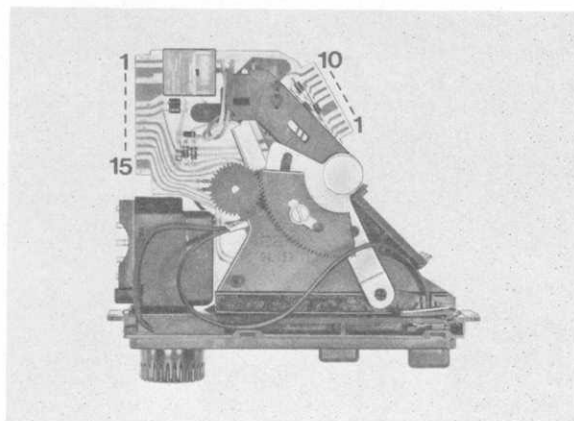
6. Install woodruff key by mounting coupling plate and driving in key.



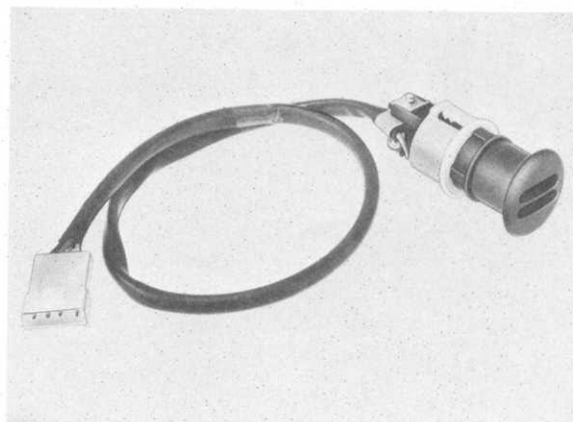


## REGULATORS AND CONTROL UNITS FOR AUTOMATIC AIR CONDITIONER

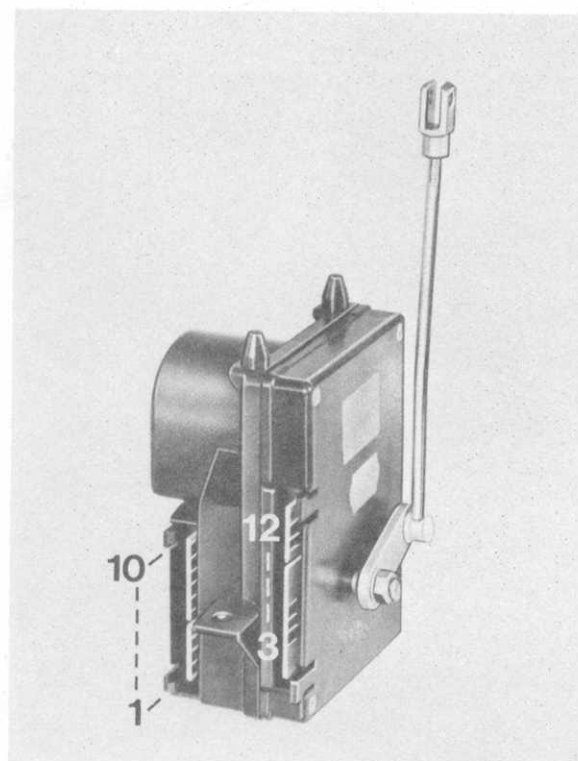
Control Switch (opened)



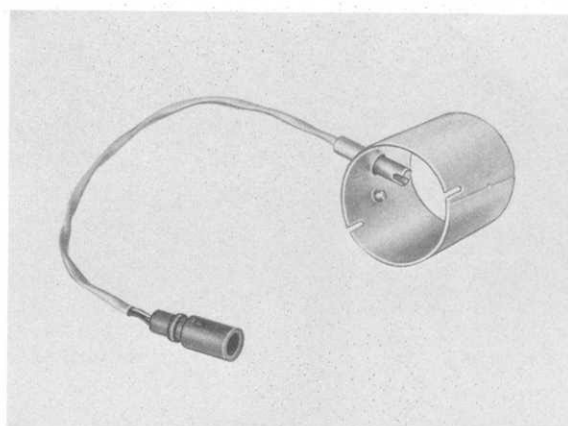
Inside Sensor



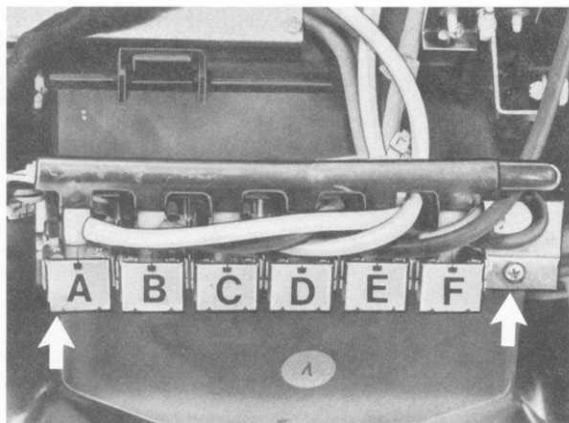
Control Unit



Outside Sensor



## Solenoid Valves



- A - Footwell flap (yellow)
- B - Defroster flap (green)
- C - Center nozzle stage I (orange)
- D - Center nozzle stage II (brown)
- E - Mixing flap and heating valve (red)
- F - Fresh air bypass flap (blue)

## Removing and Installing Control Switch

1. Press out center nozzle with a putty knife.



2. Pull off cover frame starting at top.

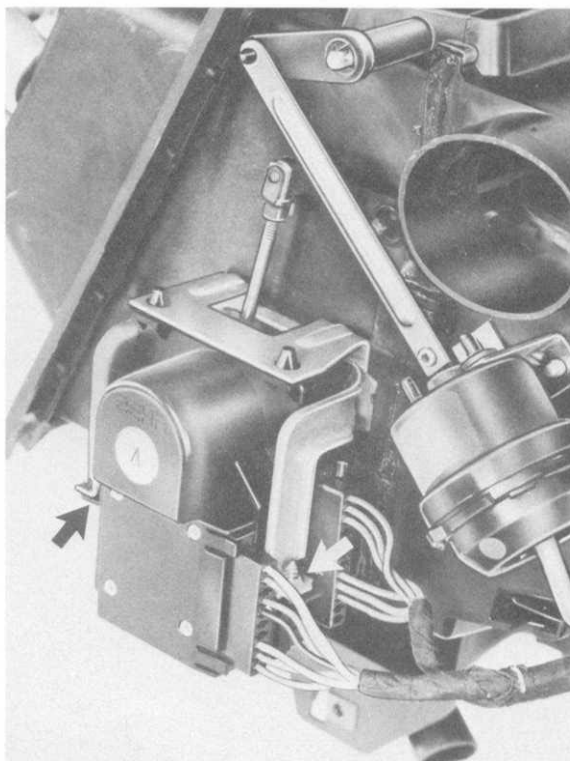


3. Loosen and remove control board (wires can remain connected).

4. Loosen and pull out control switch. Pull off plugs.

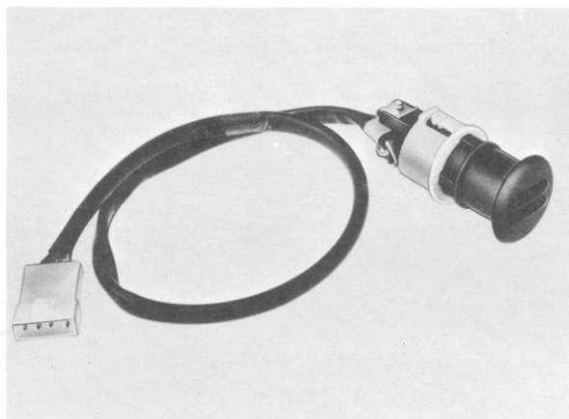
## Removing and Installing Control Unit

1. Pull off both plugs.
2. Unscrew front and rear mounting bolts. Pull out control unit downward and disconnect operating rod at bottom.

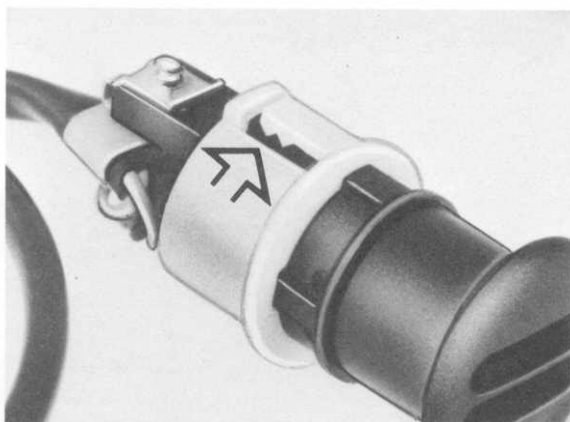


### Removing and Installing Inside Sensor

1. Remove control switch.
2. Remove tray and glove box.
3. Unscrew trim panels on left and right sides of center console.
4. Unscrew center console mounting screws on instrument panel and frame tunnel. Wires remain connected.
5. Lift center console far enough and pull back toward rear, that inside sensor is accessible.
6. Press out inside sensor from inside.

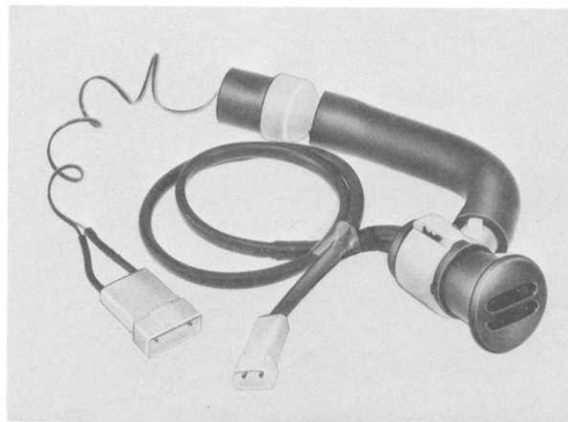


The mounting ring is pressed on and held in position by retaining tabs.



### Note

Some cars since standard production of 1980 models have an inside sensor with a separate blower.



This inside sensor is not available as a spare part. When installing a new inside sensor in these cars, the wires must be transferred in the multiple pin plug. Note colors of wires.

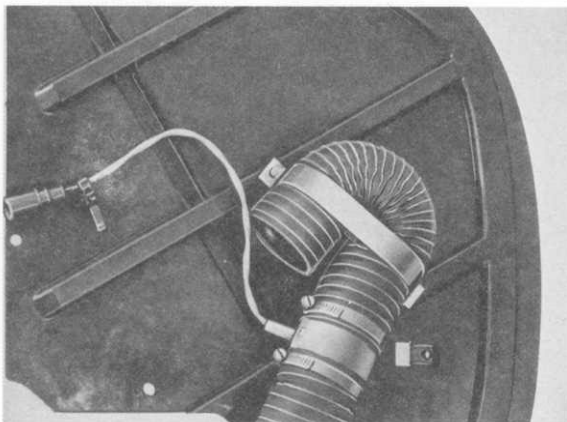
### Inside Sensor with Blower Beginning With February, 1981



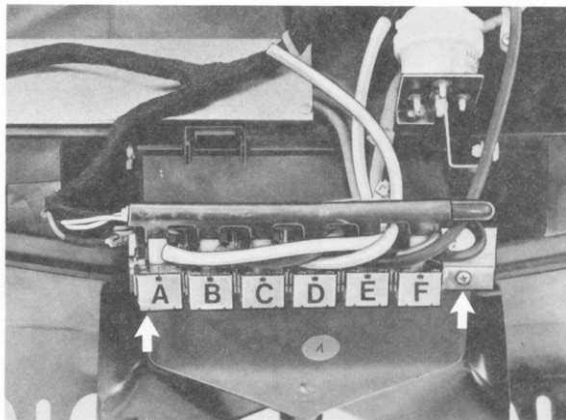
### Removing and Installing Outside Sensor

Outside sensor is located in fresh air hose of alternator.

1. Unscrew cover in front left wheel house.
2. Loosen hose straps on fresh air hoses and pull off of outside sensor housing. Disconnect plugs.



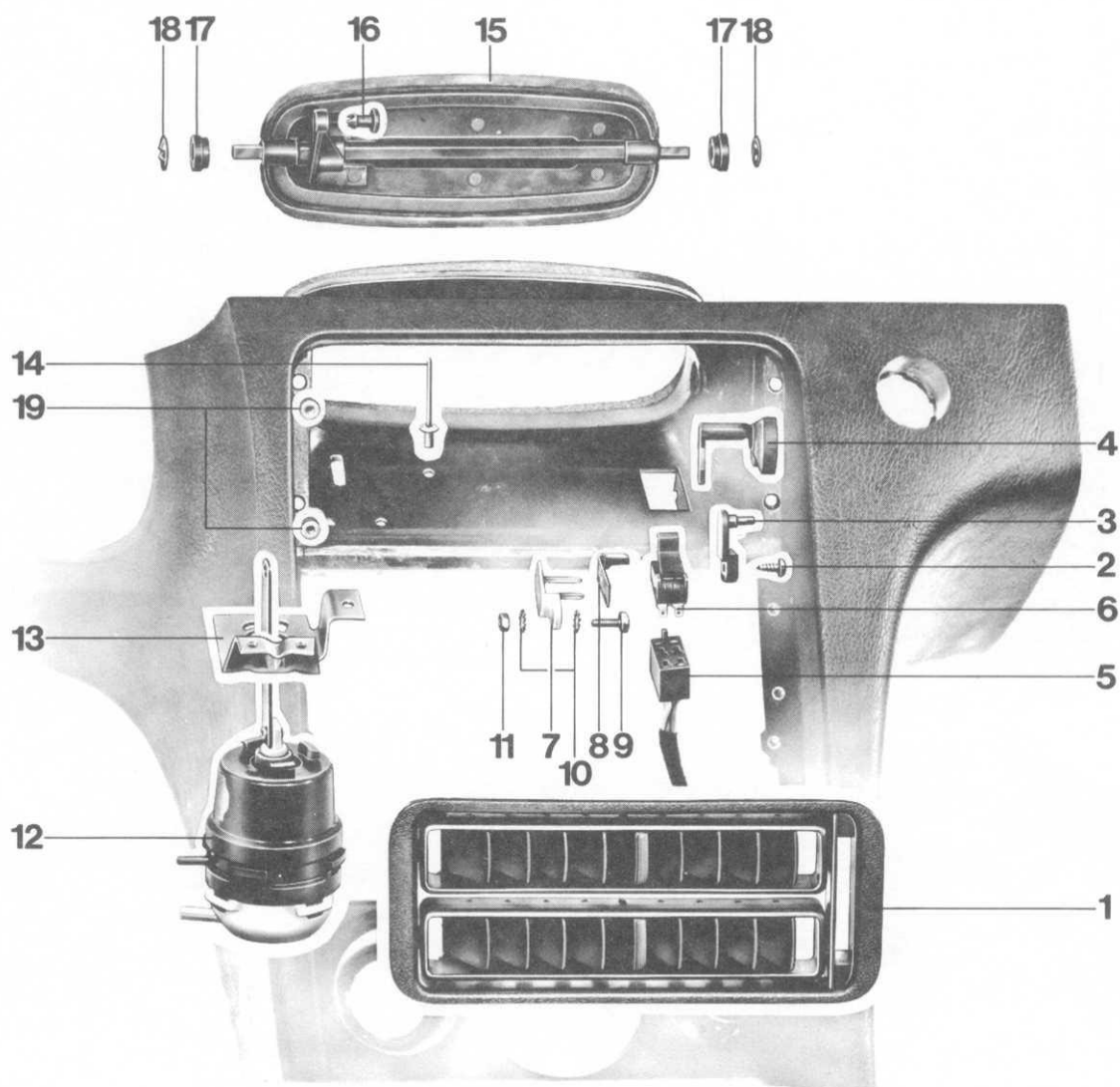
3. Unscrew valve carrier (2 screws).



4. Unscrew mounting bolt of valve being replaced and disconnect by moving up.  
Pull off vacuum line and electric wire.

### Removing and Installing Solenoid Valves

1. Remove tray.
2. Unscrew trim panels on left and right sides of center console.



No.	Description	Qty.	Note When		Special Instructions
			Removing	Installing	
1	Center nozzle	1			
2	Metal screw	1			
3	Mounting part	1			
4	Operating lever	1			
5	Plug	1			
6	Microswitch	1			
7	Microswitch holder	1			
8	Holder	1			
9	Bolt	1			
10	Lockwasher	2			
11	Nut	1			
12	Vacuum box for center nozzle	1			
13	Holder	1			
14	Rivet	3			
15	Flap, center nozzle	1			
16	Pin	1			
17	Bearing sleeve	2			
18	Speed fix	2			
19	Grommet	4			

AUTOMATIC AIR CONDITIONER  
84 MODELS ONWARD

**Technical data of air conditioning system**

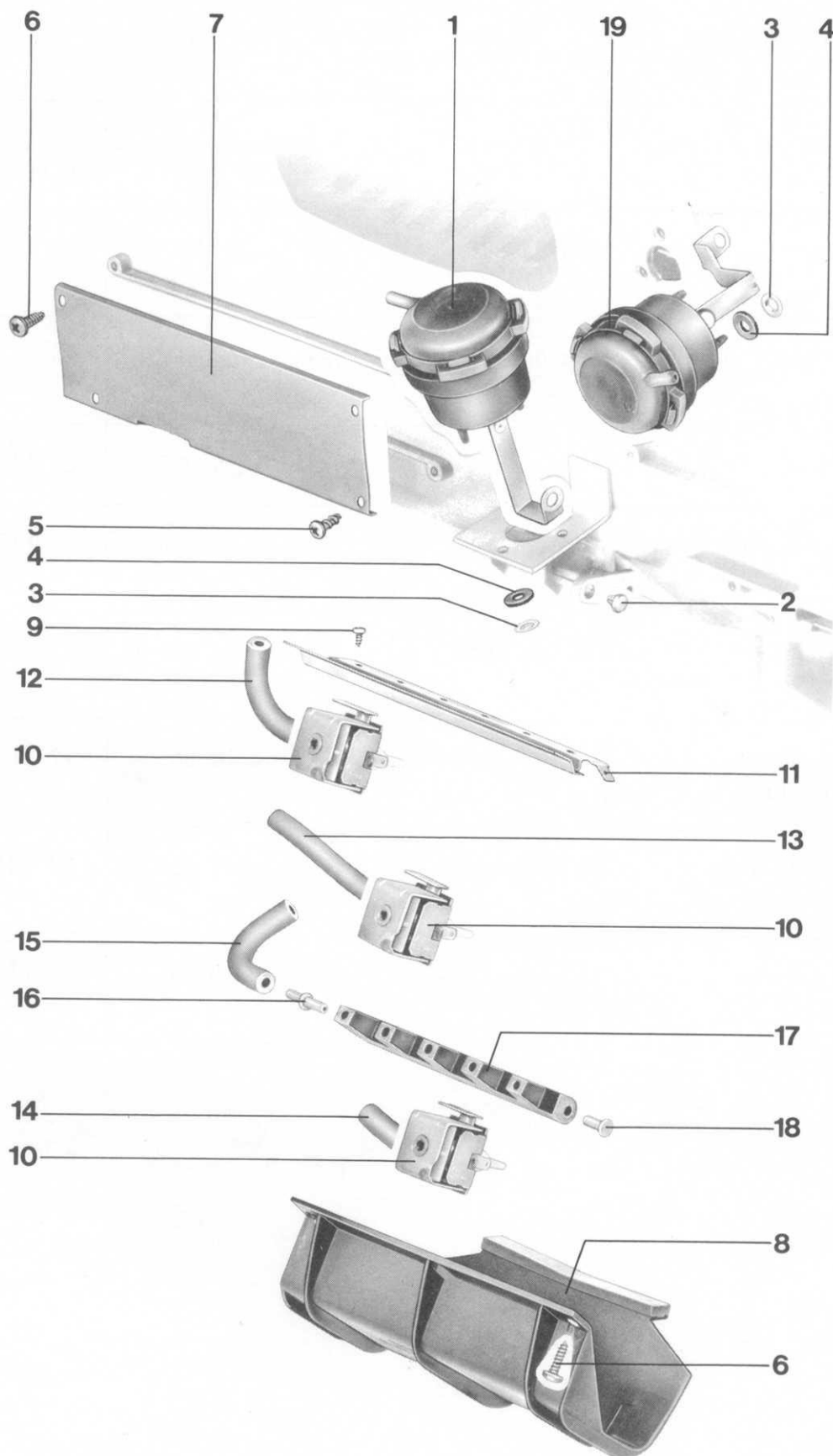
		up to June, 88	as of July, 88
Refrigerant volume with auxiliary A/C system	Refrigerant R12	1050 g	950 g
	Refrigerant R12	1200 g	1150 g
Refrigerant in compressor	Type 6 E 171	280 ± 20 c.c. Densoil 6	
	Type 10 PA 20 C	120 ± 20 c.c. Densoil 6	
Safety valve at fluid tank	The safety valve opens at a pressure of 40 ± 5 bar.		
Compressor type installation 10 PA 20 C	Club-Sport and 928 GT as of MY '89		
	928 S4 as of MY '90		



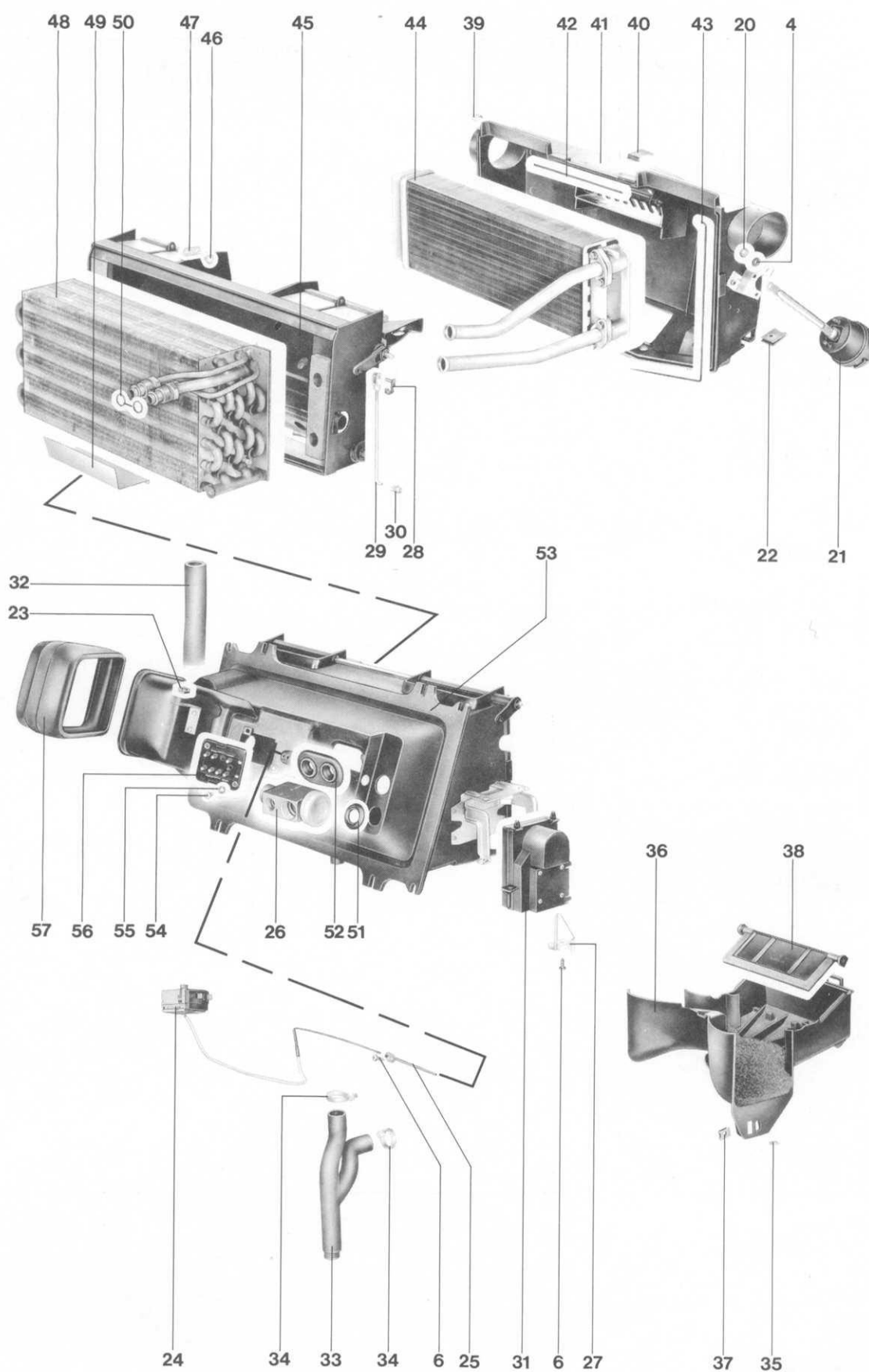
## TIGHTENING TORQUES

Location	Description	Thread	Torque in Nm (ftlb)
Compressor - intake line	Union nut	7/8'' x 14 UNF	33 (24)
Compressor - delivery line	Union nut	3/4'' x 16 UNF	24 (17)
Condenser - inlet	Union nut	3/4'' x 16 UNF	24 (17)
Condenser - fluid tank	Union nut	3/4'' x 16 UNF	24 (17)
Fluid tank - evaporator	Union nut	5/8'' x 18 UNF	17 (12)
Expansion valve - delivery line	Gland screw	5/8'' x 18 UNF	17 (12)
Expansion valve intake line	Gland screw	7/8'' x 18 NS	33 (24)
Expansion valve - evaporator	Gland screw	3/4'' x 18 NS	24 (17)

## DISASSEMBLING AND ASSEMBLING HEATER-AIR CONDITIONER



No.	Description	Qty	Note When:	
			Removing	Installing
1	Vacuum unit	1		
2	Pin	1		
3	Speed fix	6		renew
4	Rubber washer	9		
5	Self-tapping screw	3		
6	Self-tapping screw	8		
7	Cover	1		
8	Cover	1		
9	Self-tapping screw	5		
10	Solenoid valve	5		
11	Holder	1		
12	Vacuum hose	1		
13	Vacuum hose	1		
14	Vacuum hose	3		
15	Vacuum hose	1		
16	Connector	1		
17	Header	1		
18	Plug	1		
19	Vacuum hose	1		

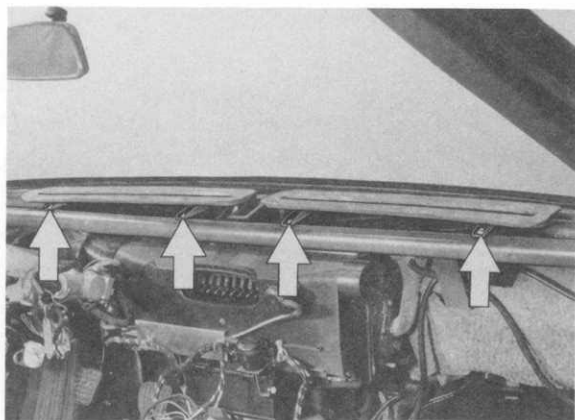


No.	Description	Qty	Note When:	
			Removing	Installing
20	Castellated nut lock	3	Do not damage capillary tube.	renew
21	Vacuum unit	1		
22	Sheet-metal	2		
23	Nut	1		
24	Antifreeze unit	1		Push in to mark
25	Guide tube	1		
26	Expansion valve	1		
27	Holder for cable plug	1		
28	Pin	1		
29	Linkage	1		
30	Clip	1		
31	Setting motor	1		
32	Hose	1		
33	Water drain hose	1		
34	Cable connector	2		
35	Castellated nut lock	1		renew
36	Housing - footwell	1		
37	Sheet-metal	1		
38	Footwell flap	1		
39	Clamp	2		renew if necessary

No.	Description	Qty	Note When:	
			Removing	Installing
40	Clamp	8		renew if necessary
41	Housing, rear	1		
42	Sealing profile	1		renew
43	Sealing profile	1		renew
44	Heat exchanger	1		
45	Vent body	1		
46	Clip	4		
47	Linkage	2		
48	Evaporator	1		
49	Holder	1		
50	O-ring	2		renew
51	Rubber grommet	2		check that grommet is correctly seated
52	Rubber grommet	1		check that grommet is correctly seated
53	Housing, front	1		
54	Screw	2		
55	Washer	2		
56	Thermo-bimetal switch	1		
57	Rubber adapter	1		install with a suitable adhesive, e.g. Loctite IS 424

## REMOVING AND INSTALLING HEATER-AIR CONDITIONER

1. Disconnect battery. If car has electrically adjustable seats, move seats to rearmost, lowest position (easier access).
2. Discharge air conditioner.
3. Drain coolant.
4. Remove instrument scoops.
5. Remove center console.
6. Remove instrument panel.
7. Remove air ducts to the side vents and to the glove compartment vent.

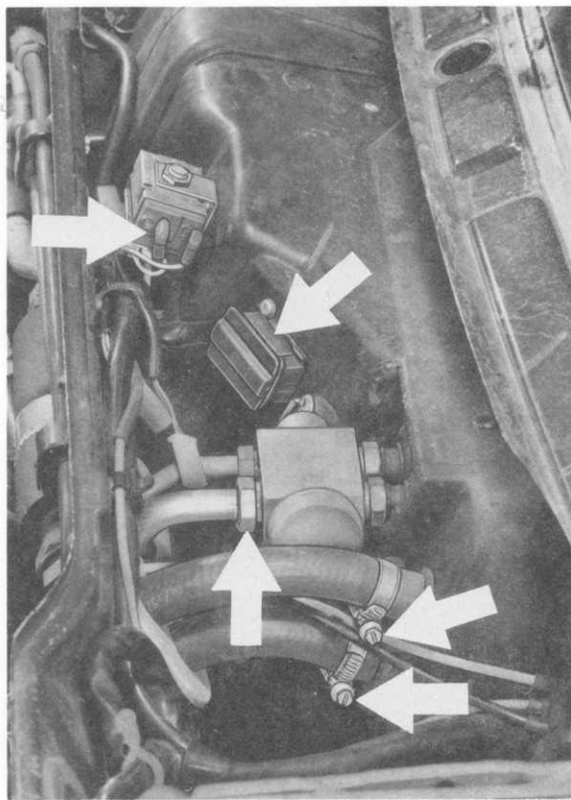


8. Remove defroster vents.

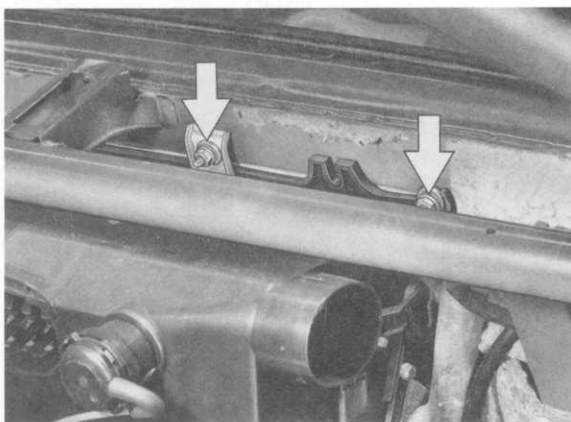
9. Remove bracket for left-hand oddments tray.



10. Unscrew bracket holding control unit of cruise control and move to right.
11. Remove blower cover in engine compartment.
12. Remove wiper motor.
13. Disconnect plug from thermo-bimetal switch and antifreeze unit.
14. Unscrew low-pressure and high-pressure lines from expansion valve and plug lines.



15. Detach coolant hoses.



16. Unscrew 4 upper and 2 lower mounting nuts.  
Remove mounting plate.



17. Detach vacuum hoses for fresh air/recirculating air flap (blue), water valve (white) and vacuum line (black).

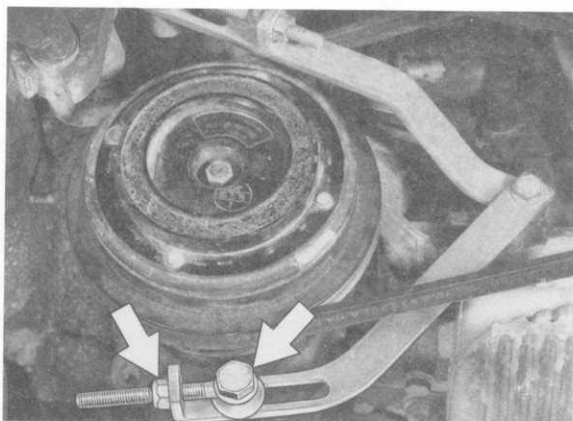
18. Pull off water drain hose.

19. Withdraw heater-air conditioner.

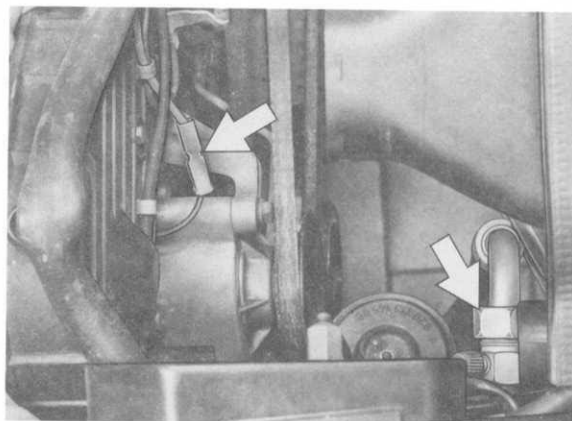
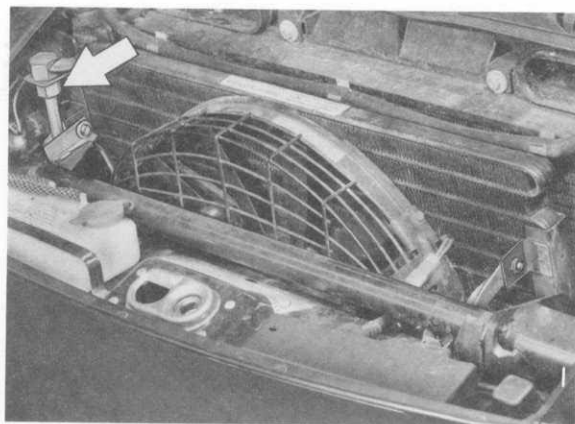


## REMOVING AND INSTALLING COMPRESSOR

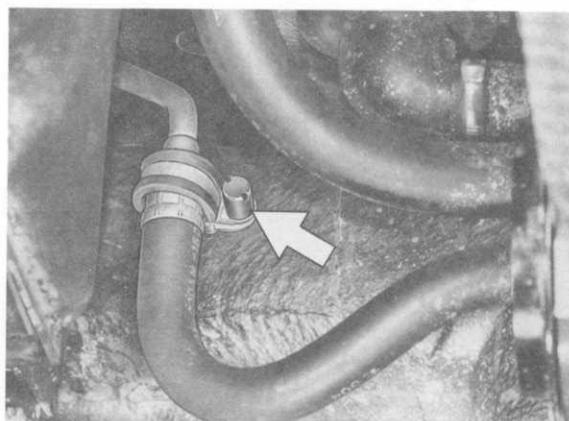
1. Drain air conditioner.
2. Unbolt guard beneath cooler.
3. Slacken compressor Vee belt and remove belt.



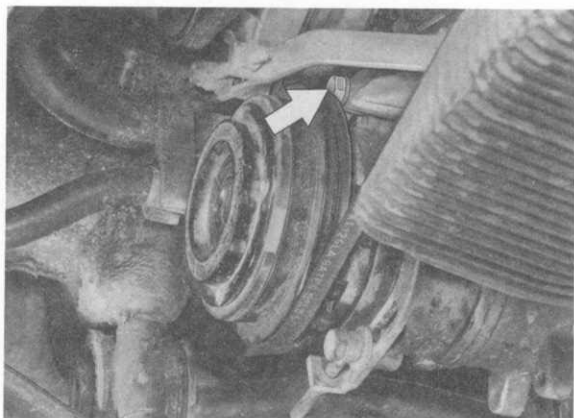
4. Disconnect hoses.



5. Disconnect plug-type connectors.
6. Slacken hose clamp.



7. Unscrew compressor mounting bolts and remove compressor complete with hoses.



8. Insert plugs in connections and lines.

#### Note :

New compressors are pressurized. Always unscrew caps slowly until refrigerant escapes with an audible hiss. Do not remove caps until compressor is depressurized.

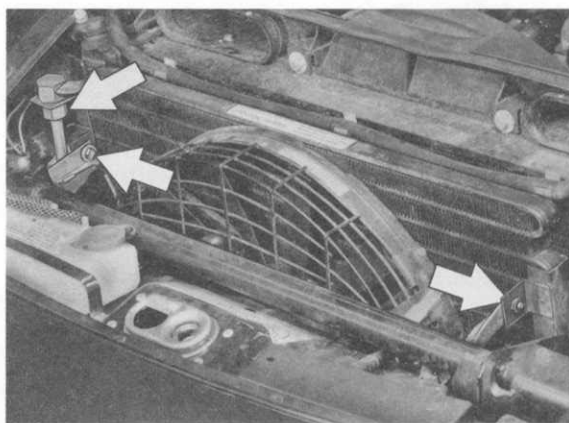
Before installation, attach hoses to compressor and tighten clamps.

#### Adjusting Vee-Belt

Check tension at a point halfway between pulleys by pressing belt with thumb. Deflection approx. 10 mm (see also page 13 - 18).

#### REMOVING AND INSTALLING CONDENSER

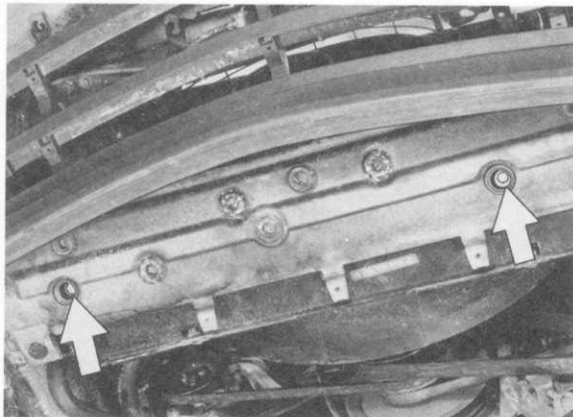
1. Discharge air conditioner.
2. Remove air intake screens.
3. Remove fluid tank (see page 87 - 101).



4. Loosen holders at top left and right of lock transverse member and swing aside.

5. Remove hose.

6. Remove condenser lower mounting screws.



7. Remove condenser by lifting upward.

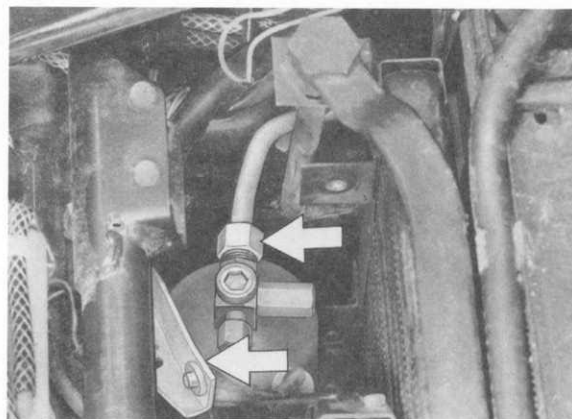
8. Plug connectors and lines.

#### REMOVING AND INSTALLING FLUID TANK

1. Discharge air conditioner

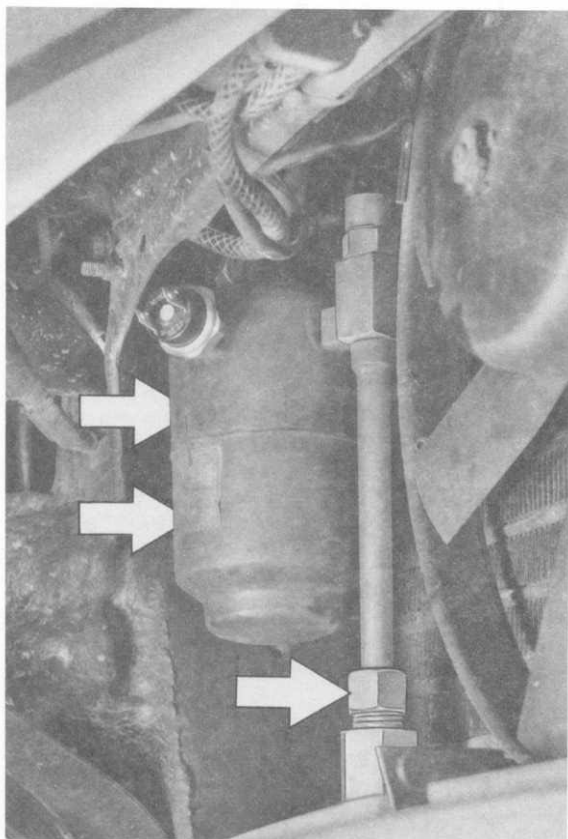
2. Remove air intake screens.

3. Disconnect plug for temperature and low-pressure switch.



4. Detach bracket at top right of lock transverse member and swing aside.

5. Disconnect feed lines.



6. Unscrew mounting bolts.

Note :

Always fit a replacement fluid tank if the system is defective or if the coolant circuit is opened.

7. Plug connectors and lines.

---

#### REMOVING AND INSTALLING ANTIFREEZE UNIT

1. Remove lower cover in engine compartment.

2. Disconnect cable plug.

3. Unscrew mounting bolts.



4. Carefully withdraw capillary tube from guide tube.

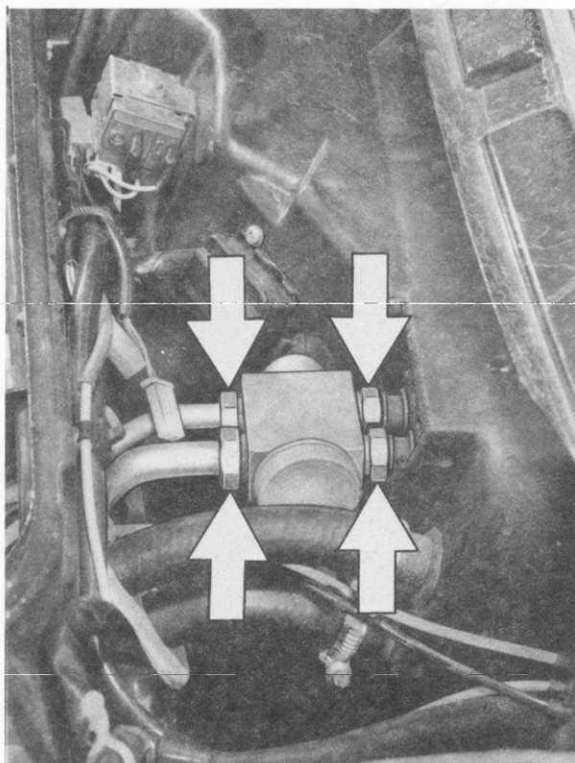
Note :

When installing, push capillary tube in to mark.

---

**Removing and installing expansion valve**

1. Remove blower cover in engine compartment.
2. Disconnect high and low-pressure lines.



86/468c

3. Disconnect evaporator connections.
4. Plug connectors and lines.

**Distribution of oil in refrigeration circuit**

Compressor	40%
Evaporator	35 %
Condenser	15 %
Fluid tank / lines	10 %

These values are approximations.

If a replacement component is fitted, top up the oil by an amount equal to the quantity left in the component removed.

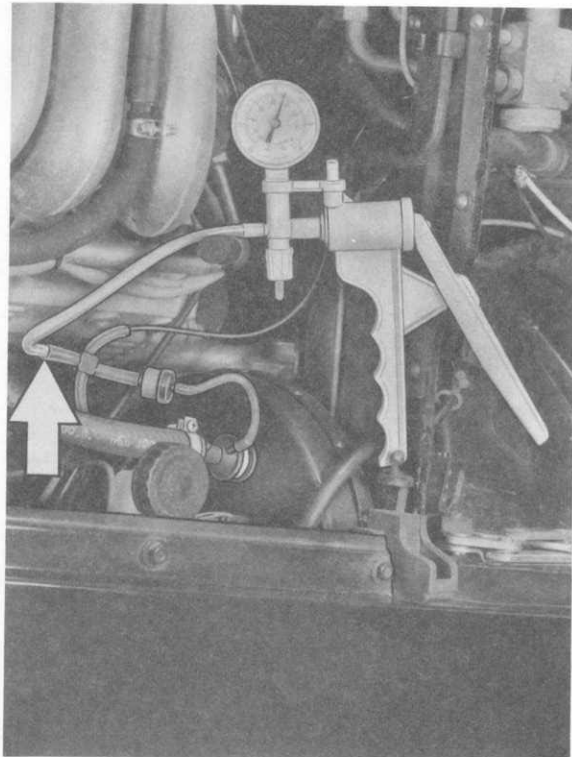
The correct amount of oil can be poured directly into the new component.

If a replacement compressor is fitted, 60% of oil must be drained from the new compressor which contains the quantity for the entire system.



### CHECKING VACUUM SYSTEM

1. Connect vacuum handpump to test connection.



2. Pump until vacuum is established.
3. If no vacuum is created, use fuel-line clamps, for example, to close distribution manifold lines one by one until leak is located.
4. Eliminate any leaks found.

## FLAP POSITION PROGRAM

	off	middle	bottom	top/ bottom	top	defrost
A	open	closed	closed	closed	closed	closed
C	closed	closed	closed	open	open	open
D	closed	closed	open	open	closed	closed
E	open	open	open	open	open	closed

Temperature regulator at max. cooling output

Flap A: open - recirculating air  
closed - fresh air



## FLAP POSITION PROGRAM

	off	defrost	BS	AC	TR
A	closed	open		0 - 10 open 10 - 100 closed	
B		max. heating output			0-100
E	open	closed			0-20 open 20-100 closed
Heating valve	closed	open			0-20 open 20-100 closed
Blower	off	stage 4	stages 1-4		
Compres- sor	off	on		on	

BS - Blower switch

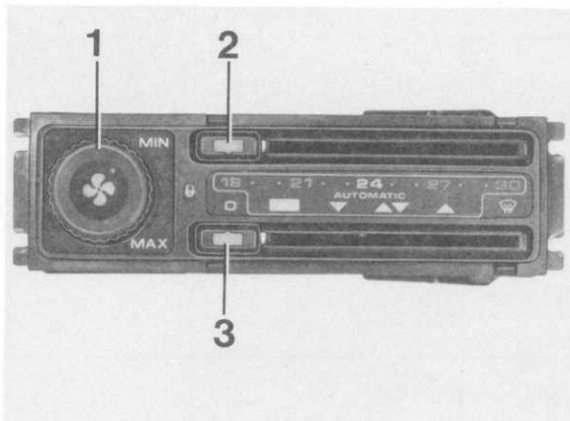
AC - Air-conditioner switch

TR - Temperature regulator

The figures from 0 - 100  
indicate the position of the  
setting motor in percent.

0% - max. cooling output  
100% - max. heating output

## CHECKING FLAP POSITION PROGRAM



- 1 - Switch for fresh-air blower
- 2 - Slide control for temperature adjustment
- 3 - Slide control for air distribution

## Testing preconditions:

Vacuum system leaktight and depressurized.

Switch ignition on. Open central vent.

- 1. Set slide 2 to max. cooling output. Set slide 3 to "Off".

The positions of the flaps must be as follows:

Flap A - recirculating air

Flap C - closed

Flap D - closed

Flap E - open

Water valve - closed

- 2. Set slide 3 for air supply to central vent.

Flap A - fresh air.

The other flaps remain at positions as for check 1.

- 3. Set slide 3 for air supply from bottom vent.

Flap D - opens.

- 4. Set slide 3 for air supply from upper/lower vents.

Flap C opens.

- 5. Set slide 3 for air distribution from top vent.

Flap D closes.

6. Set slide 3 to defrost.

Flap A - recirculating air.  
Flap E closes.  
Water valve opens.  
Compressor switches on.  
Blower switches to Stage 4.  
Setting motor moves to max.  
heating output.

The position of the temperature mixer flap can be tested by inserting a finger between setting motor and air deflector chamber.

---

7. Set slide 3 to air supply from central vent. Setting motor moves to max. cooling output.

Set slide 2 to 27.  
The setting motor moves toward heating. As of 20% heating output, water valve opens and flap E closes.

Close central vent.  
Flap E opens.

Press AC button.

At 10%, flap A switches to recirculating air.

If the specified statuses are not attained, check operating switch, solenoid valves and setting motor.

N o t e :

The position of the fresh air/recirculating air flap can be checked by inserting a finger through the hole in the intake screen in the passenger-side footwell.

The position of the bulkhead flap is visible with the cover removed from the central vent and the vent open.

## CHECKING OPERATING SWITCH

## N o t e :

With operating switch removed and all connections made, use a voltmeter to test voltages at the 15-pole plug.

1. Switch on ignition.

2. Connect voltmeter to terminal 1 (plus) and terminal 4 (minus).

Air-distribution slide at bottom and bottom/top.

Reading: Battery voltage.

3. Connect voltmeter to terminal 2 and terminal 4.

Air-distribution slide at off, center and bottom..

Reading: Battery voltage

4. Connect voltmeter to terminal 3 and terminal 4.  
Switch on position lights.

Reading: Battery voltage.

5. Connect voltmeter to terminal 5 and terminal 4.  
Air-distribution slide at centre, bottom, bottom/top, top and defrost.

Reading: Battery voltage.

If no voltage is registered, check whether fresh-air blower relay switches. If the fresh-air blower relay does not switch, test the signal at terminal 86. Connect voltmeter to terminal 15 and terminal 4 of operating switch. Air-distribution slide at the same positions.

Reading: Battery voltage.

6. Connect voltmeter to terminal 7 and terminal 4.  
Air-distribution slide at center, bottom, bottom/top and defrost.  
Switch on auxiliary air conditioner.

Reading: Battery voltage

If no voltage is registered, check air-conditioner switch.

7. Connect voltmeter to terminal 6 and terminal 4.  
Air-distribution slide at center, bottom, bottom/top and top.  
Switch on auxiliary air conditioner.

Reading: Battery voltage.

8. Connect voltmeter to terminal 8 and terminal 4.

Air-distribution slide to center, bottom, bottom/top and top. Temperature regulator slide at 18.

Reading: Battery voltage

Move temperature regulator slide to 27. The setting motor moves toward heating. At 10%, the voltage is interrupted.

9. Connect voltmeter to terminal 9 and terminal 4.

Air-distribution slide at off.

Reading: Battery voltage

10. Leave voltmeter connected to terminal 9 and terminal 4. Air-distribution slide at center, bottom, bottom/top and top. Switch on air conditioner. Temperature regulator slide at 18.

Display: Battery voltage.

Set temperature regulator slide to 27. The setting motor moves toward heating. Voltage is interrupted at 10%.

11. Connect voltmeter to terminal 10 and terminal 4.

Reading: Battery voltage

12. Connect voltmeter to terminal 11 and terminal 4.

Air-distribution slide at defrost.

Reading: Battery voltage

The fresh-air blower must run at top speed. If not, check defrost relay or fresh-air blower.

13. Connect voltmeter to terminal 12 and terminal 4.

Air-distribution slide at center, bottom, bottom/top and top. Temperature regulator slide at 18.

Reading: Battery voltage

Move temperature regulator slide to 27. The setting motor moves toward heating. Voltage is interrupted at 20%.

14. Connect voltmeter to terminal 15 and terminal 4.

Air-distribution slide at center, bottom, bottom/top, top and defrost.

Reading: Battery voltage

15. Disconnect cable plug. Connect ohmmeter to terminal 13 and terminal 14.

Move temperature regulator slide to 18.

Reading: approx.  $750 \pm 100$  Ohm

Move temperature regulator slide to 30.

Reading: approx.  $1750 \pm 100$  Ohm

N o t e :

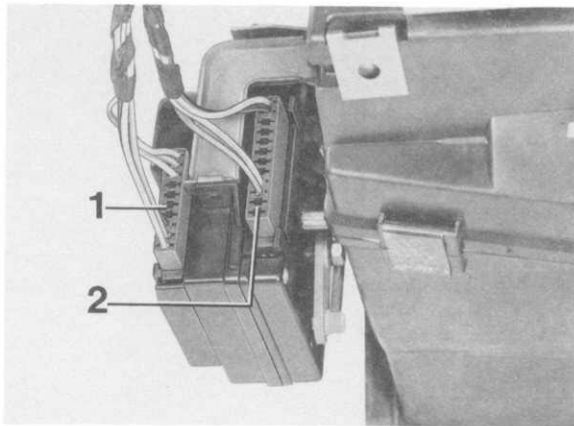
The resistance must change by approx. 1000 Ohm.

If the values at terminals 1, 2, 6, 9, 11, 12, 13, 14 and 15 are not attained, the operating switch is defective and must be replaced.

If the values are not attained at the other terminals, check the wiring using the circuit diagram.

---

## TESTING SETTING MOTOR



1. Disconnect plug 2.
2. Switch on ignition.
3. Air-distribution slide at center, bottom, bottom/top and top. Temperature regulator slide at 18. Open central vent.
4. Connect voltmeter to terminal 3 (minus) and terminal 11 (plus).  
Reading: Battery voltage.
5. Connect ohmmeter to terminal 4 and terminal 12.  
Set temperature regulator slide to 18.  
Reading: at 20°C approx. 3.7 kOhm.  
Set temperature regulator slide to 30.  
Reading: at 20°C approx. 4.7 kOhm.

## Note :

Resistance increases as temperature drops and decreases as temperature rises. A resistance change of some 1000 Ohm is important. If no change in resistance is recorded, the operating switch must be checked separately.

If the ohmmeter reads infinity, there is an interruption in the sensor chain which comprises internal sensor, external sensor and operating switch.

If the reading of the ohmmeter is smaller by a significant margin, there is a short-circuit in a sensor or in the operating switch.

Check switching functions of setting motor with plug 1 connected. Probe wires from back of plug.

6. Connect voltmeter to terminal 3 and vehicle ground.

Reading: Battery voltage.

7. Connect voltmeter to terminal 8 and vehicle ground.

Reading: Battery voltage

8. Connect voltmeter to terminal 2 and vehicle ground.

Reading: Battery voltage.

Set temperature regulator slide to 27. Setting motor moves toward heating. Voltage is interrupted at 20%.

9. Connect voltmeter to terminal 9 and vehicle ground. Temperature regulator slide to 18.

Reading: Battery voltage.

Set temperature regulator slide to 27. The setting motor moves toward heating. Voltage is interrupted at 10%.

10. Connect voltmeter to terminal 10 and vehicle ground.

Reading: 0 volt.

Close central vent.

Reading: Battery voltage

11. Reopen central vent. Connect voltmeter to terminal 1 and vehicle ground.

Reading: 0 volt

Close central vent.

Reading: Battery voltage.

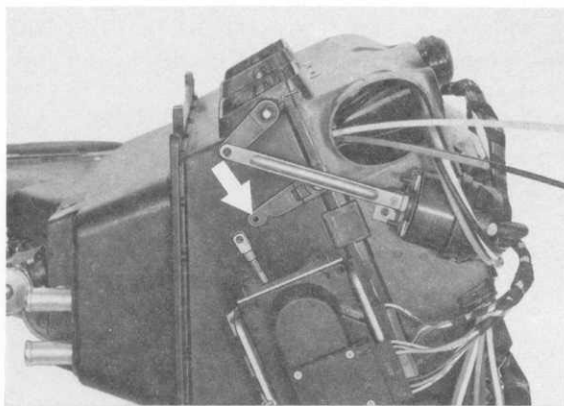
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## ADJUSTING TEMPERATURE MIXTURE FLAPS

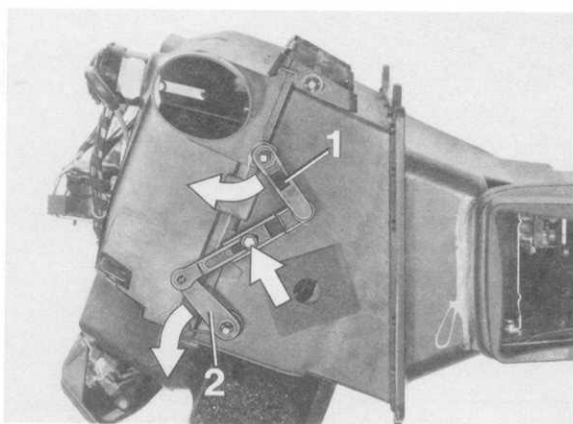
1. Set setting motor to maximum cooling output.

2. Disconnect setting motor linkage.



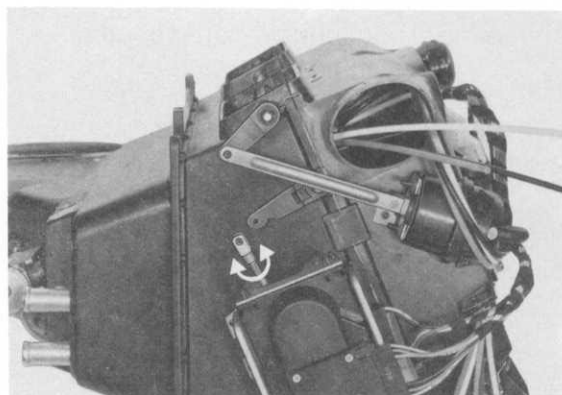
3. Move lever downward to maximum cooling position.

4. On right-hand side, remove securing screw of lever system.



5. Press lever 1 forward and lever 2 down as far as possible. Retighten securing screw.

6. Turn linkage until holes are aligned.



7. Engage pin.

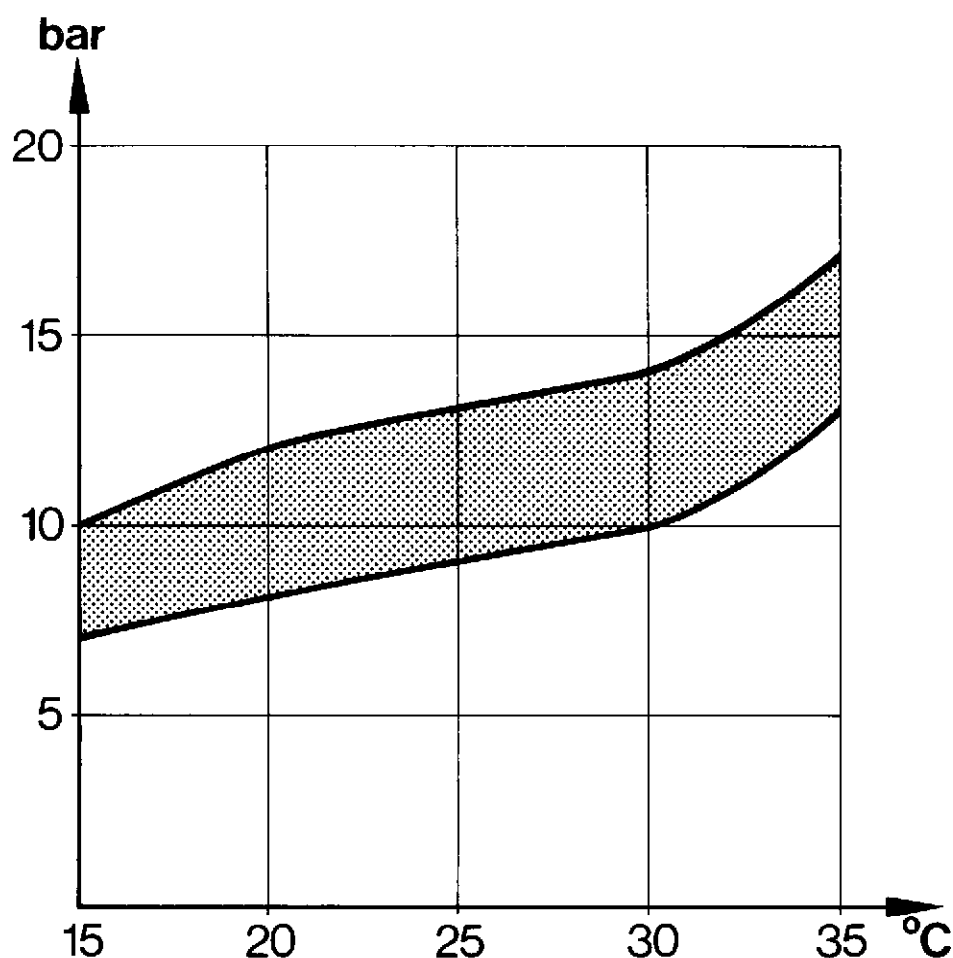
## PRESSURE AND TEMPERATURE SPECIFICATIONS

### General preconditions:

- Vee-belt properly tensioned.
- Vacuum system OK.
- Flap position program OK.
- Magnetic coupling engages.
- Condenser clean.

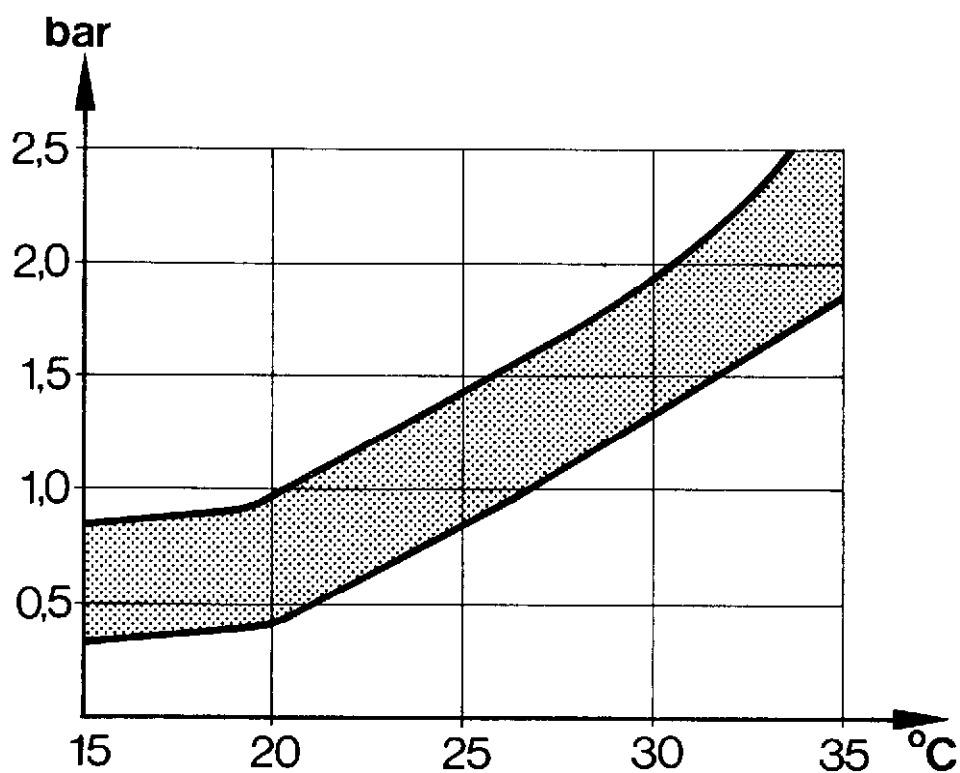
1. Switch on air conditioner.
2. Set temperature regulator to max. cooling output.
3. Set fresh-air blower to stage 2.

After running for approx. 10 minutes at a speed of 2000 rpm with compressor switched on, the pressures and temperatures must be as shown in the graphs below.



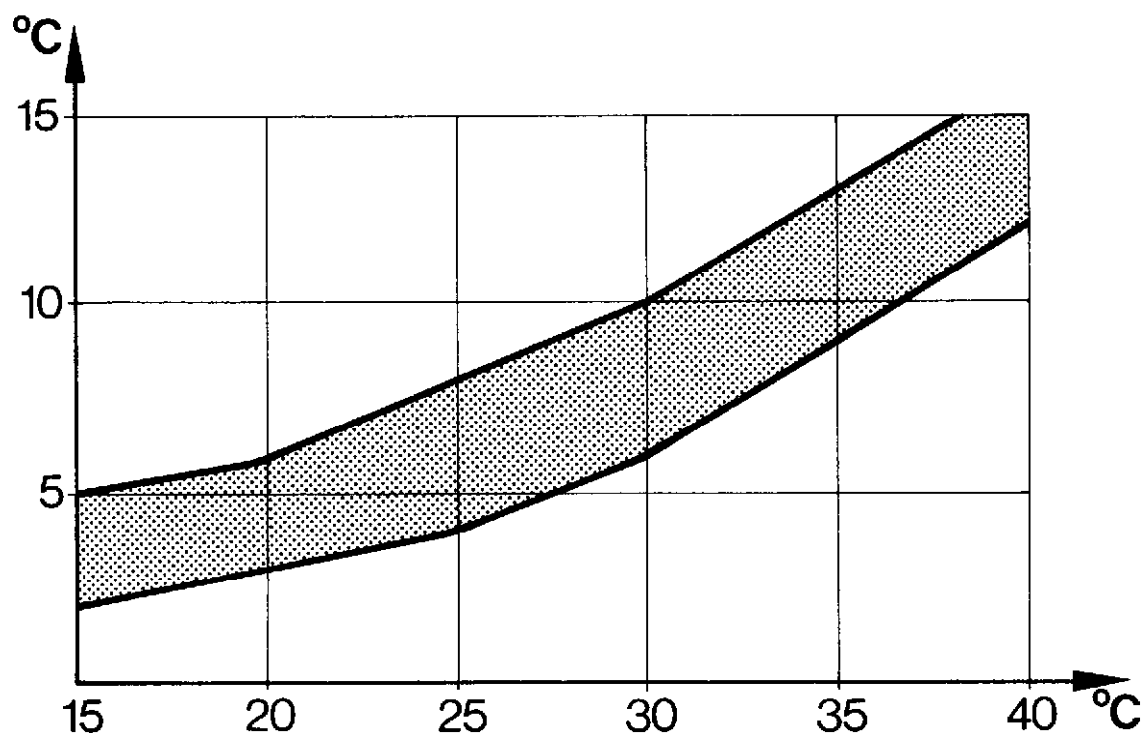
Air-intake temperature

High-pressure in the refrigeration circuit plotted against air-intake temperature



Low-pressure in the refrigeration circuit plotted against air-intake temperature.

Temperature at central vent



Temperature of air at the central vent plotted against air-intake temperature.

## AIR CONDITIONER, TROUBLESHOOTING

## Complete cooling failure

1. Rupture element in fluid tank ruptured.

The system has overheated. Check operation and direction of rotation of cooling blower.

2. Connect service device and check pressure values.

Low pressure too low.  
High pressure too low.

No refrigerant in the system.  
Look for leak. Refill air conditioner.

3. Switch on air conditioner and check pressure values.

Low pressure too high.  
High pressure too low.

Compressor defective.

Low pressure too low.  
High pressure too high.

Expansion valve defective.

## Insufficient Cooling Output

Connect service device.

Switch on air conditioner and check pressure readings.

1. Low pressure normal.  
High pressure too high.

The system is overfilled. Discharge air conditioner and refill.

2. Low pressure too low.  
High pressure too low.

Insufficient coolant in system.  
Look for leak. Refill air conditioner.

3. Low pressure too high.  
High pressure normal.

Expansion valve defective.

## Insufficient Cooling Output After Brief Period of Operation

Initial cooling output is satisfactory, but diminishes after a period of time.

Ice accretion on evaporator. Anti-freeze protection switches off air-conditioning compressor. Check correct seating of capillary tube and inspect for damage.

or

Ice accretion on expansion valve. Heat expansion valve with a hot-air blower. The cooling efficiency of the air conditioner must return to normal. Cause: moisture in refrigerant. Fit replacement fluid tank. Recharge air conditioner.

N o t e :

If the air conditioner is refilled, the air-conditioning compressor may only be switched on for the first time when the engine is idling. Subsequently, the compressor can be fully loaded under all operating conditions.

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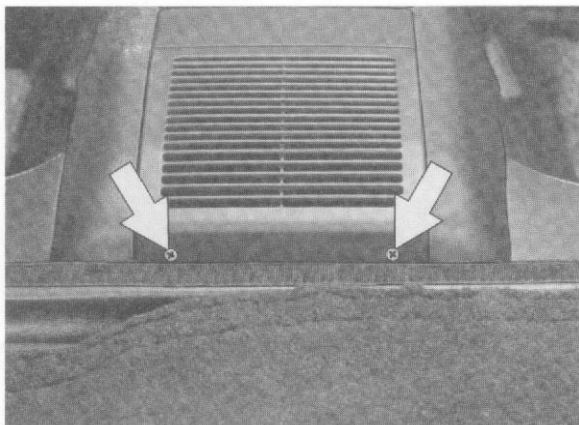
## AUXILIARY AIR CONDITIONER

An auxiliary evaporator for increased refrigeration output is available as an option (M 570). The auxiliary evaporator with 3-stage blower is installed instead of the rear parcel shelf.

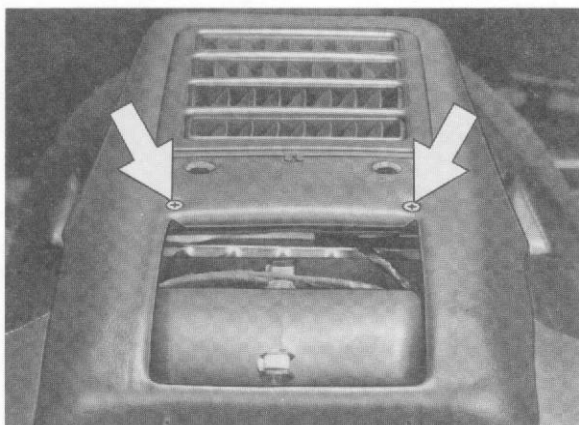
Removing and  
Installing  
Evaporator

1. Remove rear seat backrests.

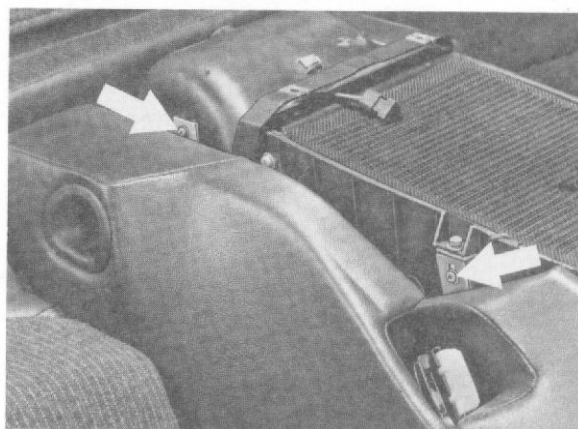
2. Remove air intake screen.



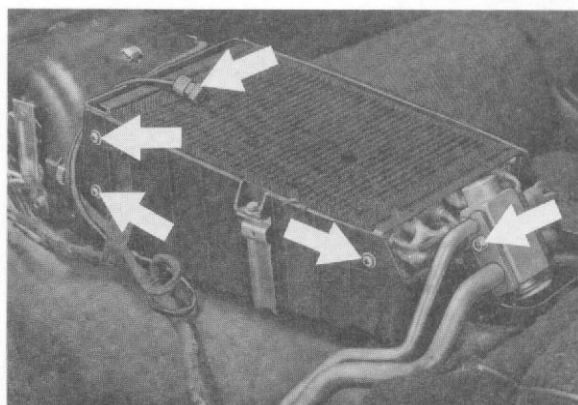
3. Remove upper cover.



4. Remove lower cover.



5. Withdraw temperature sensor.



6. Unscrew Allen-head bolt.

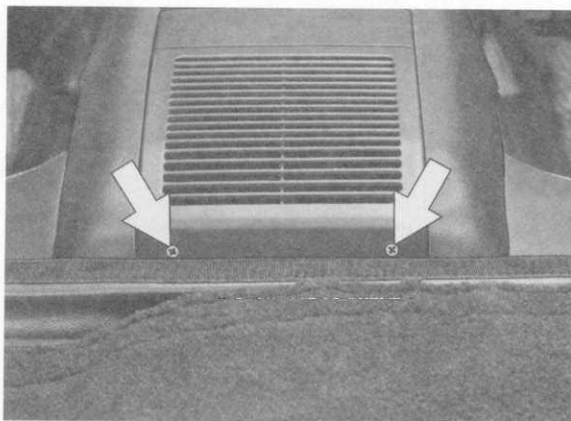
7. Remove mounting screws (6 screws).

## Note :

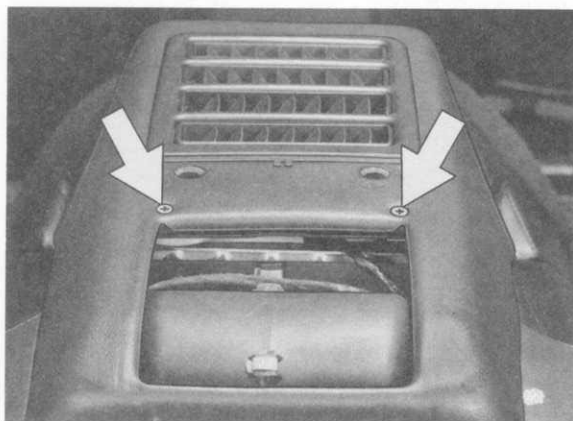
The tightening torque for the M 6 Allen-head bolt is 9 Nm (7ftlb). Renew O-rings in the connections in the lines to the expansion valve.

## Removing and Installing Expansion Valve

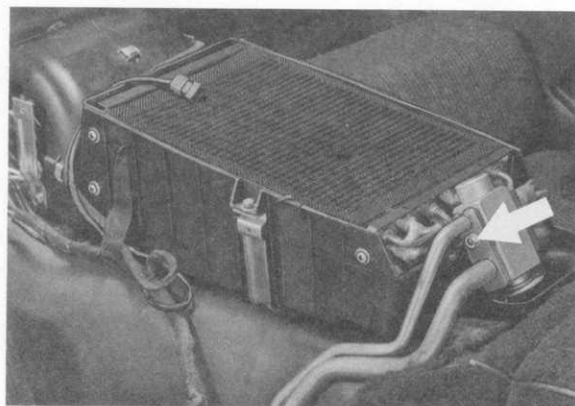
1. Remove air intake screen



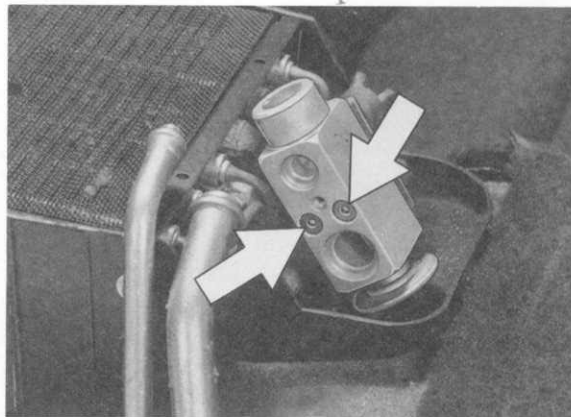
2. Remove upper cover.



3. Unscrew M 6 Allen-head bolt.



4. Unscrew M 5 Allen-head bolts.



Note :

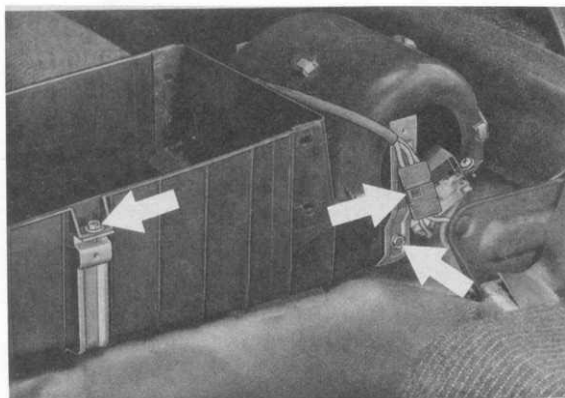
Tightening torques

M 5 bolt:	6 Nm (4 ftlb)
M 6 bolt:	9 Nm (7 ftlb)

Renew all 4 O-rings.

### Removing and Installing Blower

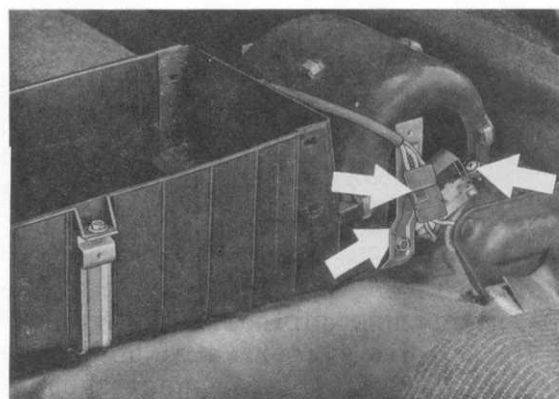
1. Remove evaporator (see page 87 - 120).
2. Disconnect cable from blower.
3. Disconnect plug-in connector to series resistors.



4. Remove 4 mounting screws.

### Removing and Installing Series Resistors

1. Remove covers, see section headed Removing and Installing Evaporator.
2. Disconnect plug-in connector.

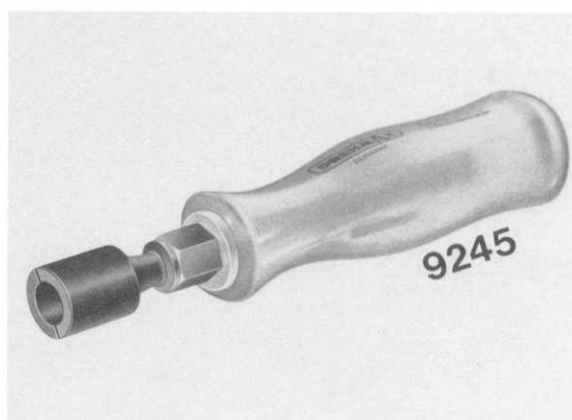
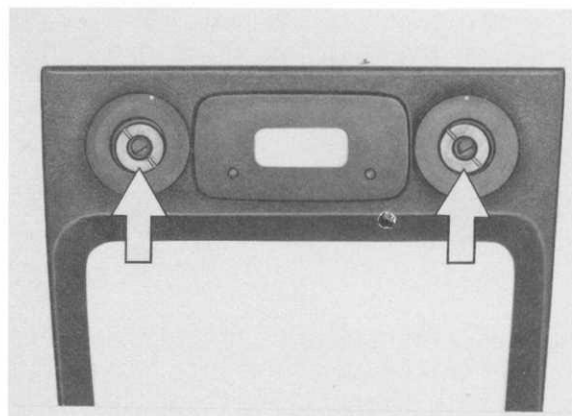


3. Remove mounting screws.



# Removing and Installing Blower Switch and Temperature Regulator

1. Remove radio.
2. Beginning at top, pull frame up and out.



3. Pull socket housing off switch and regulator.
4. Disconnect cable to clock.
5. Remove control knobs.
6. Unscrew covers with special tool P 9245.

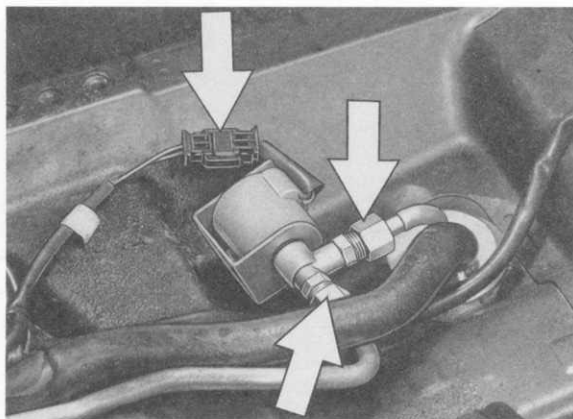
Special tool P 9245

## Removing and Installing Solenoid Valve

### Note :

The solenoid valve is located beneath the passenger seat.

- 1.Remove passenger seat. If seat is electrically adjustable, move seat to highest position to facilitate removal.
- 2.Remove carpet.
- 3.Disconnect plug-in connector.



- 4.Unscrew threaded couplers.

### Note :

Use a suitable wrench to counter when unscrewing or tightening threaded couplers.

Renew O-rings.

## Checking Control Unit

### Note :

The control unit is located to the right of the blower.



- 1.Remove covers, see section headed Removing and Installing Evaporator.

- 2.Disconnect plug.

### Note :

The terminal designations on plug receptacle and control unit are not identical. The inspection described below refers to the designations on the control unit. Check receptacle after unplugging.

- 3.Connect voltmeter to plus and terminal 1.

Reading: Battery voltage

4. Connect voltmeter to minus and terminal 4. Switch on ignition and blower for auxiliary air conditioner.

Reading: Battery voltage

5. Connect ohmmeter to terminal 2 and minus.

Reading:  $10\text{ k}\Omega \pm 10\%$

6. Connect ohmmeter to terminal 2 and terminal 3.

Reading:  $1 - 10\text{ k}\Omega \pm 10\%$ , depending on setting of temperature regulator.

N o t e :

If the readings under points 4 and 5 are not attained, check temperature regulator separately.

Terminals I and II:  $10\text{ k}\Omega \pm 10\%$   
Terminal II and +:  $0-10\text{ k}\Omega \pm 10\%$

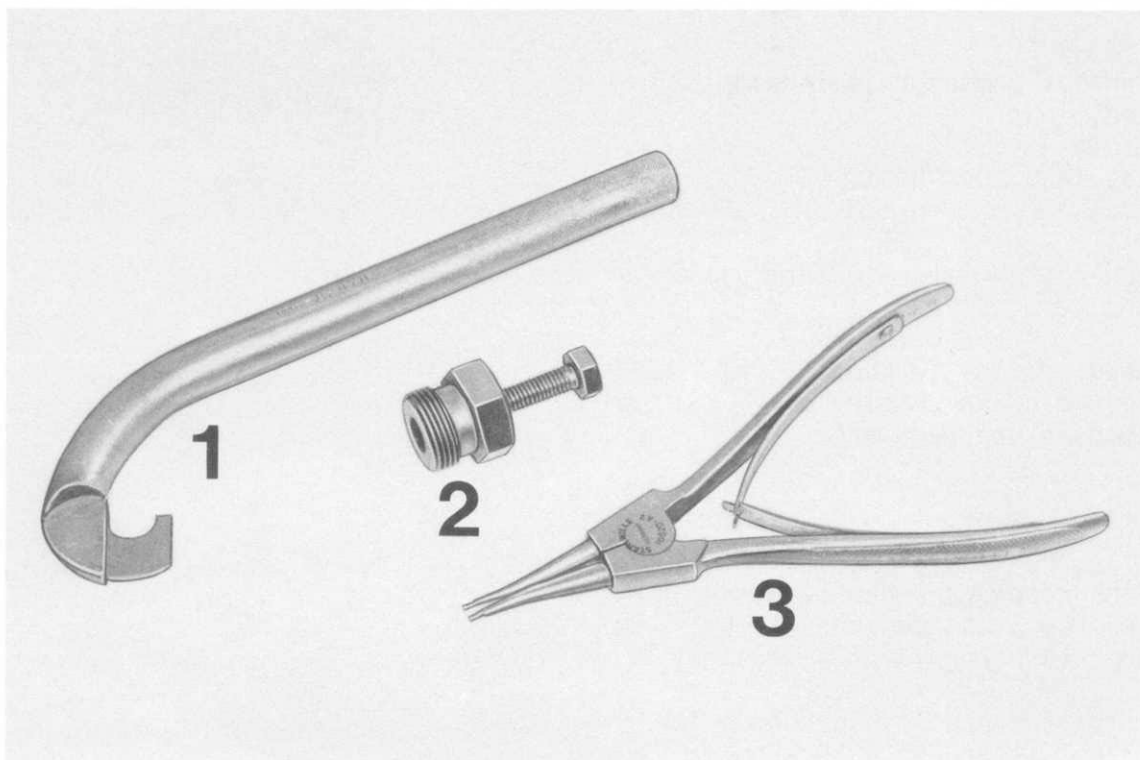
7. Connect ohmmeter to terminal 6 and minus.

Reading: at  $20^{\circ}\text{C}$  approx.  $3.5\text{ k}\Omega$   
at  $25^{\circ}\text{C}$  approx.  $2.8\text{ k}\Omega$

The resistance diminishes as temperature increases.

8. With ignition and auxiliary blower switched on, bridge terminal 4 and terminal 5 with a suitable jumper lead. The response of the solenoid valve must be audible.

## TOOLS



No.	Designation	Special Tools	Remarks
1	Strap wrench	95458 - 02070	Source: see Workshop Manual
2	Clutch plate puller	95458 - 03064	
3	Pliers for circlips		commercially available

## REMOVING AND INSTALLING MAGNETIC CLUTCH

1. Use strap wrench to counterhold when loosening or tightening the mounting nut.

Tightening torque: 16 Nm  
(12 ftlb)



2. Remove clutch plate with puller.

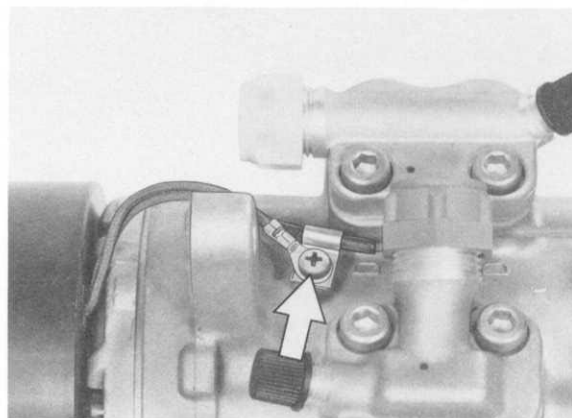


3. Remove shims.

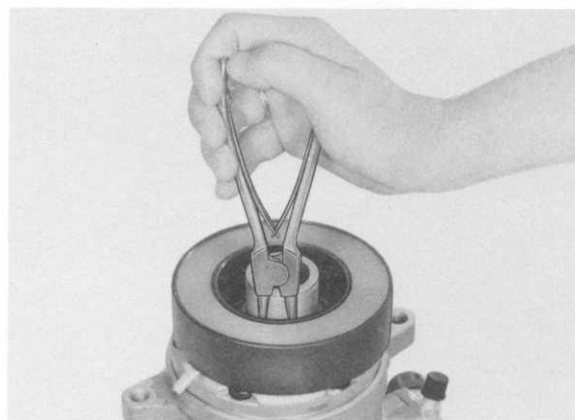
4. Remove circlip and take off pulley.



5. Unscrew cable holder



6. Remove circlip and lift off magnetic coil.

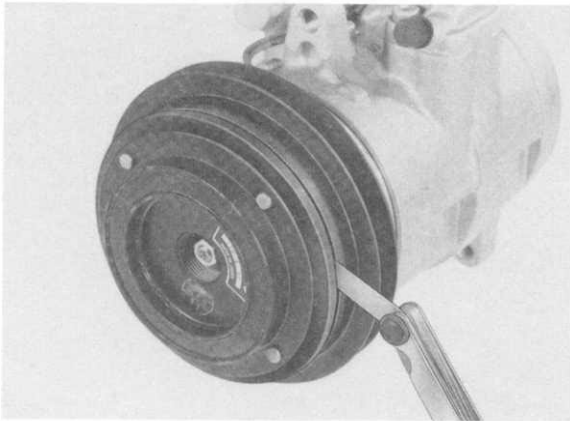


Note :

Coil resistance is  $3.8 \pm 0.2$  Ohm.

### I n s t a l l i n g

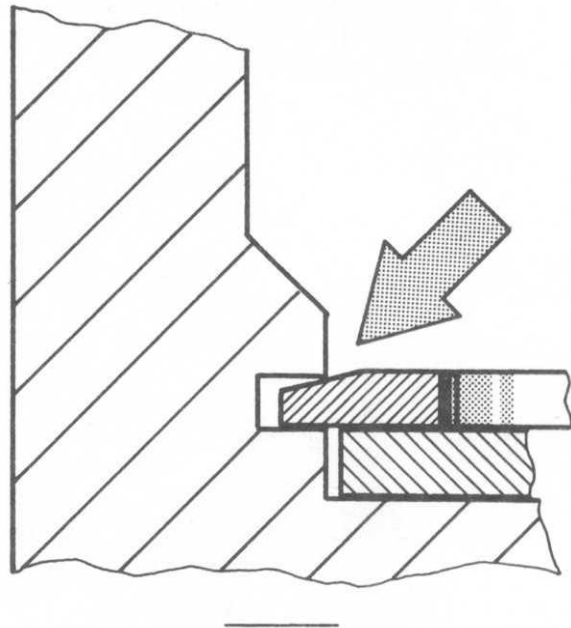
The clearance between clutch plate and belt pulley is 0.4 - 0.7 mm.



If necessary, correct clearance by inserting or removing shims.



Install both circlips with bevelled edges facing upward.



## Technical data of air conditioning system

### As of MY '93

Refrigerant charge	Refrigerant R 134 a	860 g
with auxiliary air conditioning		1050 g
Refrigerant oil in compressor		160 ± 20 c.c. ND 8
Compressor type	10 PA 20 C	
Safety valve on fluid tank	The valve opens at a positive pressure of 41 to 43 bar and closes again as soon as the pressure drops below this value.	

### Note

When fitting the refrigerant lines, coat the fittings and O-rings with refrigerant oil.

Dispose of the refrigerant oil as **hazardous waste**.

## Pressure and temperature specifications

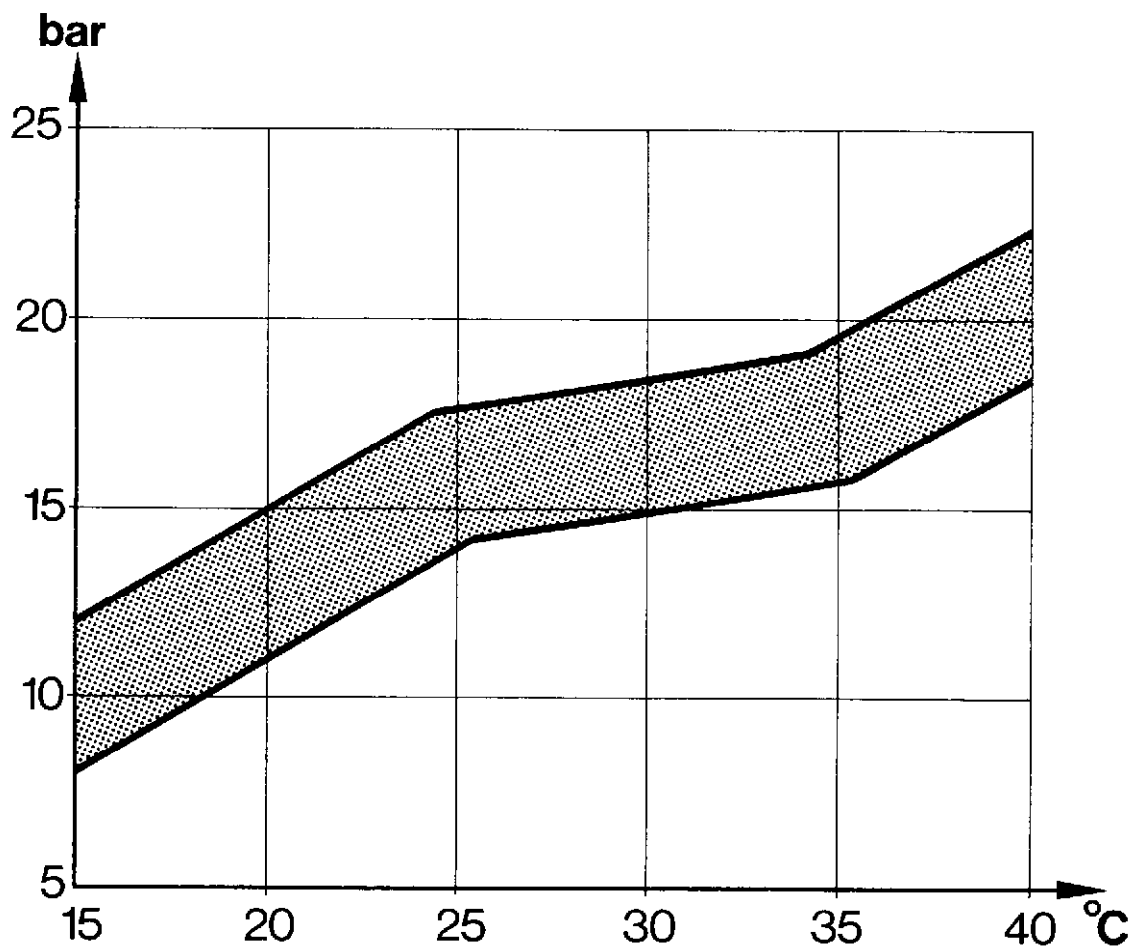
### Refrigerant R 134 a

#### General Testing Requirements:

- V-beit tightened properly.
- Vacuum system o.k.
- Solenoid clutch energized.
- Clean condenser.

1. Turn on air conditioning.
2. Set temperature control to max. cooling position.
3. Set fresh-air blower to stage 2.

After an operating time of approx. 10 mins., at an engine speed of 2,000 rpm and with the compressor switched on, the pressures and temperatures from the below diagrams must be reached.

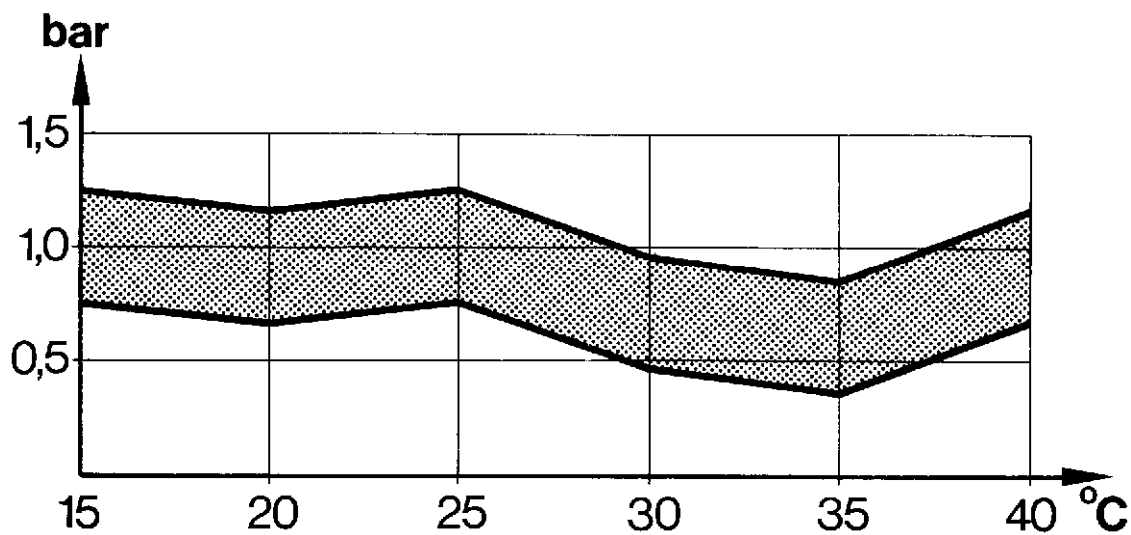


Ambient temperature

High pressure in refrigerant circuit vs. ambient temperature

1340 - 87



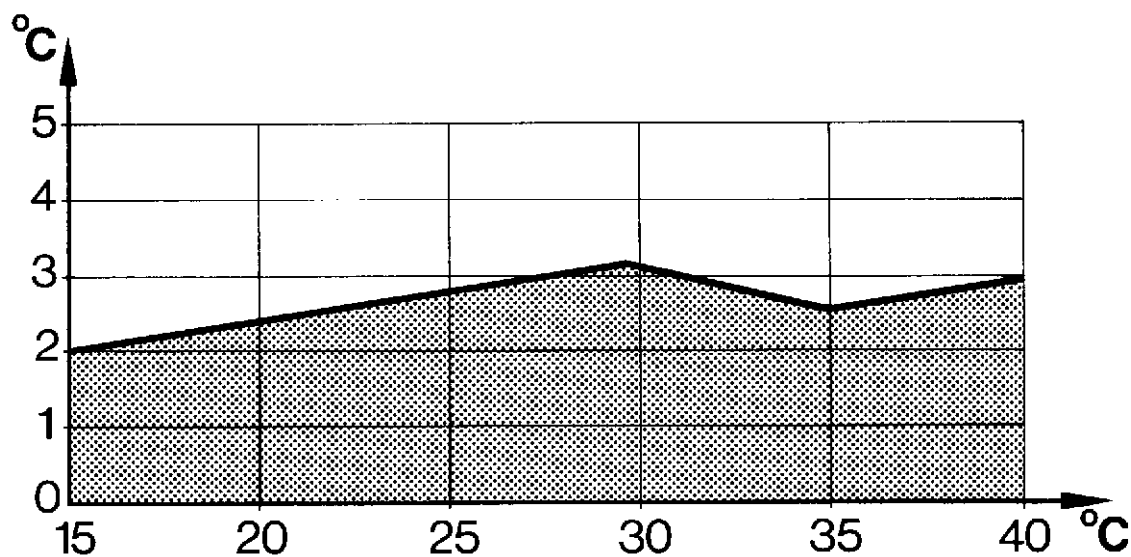


Ambient temperature

1341 - 87

### Low pressure in refrigerant circuit vs. ambient temperature

Temperature at center nozzle



Ambient temperature

1342 - 87

### Air temperature at center nozzle vs. ambient temperature