

## Section 6

# Front End and Steering Gear

## Service Procedures

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# Specifications

## Wheel Alignment (unloaded)

	Metric	US
Caster .....	+2° to +3°	
Camber .....	+1° to +1.5°	
Toe-in, manual steering .....	4.5±1.5 mm	0.177"±0.06"
power steering .....	3.0±1.5 mm	0.120"±0.06"
King pin inclination at camber 0 .....	12°	
Turning angles: at 20° turn of the outer wheel, the inner wheel should be turned 20.8°		

## Manual steering gear, rack and pinion type

### Cam Gear:

Number of turns from lock to lock .....	4.34	
Ratio .....	21.4	
Pinion, pre-tension .....	0.1 mm	
shims available .....	0.127 mm, 0.254 mm, 0.381 mm, 0.508 mm	
Clearance between pre-tensioner piston and cover .....	0.02–0.15 mm	0.0008"–0.006"
Pre-tension: pinion to rack .....	0.6–1.7 Nm	5–15 lb.in.
Lubricant .....	Engine oil SAE 20W–50 alt. SAE 20W–40	
Capacity .....	0.2 liter	6.75 fl. oz.

### ZF:

Number of turns from lock to lock .....	4.34	
Ratio .....	21.4	
Pre-tension: pinion to rack .....	0.6–1.7 Nm	5.15 lb.in.
Lubricant .....	Grease, Calypsol D4024-OK	
Capacity .....	25 grams	1 oz.

## Power steering gear, rack and pinion type, Cam Gear

Number of turns from lock to lock .....	3.5	
Ratio .....	17.2	
To adjust pinion pre-tension, use gasket P/N .....	1206931, 1206934	
Clearance between pre-tensioner piston and cover .....	0.05–0.15 mm	0.0012"–0.006"
Shims available .....	0.051 mm, 0.089 mm, 0.127 mm, 0.254 mm	
Pre-tension: pinion to rack .....	0.9–1.7 Nm	8–15 lb.in.

### Checking balance:

Pump pressure should be — .....	1.2 MPa	170 psi
— when reading steering shaft torque .....	3.5–4.5 Nm	30–40 lb.in.
Max. torque difference between right and left sides .....	1 Nm	8.5 lb.in.
Lubricant .....	Engine oil SAE 20W–50 alt. SAE 20W–40	
Capacity .....	0.2 liter	6.75 fl.oz.
Hydraulic oil .....	ATF Type A or Dexron	
Capacity .....	1.1 liter	37 fl.oz.

## Power pump (vane type), ZF, belt driven

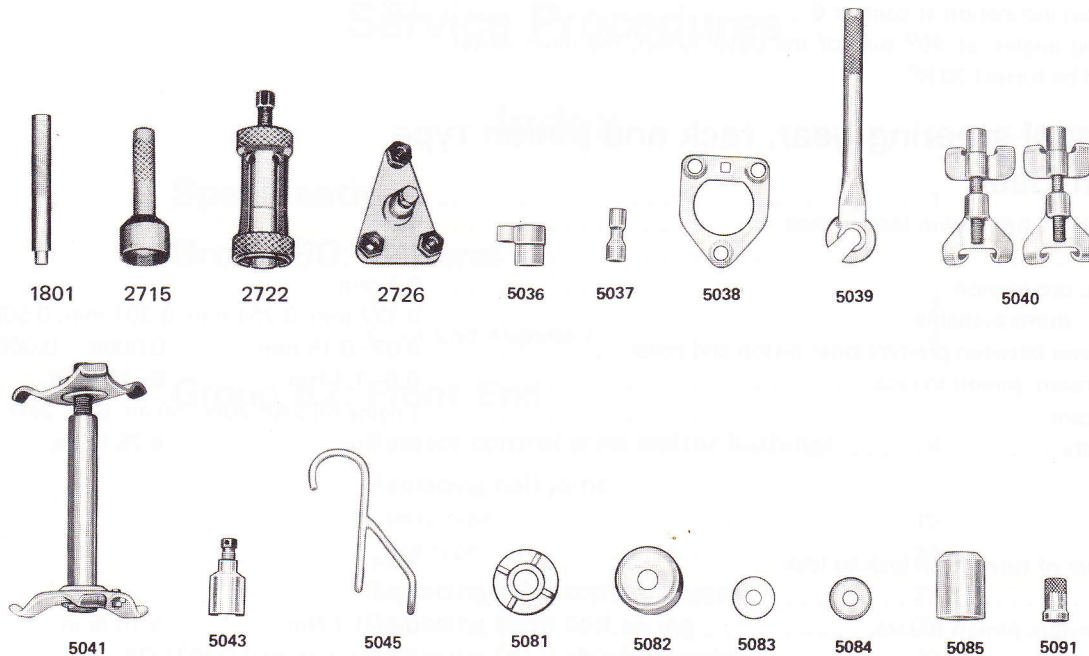
Max. pressure .....	7–8 MPa	1000–1150 psi
Theoretical pumped volume at 500 rpm .....	6.65 l/m	7 Qt/minute
Drive ratio .....	1:1	

## Torques

Nut for ball joint (in strut) .....	50–70 Nm	35–50 lb.ft.
Bolts, retaining ball joint, late type .....	18–28 Nm	15–20 lb.ft.
Steering wheel nut .....	40–60 Nm	30–45 lb.ft.



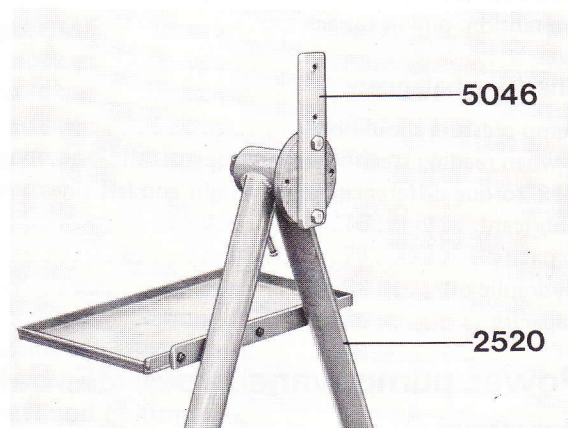
## Group 60 General Tools



### Tools, front end and front end suspension

999—

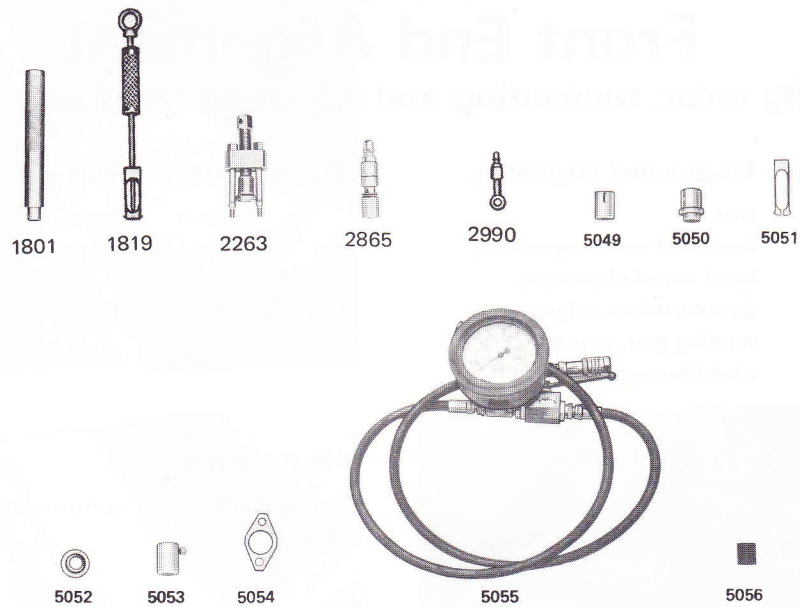
- 1801 **Standard handle**, 18x200 for drifts
- 2715 **Drift**, removing/installing grease cup on hub
- 2722 **Puller** for inner front bearing race
- 2726 **Puller**, front wheel hub
- 5036 **Wrench**, shock absorber nut
- 5037 **Retaining tool**, shock absorber rod
- 5038 **Adjustment tool**, front end alignment
- 5039 **Spanner**, shock absorber nut
- 5040 **Spring compressor**, used in pairs
- 5041 **Spring compressor**
- 5043 **Puller**, steering rod
- 5045 **Retaining hook**, supporting when replacing shock absorbers
- 5081 **Sleeve**, removing/installing control arm rear bushing
- 5082 **Sleeve**, installing control arm rear bushing
- 5083 **Drift**, removing control arm rear bushing
- 5084 **Drift**, installing control arm front bushing
- 5085 **Sleeve**, removing/installing control arm front bushing
- 5091 **Drift**, removing control arm front bushing



### Tools, steering gear removed

999—

- 2520 **Stand**
- 5046 **Fixture**, to retain steering gear on stand



## Tools, power steering gear

999—

- 1801 **Standard handle**, 18x200 mm for drifts
- 1819 **Puller**, bearing in steering gear housing
- 2263 **Puller**, steering wheel
- 2865 **Connecting nipple**, oil pressure gauge
- 2990 **Connecting nipple**, oil pressure gauge
- 5049 **Sleeve**, adjusting balance
- 5050 **Drift**, installing seal and bearing in valve housing cover

- 5051 **Puller**, seal and bearing in valve housing cover
- 5052 **Drift**, installing bearing in steering gear housing
- 5053 **Connecting sleeve**, when gauging pinion torque
- 5054 **Cover ring**, adjusting balance
- 5055 **Pressure gauge**, oil pressure test
- 5056 **Sleeve**, installing rack seal

## Tools, manual steering gear

999—

- 1801 **Standard handle**, 18x200 mm for drifts
- 2263 **Puller**, steering wheel
- 2734 **Drift**, installing cover seal
- 2993 **Drift**, installing rack bushing
- 4078 **Puller**, rack bushing
- 5047 **Puller**, lower pinion bearing
- 5048 **Drift**, installing lower pinion bearing
- 5053 **Connecting sleeve**, when gauging pinion torque
- 5119 **Sleeve**, pinion cover and pre-tensioning device piston (ZF steering gear)



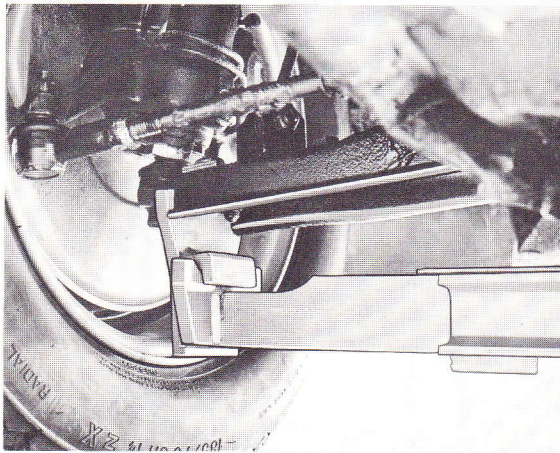
## Group 60

# Front End Alignment

### Checking wear, measuring and adjusting front end alignment

#### Op. No. 60120: Front wheel alignment,

Incl.:  
front end wear inspection,  
front wheel alignment,  
steering wheel, align,  
steering gear, adjust,  
wheel bearing, adjust



#### Op. No. 60106: Toe-in

check and adjust  
incl. tire pressure check

#### Op. No. 60152: Front end alignment,

check and adjust

#### Hoist the front end

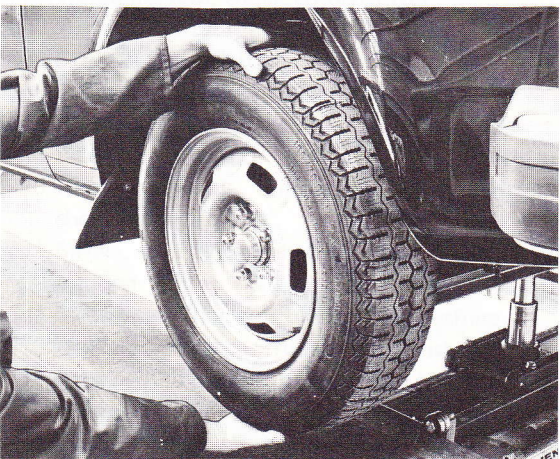
Support under the control arms, close to the ball joints.



#### Check steering rod joints and steering gear for play.

Jerk the wheels in positions 3 o'clock and 9 o'clock.  
No steering rod play is permitted.

Max. play for rack: 0.08" (2 mm)

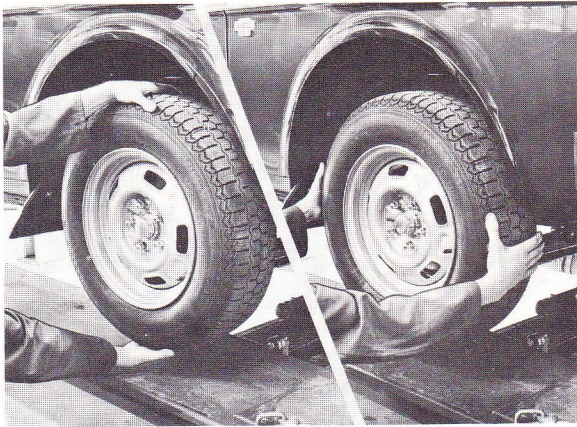


#### Check wheel bearings, shock absorber mounts and strut upper attachment for play and wear.

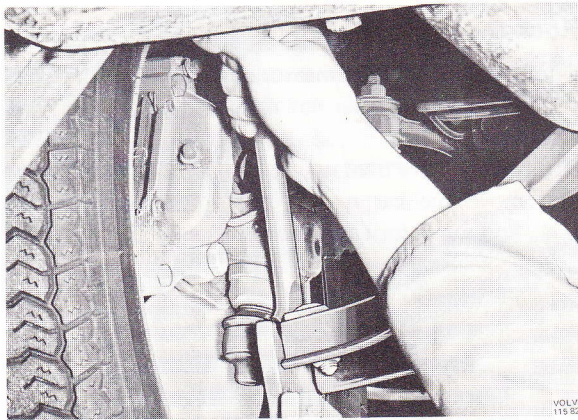
If there is wheel bearing play, the wheel bearings should be serviced immediately.

Play in mounts and attachments may indicate looseness.





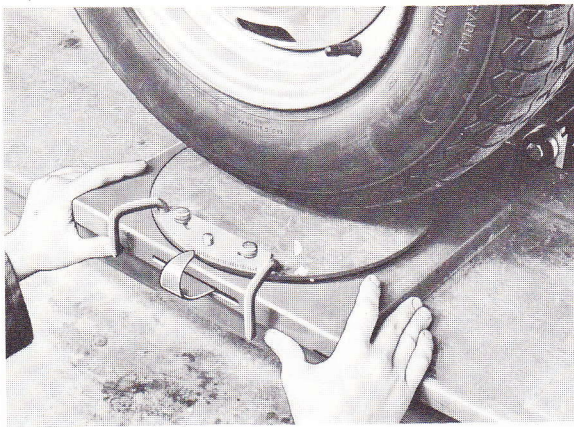
**Check other side for play and wear**



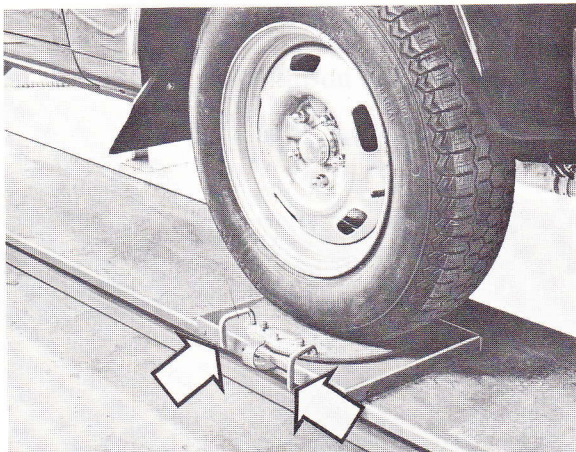
**Check ball joints for play.**

Maximum permitted axial play is 5 mm (0.2 in.)

Use heavy screwdriver or bar.

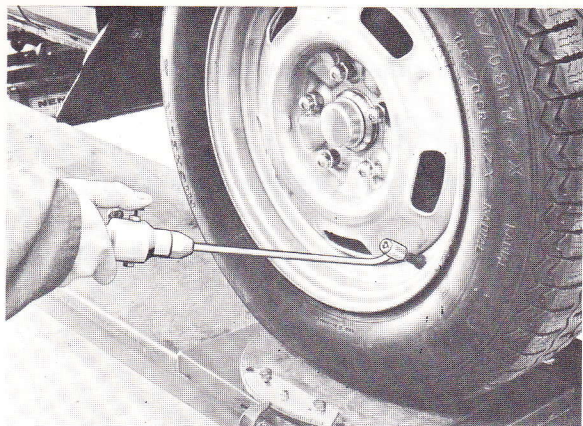


**Place turn tables under front wheels.**

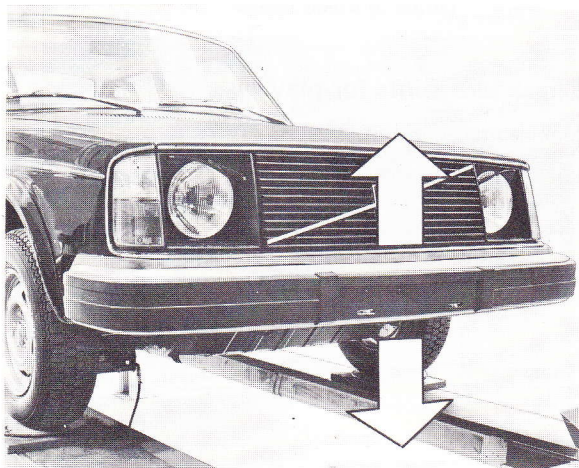


**Lower front end and remove catches for the turn tables.**





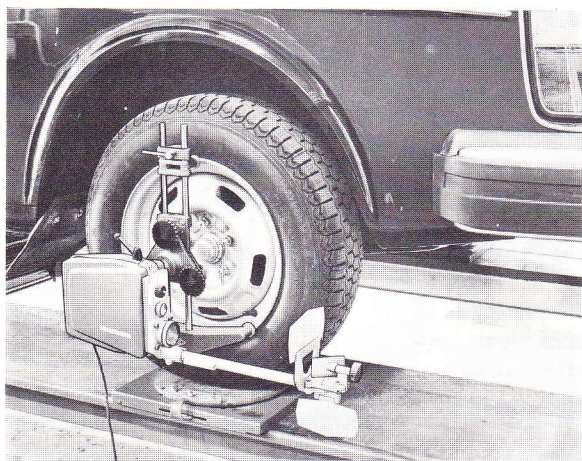
**Check tire pressure and correct if necessary.**



**Rock the front end heavily several times.**

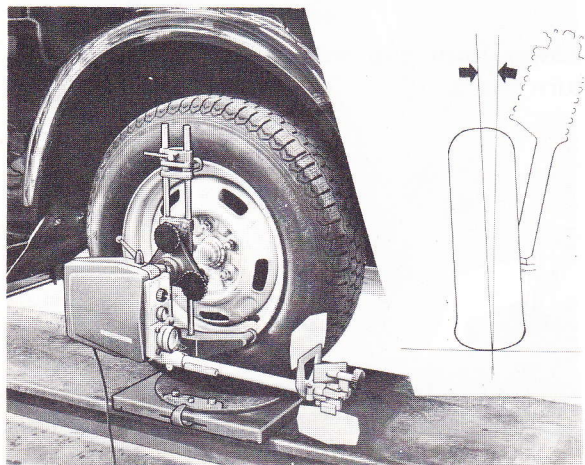
Otherwise the camber measurements will be excessive as the control arms do not return to correct position after hoisting.

If turn tables are used which do not stand side forces, first move the car rearwards from the turn tables, rock, and move forwards again.



**Fit projectors.**

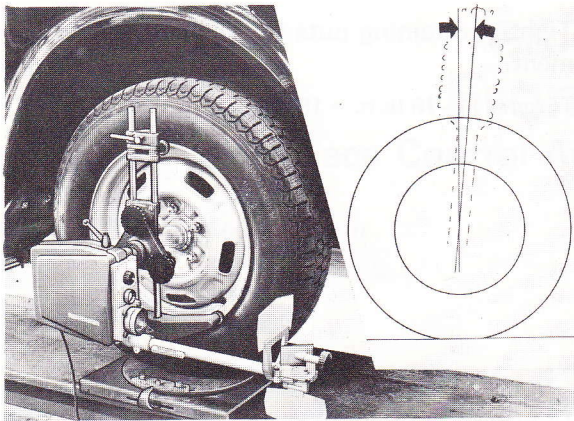
If compensation for wheel warp is made with front wheels hoisted, front end must be rocked heavily several times in order to restore correct position.



**Check camber on both sides.**

**Correct camber:  $+1^{\circ}$  to  $+1.5^{\circ}$**

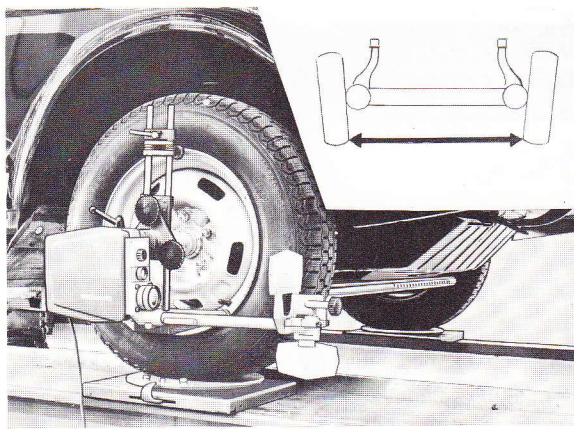




### Check caster on both sides.

Caster cannot be adjusted. If outside specifications, check front end parts for damages or misalignment.

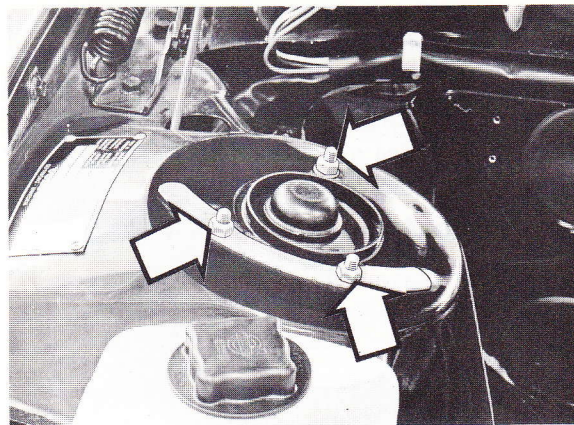
Correct caster:  $+2^{\circ}$  to  $+3^{\circ}$ ..



### Attach wheel spreader and measure toe-in.

### To adjust, proceed as follows:

Loosen the retaining nuts for the strut upper attachment.

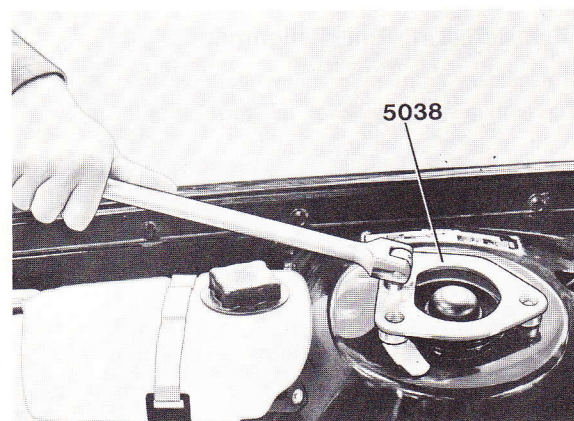


13 mm

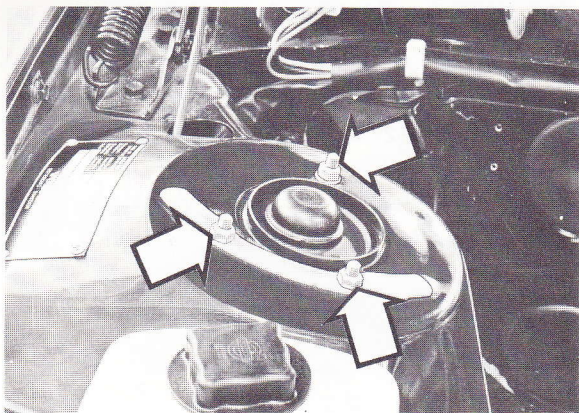
### Adjust camber.

Use tool 9995038 and adjust camber.

Correct camber:  $+1^{\circ}$  to  $+1.5^{\circ}$ .



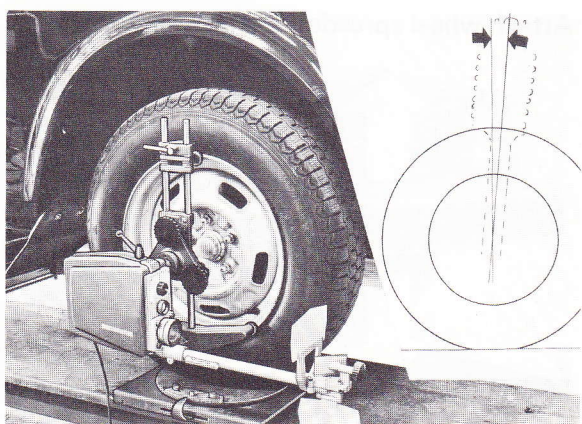




**Tighten retaining nuts for strut upper attachment.**

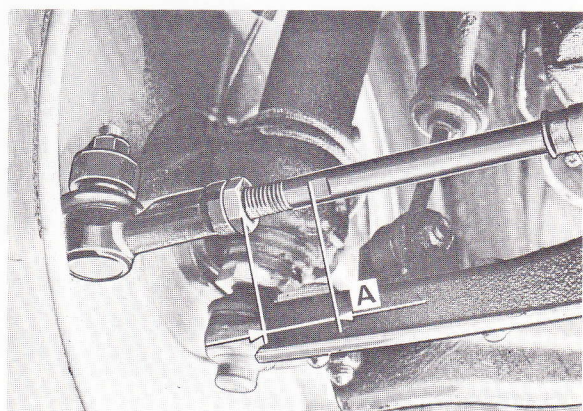
**Torque: 11–18 lb.ft. = 15–25 Nm**

**13 mm**



**Re-check caster.**

**Correct caster: +2° to +3°.**



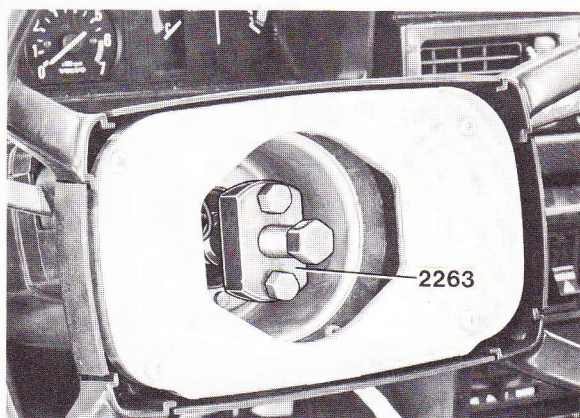
**Adjust toe-in.**

To adjust, loosen lock nuts and turn the steering rods. Use 22 mm and 11 mm.

Length of steering rods may not differ more than 2 mm (0.08"). Measure from groove to lock nut (A).

**Correct toe-in: 4.5–7.5 mm 0.18–0.30 in.**

**Lock nut, 22 mm**



**Check steering wheel alignment.**

If necessary, adjust steering wheel position.

To remove steering wheel, use tool 9992263.

**Restore**

**Nut, 27 mm**

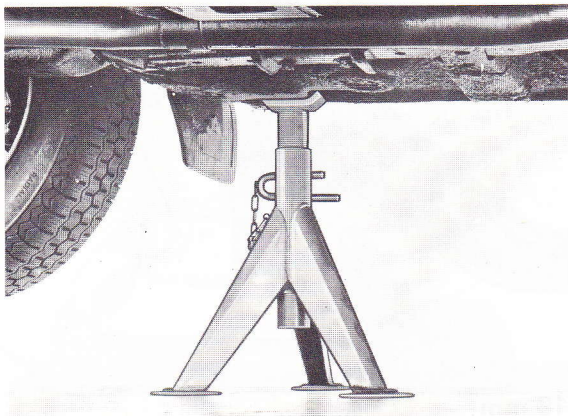


## Group 62 Front End

### Replace Control Arms and/or Bushings

Op. No. 62208: control arm  
replace one side

Op. No. 62228: control arm shaft or bushings  
replace one side

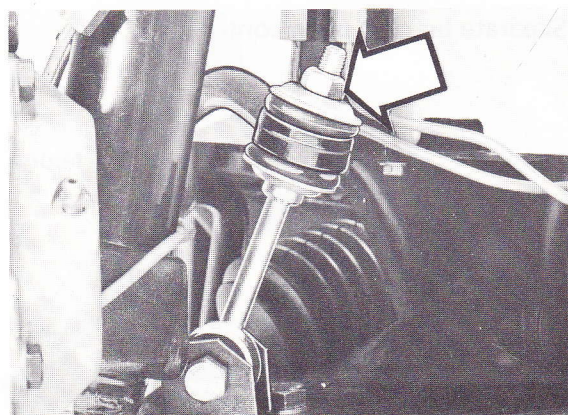


**Put front end on stands.**

Position the stands at the front jack attachment.

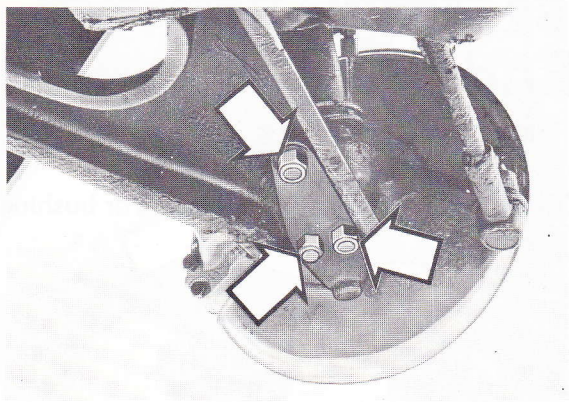


**Remove wheel.**



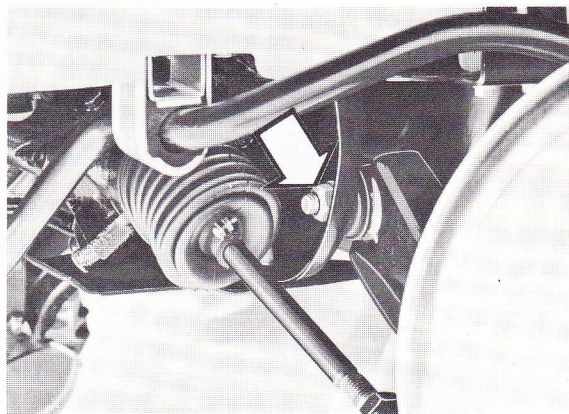
**Disconnect stabilizer bar from link.**

17 mm



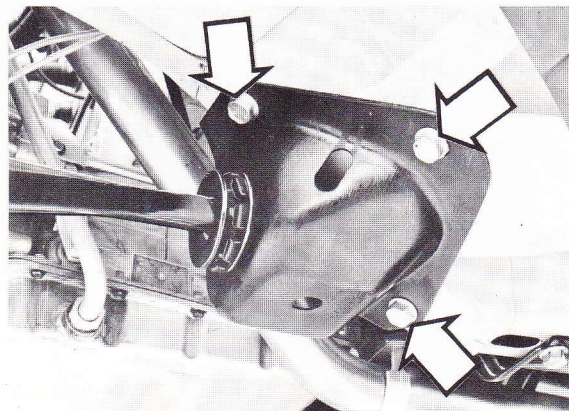
**Disconnect ball joint from control arm.**

**19 mm**



**Remove control arm front retaining bolt.**

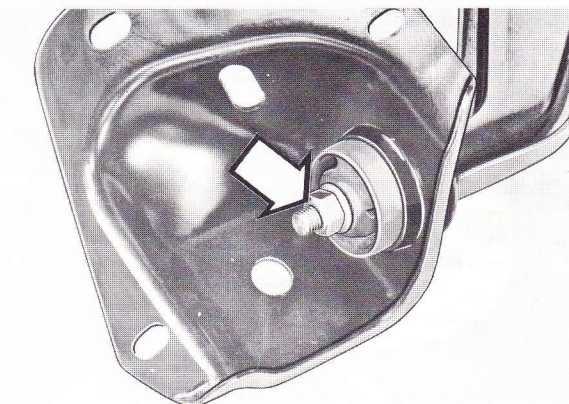
**19 mm**



**Remove control arm rear attachment.**

Separate bracket from member and lower the control arm.

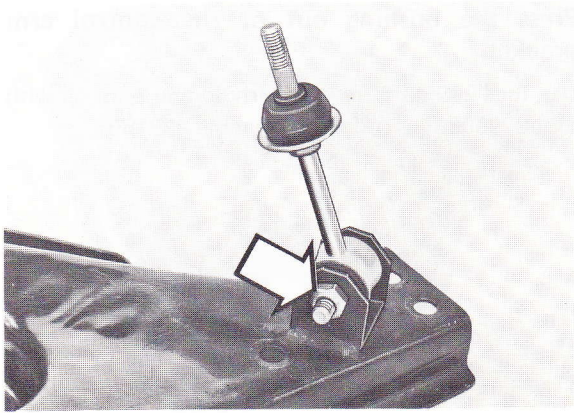
**14 mm**



**Separate bracket from control arm.**

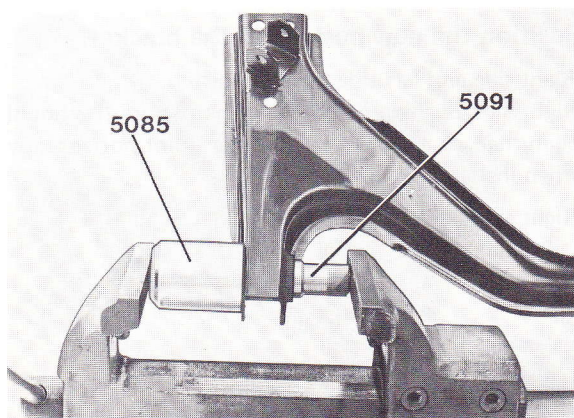
**19 mm**





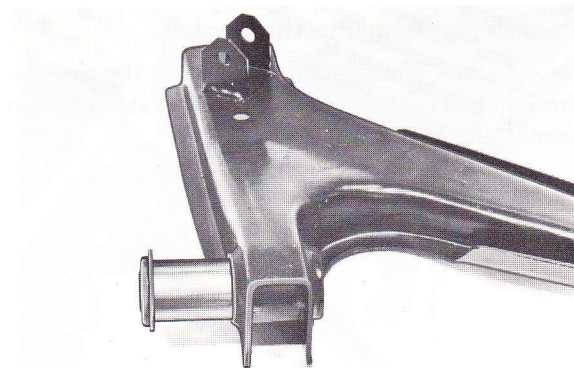
**Separate link from control arm.**

**17 mm**



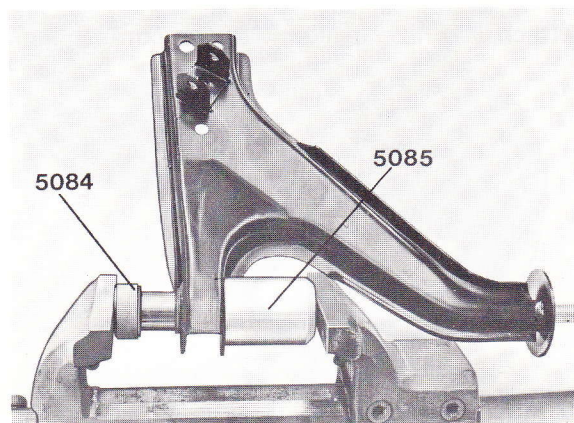
**Press out control arm bushing.**

Position adapter 9995085 on the flanged end of the bushing. Press out the bushing with driver 9995091.



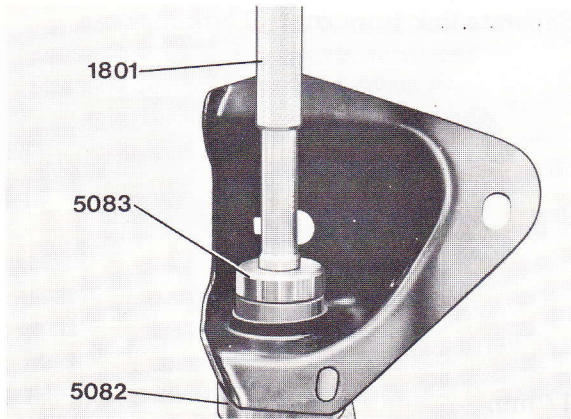
**Position the new bushing in the control arm.**

The bushing flanged end should point from the control arm.



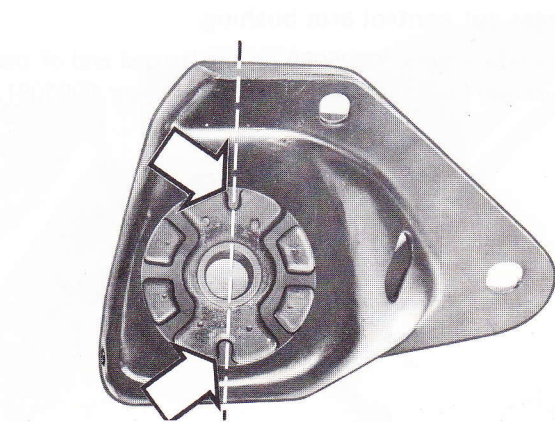
**Press in the new bushing.**

Use adapter 9995085 and driver 9995084.



**Press the bushing out of the control arm bracket.**

Use tool 9995082 for counterhold and press in with tool 9995083 extended with handle 9991801.



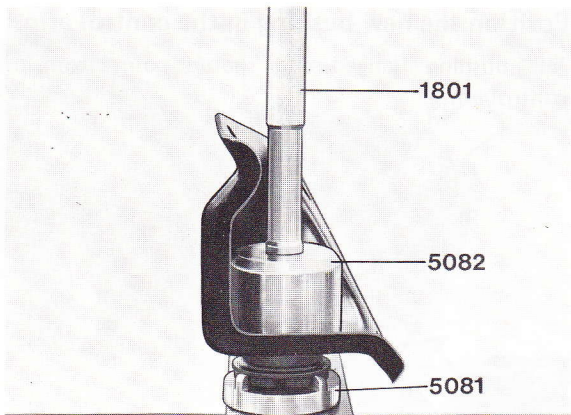
**Position the new bushing in the bracket.**

Right side and left side bushings differ.

Right side bushing is shown in the picture. It should be turned so that the small slots point horizontally when installed on vehicle.

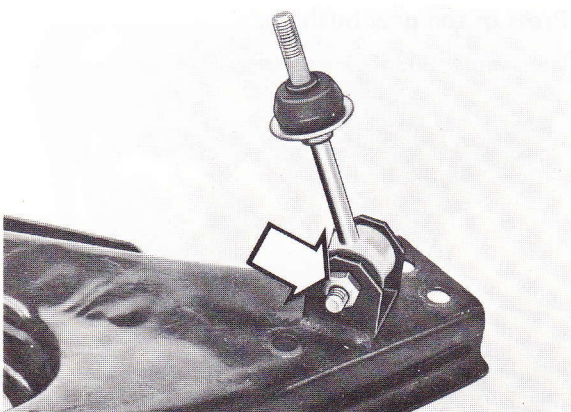
Right side bushing: P/N 1205826

Left side bushing: P/N 1221982



**Press the bushing into the bracket.**

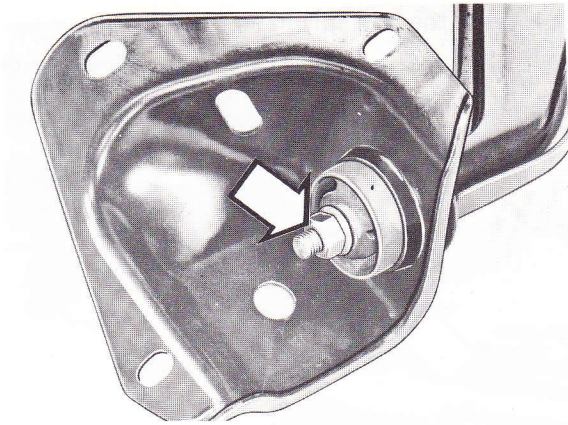
Place adapter 9995081 on the bushing flanged side. Press on bracket with driver 9995082 extended with handle 9991801.



**Attach stabilizer bar link to the control arm.**

17 mm

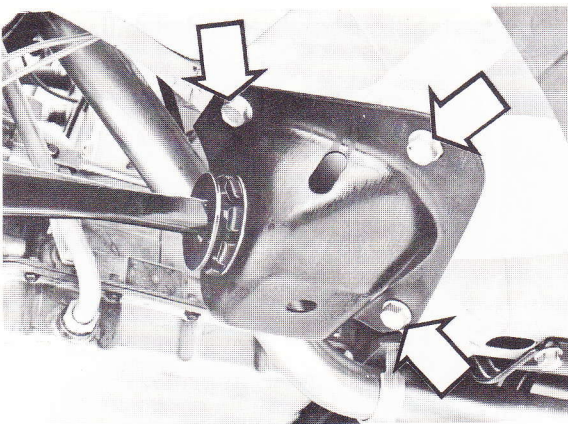




**Install bracket.**

Do not tighten the nut.

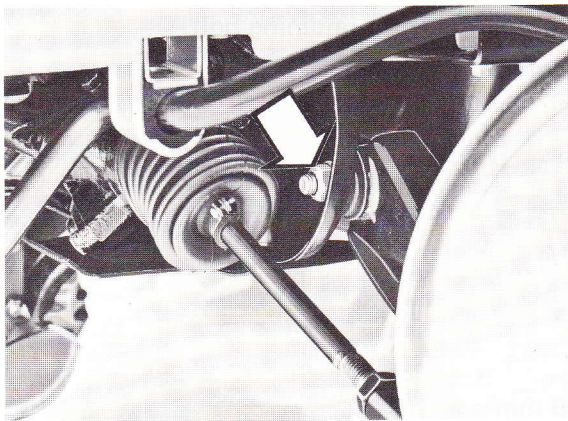
**19 mm**



**Position rear end of control arm.**

Fit the bracket bolts but do not tighten.

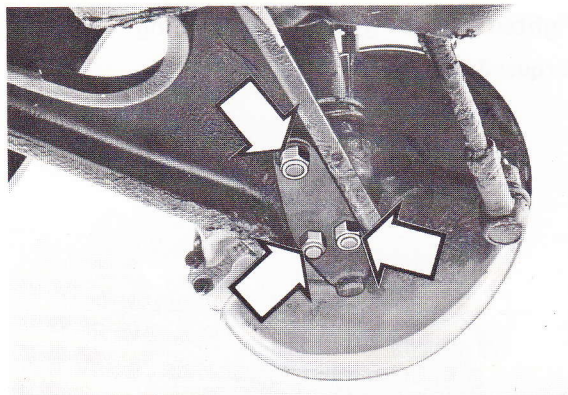
**14 mm**



**Fit front retaining bolt.**

Do not tighten the nut.

**19 mm**

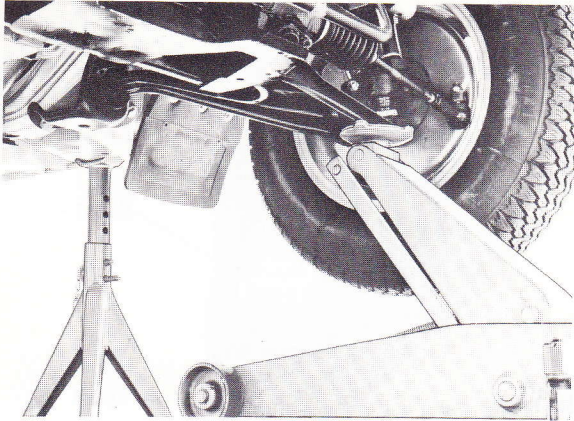


**Attach ball joint to control arm.**

Torque: 7–9 lb.ft. (= 95–130 Nm)

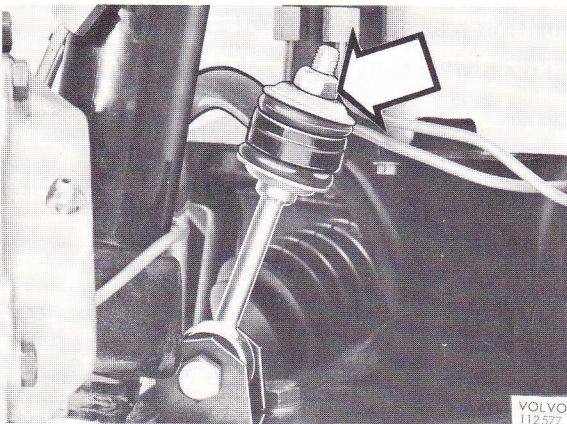
**19 mm**





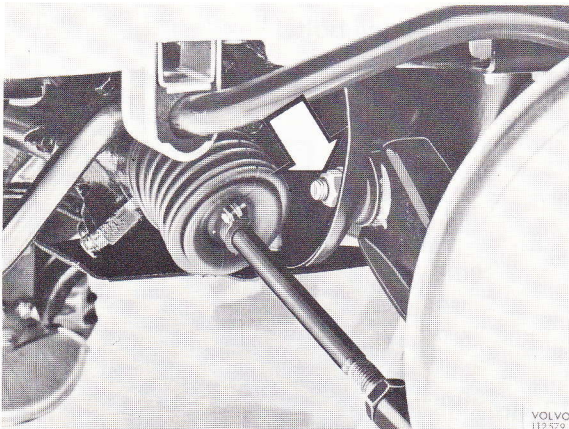
### Compress the coil spring

Position a jack under the outer end of the control arm. Jack up, and compress the spring.



Connect stabilizer bar link and stabilizer bar.

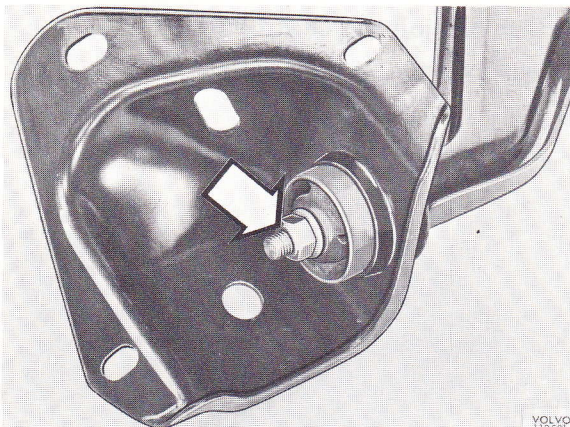
17 mm



Tighten the front retaining bolt.

Torque 40–70 lb.ft. = 55–95 Nm

19 mm

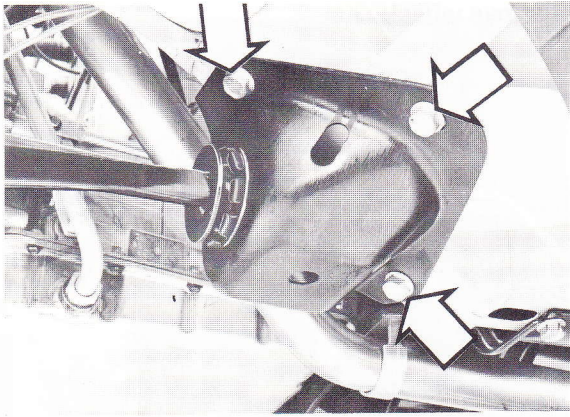


Tighten the nut for the rear bushing

Torque: 3.6–4.3 lb.ft. (= 50–60 Nm)

19 mm

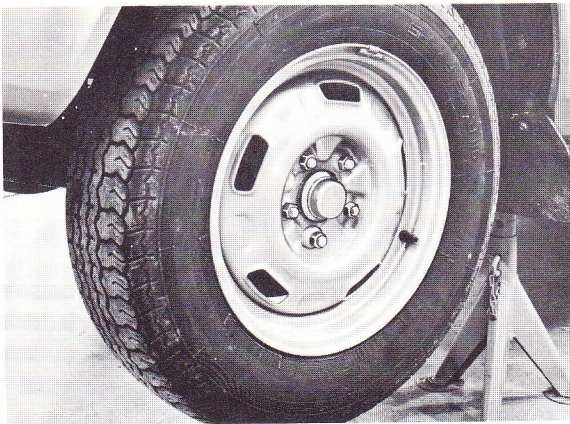




**Tighten the bracket bolts**

**Torque: 22–36 lb.ft. = 30–50 Nm**

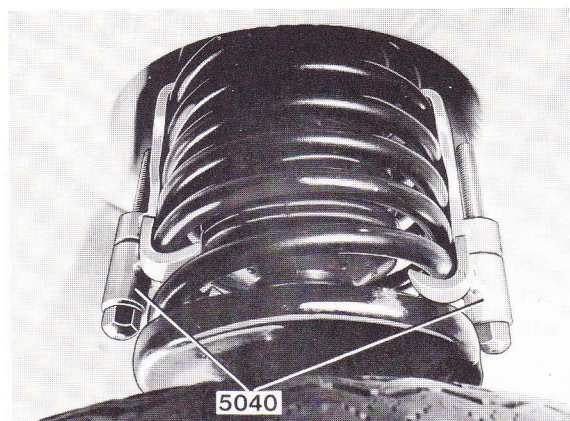
**14 mm**



**Install the wheel and lower the vehicle.  
Restore.**

## **Replacing ball joint Early type**

**Op. No. 62154**



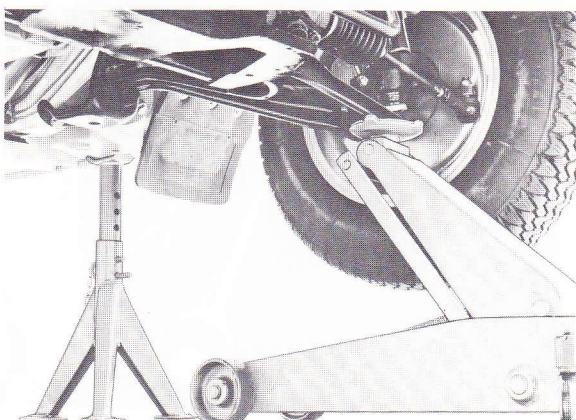
**Compress the spring.**

Hook on spring compressor 9995040. Catch five (5) coils.



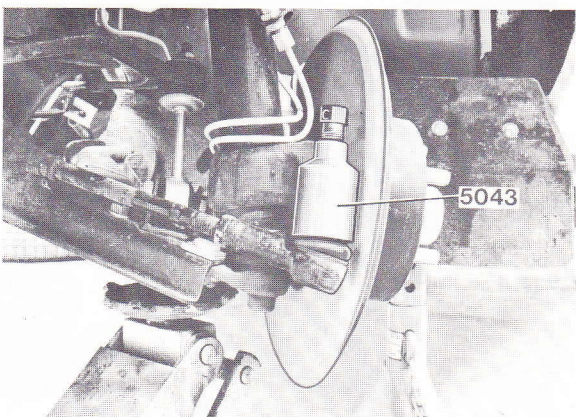


**Remove wheel.**



**Put front end on stands.**

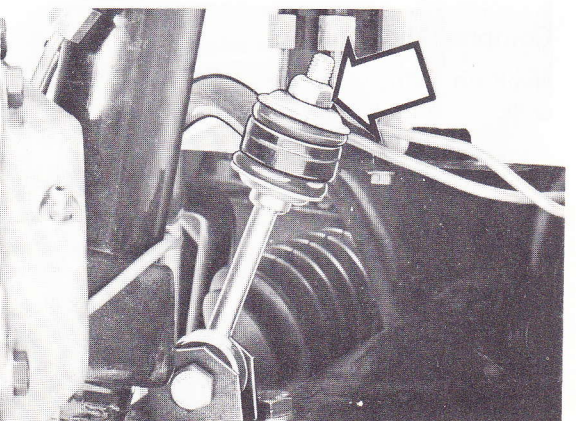
Position the stands at the front jack attachment.



**Disconnect steering rod from steering arm.**

Use tool 9995043.

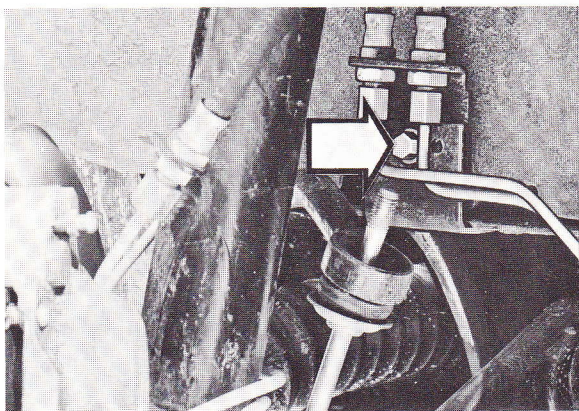
**Steering rod nut, 19 mm**



**Disconnect stabilizer bar from link upper attachment.**

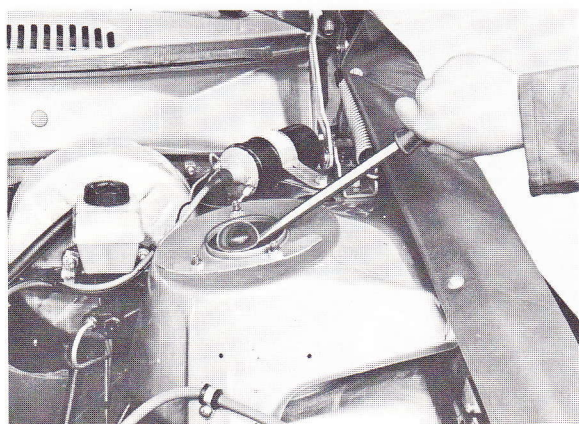
**17 mm**



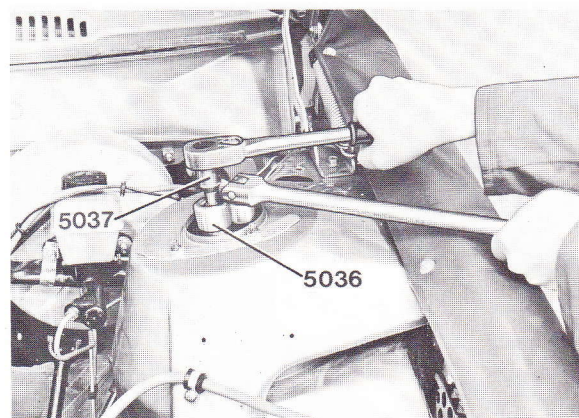


Remove the bolt for the brake line bracket.

13 mm



Remove cover for the spring and strut assembly upper attachment.

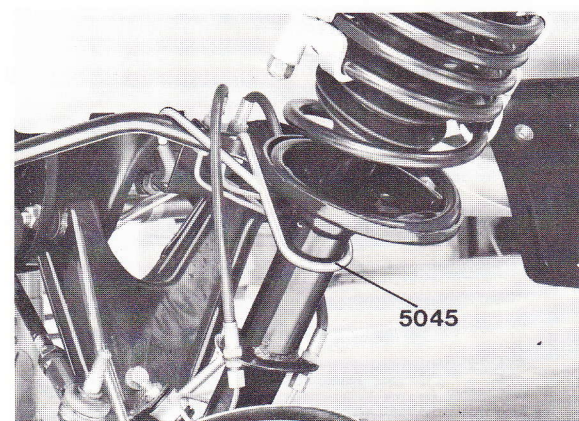


Remove center nut.

Use tool 9995036 to loosen the nut while retaining with tool 9995037.

Can also use an impact wrench and tool 5036.

**NOTE:** place tape on upper fender well and use fender protection to avoid paint damage.



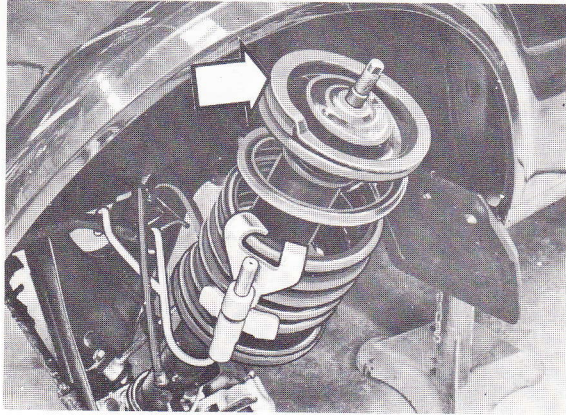
Lower the jack and hook up the strut assembly.

Support the strut assembly when lowering the jack so that brake lines and hoses do not get damaged.

Hook up tool 9995045 to the strut assembly and the stabilizer bar.

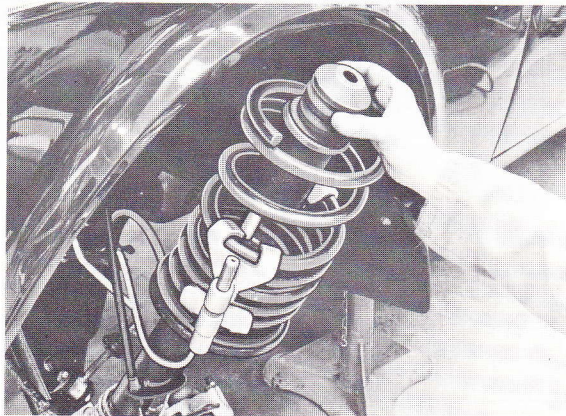
Catch 5 coils.



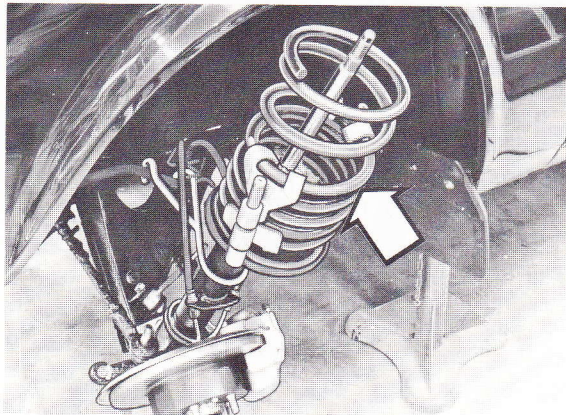


#### **Remove spring seat.**

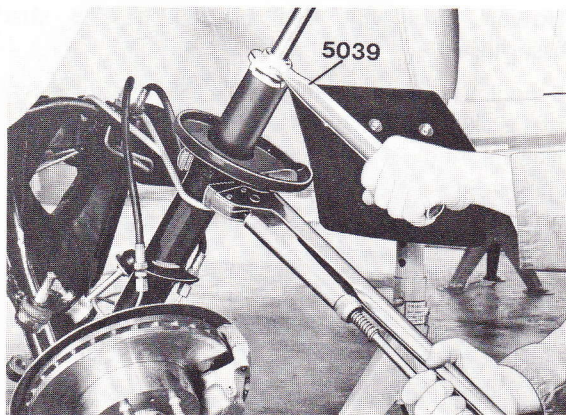
NOTE: watch that fender well. Use tape to protect.



#### **Remove rubber bumper and shock absorber protection.**



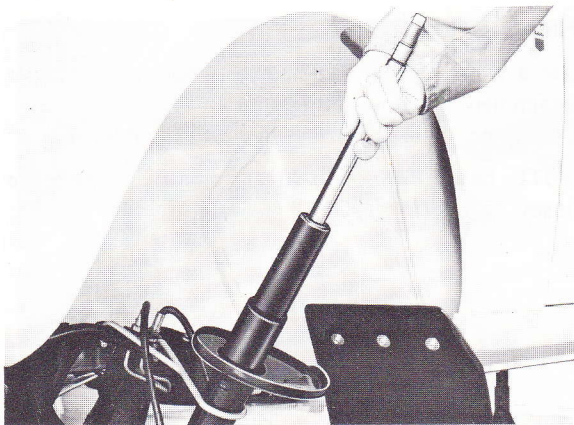
#### **Remove coil spring.**



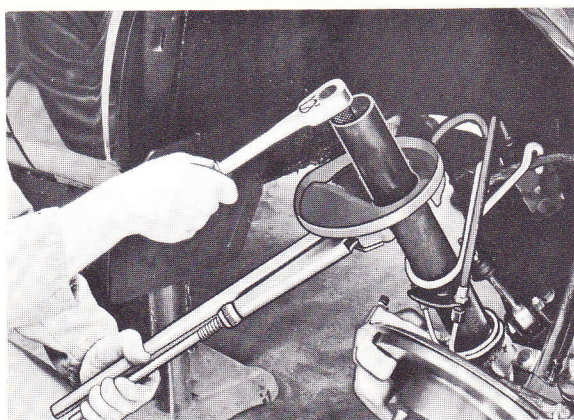
#### **Remove shock absorber retaining nut.**

Use tool 9995039 to loosen the nut while retaining strut outer casing with a plier wrench at the weld.



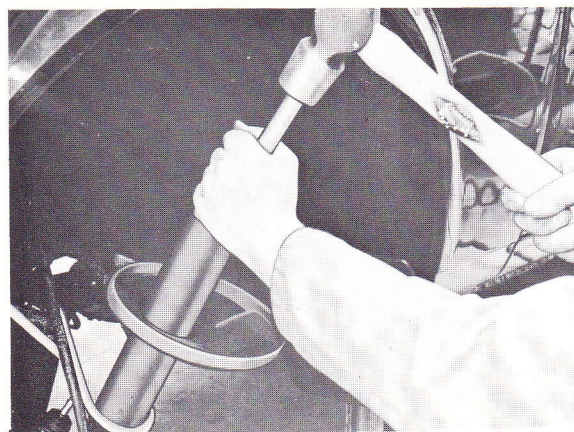


**Pull the shock absorber out of the housing.**



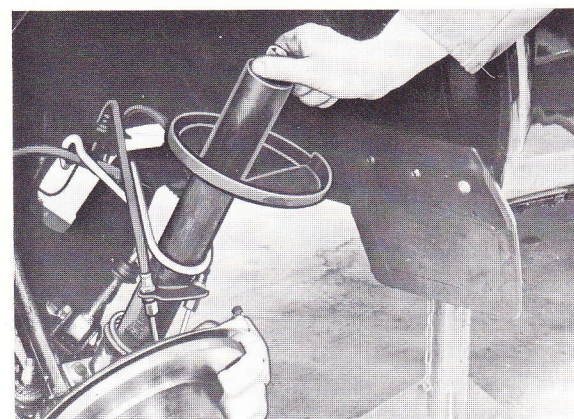
**Loosen the ball joint retaining nut.**

Loosen the nut a few turns until the ball joint bracket comes loose. Use a 19 mm socket with extension. Retain with a plier wrench at the weld.



**Loosen ball joint conical part from strut assembly.**

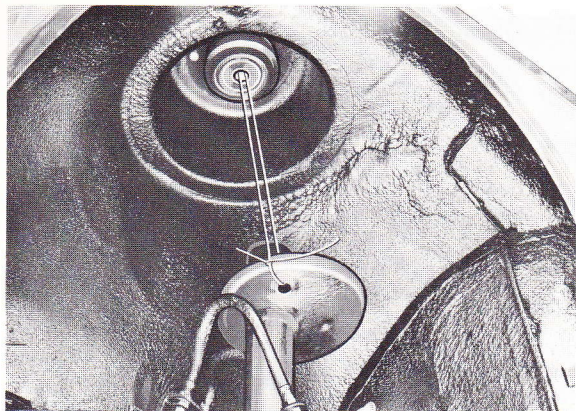
Use drift and hammer.



**Unscrew nut.**

Use extension and a 19 mm socket. Coat the inside of the socket with vaseline so that the nut can be picked up when it comes loose from the threads.



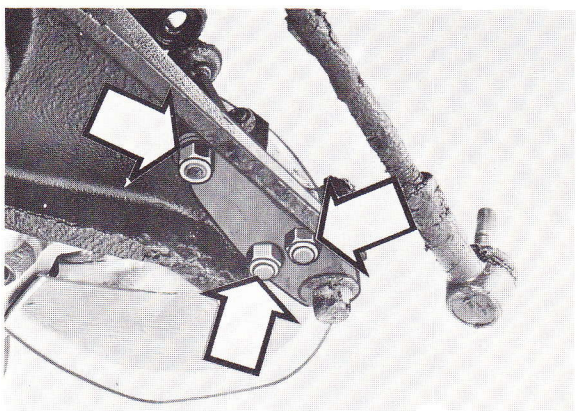


### **Hang up the strut assembly.**

Use a wire to hang the strut assembly to the upper attachment. Remove the hook.

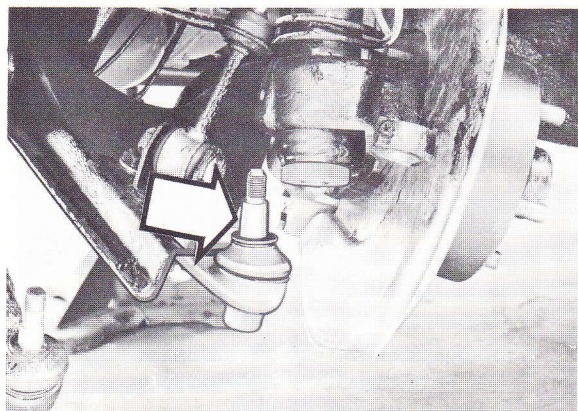
Disconnect ball joint from the strut assembly.

NOTE: be careful not to stretch or damage the brake hoses.



### **Disconnect ball joint from control arm.**

19 mm



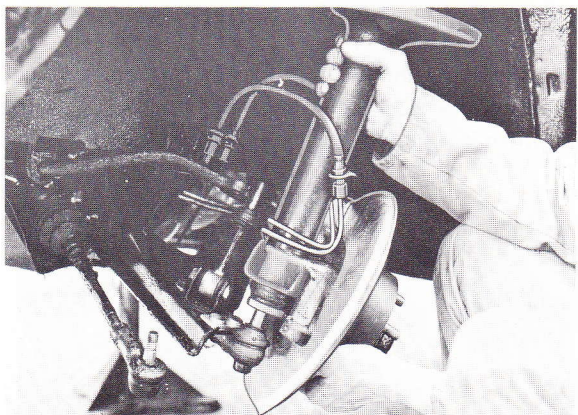
### **Attach the new ball joint to the control arm.**

NOTE: the ball joint stud must be cleaned so that it is free from grease.

Otherwise the stud can be tightened too far into the cone so that the rubber bellow sticks to the strut.

Torque: 70–95 lb.ft. = 95–130 Nm.

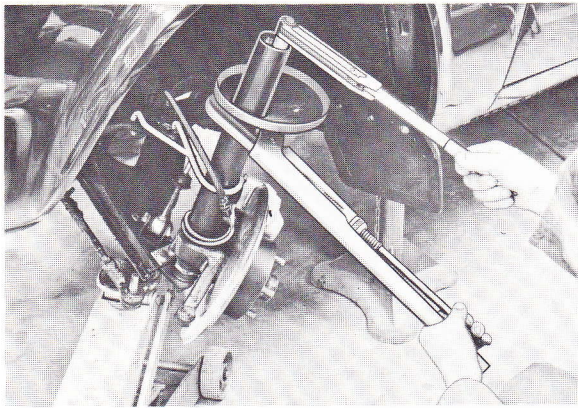
19 mm



### **Lift the strut assembly into position.**

Remove wire and hook up tool 9995045.

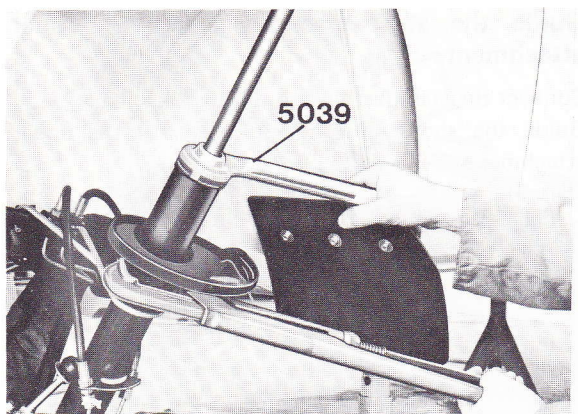




#### **Install ball joint nut.**

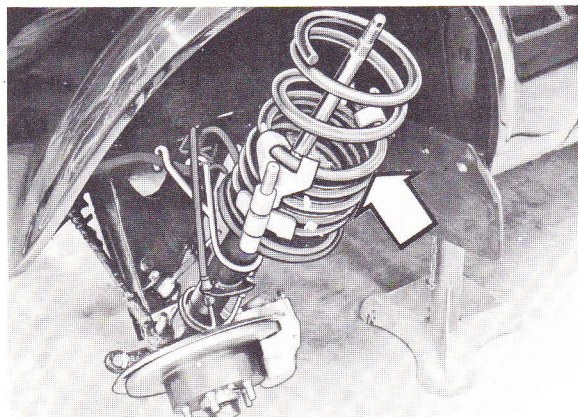
Torque the nut to 5–7 kpm (30–50 lb.ft.).  
Retain with a plier wrench at the casing weld.

#### **19 mm and extension**



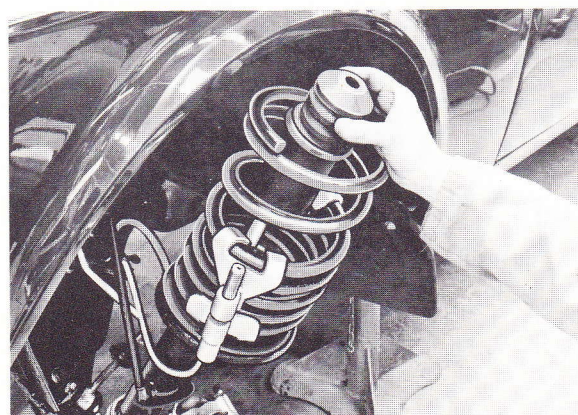
#### **Install shock absorber and retaining nut.**

Tighten the nut with tool 9995039 and retain with a plier wrench at the casing weld. Pull the shock absorber spindle to its uppermost position.



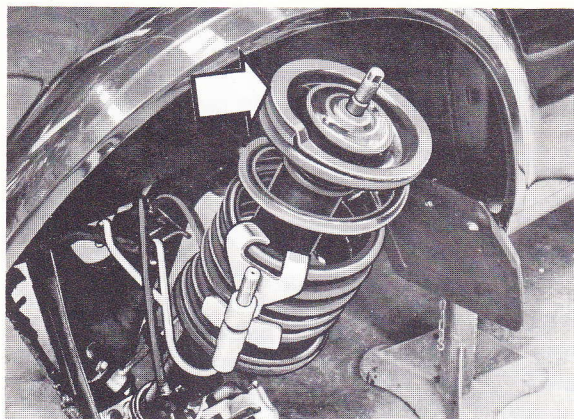
#### **Position the spring on the strut assembly.**

Check that the spring end is correctly aligned on the strut bracket. Tool bolt heads should be down.



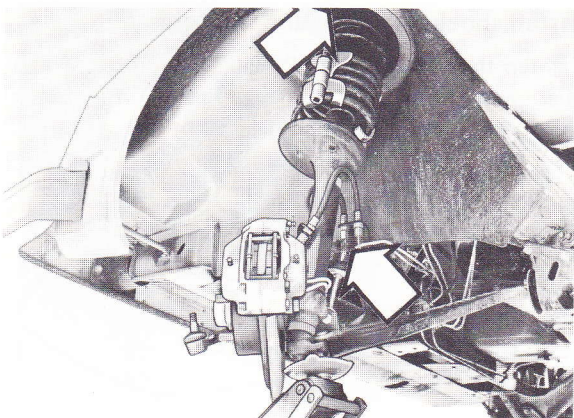
#### **Install rubber bumper and shock absorber protection.**





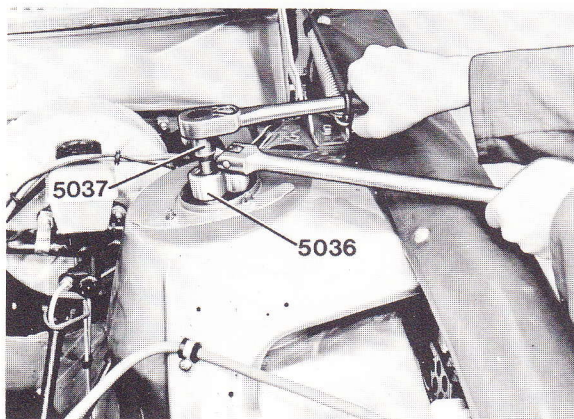
**Position spring seat on spring.**

Check that the seat is correctly aligned on the spring.



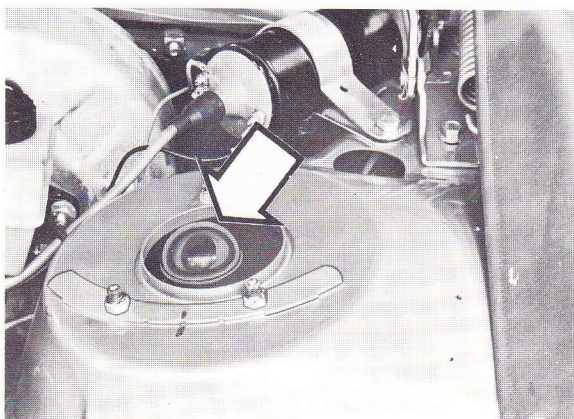
**Guide the strut assembly into the upper attachment.**

Connect the stabilizer link to the stabilizer bar.  
Guide the shock absorber spindle into the upper attachment.  
Raise the jack.



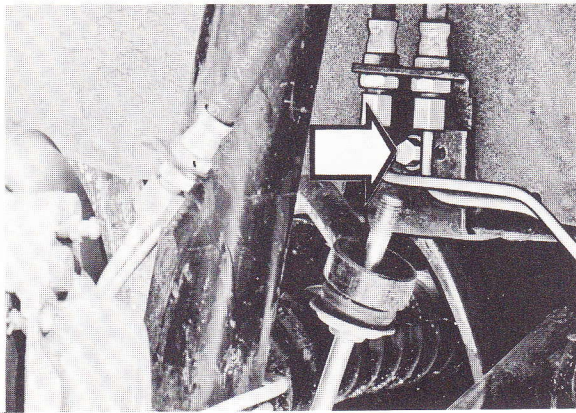
**Install washer and nut on top of shock absorber spindle.**

Tighten the nut with tool 9995036 while retaining with tool 9995037.



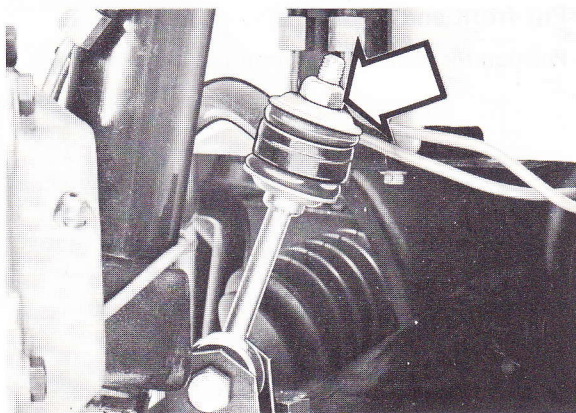
**Install cover for upper attachment.**





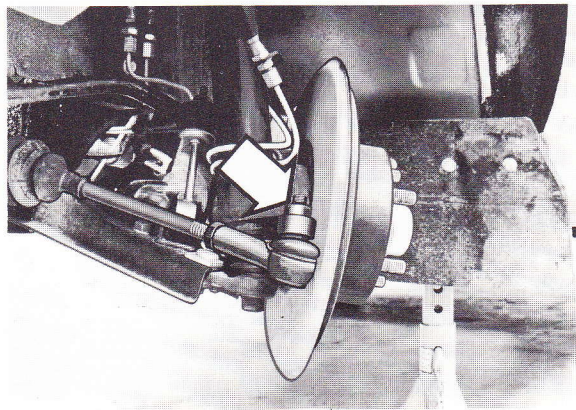
Attach brake line bracket

13 mm



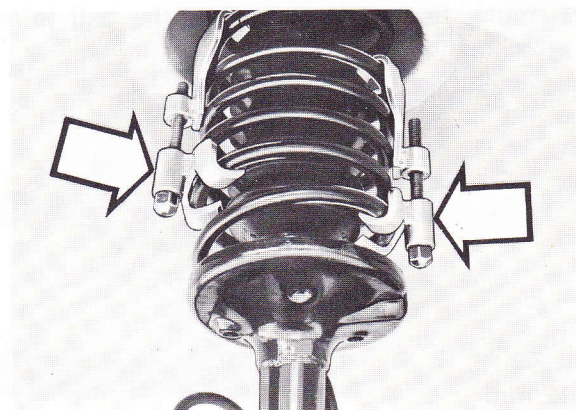
Attach the link to the stabilizer bar.

19 mm



Connect steering rod to steering arm.

19 mm



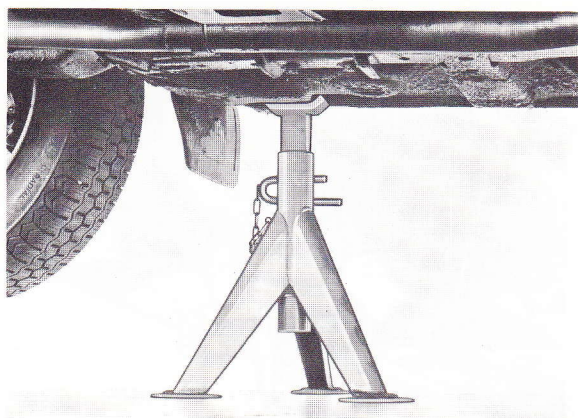
Remove coil spring compressor.

Install wheel.  
Restore.



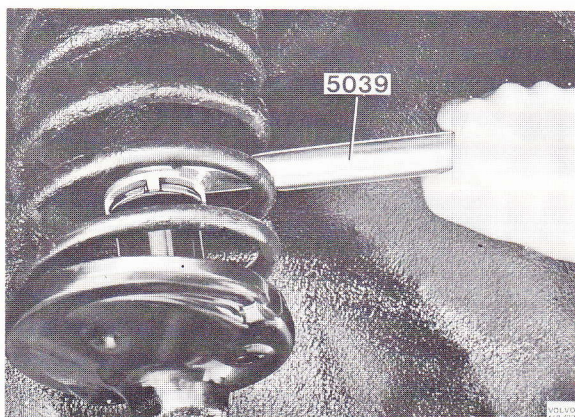
# Replacing ball joint Late type

Op. No. 62154



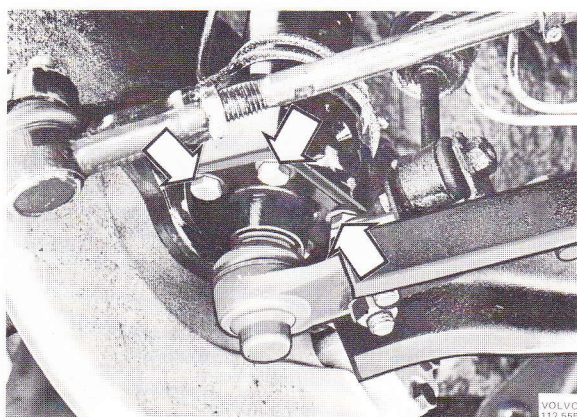
**Put front end on stands**

Position the stands at the front jack attachments



**Slacken the shock absorber cap nut a few turns**

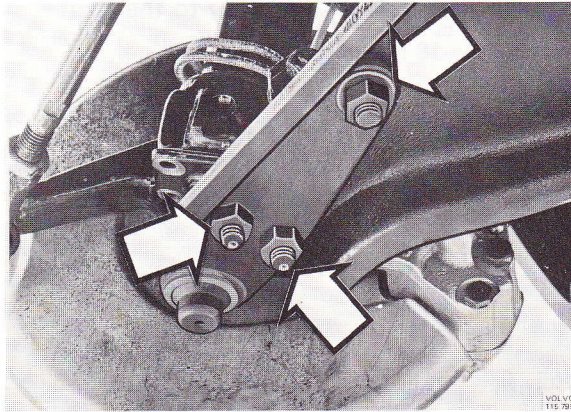
Use tool 9995039.



**Remove four bolts retaining the ball joint attachment**

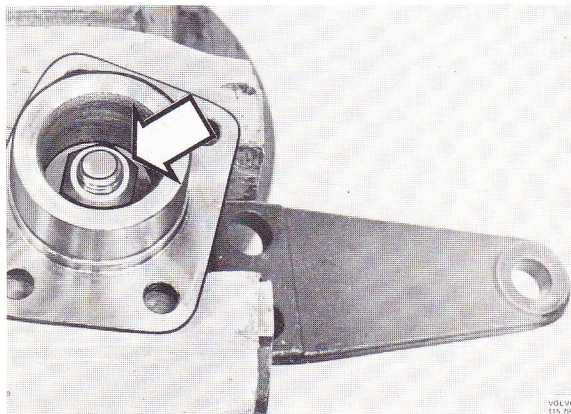
12 mm





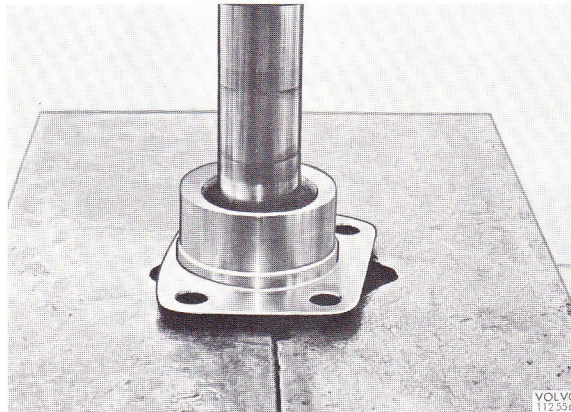
**Remove the ball joint from the control arm**

**19 mm**

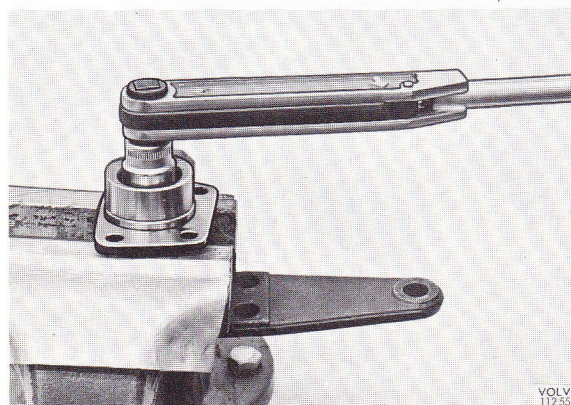


**Remove the ball joint nut**

**19 mm**



**Separate the ball joint from the attachment**



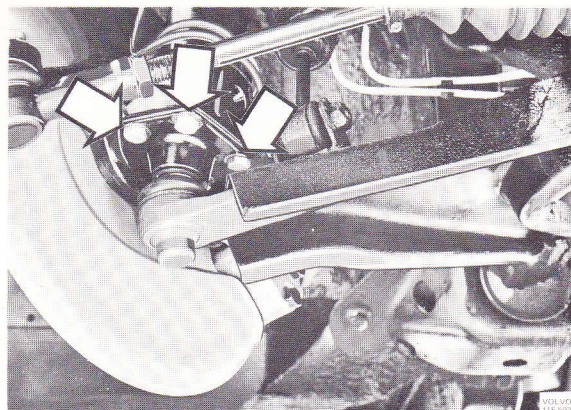
**Attach the new ball joint to the attachment**

**Torque: 35–50 lb.ft. = 50–70 Nm**

**NOTE:** The ball stud must be cleaned from grease. Otherwise it might seat too deeply, causing the rubber bellow to jam on the strut.

**19 mm**

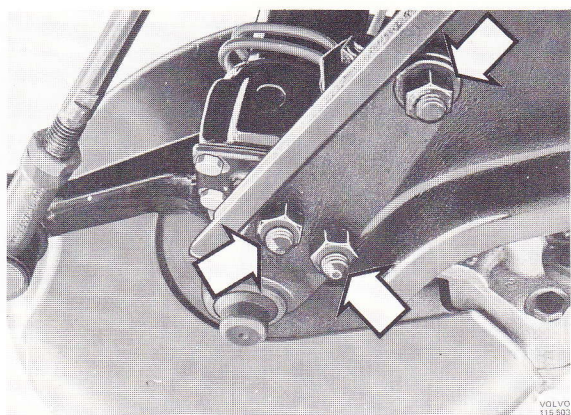




**Attach the ball joint assembly to the strut**

Torque: 11–18 lb.ft. = 15–25 Nm

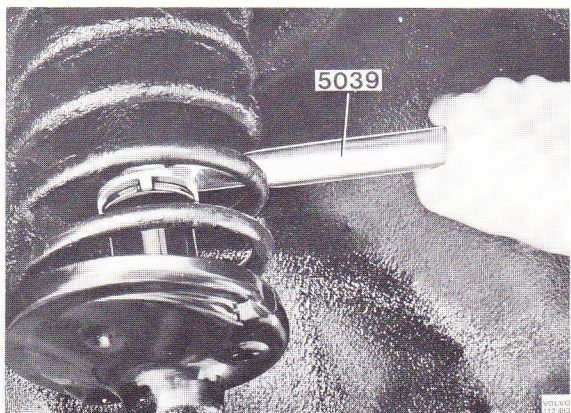
**12 mm**



**Attach the ball joint assembly to the control arm**

Torque: 70–95 lb.ft. = 95–130 Nm

**19 mm**



**Tighten the shock absorber cap nut**

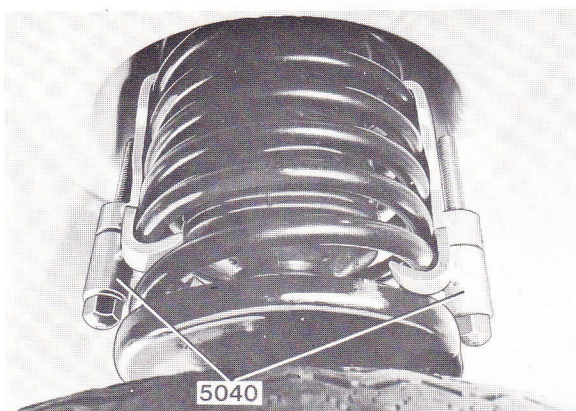
Use tool 9995039



**Restore**



## Replacing strut top attachment

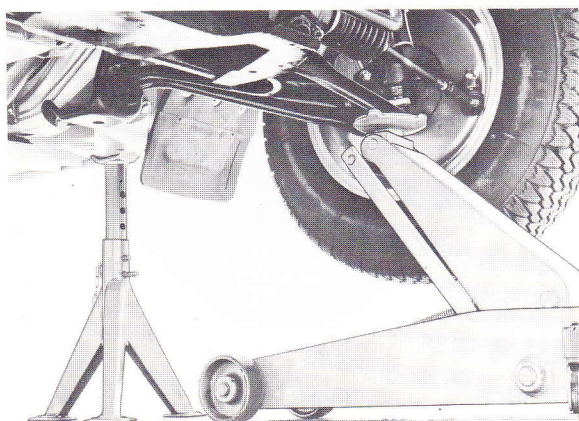


### Compress the spring

Hook on spring compressor 9995040. Catch five coils.



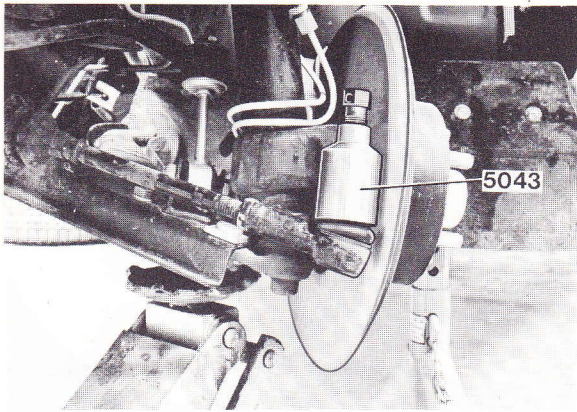
### Remove wheel.



### Put front end on stands.

Position stands at the front jack supports.  
Position a jack to support under the control arm outer end.

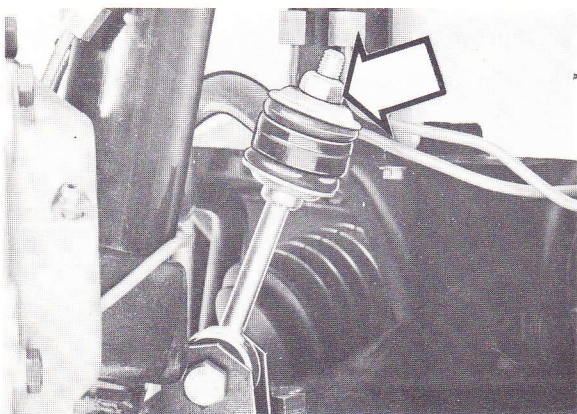




**Disconnect steering rod from steering arm.**

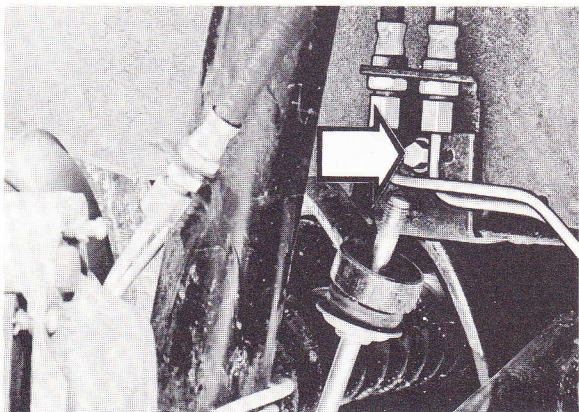
Use tool 9995043.

**19 mm**



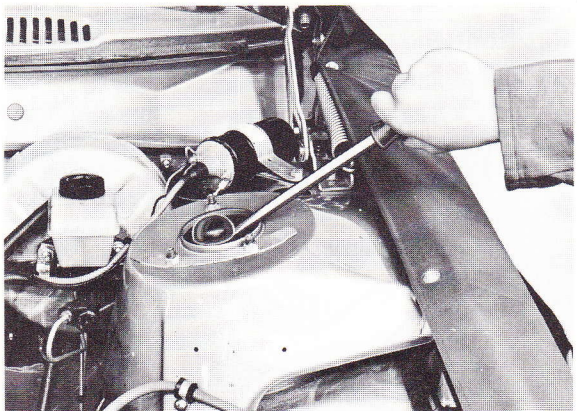
**Disconnect the stabilizer bar from the link upper attachment.**

**17 mm**



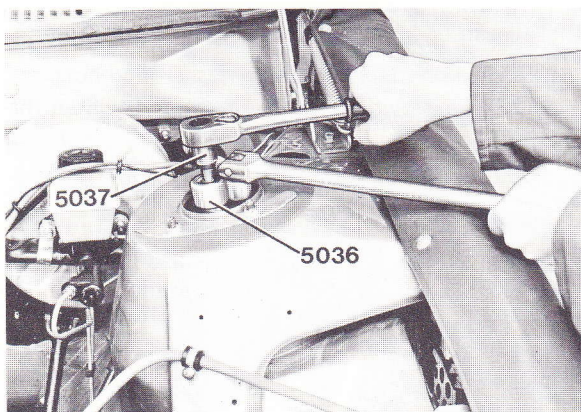
**Remove the bolt for the brake line bracket.**

**13 mm**



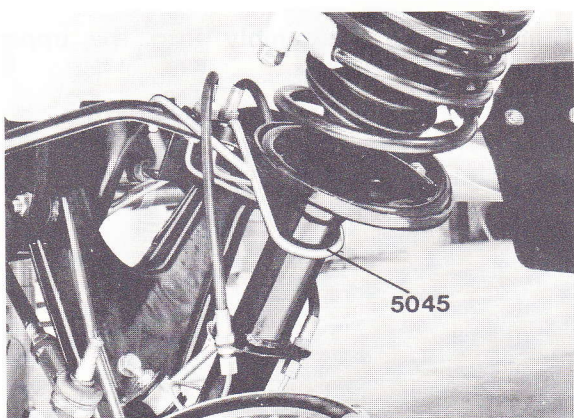
**Remove the cover for spring and strut assembly upper attachment.**





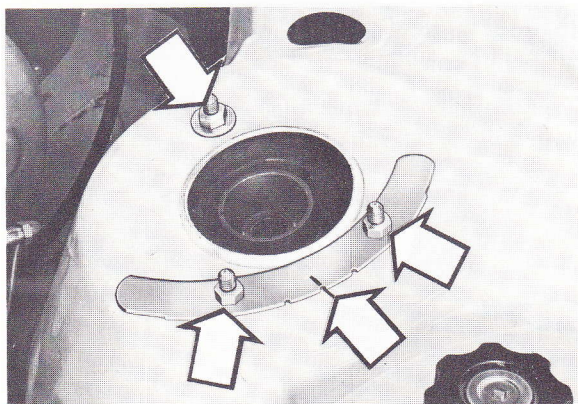
### Remove center nut.

Use tool 9995036 to loosen the nut while retaining with tool 9995037.



### Lower the jack and hook up the strut assembly.

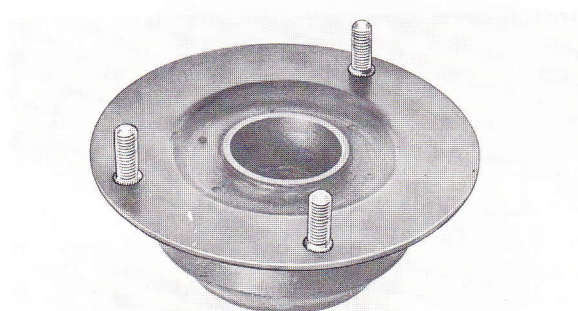
Support the strut assembly when lowering the jack so that brake lines and hoses do not get damaged. Hook up tool 9995045 to the strut assembly and the stabilizer bar.



### Remove upper attachment.

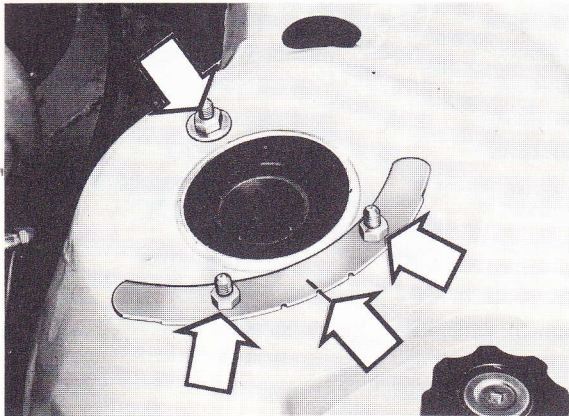
Mark the position of the attachment and then remove the three retaining nuts.

13 mm



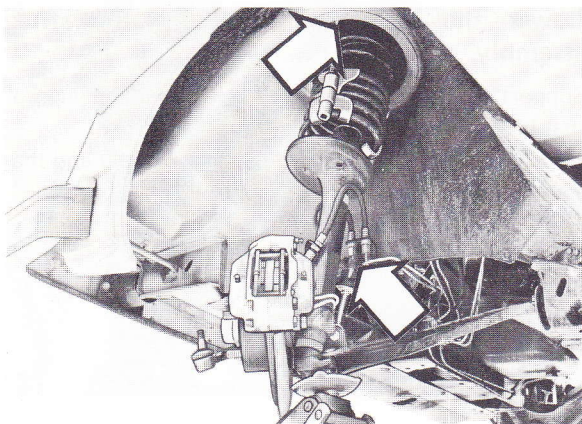
### Replace the attachment assembly.





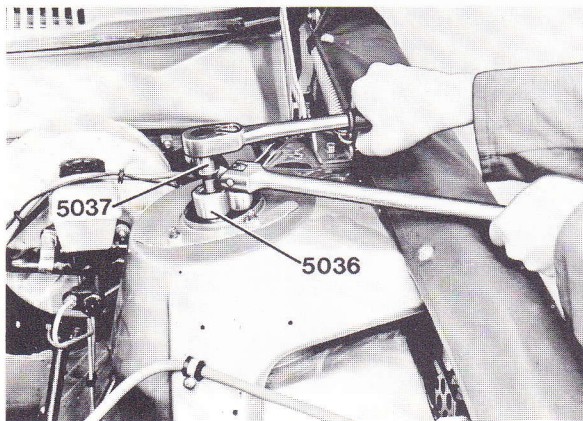
### Install upper attachment.

Install the new attachment with washers and nuts. Align to the previously made marks and tighten the nuts.



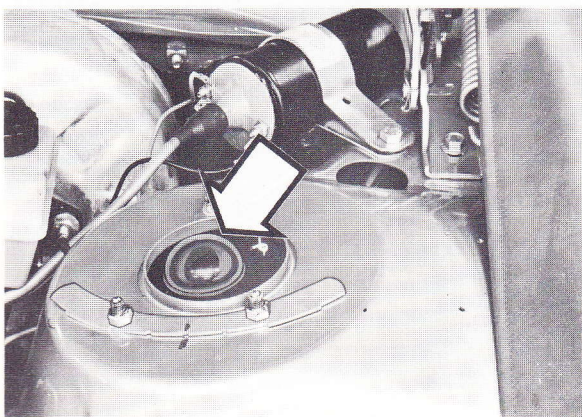
### Guide the strut assembly into the upper attachment.

Connect the stabilizer link to the stabilizer bar. Guide the shock absorber spindle into the upper attachment. Raise the jack.



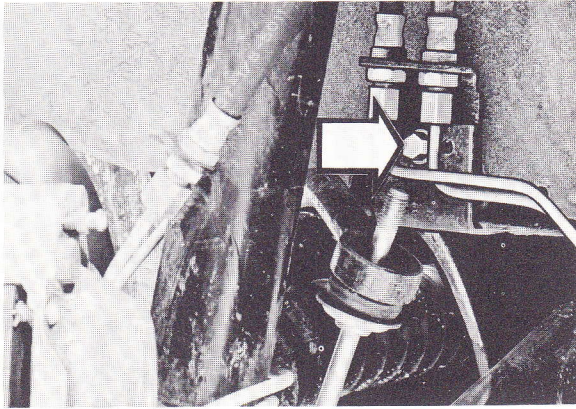
### Install washer and nut on top of shock absorber spindle.

Tighten the nut with tool 9995036 while retaining with tool 9995037.



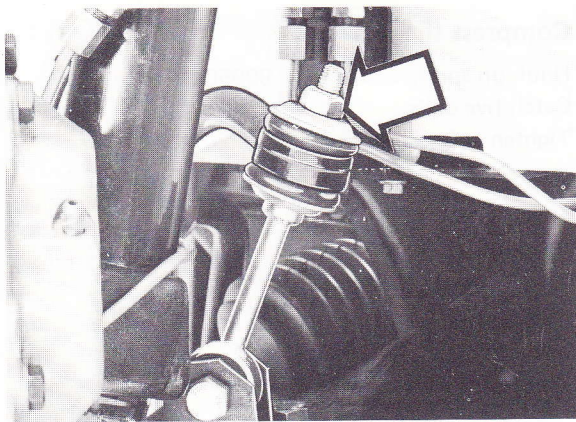
### Install cover for upper attachment.





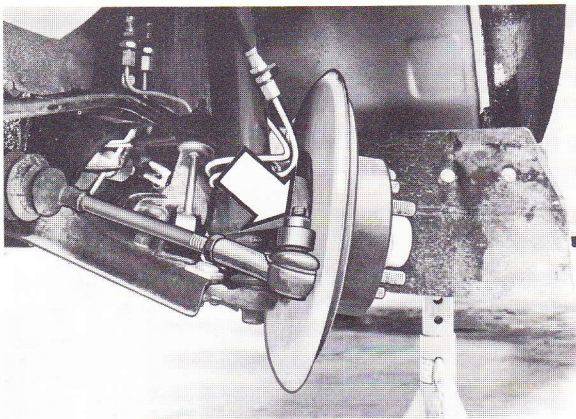
Attach brake line bracket.

13 mm



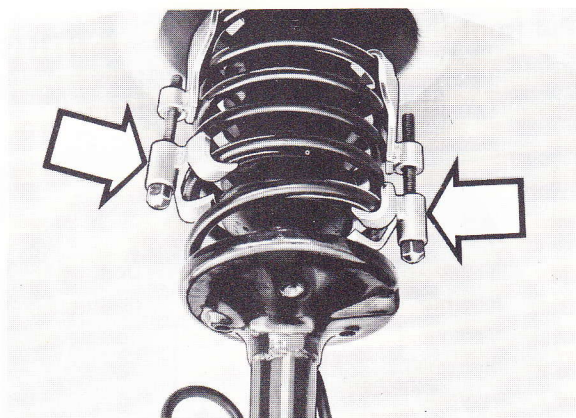
Attach the link to the stabilizer bar.

17 mm



Connect steering rod to steering arm.

19 mm



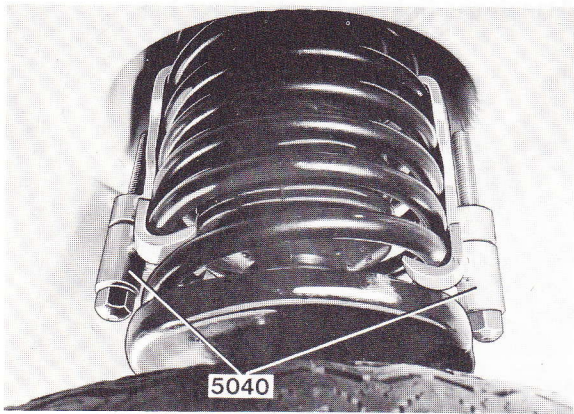
Remove coil spring compressor.

Install wheel.  
Restore.



# Replacing front coil spring

Op. No. 73104

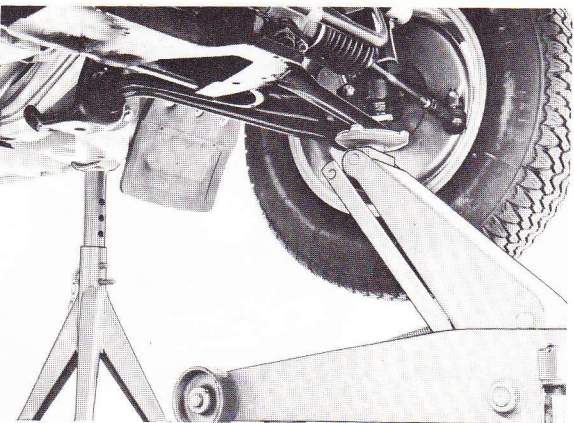


## Compress the spring.

Hook on spring compressor 9995040.  
Catch five coils.  
Tighten before hoisting.



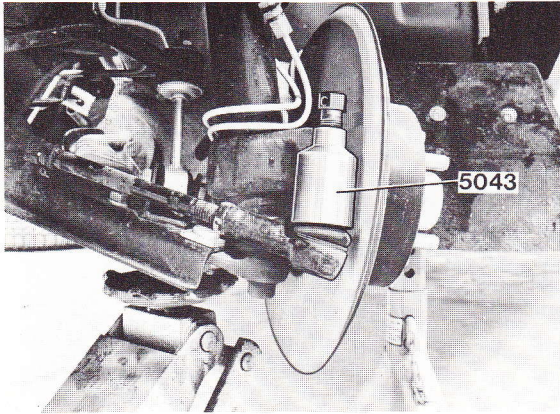
## Remove wheel.



## Put front end on stands.

Position stands at the front jack supports.  
Support with a jack at the control arm outer end.

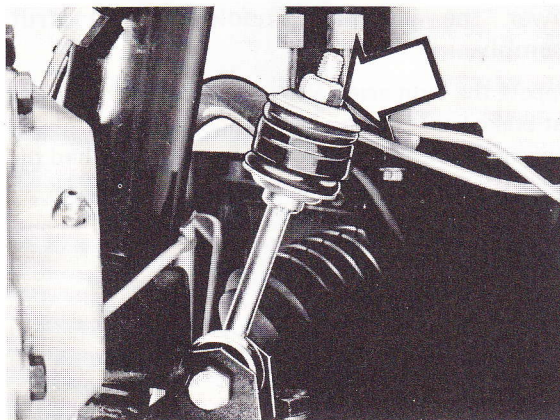




**Disconnect steering rod from steering arm.**

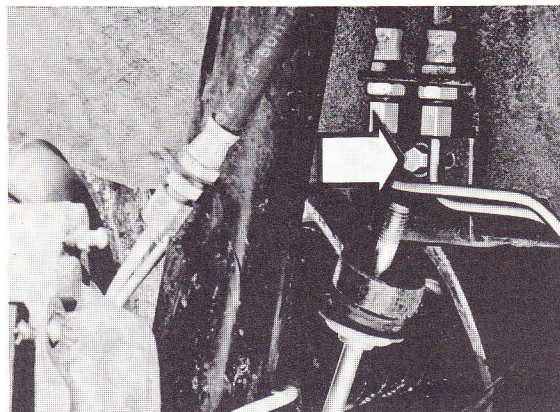
Use tool 9995043.

19 mm



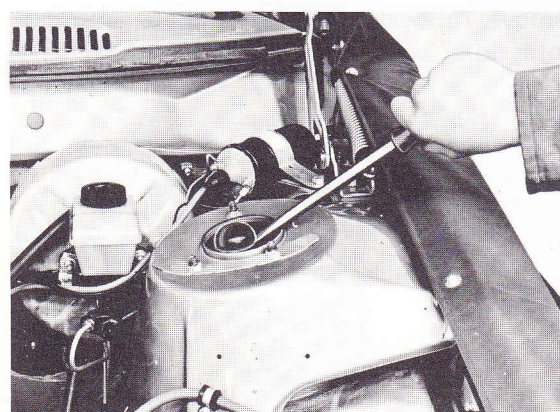
**Disconnect the stabilizer bar from the link upper attachment.**

17 mm



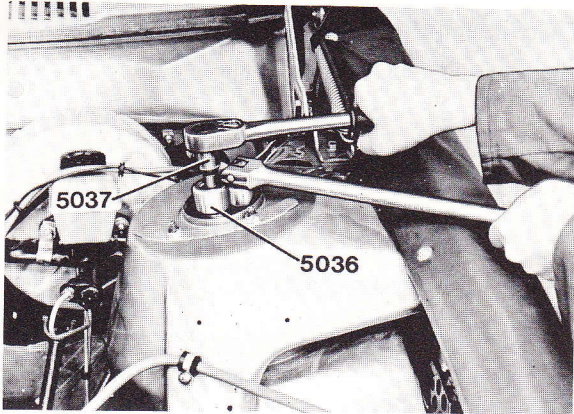
**Remove the bolt for the brake line bracket.**

13 mm



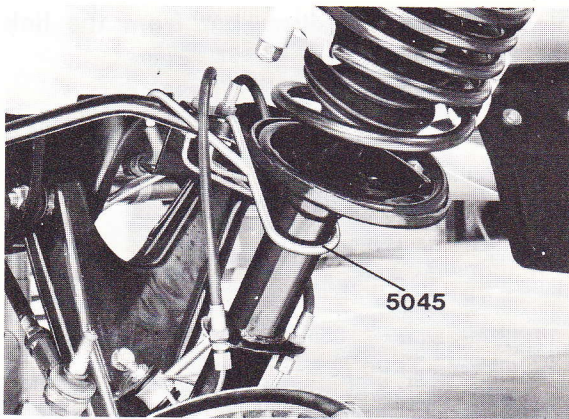
**Remove cover for spring and strut assembly upper attachment.**





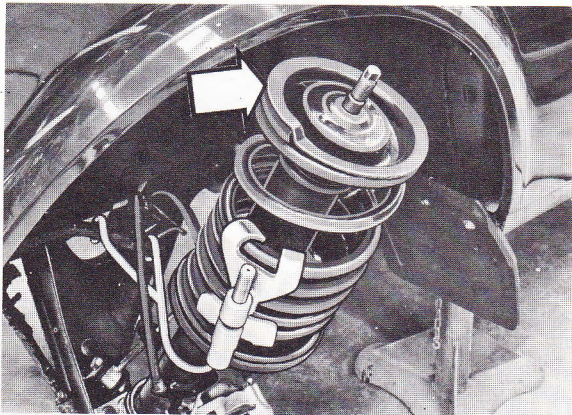
#### **Remove center nut.**

Use tool 9995036 to loosen the nut while retaining with tool 9995037.

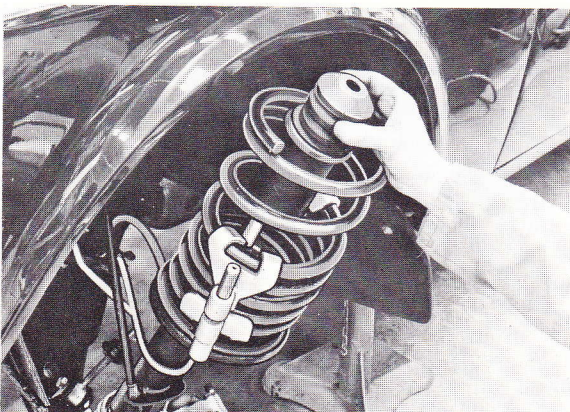


#### **Lower the jack and hook up the strut assembly.**

Support the strut assembly when lowering the jack so that brake lines and hoses do not get damaged. Hook up tool 9995045 to the strut assembly and the stabilizer bar.

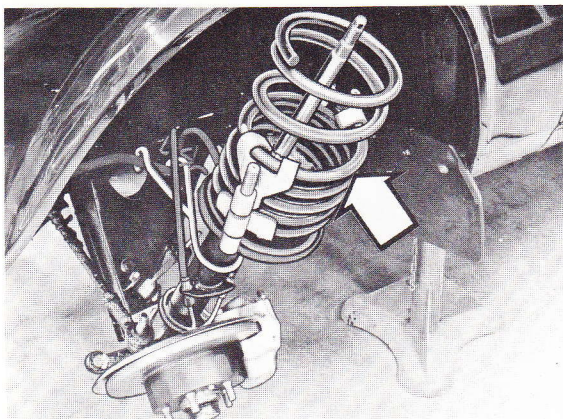


#### **Remove spring seat.**

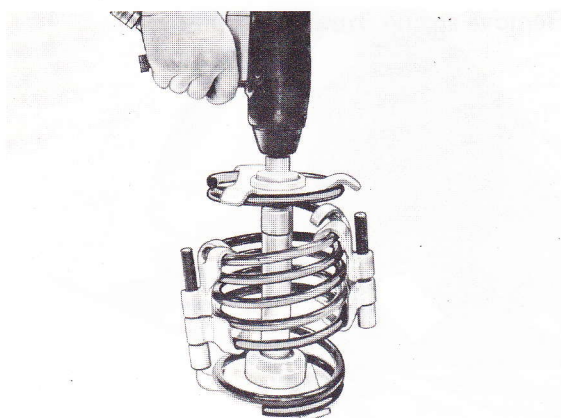


#### **Remove rubber bumper and shock absorber protection**



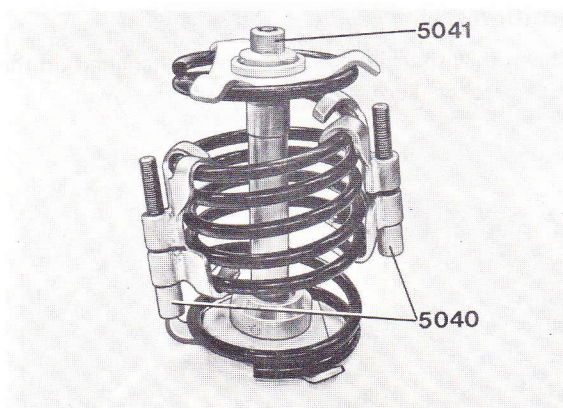


**Remove the coil spring.**



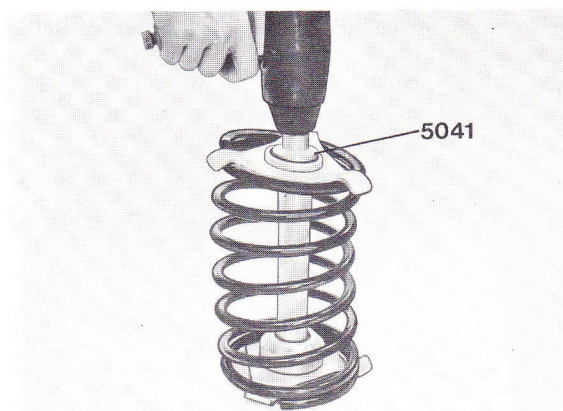
**Compress the spring**

Use spring compressor 9995041 and a nutrunner.



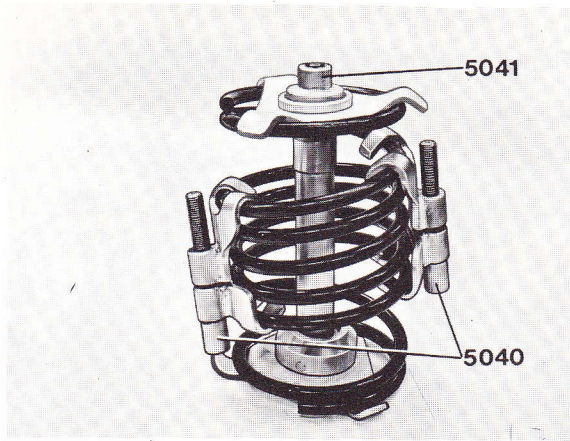
**Remove spring compressors.**

First remove spring compressor 9995040 and then spring compressor 9995041.



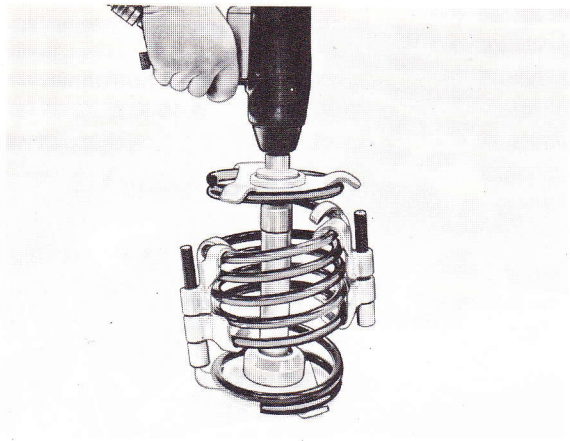
**Position spring compressor 9995041 on new spring and compress.**



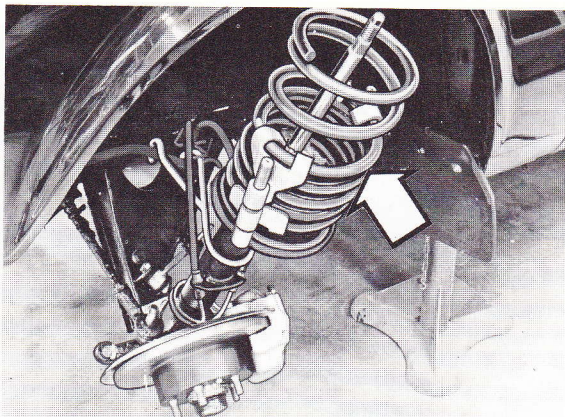


### Fit spring compressor 9995040.

Three coils of the spring should be free between the attachment points.

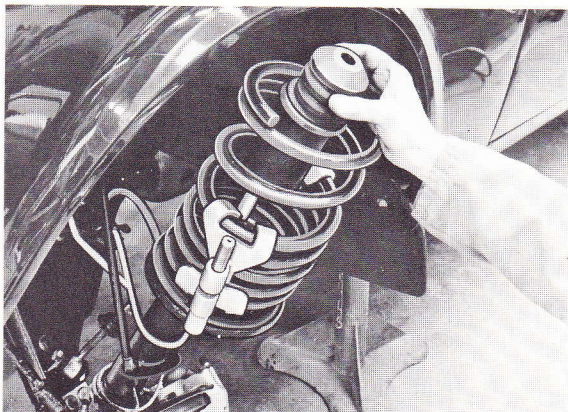


### Remove spring compressor 9995041



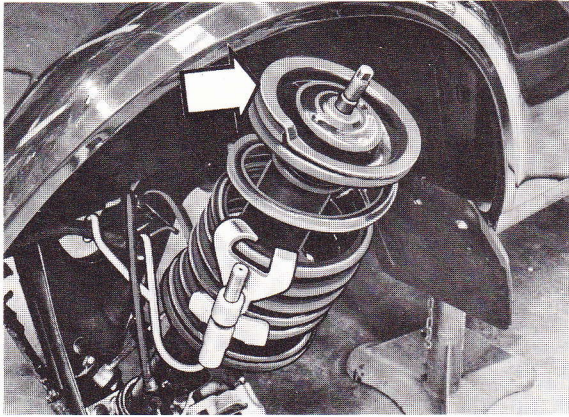
### Position spring on strut assembly.

Check that the spring end is correctly aligned on the strut bracket. Tool bolt heads should be down.



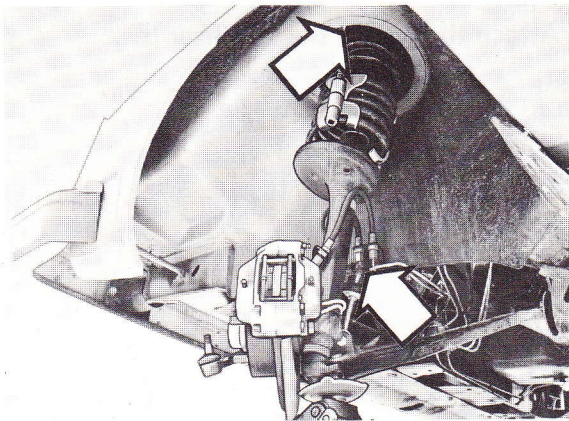
### Install rubber bumper and shock absorber protection.





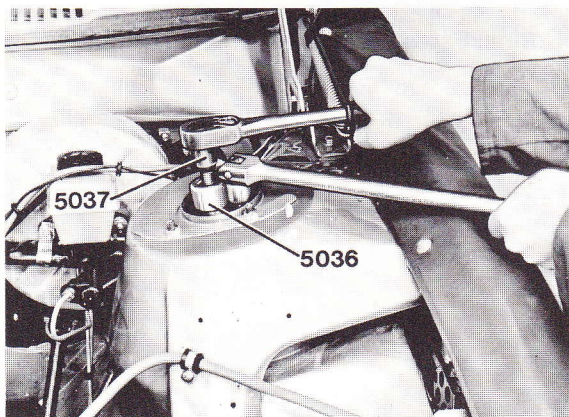
**Position spring seat on spring.**

Check that the seat is correctly aligned on the spring.



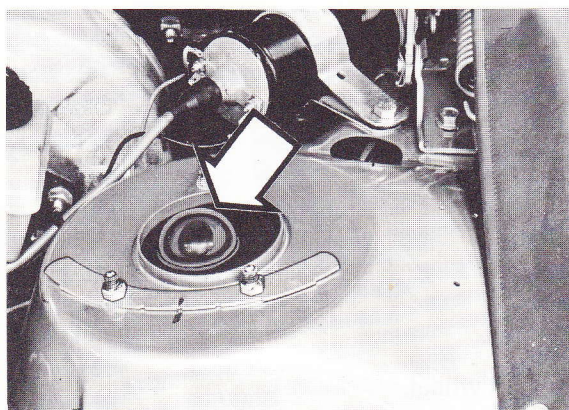
**Guide the strut assembly into the upper attachment.**

Connect the stabilizer link to the stabilizer bar.  
Guide the shock absorber spindle into the upper attachment.  
Raise the jack.



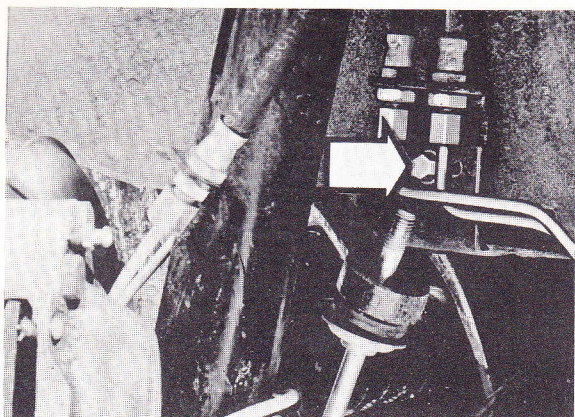
**Install washer and nut on top of shock absorber spindle.**

Tighten the nut with tool 9995036 while retaining with tool 9995037.



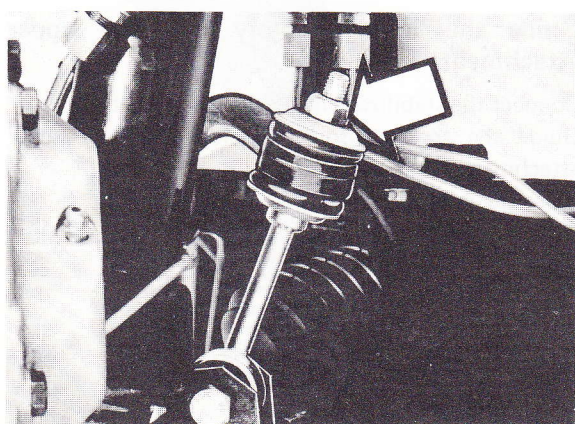
**Install cover for upper attachment**





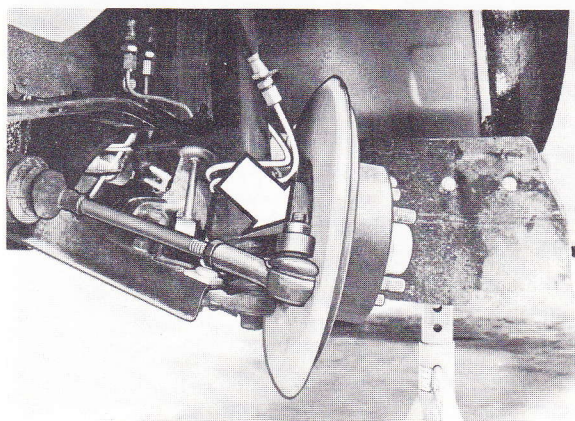
Attach brake line bracket.

13 mm



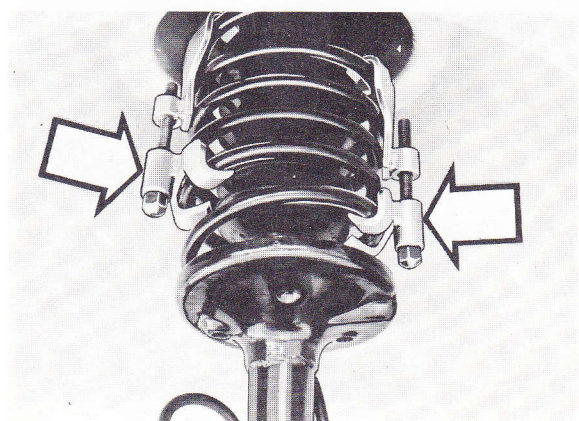
Attach the link to the stabilizer bar.

17 mm



Connect steering rod to steering arm.

19 mm

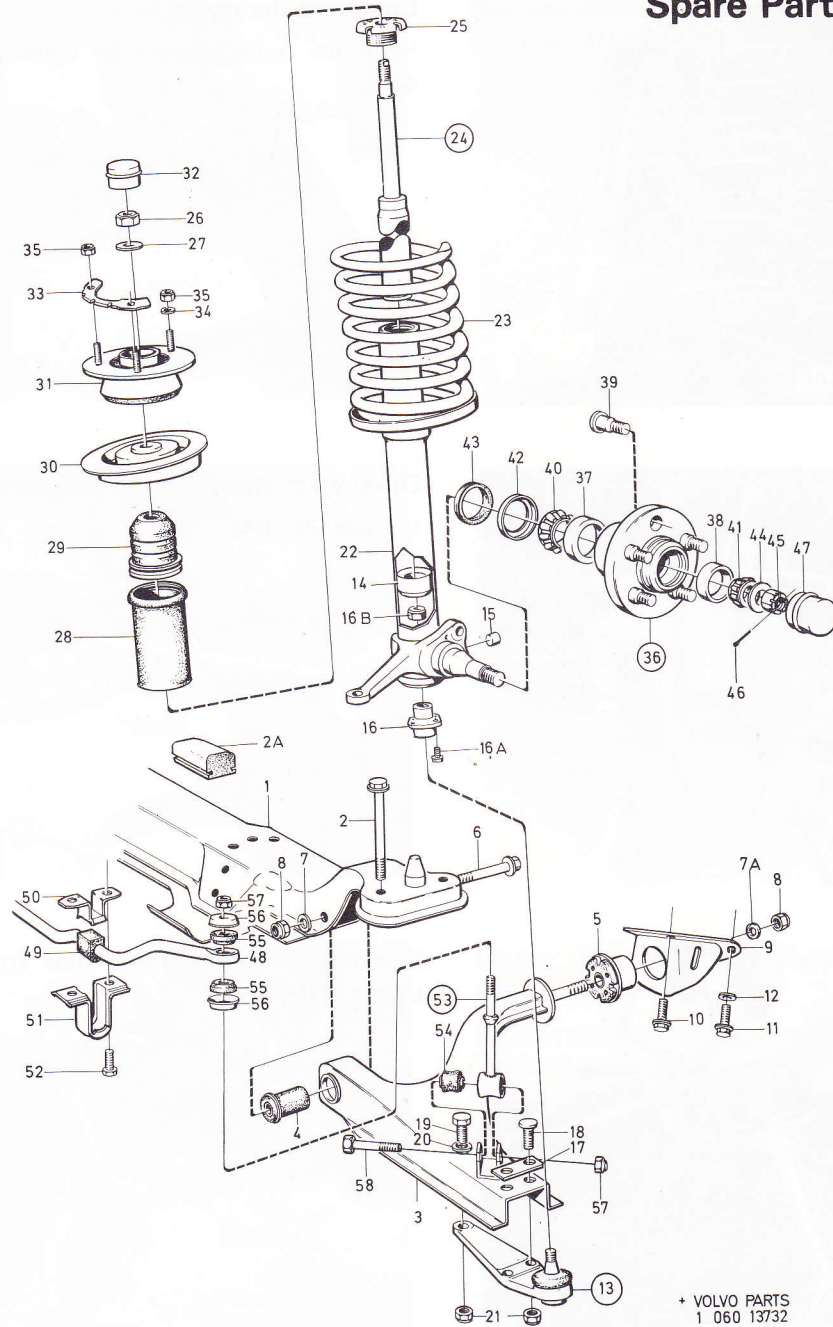


Remove coil spring compressor.

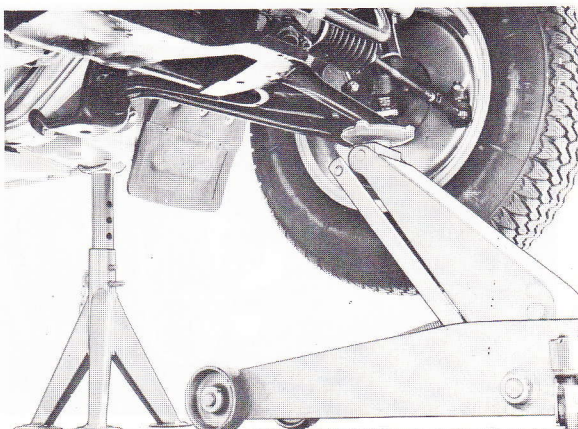
Install wheel.  
Restore.



## Spare Parts Illustration



+ VOLVO PARTS  
1 060 13732



## Replacing front shock absorber

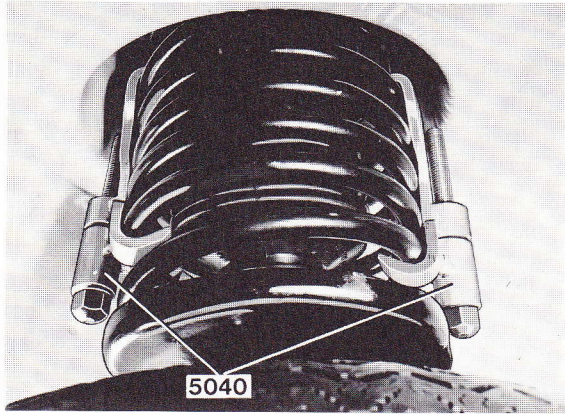
One side = Op. No. 76102  
Both sides = Op. No. 76122

### Put front end on stands

Position the stands at the front jack supports.

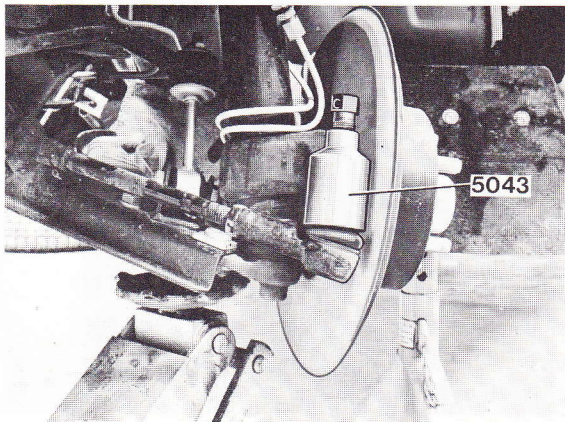
Remove wheel.





### Compress the spring

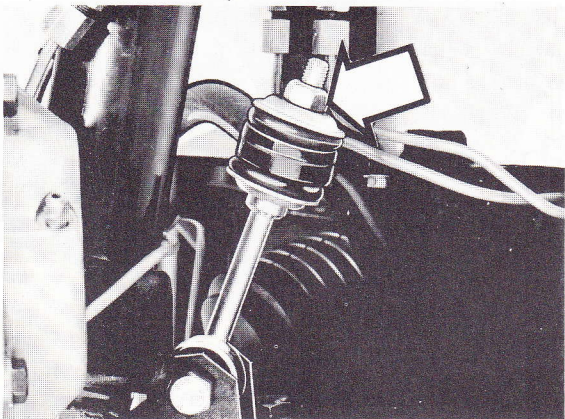
Hook on spring compressor 9995040. Catch five coils.



### Disconnect steering rod from steering arm.

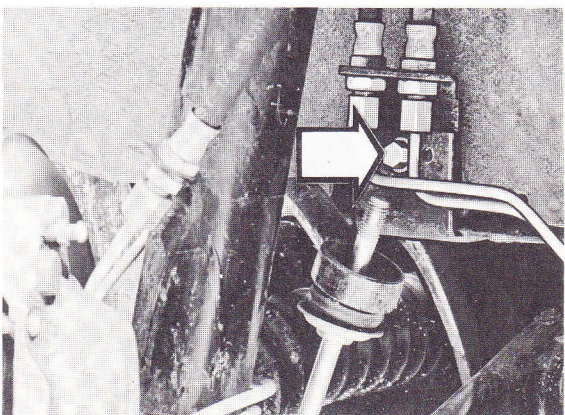
Use tool 9995043.

19 mm



### Disconnect the stabilizer bar from the link upper attachment

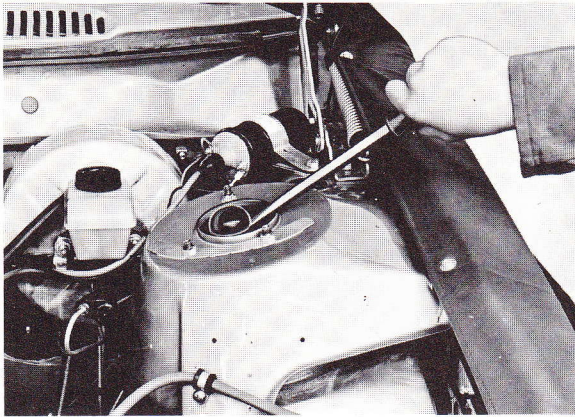
17 mm



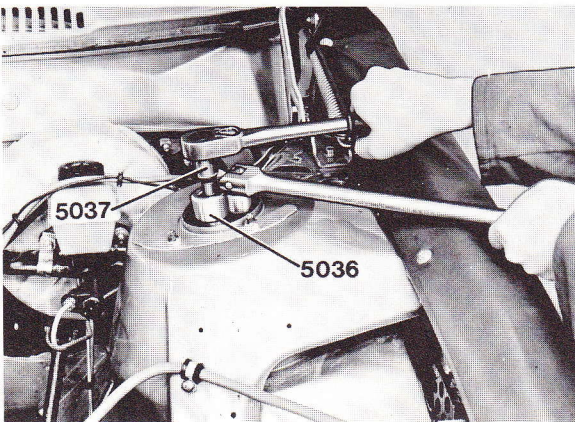
### Remove the bolt for the brake line bracket.

13 mm



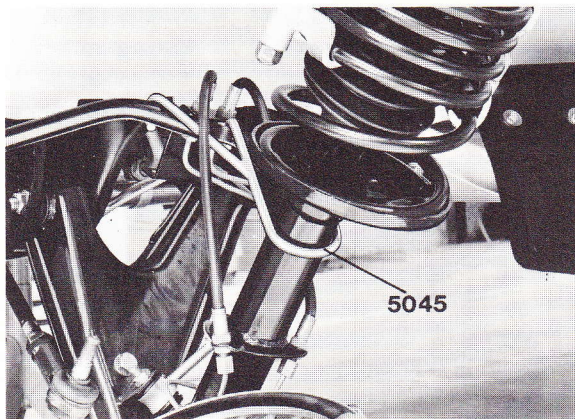


**Remove cover for the spring and strut assembly upper attachment.**



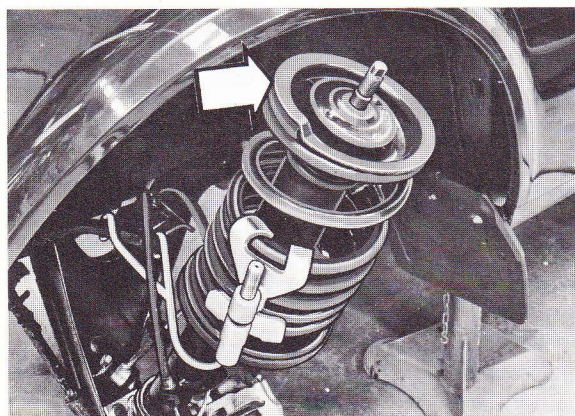
**Remove center nut.**

Use tool 9995036 to loosen the nut and retain with tool 9995037.



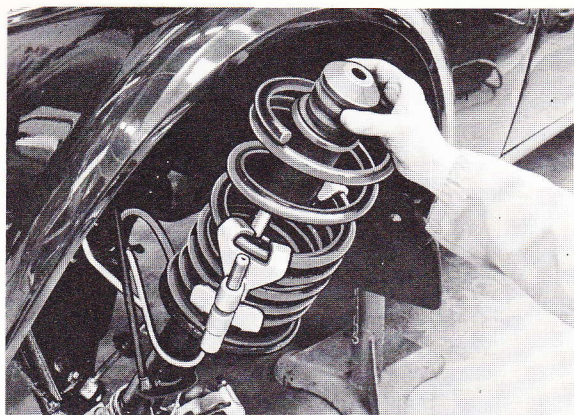
**Lower the jack and hook up the strut assembly.**

Support the strut assembly when lowering the jack so that brake lines and hoses do not get damaged. Hook up tool 9995045 to the strut assembly and the stabilizer bar.

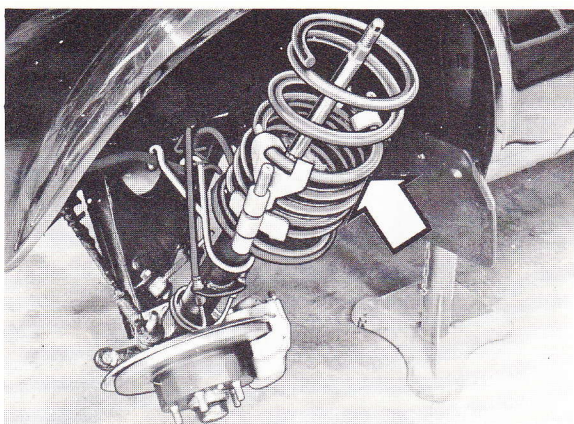


**Remove the spring seat.**

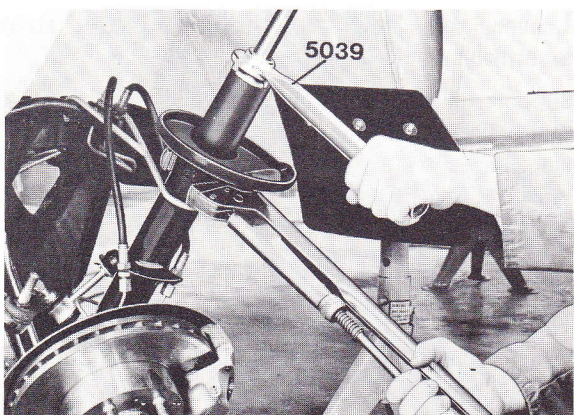




**Remove rubber bumper and shock absorber protection.**

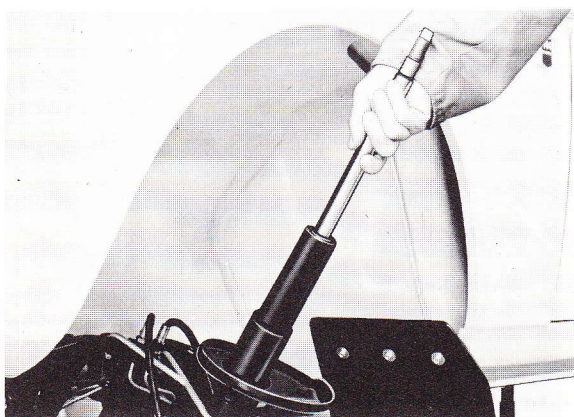


**Remove coil spring.**



**Remove shock absorber retaining nut.**

Use tool 9995039 to loosen the nut while retaining the strut outer casing with a plier wrench **at the weld**.



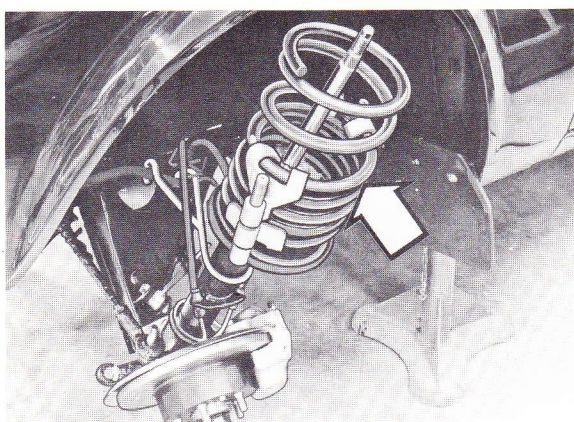
**Pull the shock absorber out of the casing.**





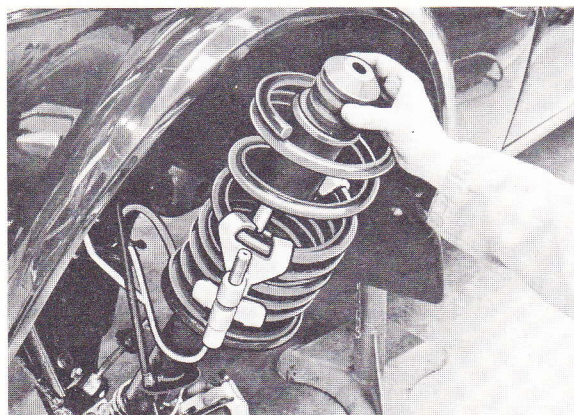
**Install the new shock absorber and retaining nut.**

Tighten the nut with tool 9995039 while retaining with a plier wrench at the casing weld. Pull the shock absorber spindle to its uppermost position.

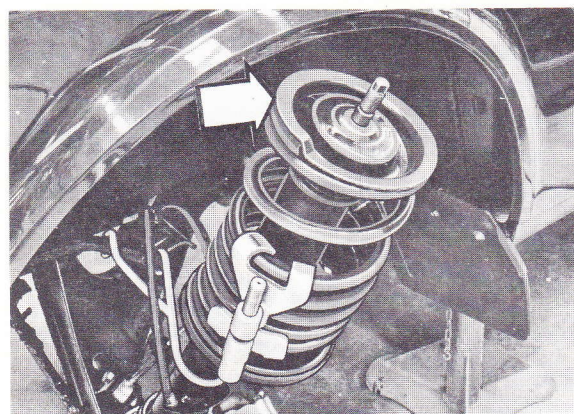


**Position spring on strut assembly.**

Check that the spring end is correctly aligned on the strut bracket. Tool bolt heads should be down.



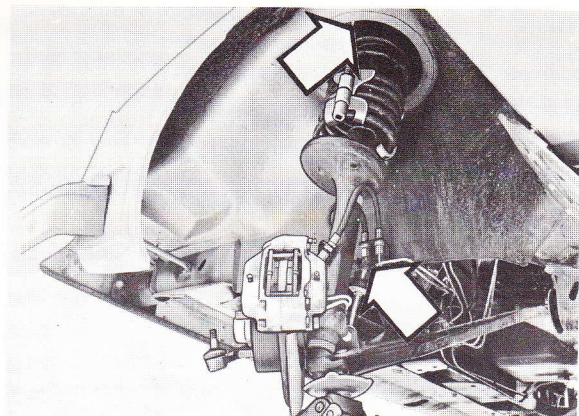
**Install rubber bumper and shock absorber protection.**



**Position the spring seat on the spring.**

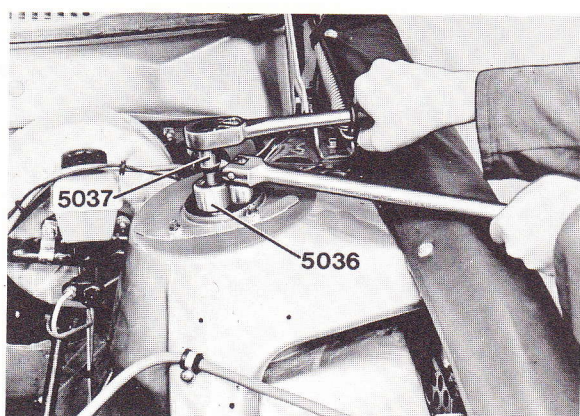
Check that the seat is correctly aligned on the spring.





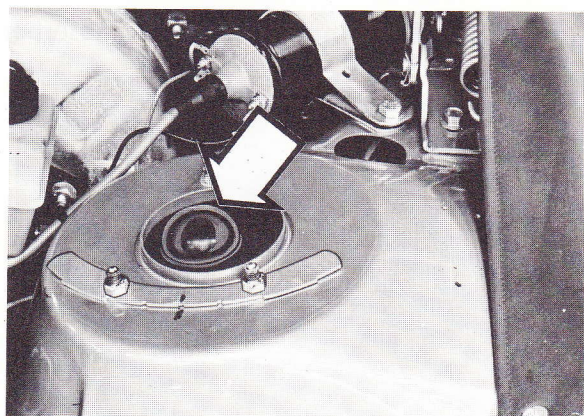
### **Guide the strut assembly into the upper attachment**

Connect the stabilizer link to the stabilizer bar.  
Guide the shock absorber spindle into the upper attachment.  
Raise the jack.

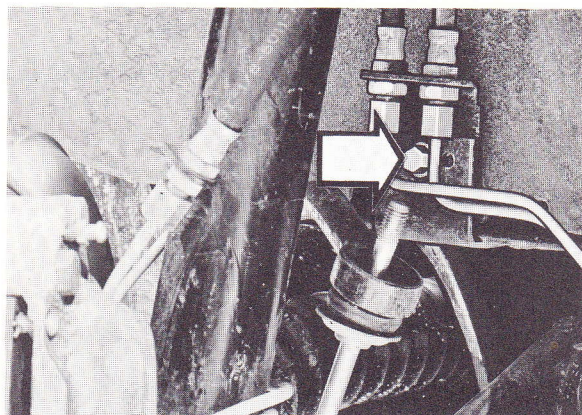


### **Install washer and nut on top of the shock absorber spindle.**

Tighten the nut with tool 9995036 while retaining with tool 9995037.



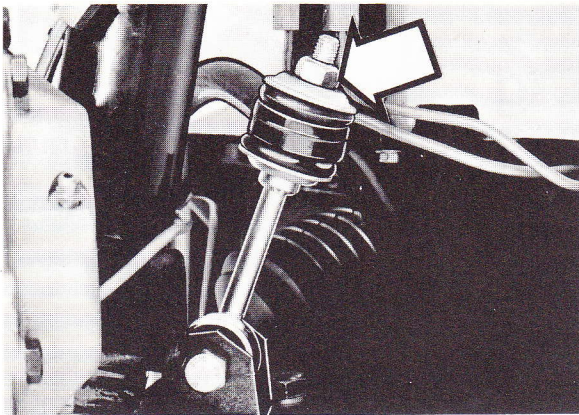
### **Install cover for upper attachment**



### **Attach brake line bracket.**

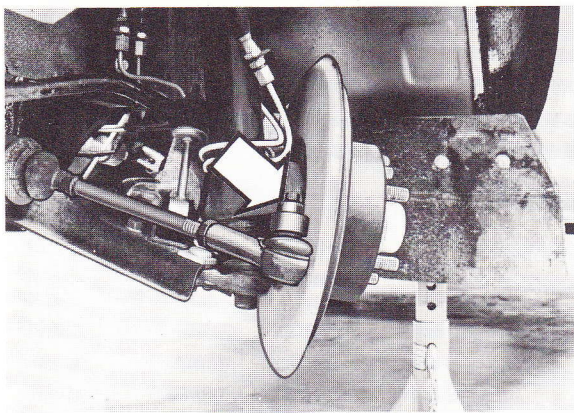
13 mm





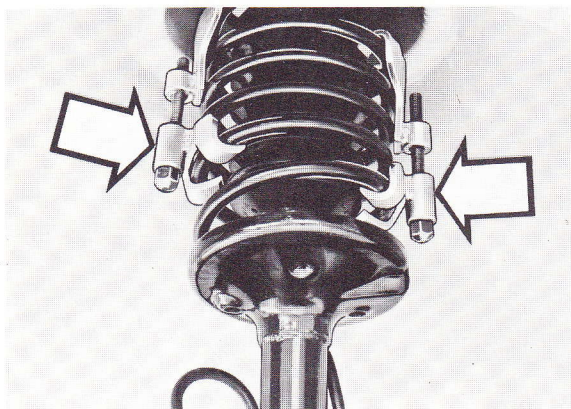
Attach the link to the stabilizer bar.

17 mm



Connect steering rod to the steering arm.

19 mm



Remove coil spring compressor.



Remove jack.

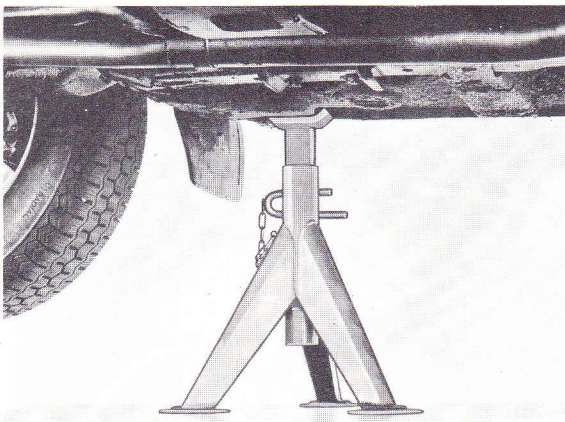
Install wheel.  
Restore.



## Group 64 Steering

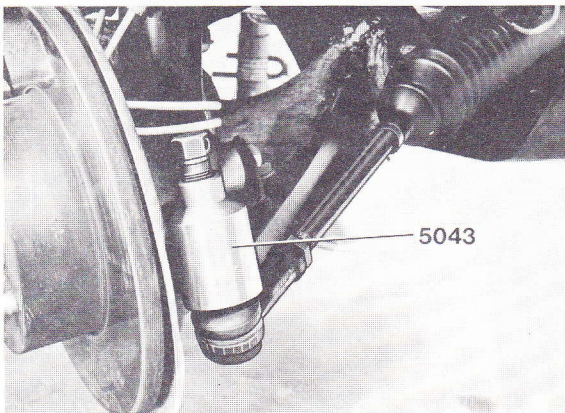
### Replacing steering rods

- Op. No. 64310 = Steering rod, replace one side, excl. adjust toe-in.  
64316 = Steering rods, replace, both sides  
64338 = Steering rod ends, replace two  
64346 = Rubber bellow, replace one side, incl. refill lubricant  
64348 = Rubber bellows, replace two sides, incl. refill lubricant



**Put the vehicle on stands and remove the wheel.**

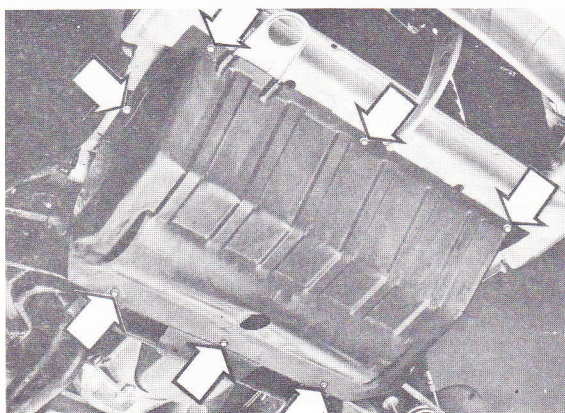
The stands should be positioned at the jack supports.



**Disconnect steering rod from steering arm.**

Remove nut and disconnect the ball stud. Use tool 9995043.

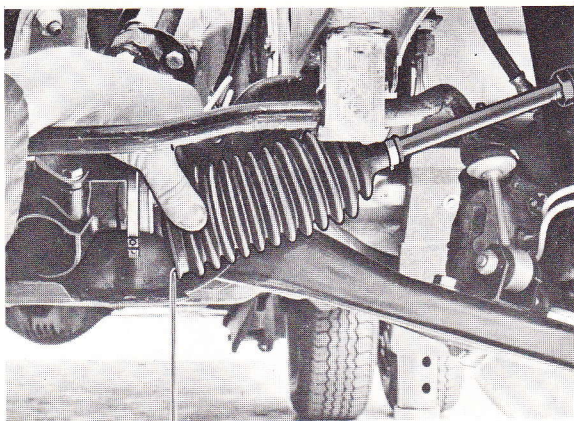
19 mm



**Remove splash guard.**

10 mm

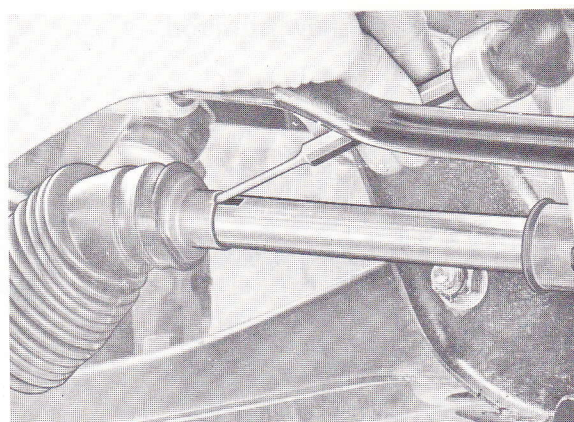




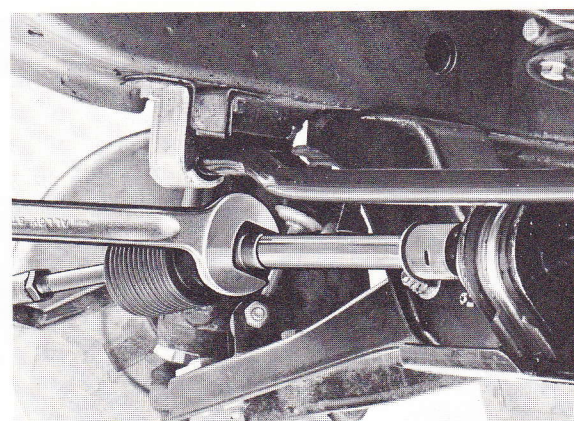
### **Drain the steering gear.**

Loosen inner clamps for both rubber bellows and drain the oil.

Then re-attach the clamp on the side which is not being repaired.

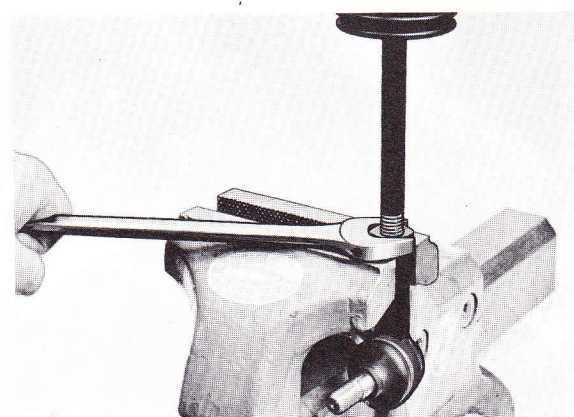


### **Bend up the lock.**



### **Disconnect rod from steering gear rack.**

Use a 32 mm open end wrench.



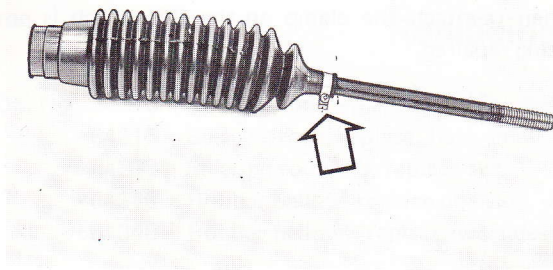
### **Disconnect rod and ball stud.**

Clamp the ball stud in a vise. Loosen lock nut and unscrew the rod. Count the thread turns.

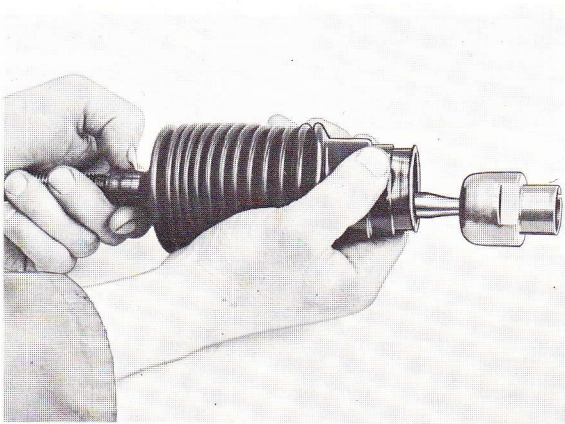
22 mm



**Remove clamp for rubber bellow.**

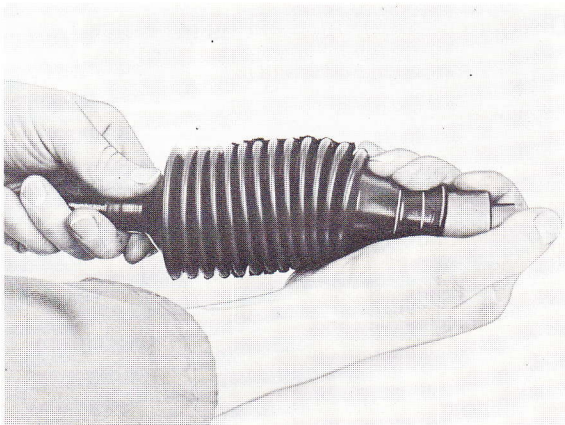


**Remove rubber bellow from rod.**

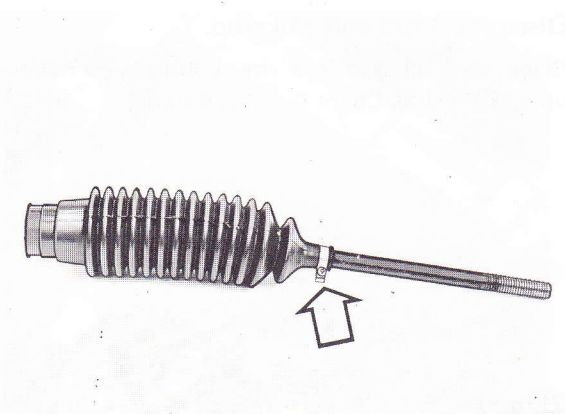


**Place the rubber bellow on the new rod.**

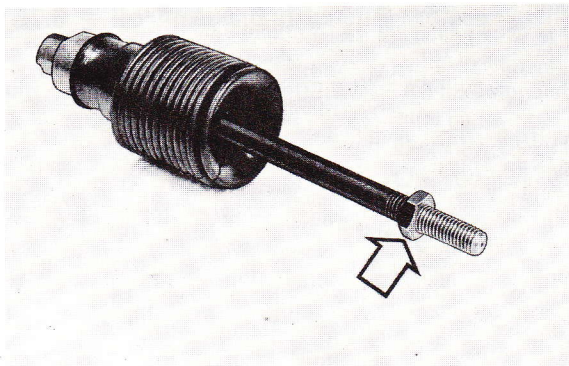
First check that the rubber bellow is correct. If damaged, replace.



**Install outer clamp.**

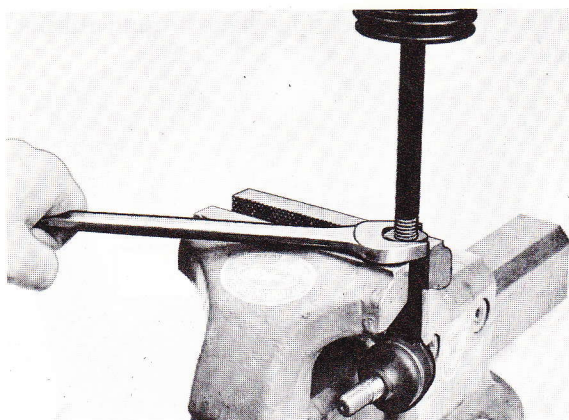






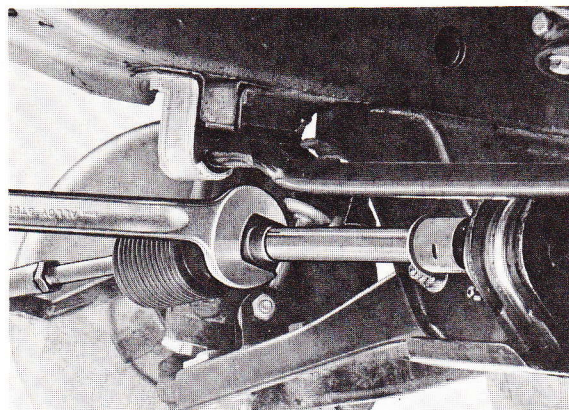
### **Screw on lock nut.**

Screw on the nut same amount of turns as when unscrewed.



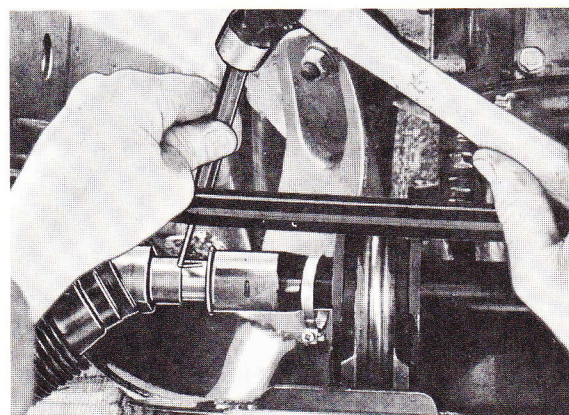
### **Install ball stud and tighten lock nut.**

22 mm



### **Attach rod to steering gear rack.**

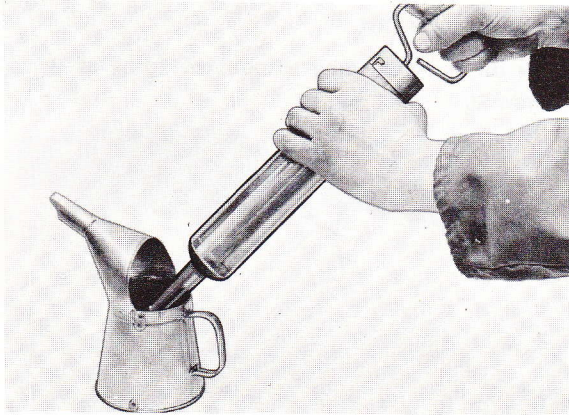
32 mm



### **Lock the rod to the steering gear rack.**

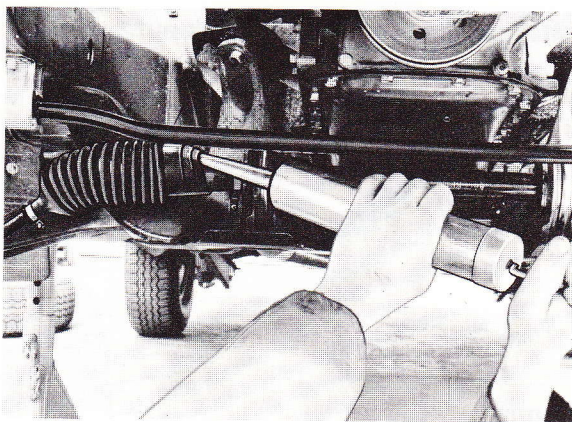
Punch the ball stud edge into the rack groove.



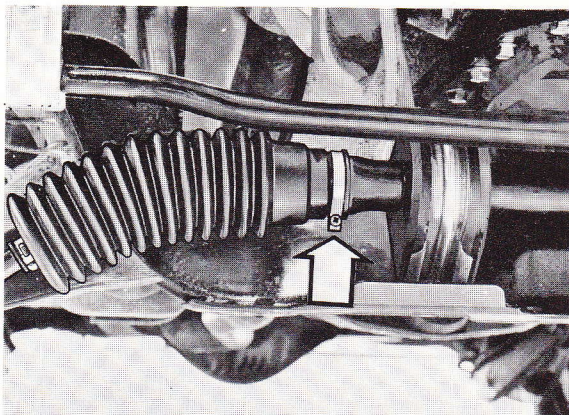


**Fill a suction gun with 0.2 dm<sup>3</sup> oil = 6.75 fl.oz.**

Use engine oil SAE 20W-50, alt. SAE 20W-40.

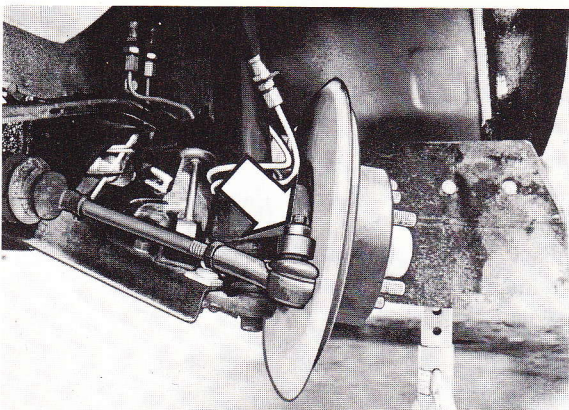


**Fill oil into the steering gear through rubber bellow.**



**Install inner clamp for rubber bellow.**

Before tightening, turn the rod so that the ball stud is up.



**Attach steering rod to steering arm.**

NOTE: Both rods should be same length, within a tolerance at 1/16" = 2 mm

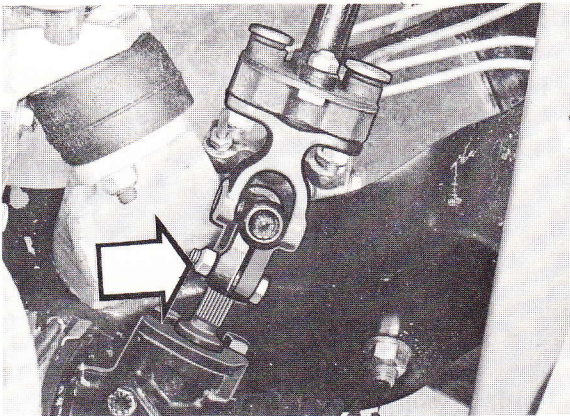
**19 mm**

**Re-install splash guard  
Restore**



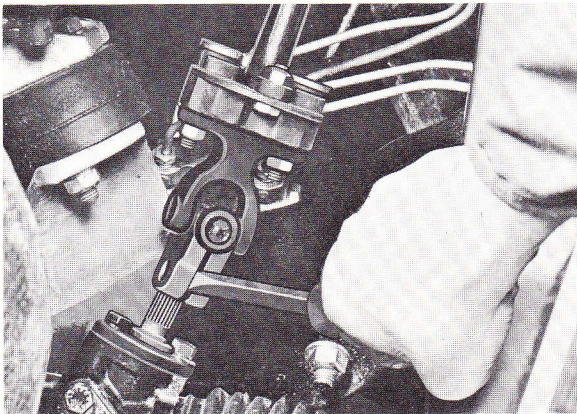
## Manual steering gear Removal

Op. No. 64270: Steering gear, remove  
Op. No. 64272: Steering gear, install

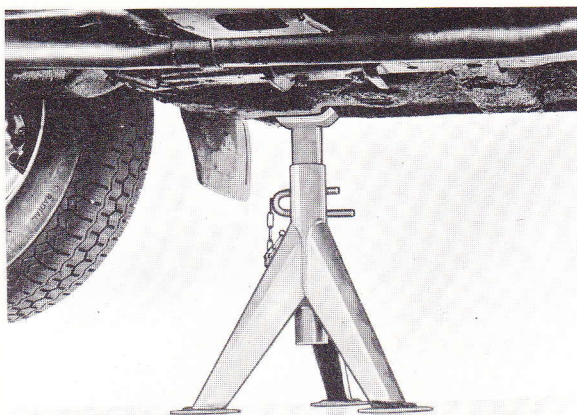


Remove lock bolt and nut from flange.

13 mm



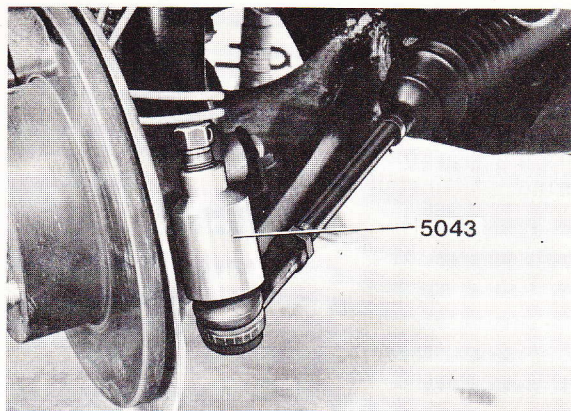
Bend apart the flange slightly with a screwdriver.



Put front end on stands.  
Remove front wheels.

The stands should be positioned at the jack supports.

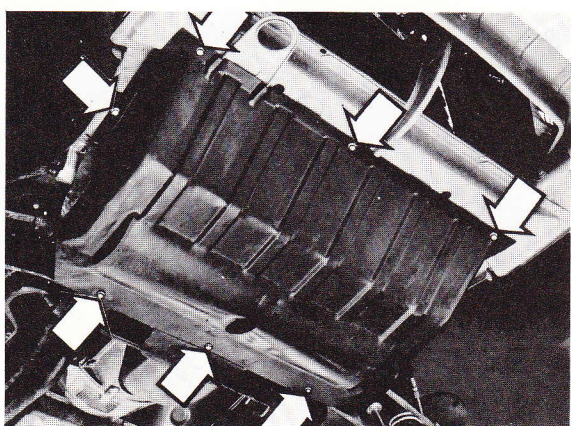




**Disconnect steering rods from steering arms.**

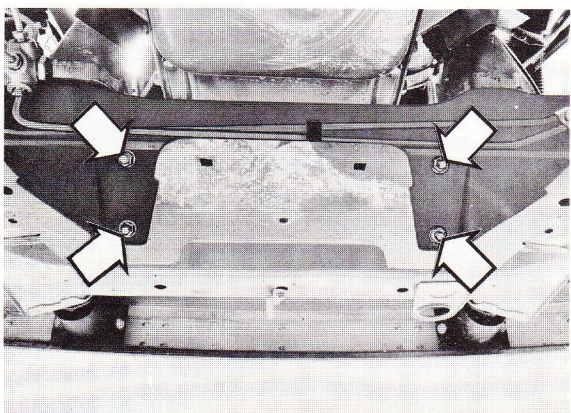
Remove nuts. Disconnect ball studs with tool 9995043.

19 mm



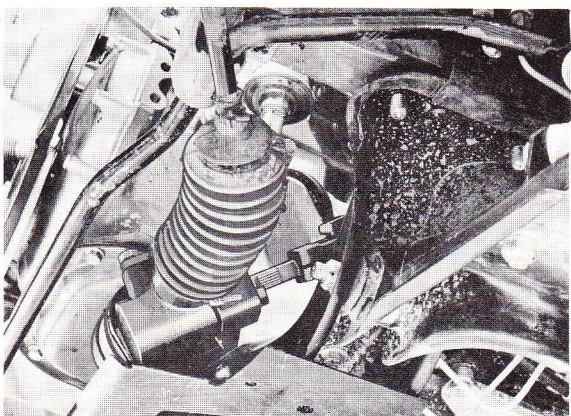
**Remove splash guard.**

10 mm



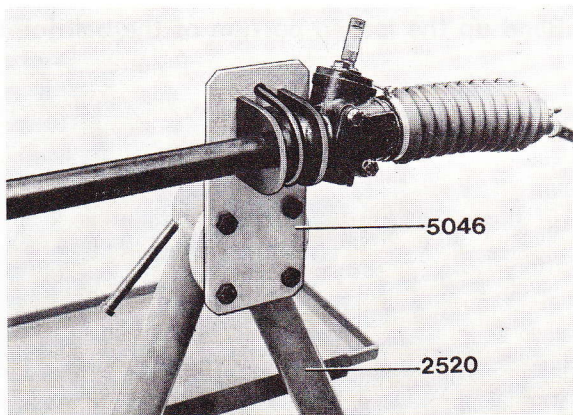
**Disconnect steering gear from front axle member.**

13 mm



**Disconnect steering gear from steering gear flange.  
Remove steering gear.**



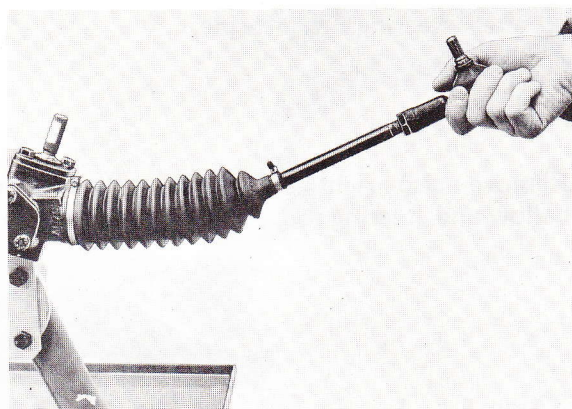


## Manual steering gear Disassembly (Cam Gear)

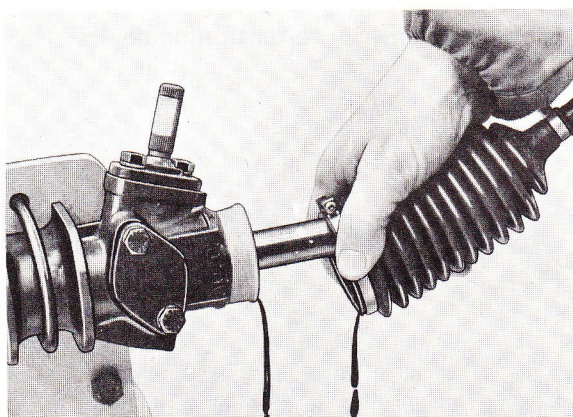
Op. No. 64275 = Manual steering gear, rebuilt  
steering gear removed

Put the steering gear on a stand.

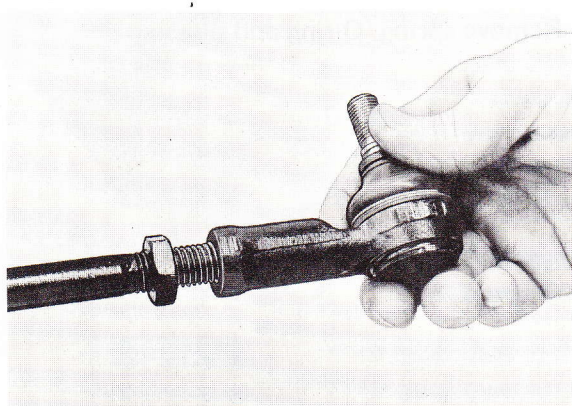
Use stand 9992520 and fixture 9995046.



Clean the exterior of the steering gear.  
Check inner ball joints for wear.



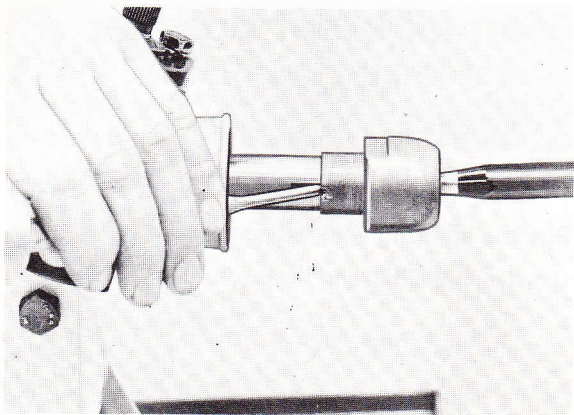
Loosen left side rubber bellow and drain the  
oil.



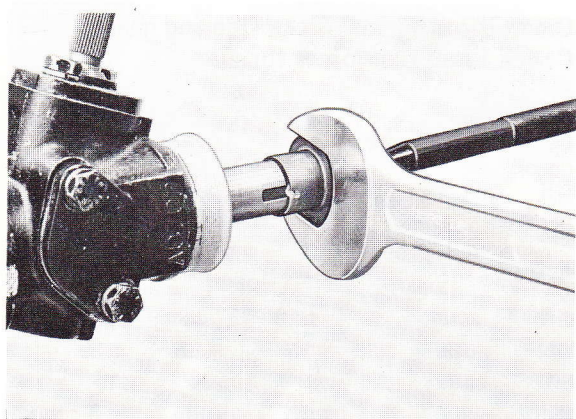
Remove left ball stud, lock nut and rubber  
bellow.

22 mm



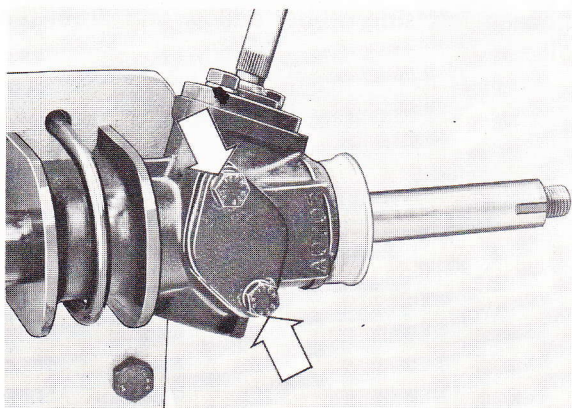


**Bend up the locked portion of the ball joint.**



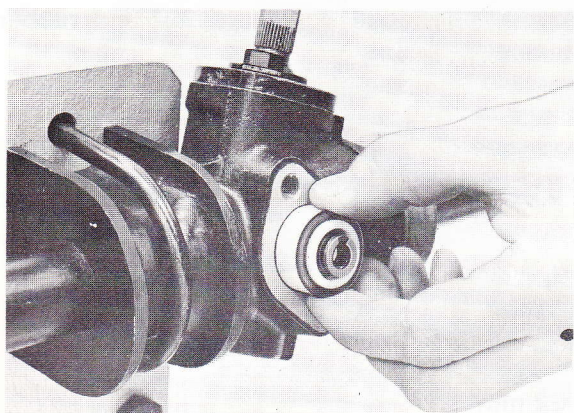
**Unscrew steering rod left side.**

**Remove also right side ball stud, rubber bellow and steering rod.**



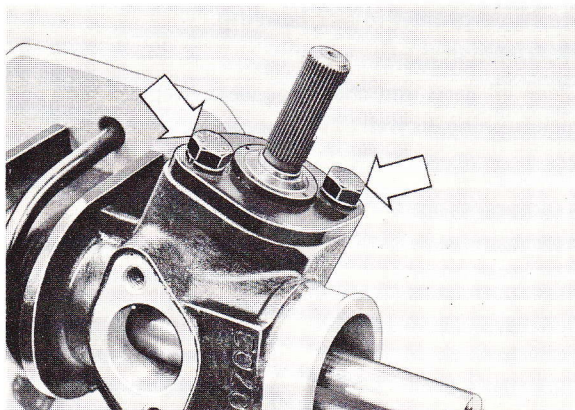
**Remove cover for pre-tensioning device.**

**13 mm**



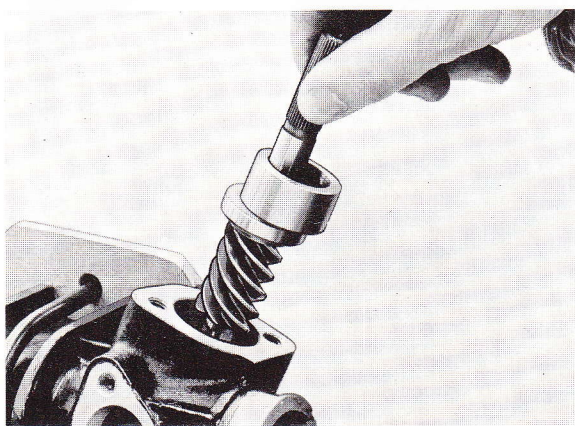
**Remove spring, O-ring and piston.**



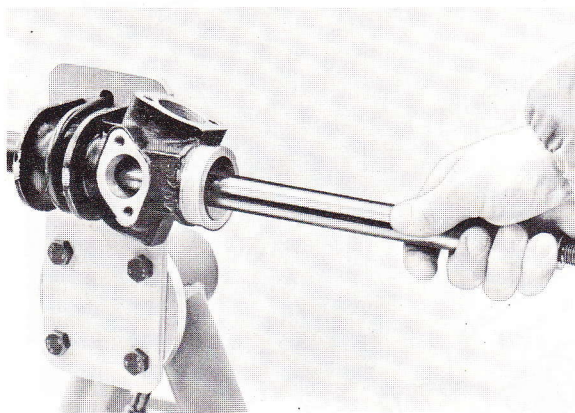


**Remove pinion cover.**

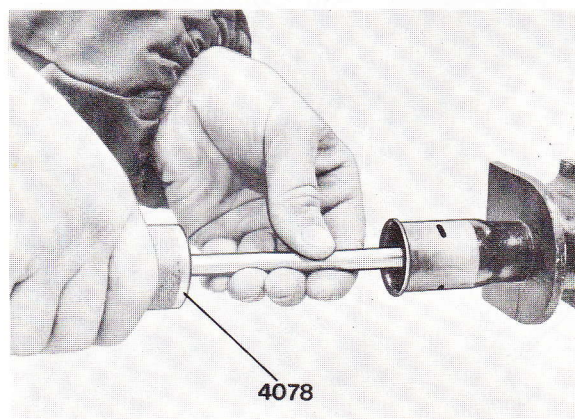
**13 mm**



**Lift out pinion and spacer sleeve.**



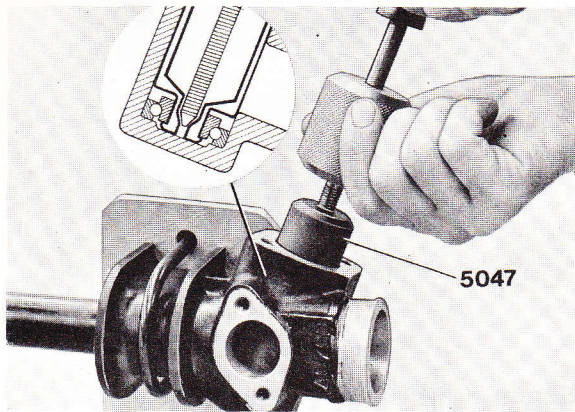
**Pull out the rack towards the pinion side of the steering gear.**



**Remove bushing for rack.**

**Use tool 4078.**

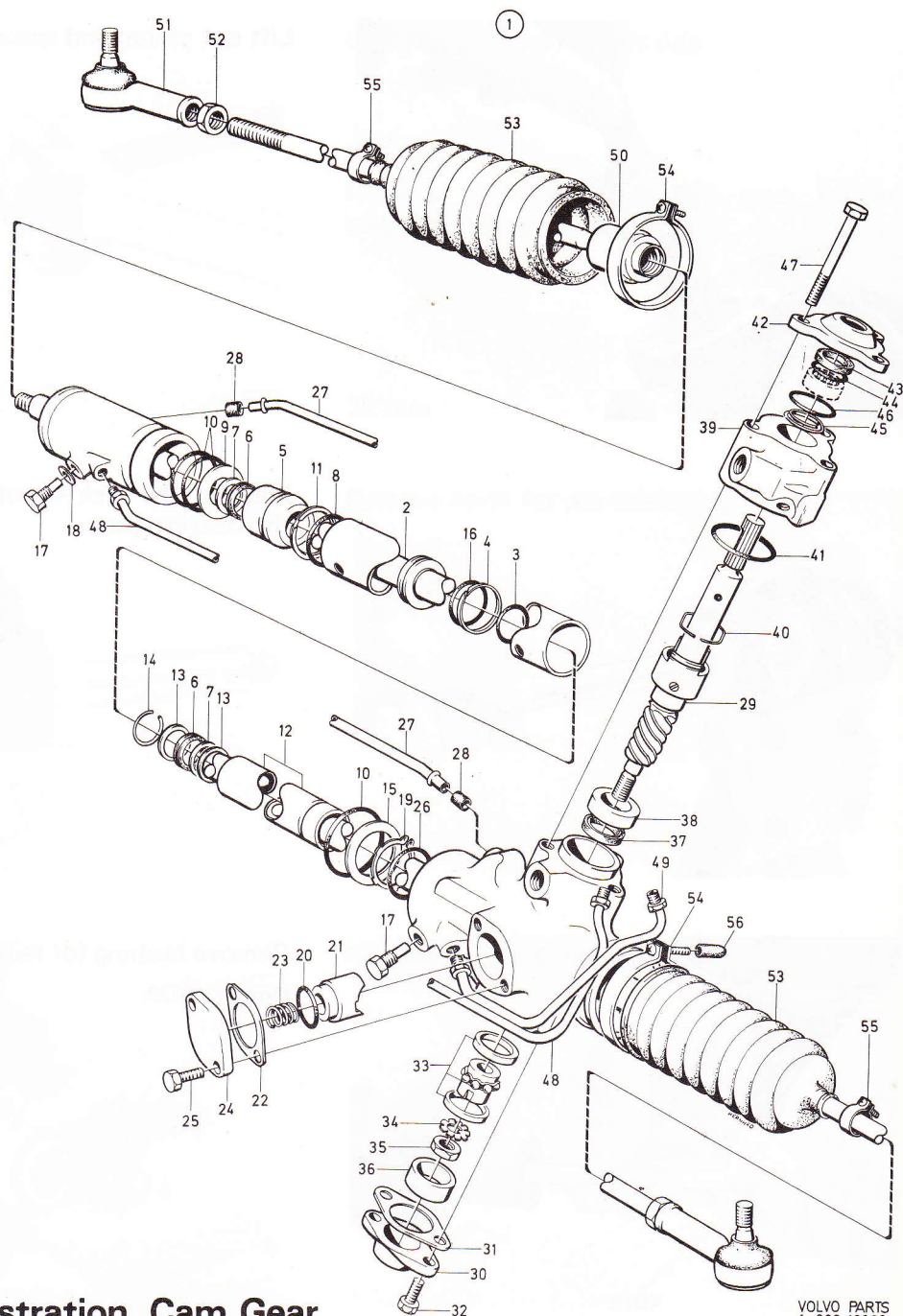




### Remove pinion lower bearing.

Use tool 9995047.

Clean all parts and check for wear. Replace seals and rack bushing, as well as worn parts.



**Spare Parts Illustration, Cam Gear**

VOLVO PARTS  
1 060 12869

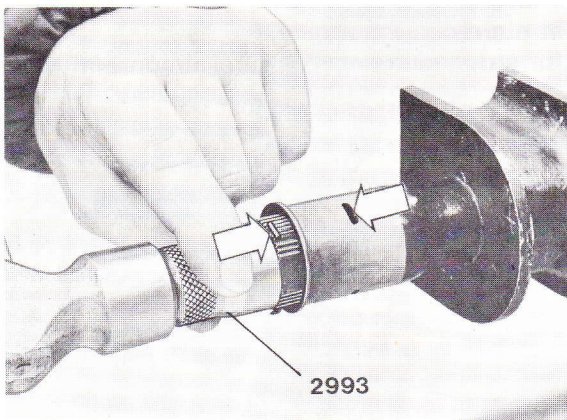


## Manual Steering gear Assembly (Cam Gear)

Oil all parts prior to assembly.

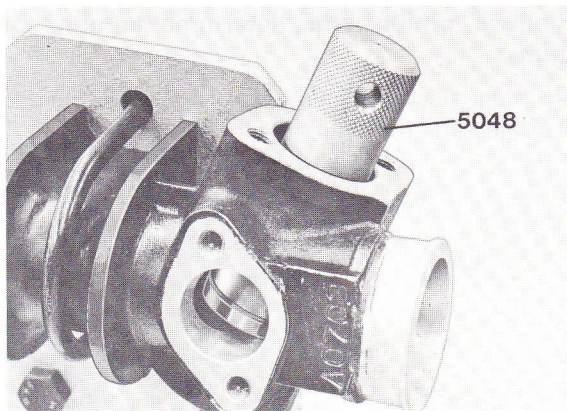
Thumb rule: always use same oil as later filled.

In this case: engine oil SAE 20W-50, alt. SAE 20W-40.



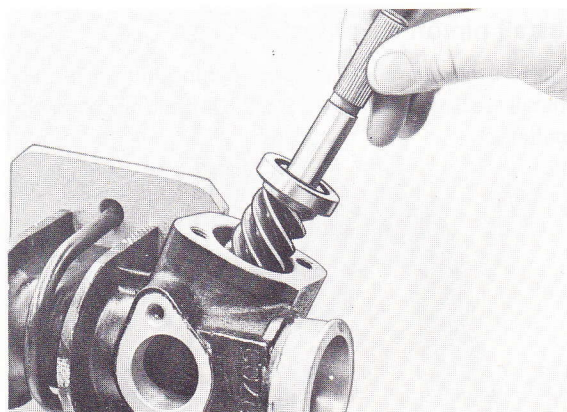
### Install the new rack bushing.

Position the bushing so that the locks align to the housing slots. Install the bushing with driver 9992993.



### Install pinion lower bearing.

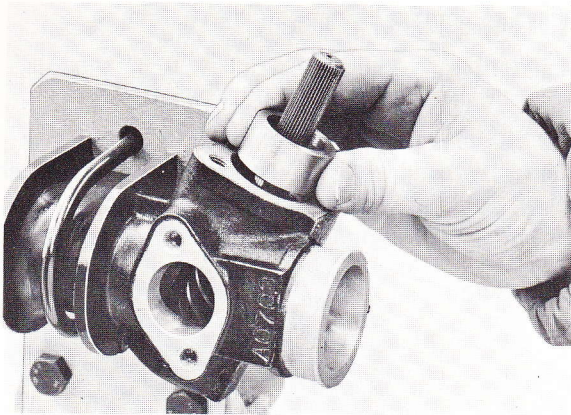
Use tool 9995048.



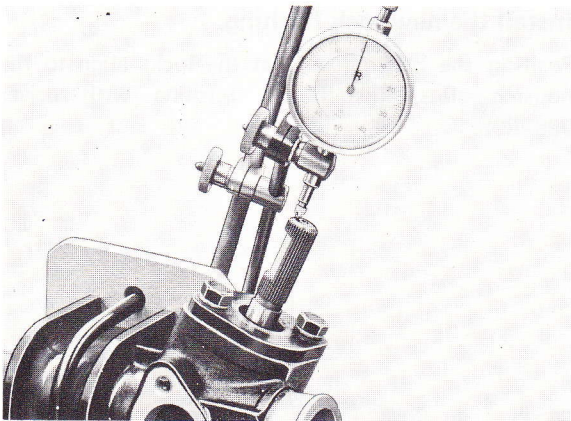
### Place pinion with upper bearing in the housing.

NOTE: no shims on the upper bearing.



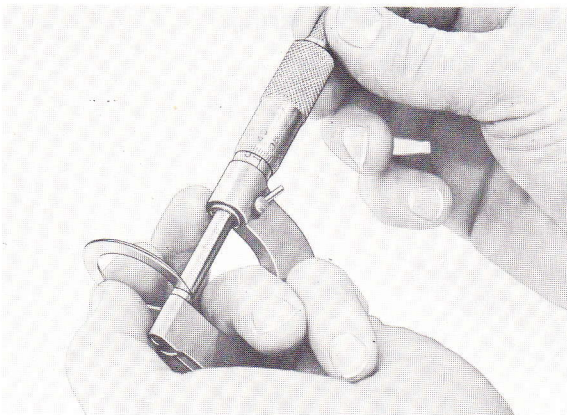


**Place spacer sleeve in the housing.**



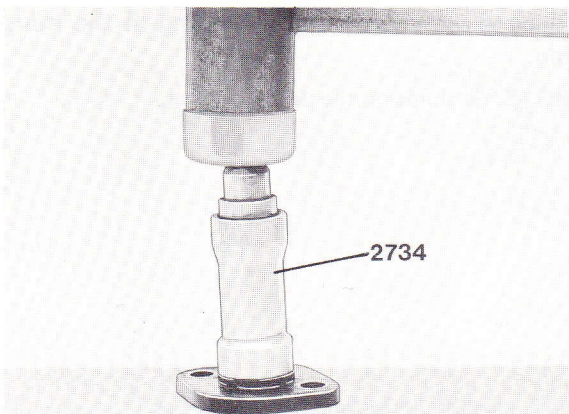
**Fit pinion cover.**  
**Use a dial gauge to measure pinion end play.**  
 Fit cover with gasket but without seal.

**1/2"**



**Remove pinion and determine amount of shims.**

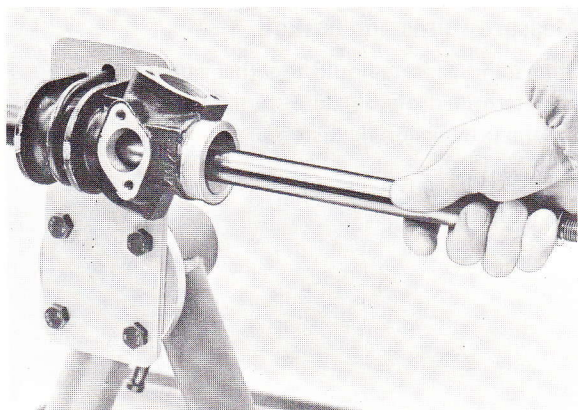
The shim thickness should equal the measured end play. Add 0,1—0,25 mm shim for pre-tensioning.



**Install pinion cover seal.**

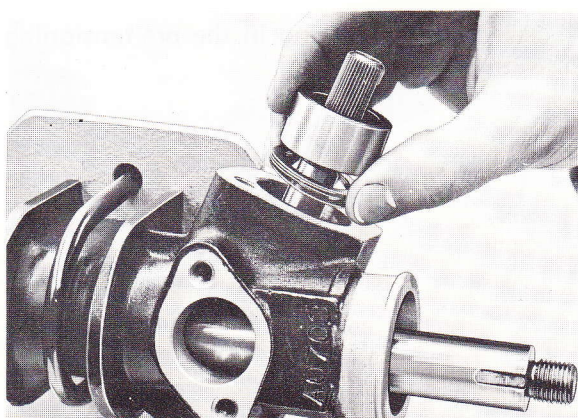
Apply a non-hardening gasket compound on the seal. Install seal with driver 9992734 and a plastic-tip mallet.





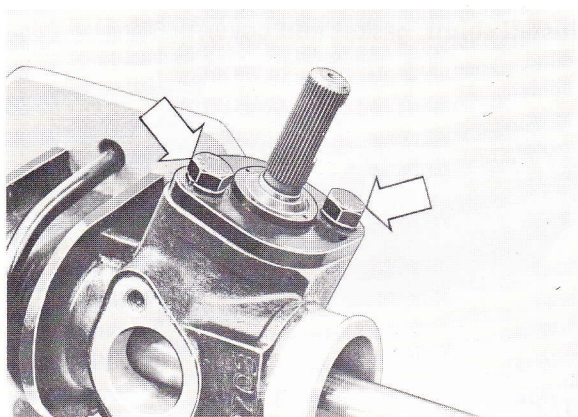
#### **Install the rack.**

Insert the rack from the pinion side so that the teeth do not damage the bushing.



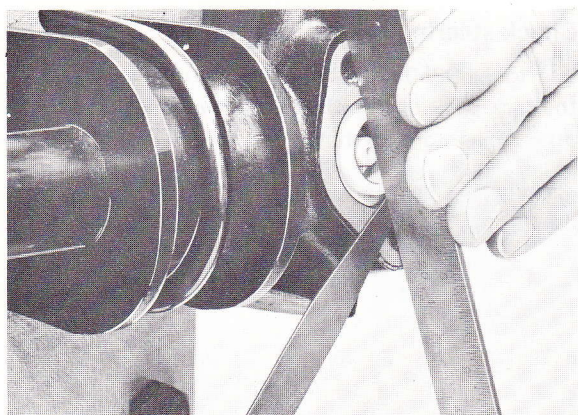
#### **Install pinion, shims and spacer sleeve.**

Place the shims between upper bearing and spacer sleeve.



#### **Install pinion cover with gasket.**

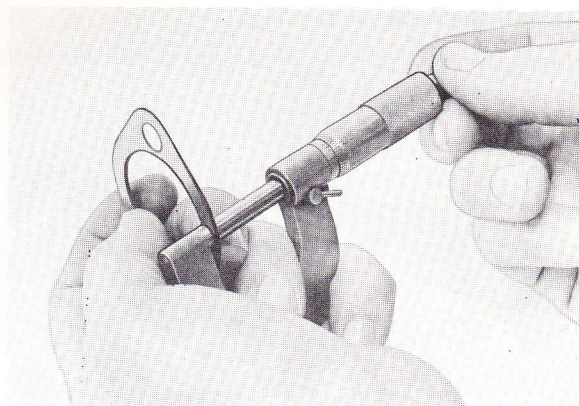
1/2"



#### **Place the pre-tensioning piston in the housing and measure play between piston and housing.**

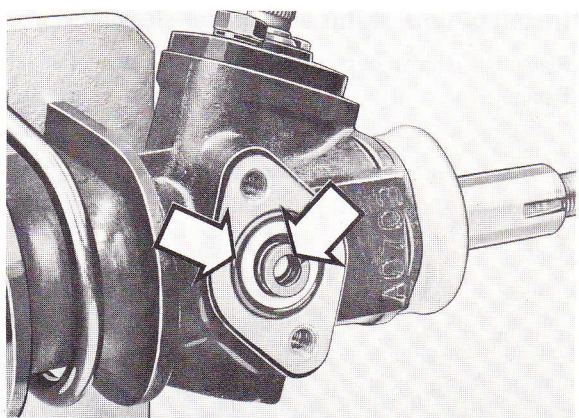
Piston without O-ring and spring. Use vernier caliper (or steel ruler) and feeler gauge to determine the play.



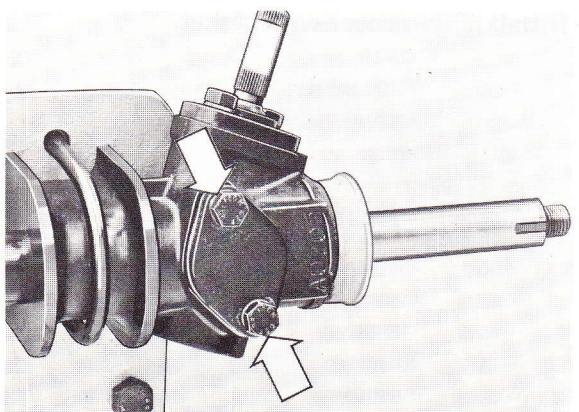


### Measure shims and gasket.

Shims and gasket should together equal the previously determined play. Add a shim 0.02–0.15 mm thick for the pre-tensioning piston play.

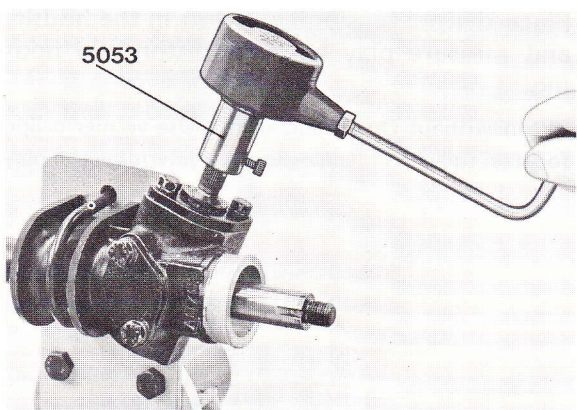


Place spring and O-ring in the pre-tensioning piston.



Install shims, gasket and cover.

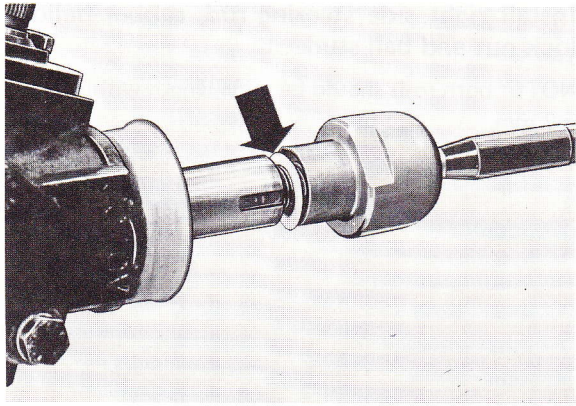
1/2"



### Check steering gear torque.

Use tool 9995053 to connect a torque gauge. Crank the rack back and forth from one end position to the other. The torque should be 0.6–1.7 Nm = 5–15 lb.in.

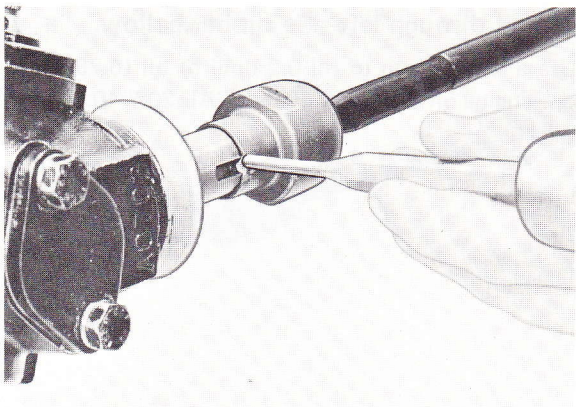




### Install left side steering rod.

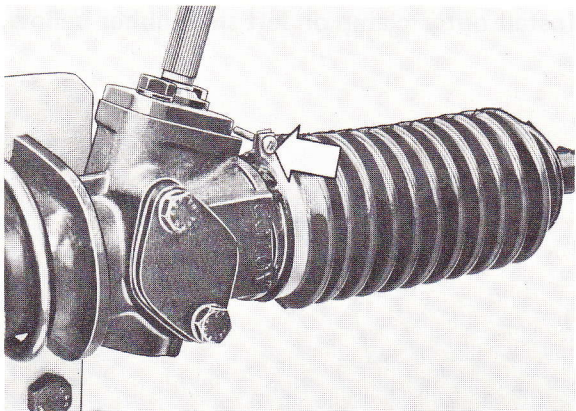
When fitting a previously used rod, a thin shim should be placed between ball joint and rack shoulder so that an unused portion of the ball joint can be used for locking.

32 mm



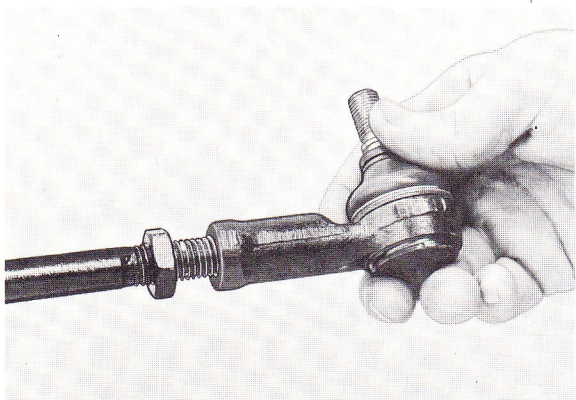
### Lock the ball joint.

Punch the ball joint edge into the rack groove.



### Install left side rubber bellow.

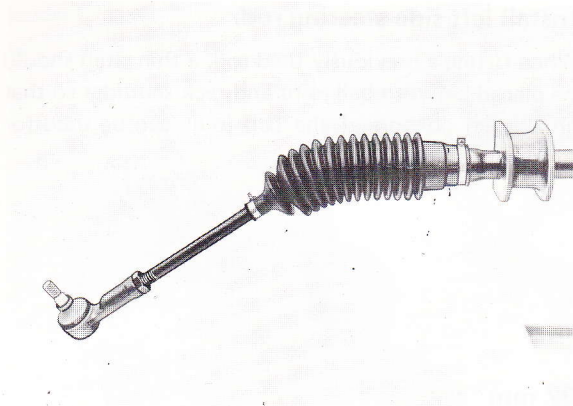
Fit only the inner clamp.



### Install lock nut and ball stud.

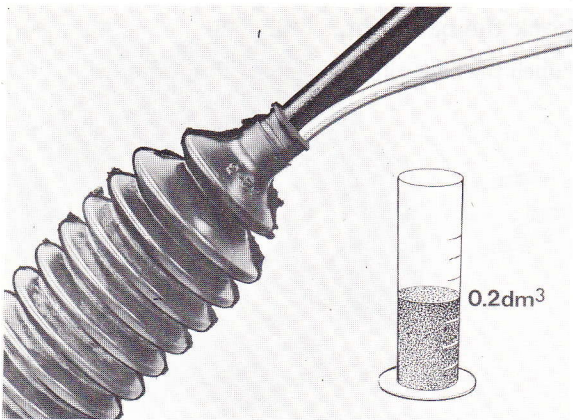
22 mm





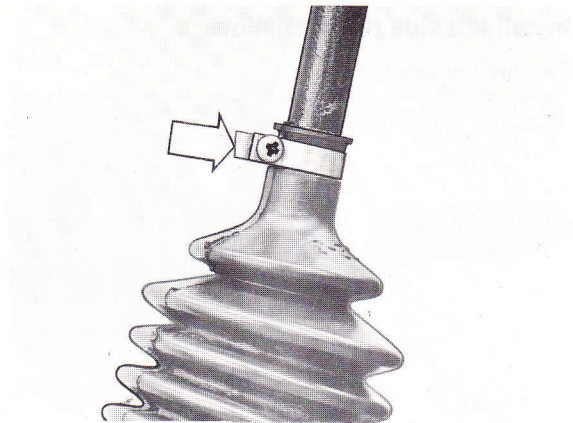
**Install right side steering rod, rubber bellow, lock nut and ball stud.**

NOTE: both rods should be same length within  $1/16''$  = 2 mm.



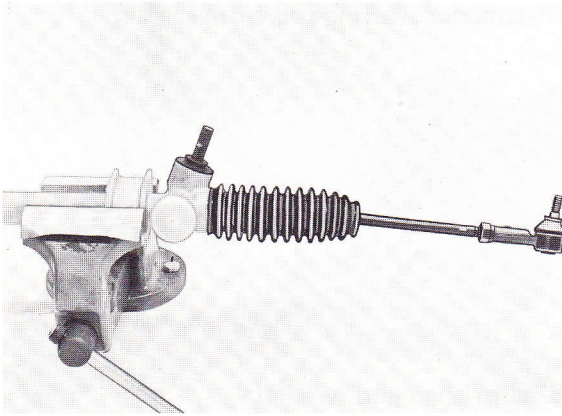
**Fill oil through left side rubber bellow.**

Use a suction gun to fill 0.2 dm<sup>3</sup> of oil (6.75 fl.oz.)  
Use engine oil SAE 20W-50, alt. SAE 20W-40.



**Install outer clamp on left side rubber bellow.**





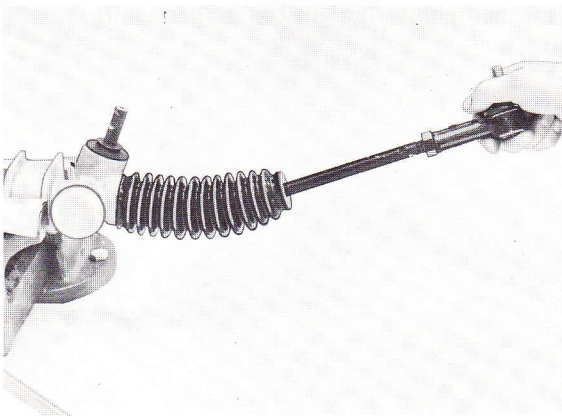
## Manual steering gear Disassembly (ZF)

Op. No. 64275 = Manual steering gear, rebuild  
steering gear removed

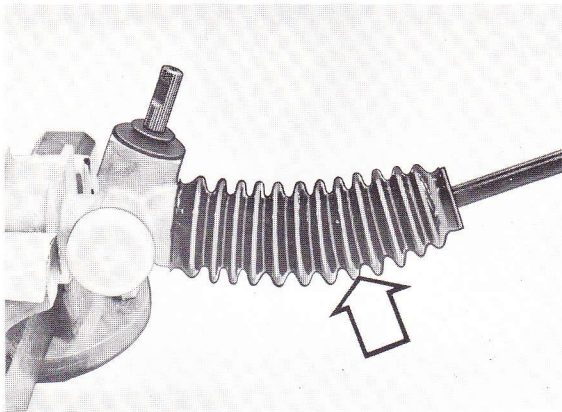
Clean the exterior of the steering gear.

Clamp it in a vise.

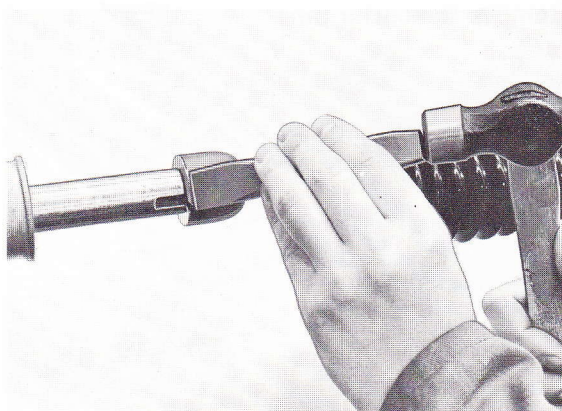
Use soft jaws.



Check inner ball joints for wear.

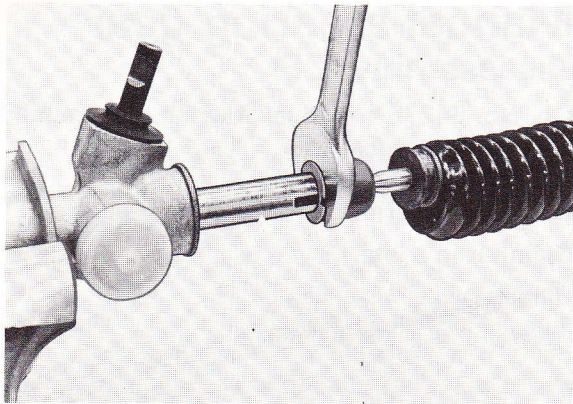


Remove left side rubber bellow.



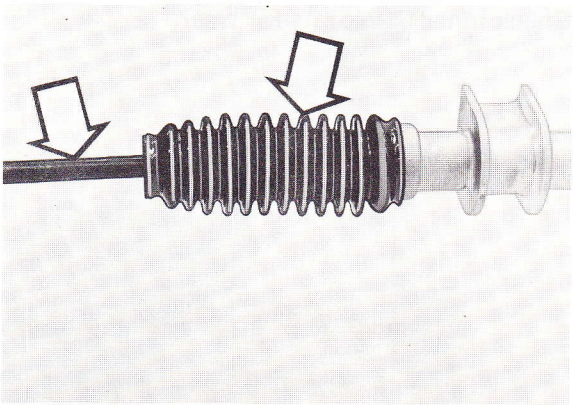
Bend up the lock.



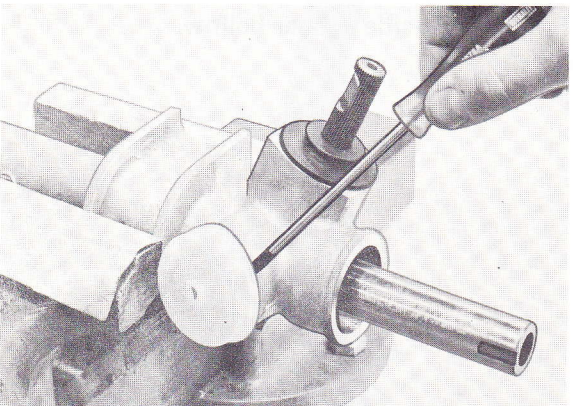


Disconnect steering rod from rack.

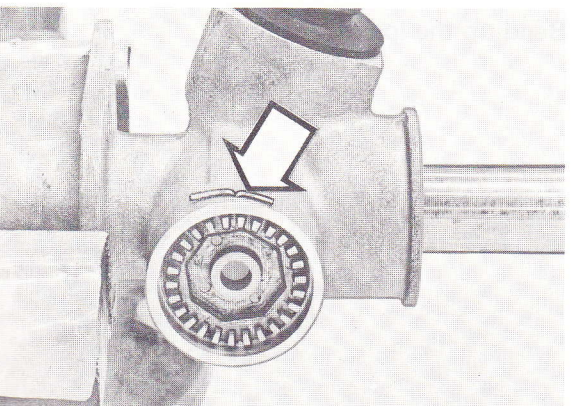
32 mm open end wrench.



Remove right side rubber bellow and steering rod.

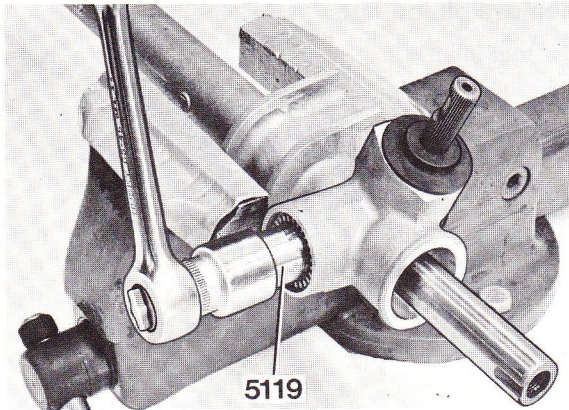


Remove dust seal for the pre-tensioning device.



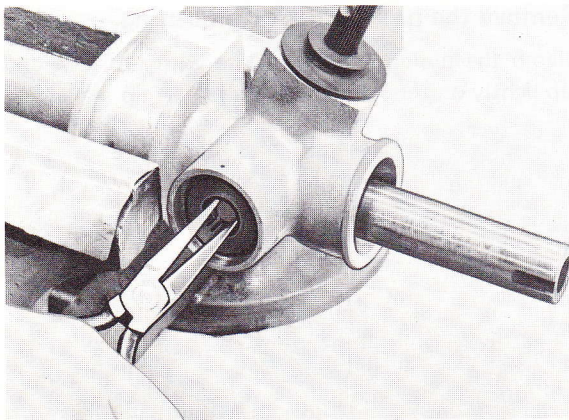
Remove the cotter pin.





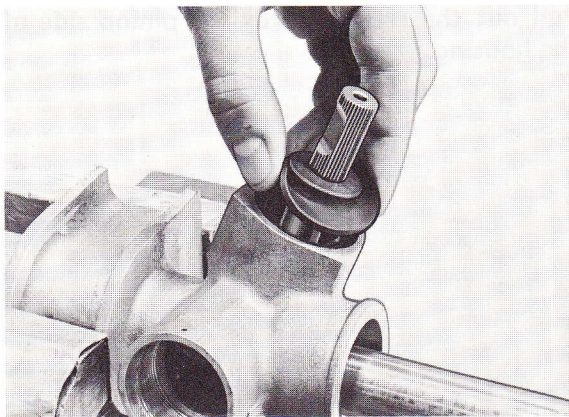
**Remove cover and spring for the pre-tensioning device.**

Use tool 9995119.

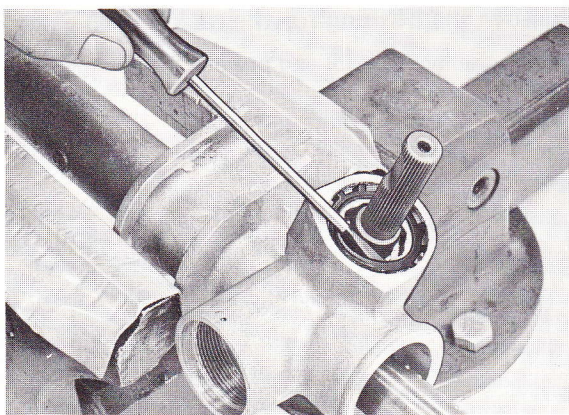


**Remove the pre-tensioning device piston.**

Removal might be facilitated by knocking the rack with the palm.

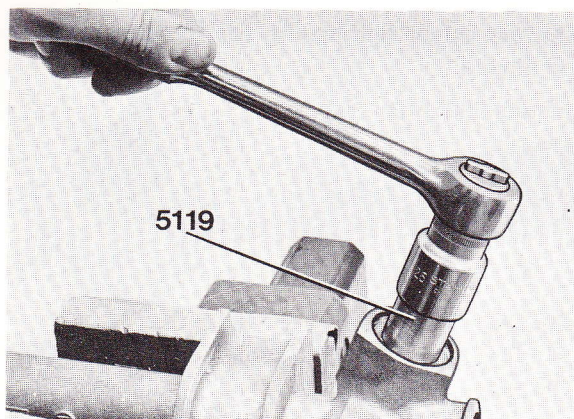


**Remove pinion dust seal.**



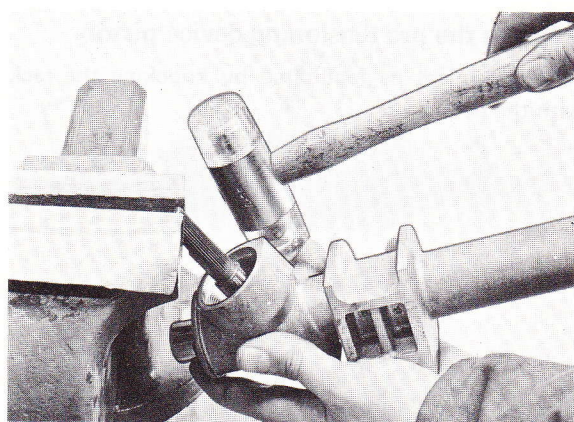
**Remove the lock ring for the pinion nut.**





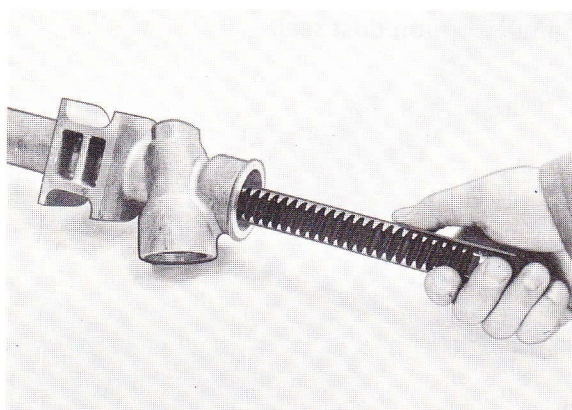
### **Remove pinion nut.**

Use tool 9995119.

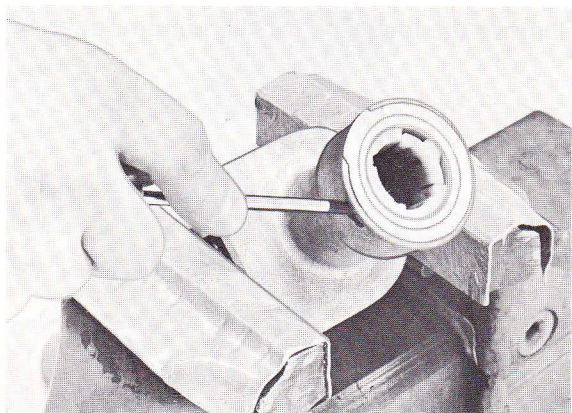


### **Remove the pinion from the housing.**

Clamp the pinion shaft in a vise with soft jaws and tap lightly on the housing with a plastic-tip mallet.



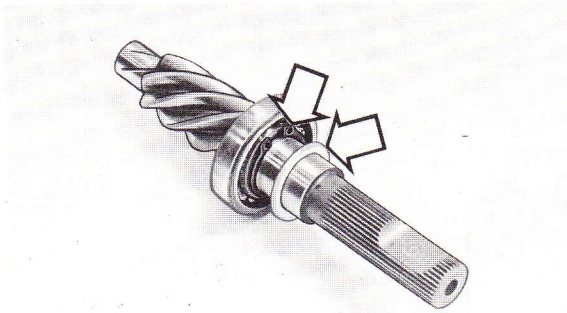
**Pull out the rack towards the pinion side of the housing.**



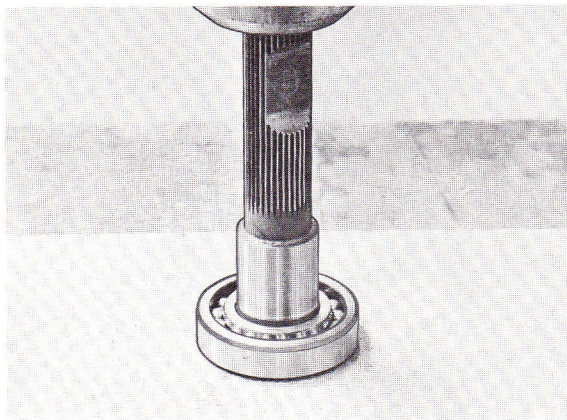
### **Remove the bushing for the rack.**

Press in the locking tabs and pry out the bearing.





**Remove thrust washer and snap ring for bearing**

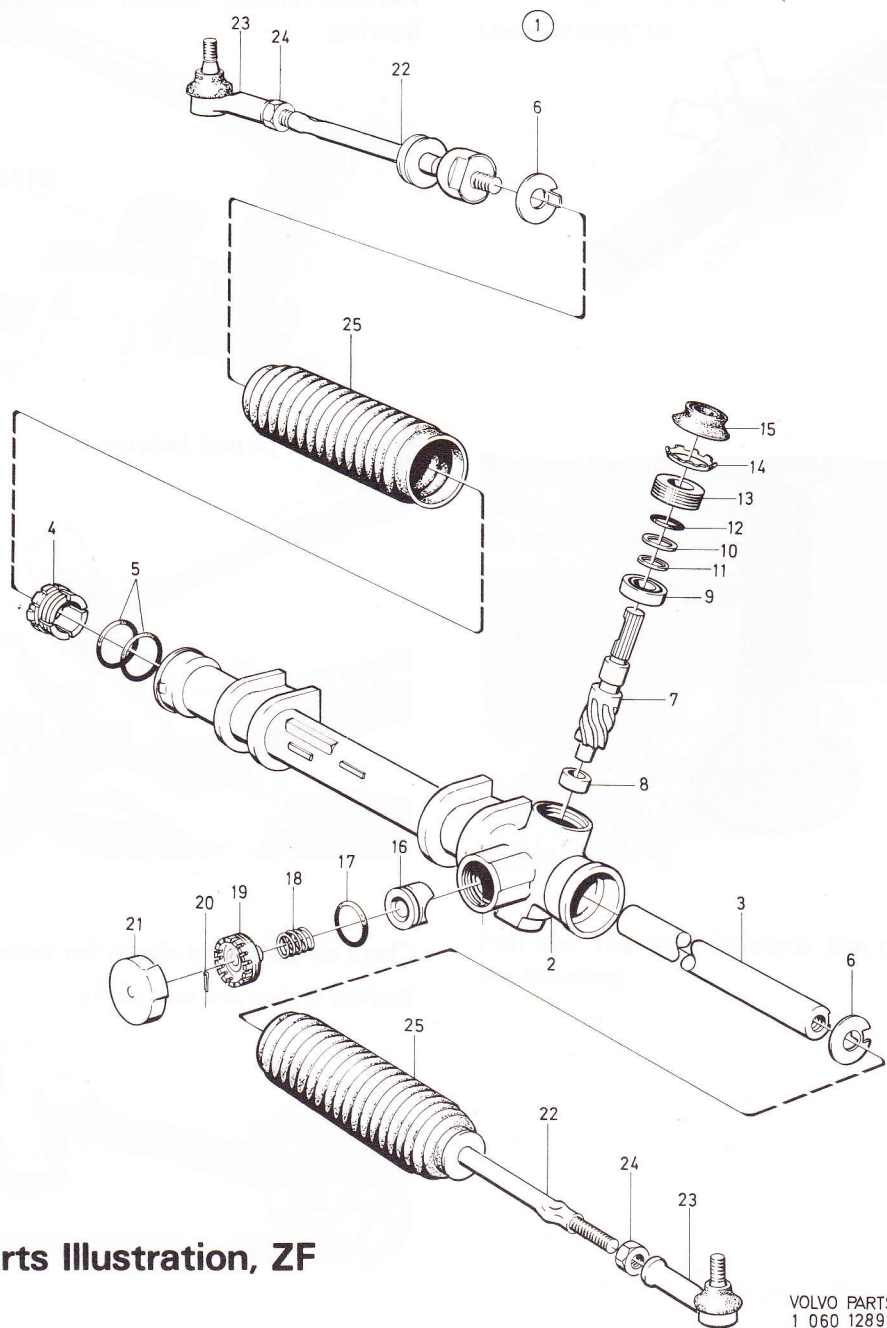


**Press loose pinion bearing**

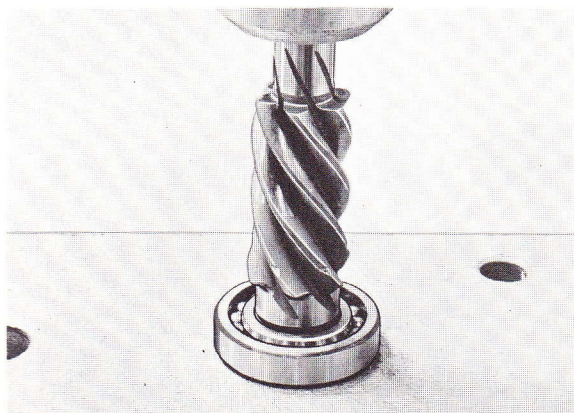
**Clean all parts and check for wear.**

Replace O-rings and worn parts.





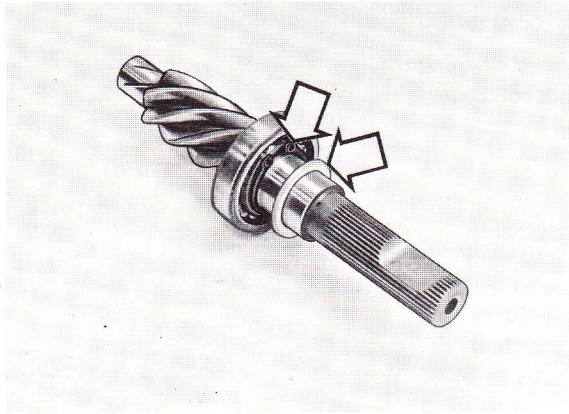
**Spare Parts Illustration, ZF**



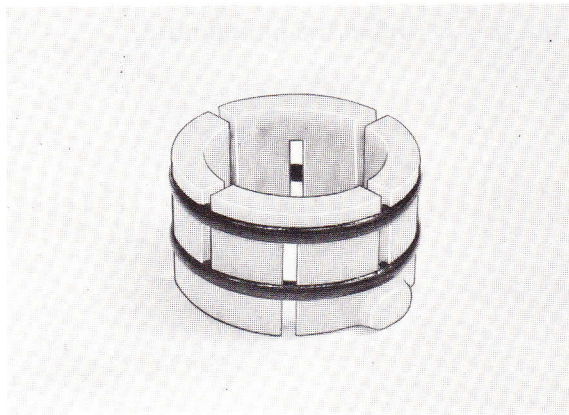
**Manual steering gear  
Assembly (ZF)**

Press the bearing onto the pinion.

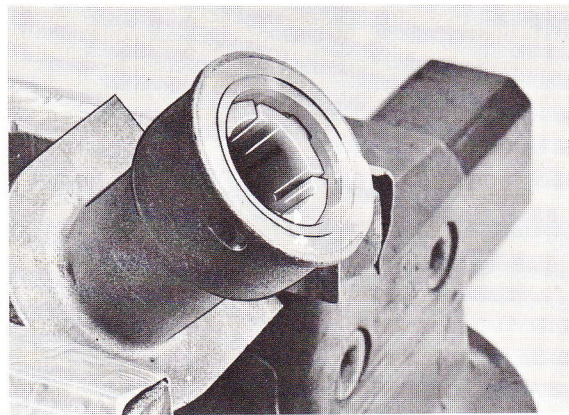




**Install snap ring and thrust washer.**

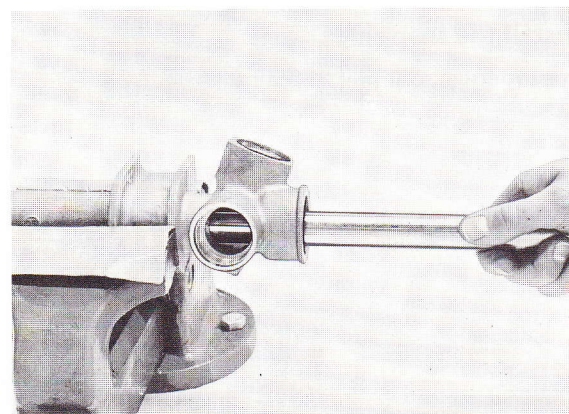


**Fit new O-rings on the bushing for the rack.**



**Press the bearing into the housing.**

Check that the locking tabs for the bearing fit correctly into the housing recesses.

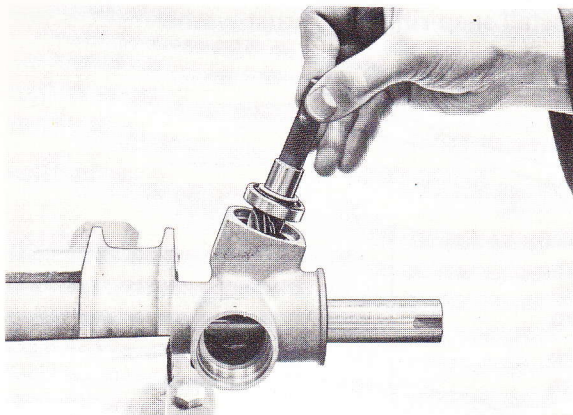


**Grease and install the rack.**

Use grease Calypsol D 4024-OK.

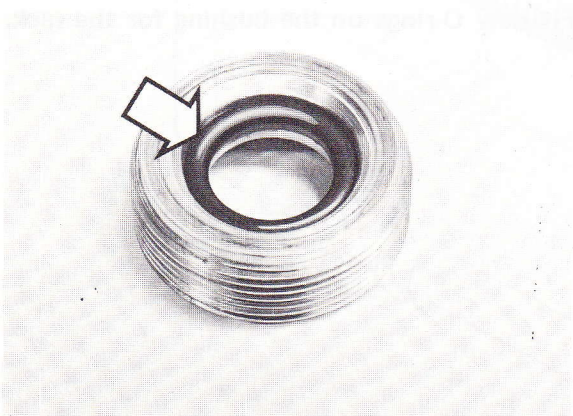
Insert the rack in the pinion side of the housing. Be careful not to damage the bushing with the rack teeth.



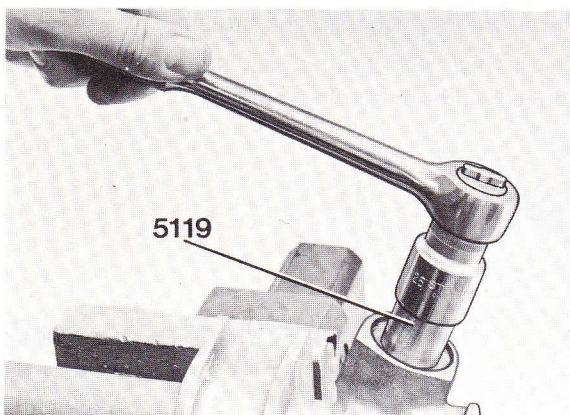


### **Grease and install the pinion.**

Use grease Calypsol D 4024-OK.  
Fill ball bearing and gear.

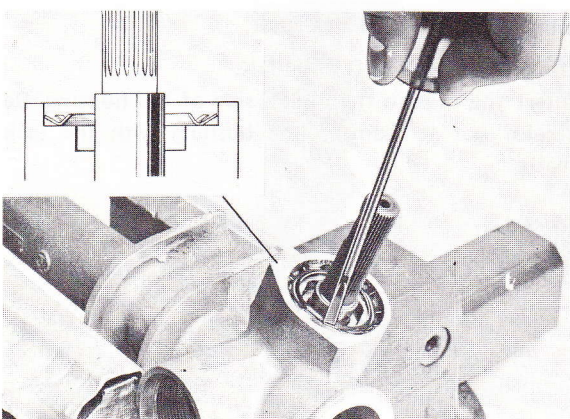


### **Fit a new O-ring in the pinion nut.**



### **Install the pinion nut.**

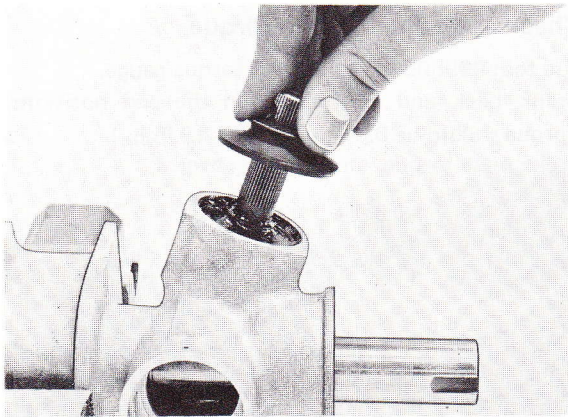
Use tool 9995119.



### **Install the snap ring.**

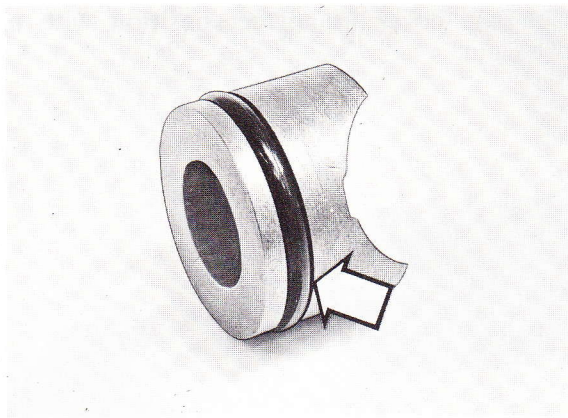
Press it down so it presses against the nut.



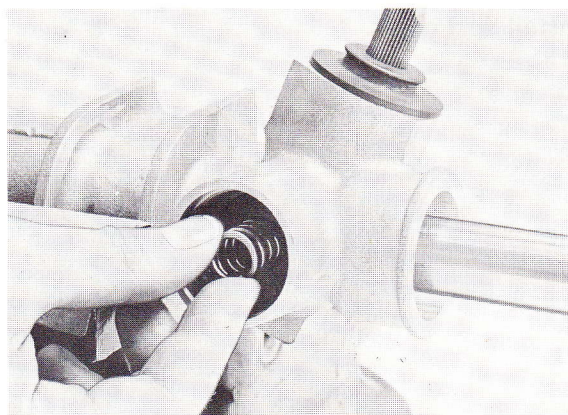


**Fill the cavity on top of the nut with grease.  
Install dust seal.**

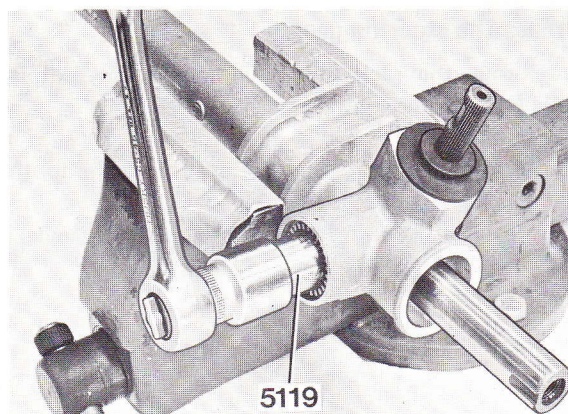
Use grease Calypsol D 4024-OK.



**Fit a new O-ring on the pretensioning device  
piston.**



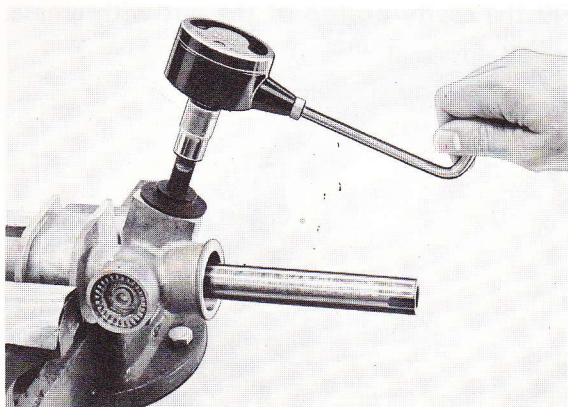
**Grease the piston.  
Install piston and spring.**



**Install the cover for the pretensioning device.**

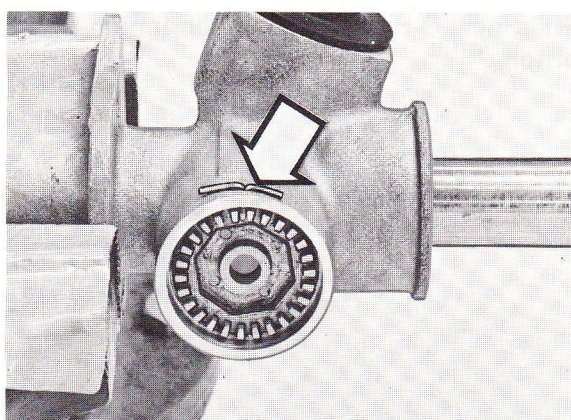
Use tool 9995119. Do not tighten the cover completely.



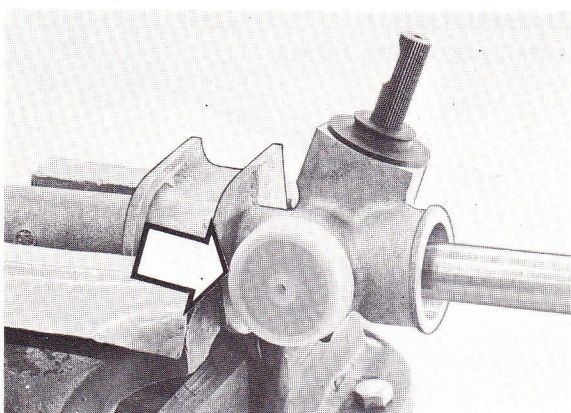


### Check and adjust pinion torque.

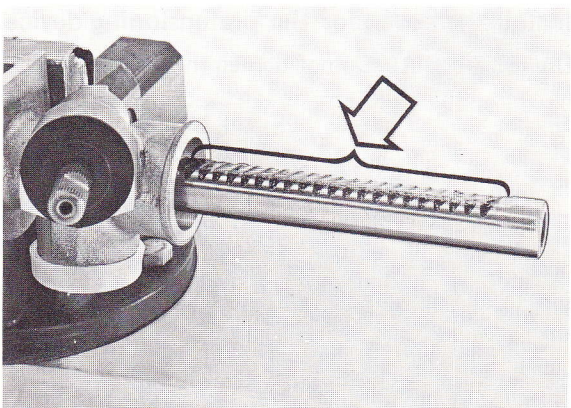
Use tool 9995053 to connect a torque gauge.  
Crank back and forth between the end positions.  
Torque should be 0.6–1.7 Nm (5–15 lb.in.)  
To increase torque, screw in the cover.



Lock the cover in correct position with a cotter pin.



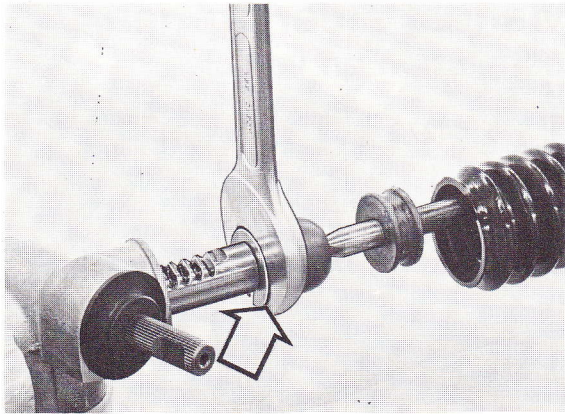
Install dust cover.



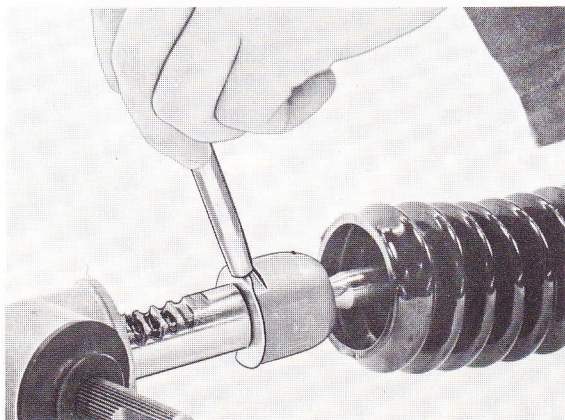
### Grease the steering gear.

Crank out the rack fully. Fill grease Calypsol D 4024-OK into the tooth spaces.  
Crank in the rack.  
Crank out again and fill grease again into the tooth spaces.  
The grease charge will be approx. 25 grams (1 ounce).

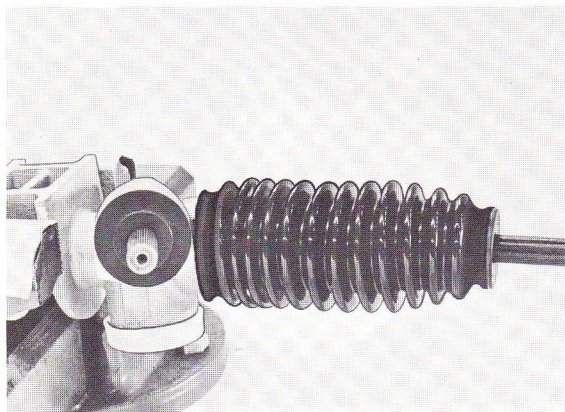




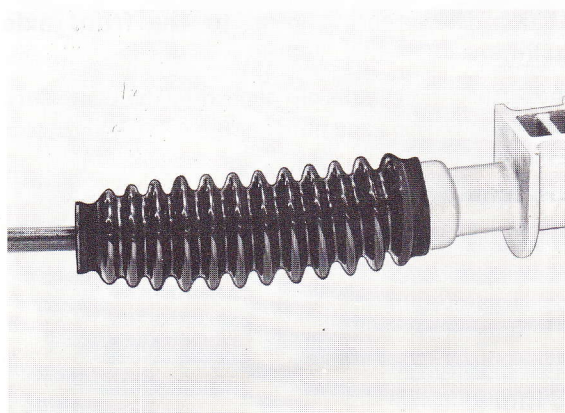
**Install a new lock washer and the steering rod.**  
Use a 32 mm open end wrench.



**Lock the washer.**



**Install the rubber bellow.**

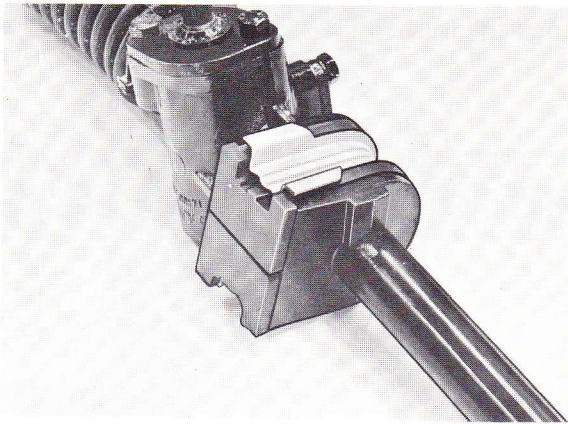


**Install steering rod and rubber bellow on other side.**

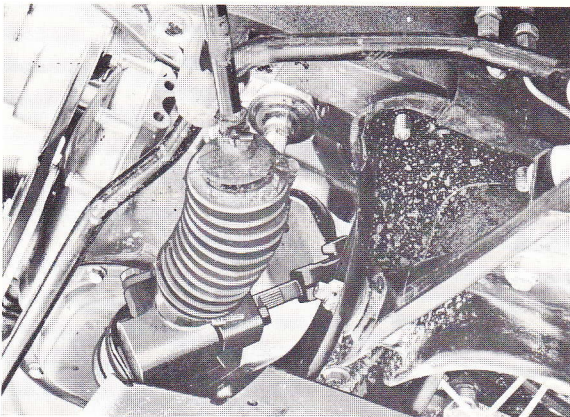


## Manual steering gear Installation on vehicle

Op. No. 64272

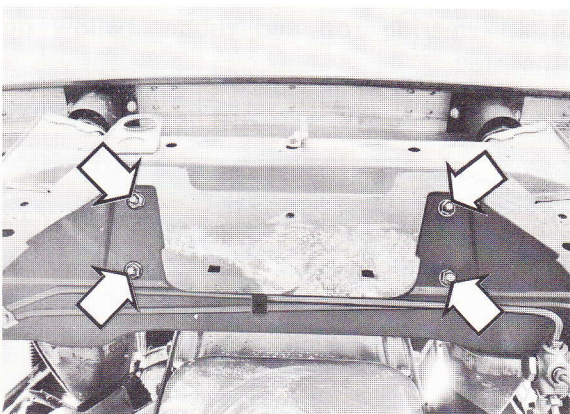


Install rubber spacers and plates for the steering gear attachment points.



**Position the steering gear.**

Guide the pinion shaft into the steering shaft flange. The recess on the pinion shaft should be aligned towards the lock bolt opening in the flange.

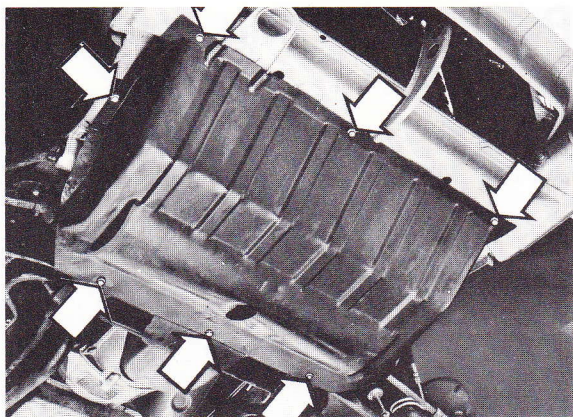


**Attach the steering gear to the front axle member.**

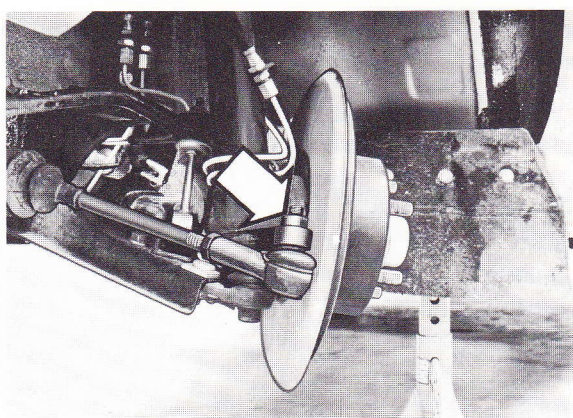
Check that the U-bolts are aligned in the plate slots. Install flat washers and nuts.

13 mm





Install the splash guard.

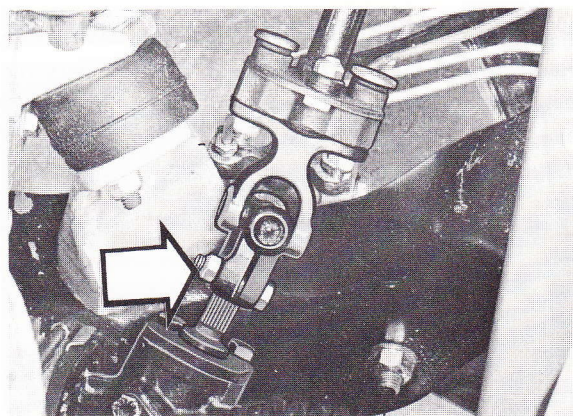


Connect steering rods to the steering arms.

19 mm



Install front wheels and lower the vehicle.



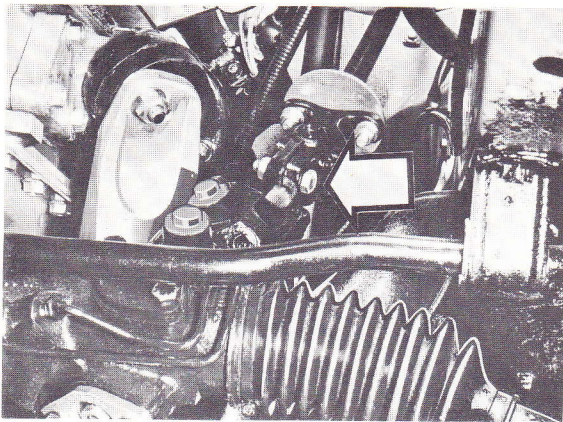
Install the lock bolt for the steering shaft flange.

13 mm



## Power steering gear Removal

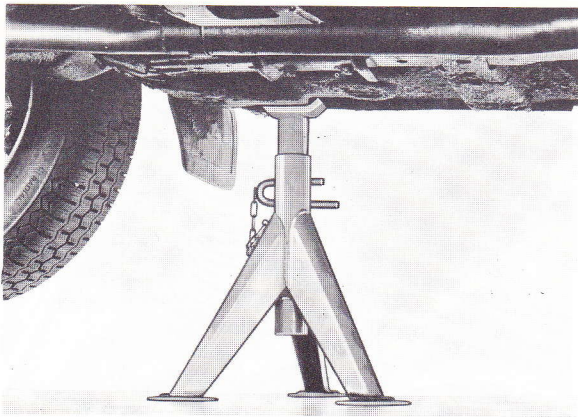
Op. No. 64270 = Steering gear, remove  
Op. No. 64272 = Steering gear, install



**Loosen steering shaft flange from pinion shaft.**

Remove the lock bolt and bend apart the flange slightly.

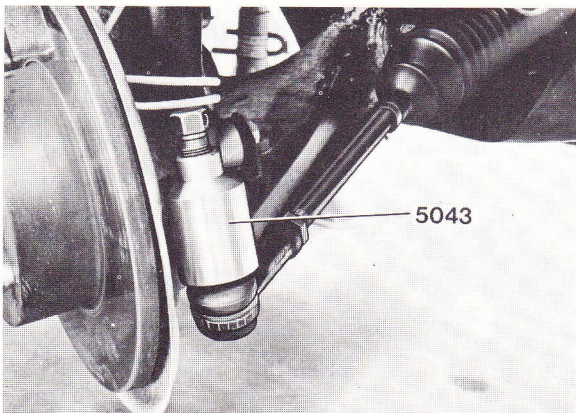
13 mm



**Put front end on stands.**

**Remove front wheels.**

Position the stands at the front jack supports.

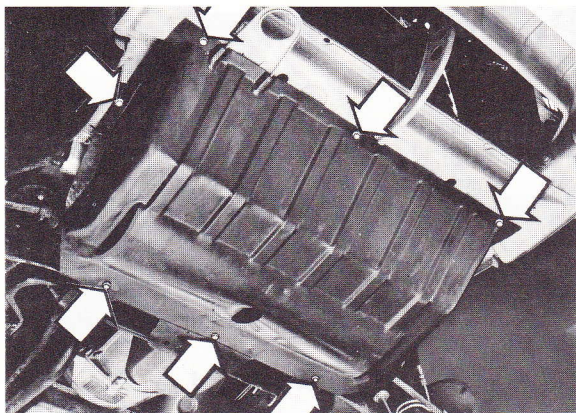


**Disconnect steering rods from steering arms.**

Remove nuts. Use tool 9995043 to disconnect the ball studs.

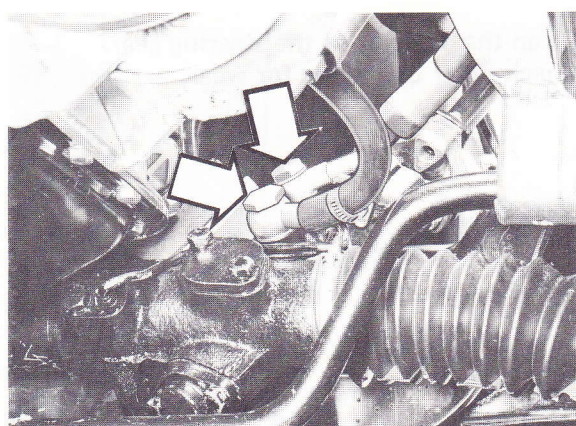
19 mm





**Remove the splash guard.**

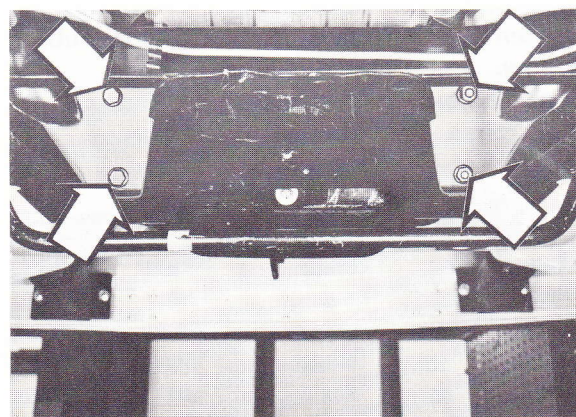
**10 mm**



**Disconnect hoses at steering gear.**

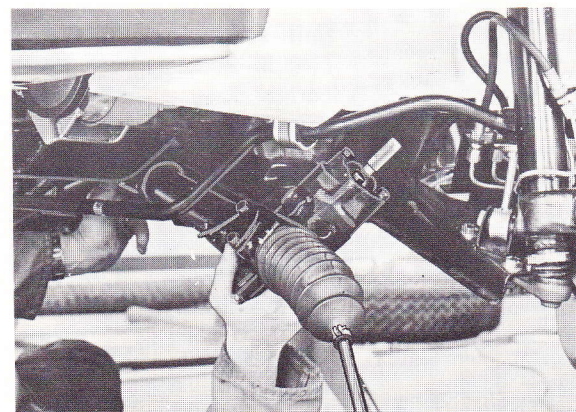
Install protection plugs in the hose connections.

**19 mm and 22 mm**



**Remove steering gear from front axle member.**

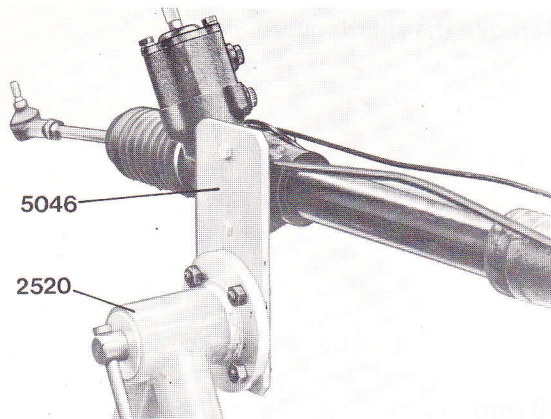
**12 mm and 13 mm**



**Remove steering gear.**

Pull down until free from steering shaft flange.  
Then remove on left side of vehicle.





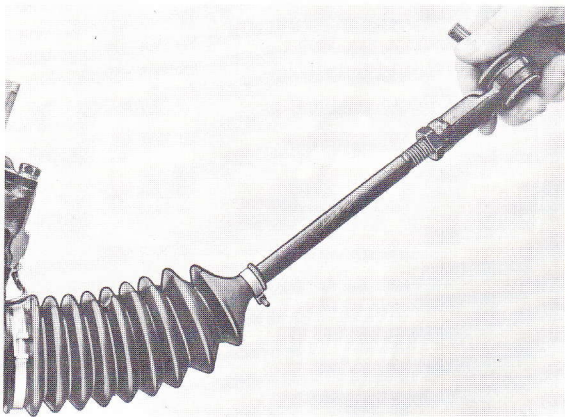
## Power Steering Gear Disassembly

**Op. No. 64412 = Power steering gear, rebuild**

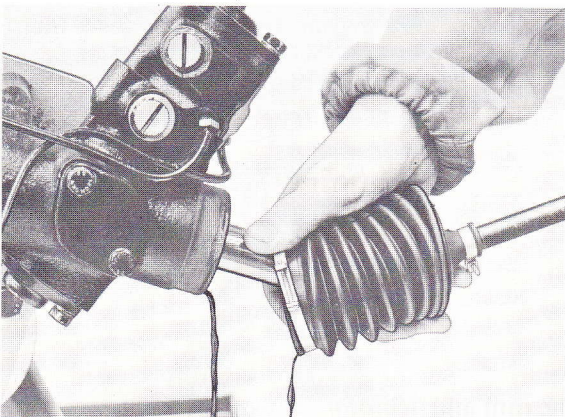
**Incl.:** steering gear remove,  
steering gear rebuild,  
steering gear install,  
power steering test,  
steering gear adj. servo balance

**Put the steering gear on a stand.**

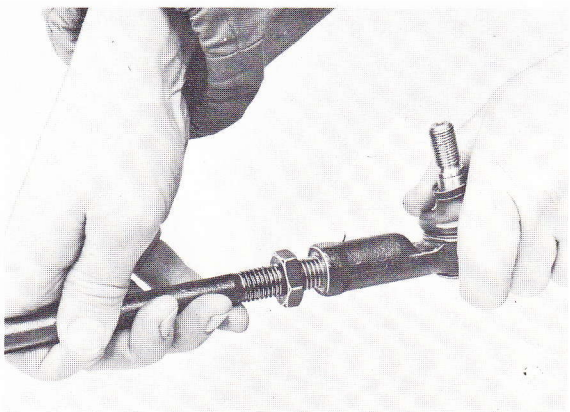
Use stand 9992520 and fixture 9995046.



**Clean the exterior of the steering gear.  
Check inner ball joints for wear.**

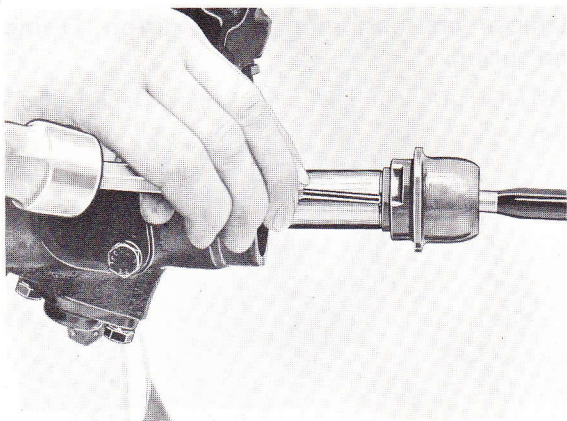


**Loosen inner clamp for left side rubber bellow.  
Drain the oil.**

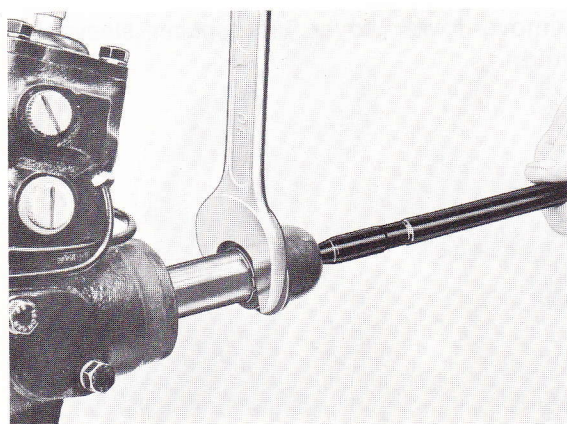


**Remove left side ball stud, lock nut and rubber bellow.**



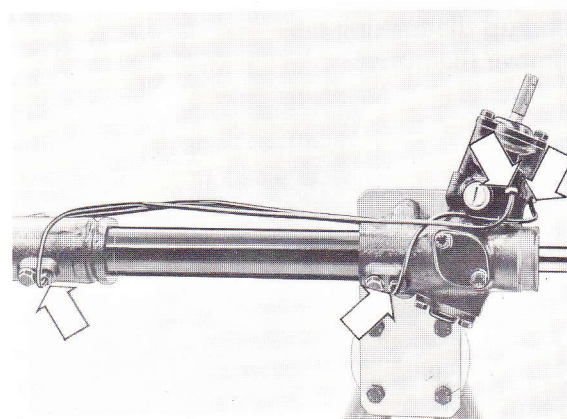


Bend up the locked portion of the ball joint.



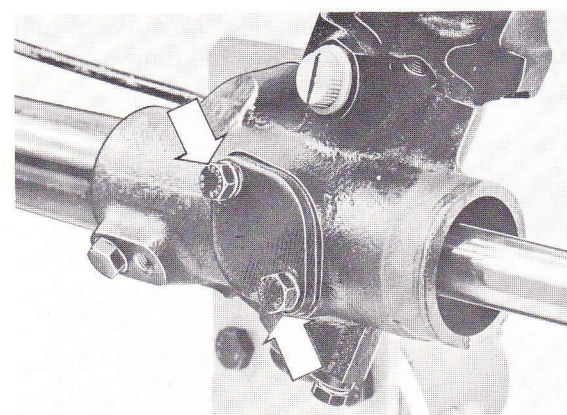
Unscrew steering rod.  
Then remove also right side rubber bellow,  
ball joint and steering rod.

32 mm



Remove oil tubes.

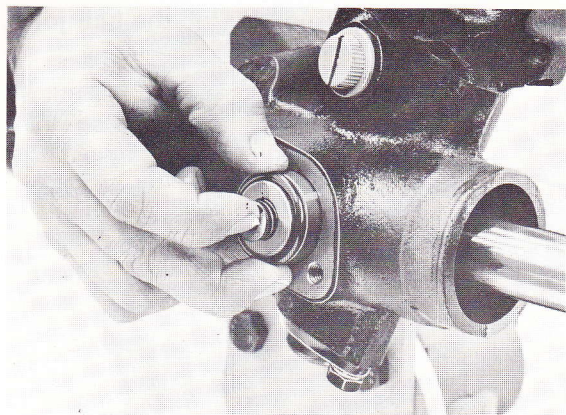
1/16"



Remove the cover for the pre-tensioning  
device.

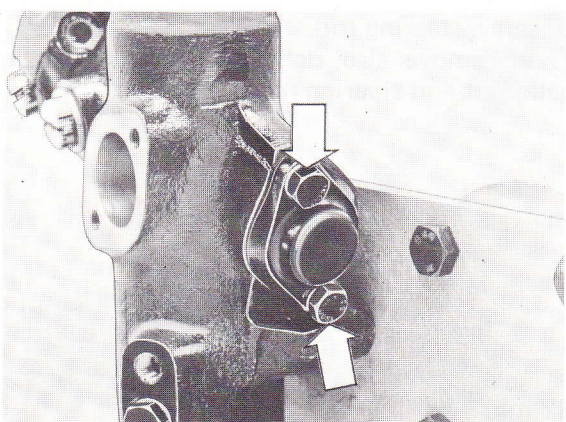
1/2"





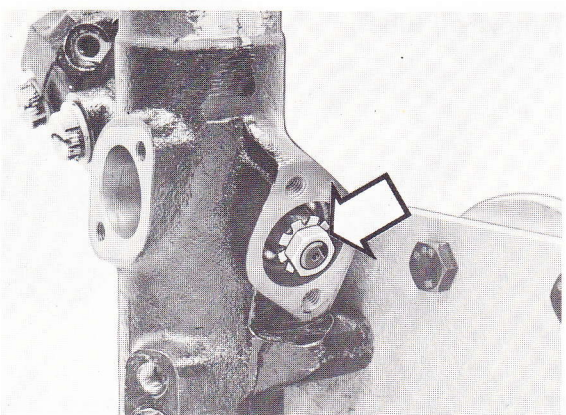
**Remove pre-tensioning device piston, O-ring and spring.**

**CAUTION:** Do not turn pinion shaft. Danger of oil spray.



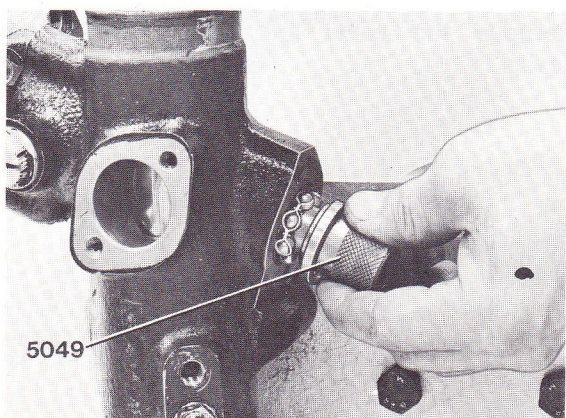
**Remove lower cover and spacer sleeve for pinion.**

**1/2"**



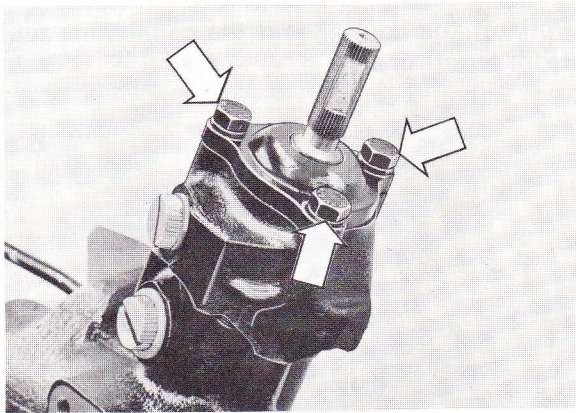
**Bend up the locking tab.  
Remove the nut.**

**16 mm**



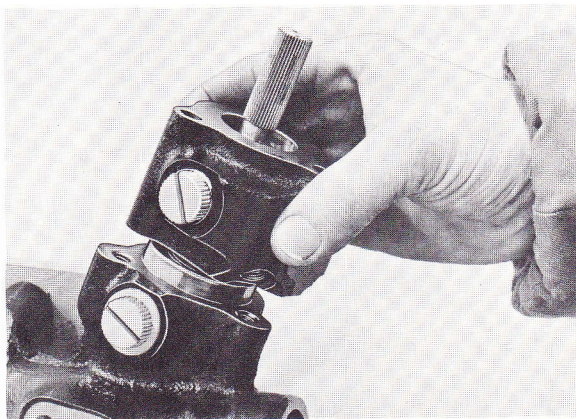
**Unscrew the inner bearing race with ball retainer and outer race from the pinion.  
Use tool 9995049.**





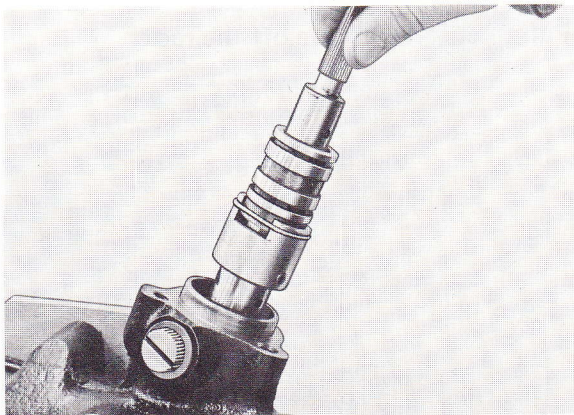
**Remove valve housing cover.**

**1/2"**

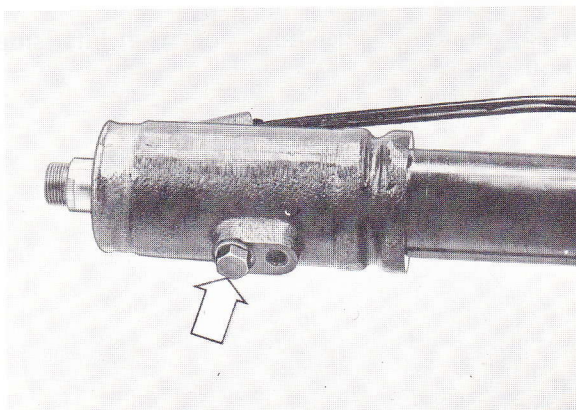


**Remove the spring.  
Lift off the valve housing.**

**CAUTION:** Be careful, do not damage valve housing or valve.



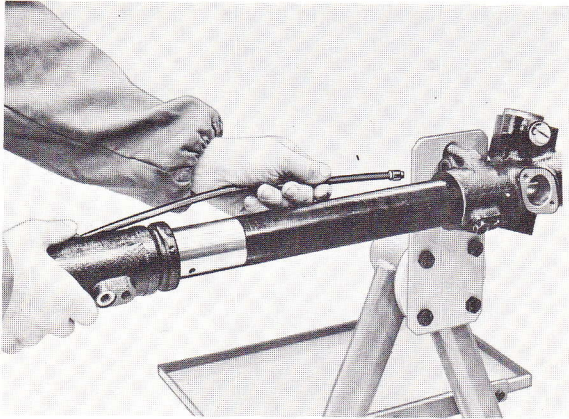
**Lift out the pinion.**



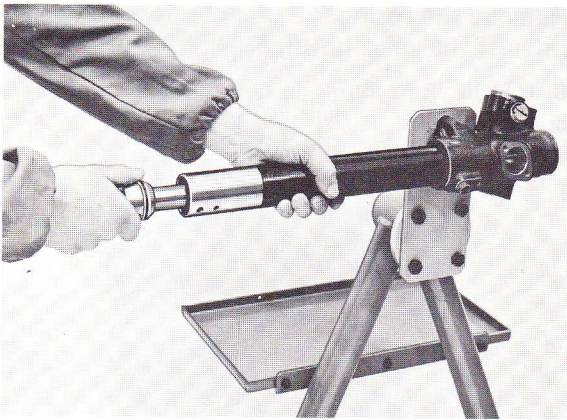
**Remove the lock bolt for the right side housing.**

**9/16"**

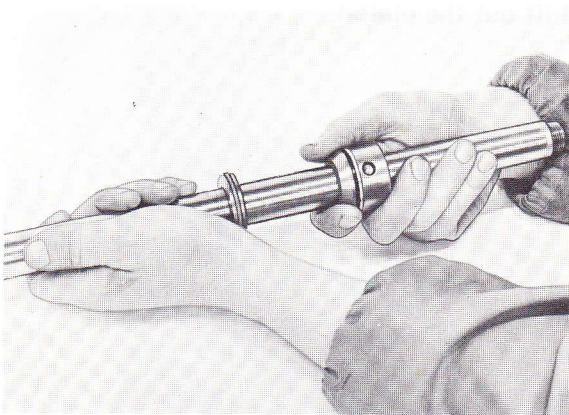




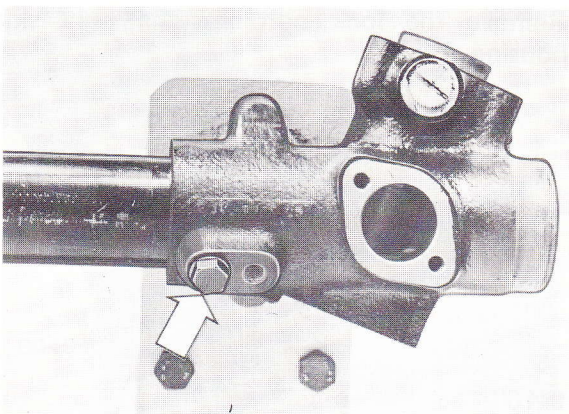
Pull off the housing and the connecting tube from outer tube.



Pull out rack and bearing sleeve.



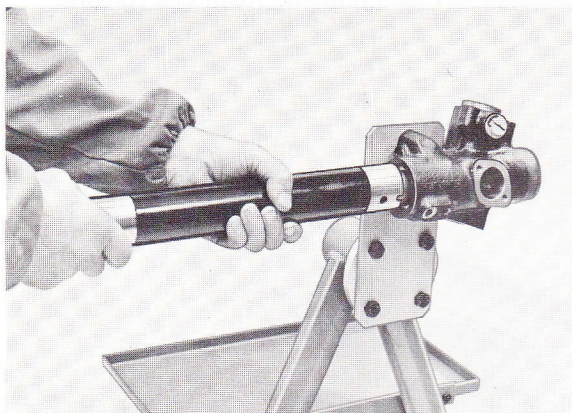
Pull the bearing sleeve off the rack.



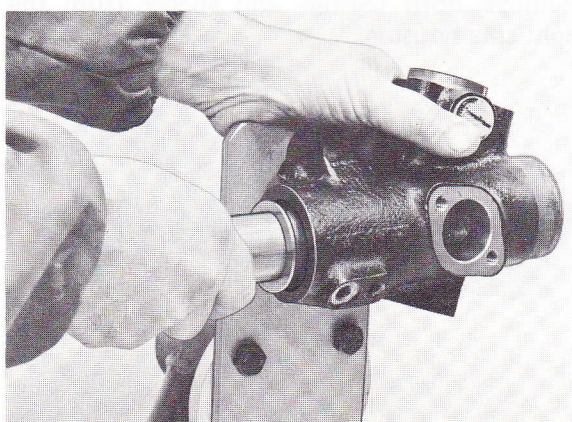
Remove the lock bolt for the left side housing.

9/16"

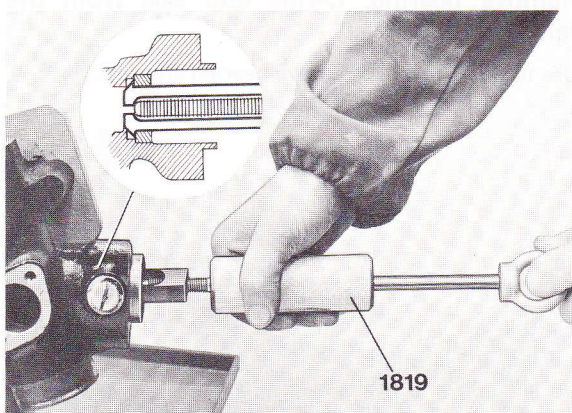




**Pull out the outer tube from the housing.**



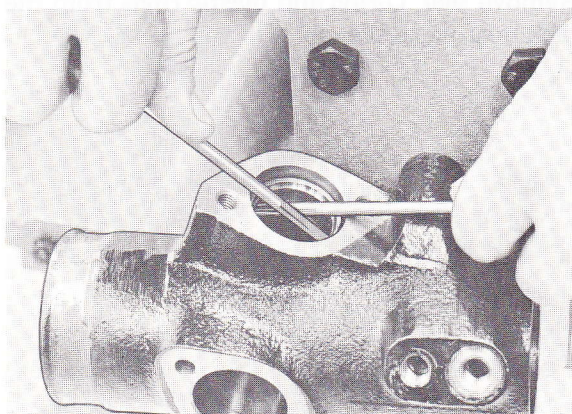
**Pull out the inner tube from the housing.**



**Remove upper bushing.**

Use tool 9991819.

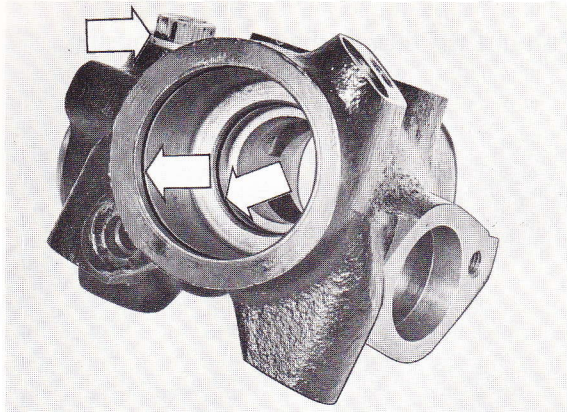
Use tool in middle of sleeve way.



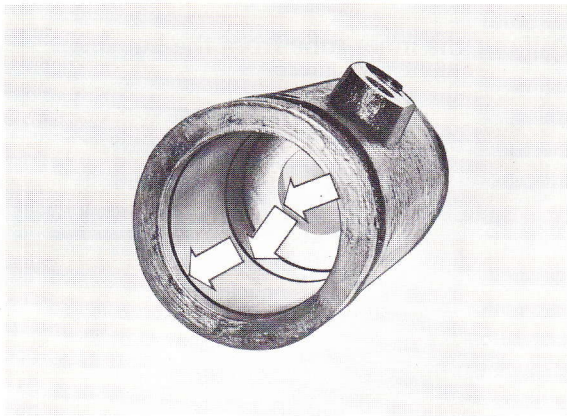
**Remove the upper outer race for the pinion lower bearing.**

Use two narrow screwdrivers.

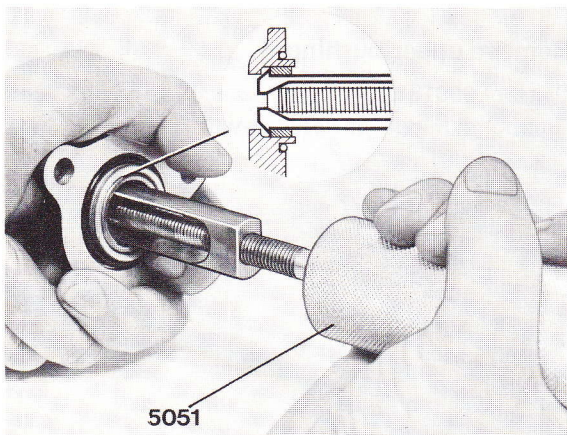




**Remove left side housing from the fixture.**

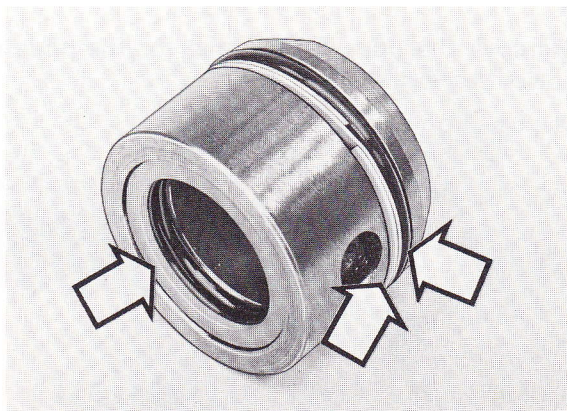


**Remove both O-rings and spacer from the right side housing.**



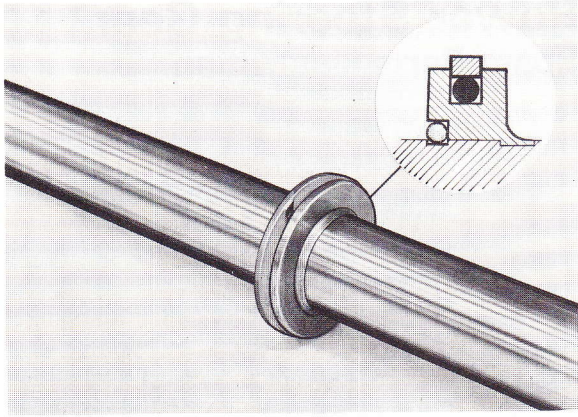
**Remove bearing, O-ring and seal from the valve housing cover.**

Use tool 9995051 to remove bearing and seal.

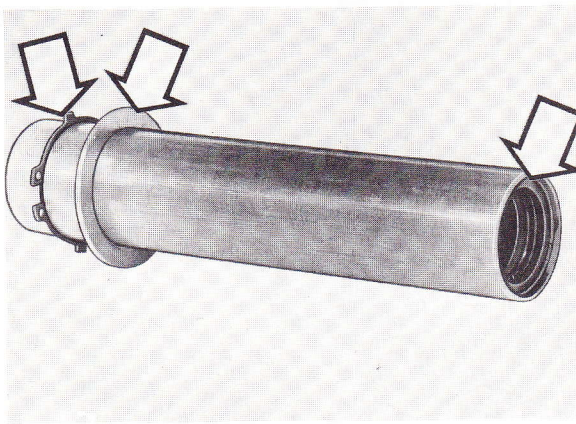


**Remove seal, O-ring and plastic rings from the rack bearing sleeve.**





**Remove plastic ring, and O-ring under it, from the rack.**



**Remove oil seal in inner tube.  
Remove washer and snap ring on tube.**

#### **Clean and check all parts.**

Replace all seals and O-rings.  
Replace defective parts.

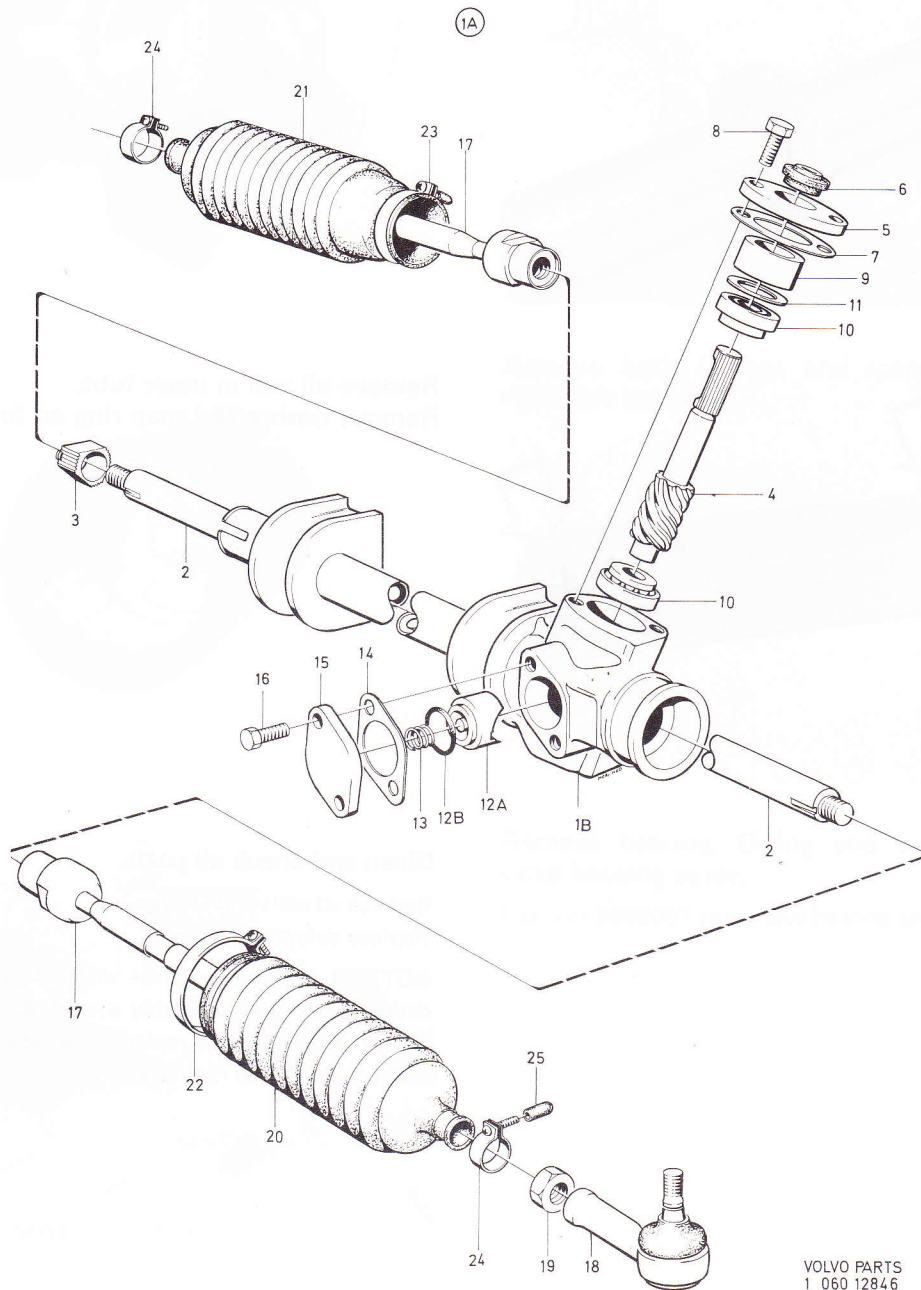
**NOTE:** if a pinion, control valve or valve housing is damaged, the parts assembly should be replaced.  
Also, if the bearing is replaced the bearing sleeve for the rack should be replaced.

**Oil all parts prior to assembly.**

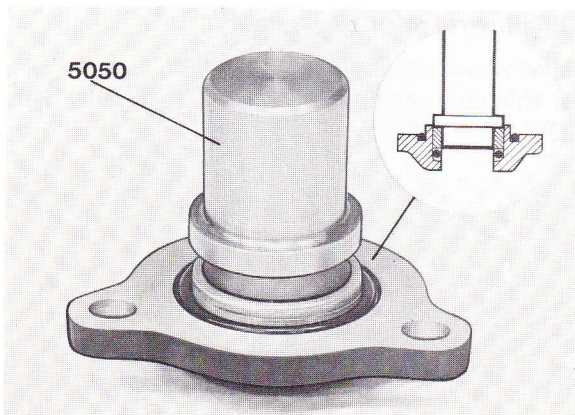
**Always use same oil as later filled.  
In this case: engine oil SAE 20W-50, alt. SAE 20W-40.**



## Power Steering Gear Spare Parts Illustration



VOLVO PARTS  
1 060 12846

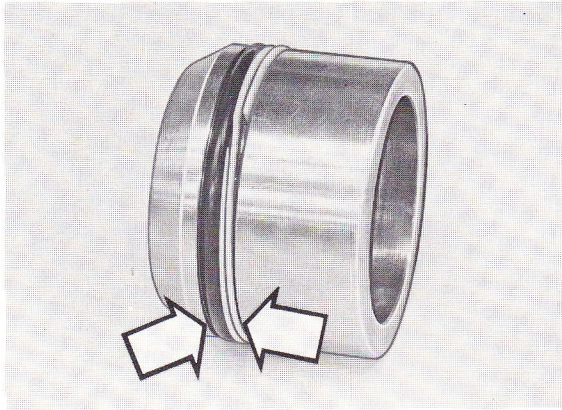


## Power Steering Gear Assembly

Install oil seal, bearing and O-ring in the valve housing cover.

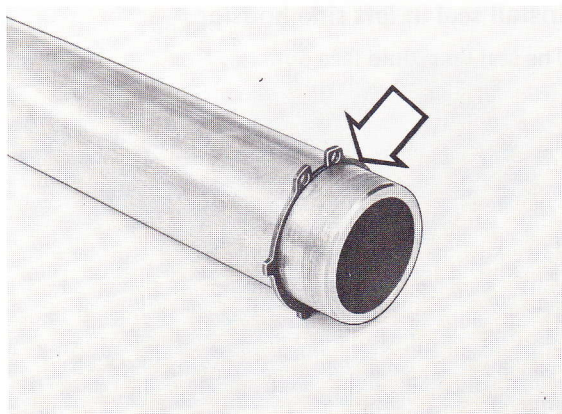
Use tool 9995050.



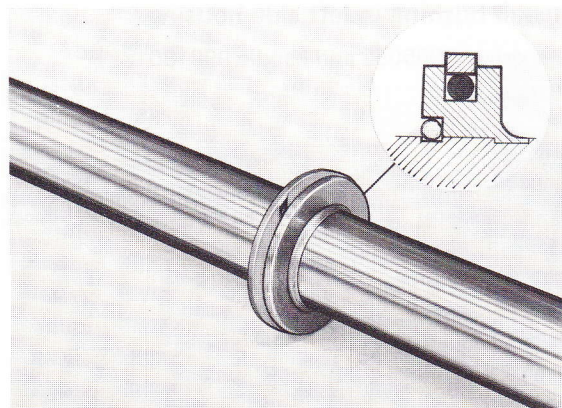


**Fit plastic ring and O-ring on rack bearing sleeve.**

Position the O-ring on the tapered side of the bearing sleeve.

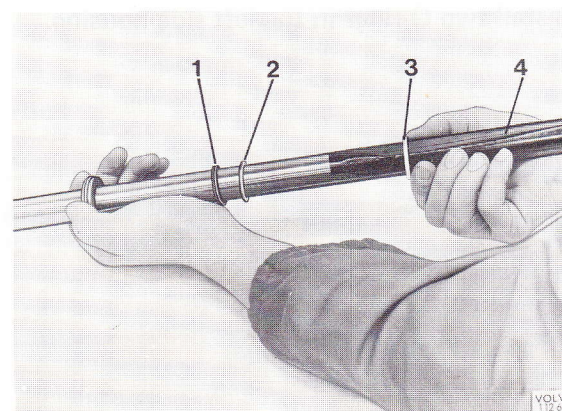


**Install snap ring on inner tube.**



**Install O-ring and plastic ring on the rack piston.**

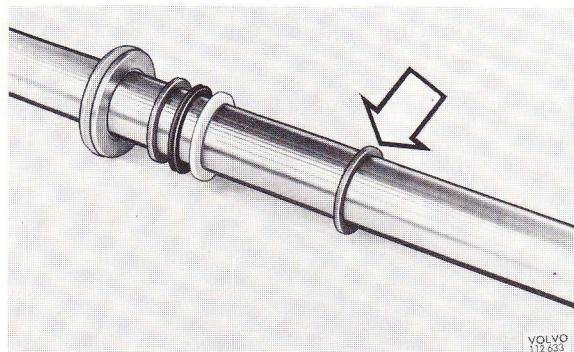
The O-ring in the bottom of the groove.



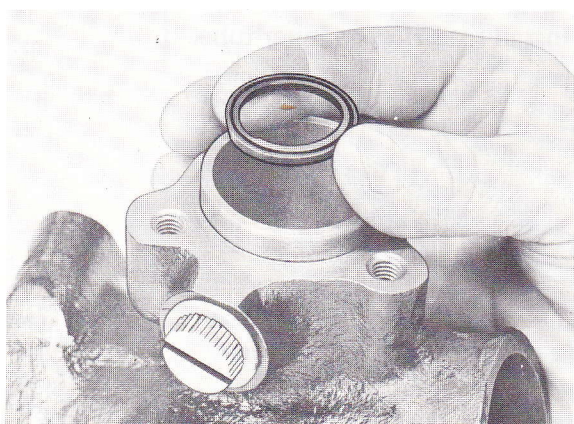
**Fit spacer sleeve (1), oil seal (2) and plastic ring (3) on the rack.**

Fit the parts from the teathed side of the rack but place a wide tape (4) over the teeth to protect when fitting the oil seal.



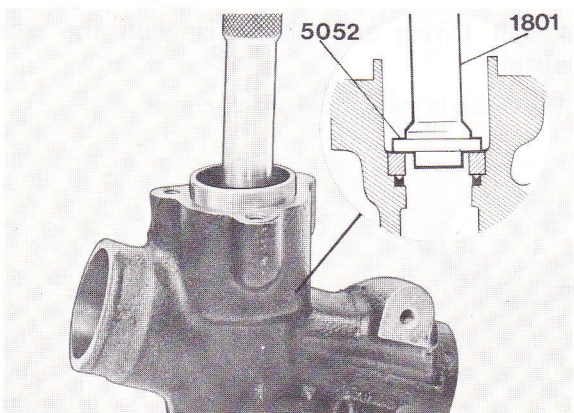


**Remove tape and fit spacer sleeve on the rack.**



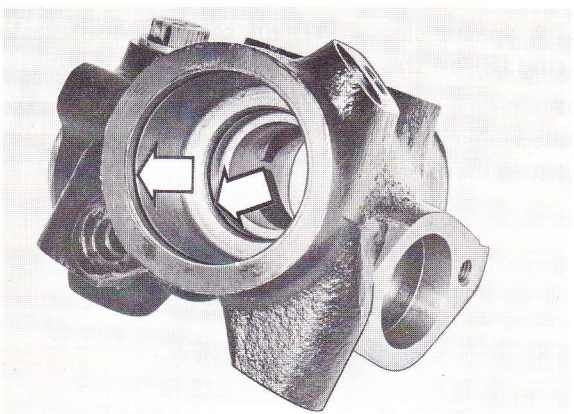
**Install seal in left side housing.**

The seal lip should face out.



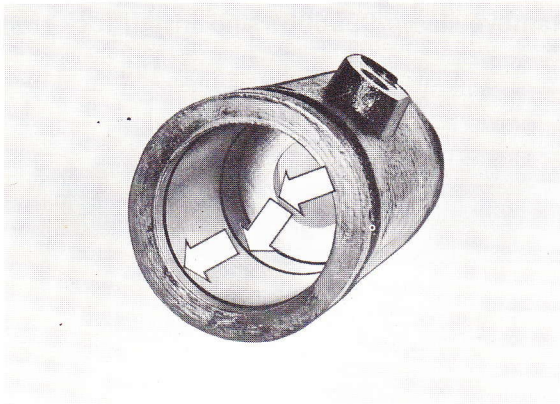
**Install bushing in left side housing.**

Use driver 9995052 and handle 9991801.

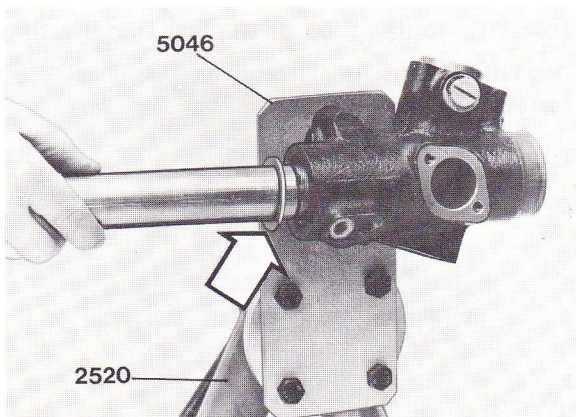


**Install two O-rings in the left side housing.**



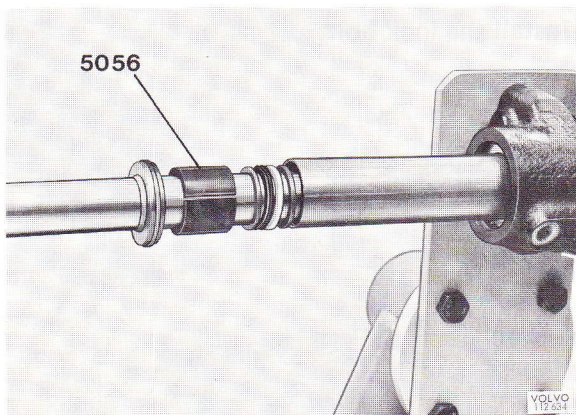


**Install spacer washer and two O-rings in right side housing.**

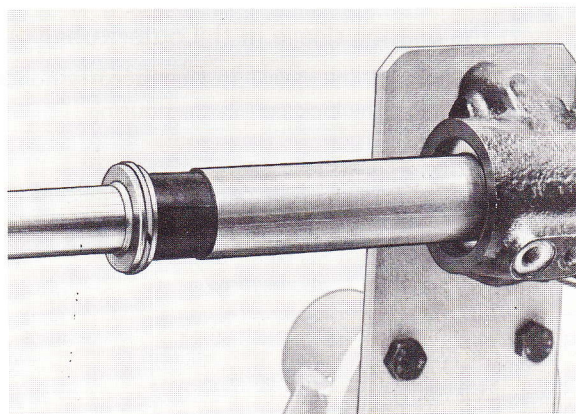


**Install left side housing on the stand.  
Install inner tube and its spacer washer.**

Use stand 9992520 and fixture 9995046.

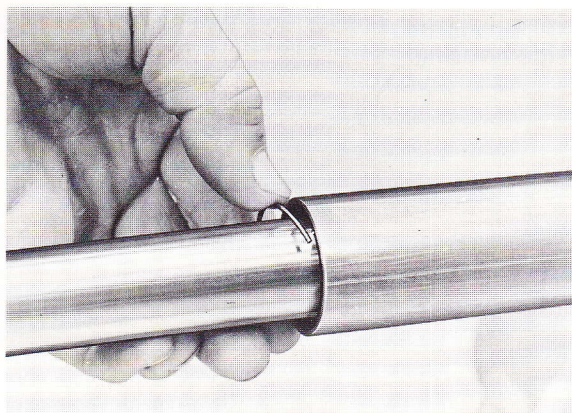


**Insert the rack with seal and spacer rings into the inner tube.  
Position sleeve 9995056.**

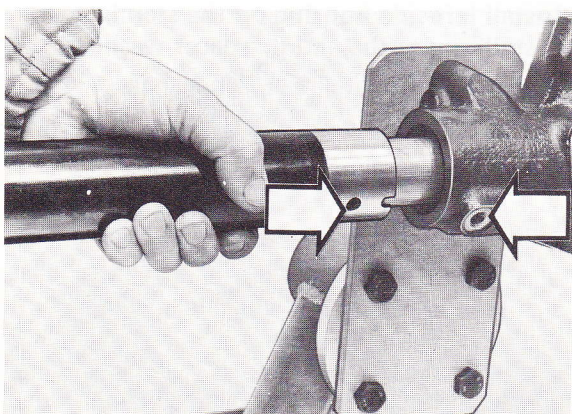


**Press in seal and spacer rings, using rack and tool.**



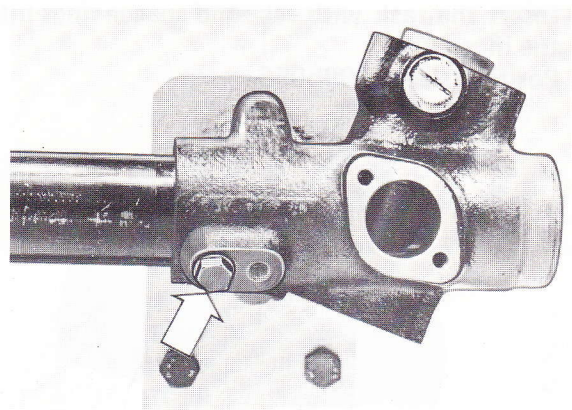


**Remove sleeve 9995056 and install lock ring.**



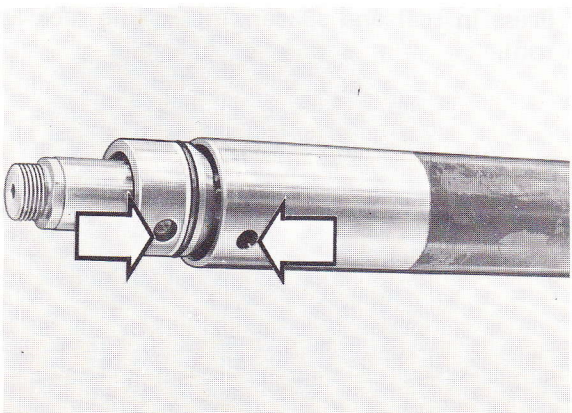
**Insert the outer tube in the left side housing.**

Align the tube so that the hole for the lock bolt corresponds with the hole in the housing.



**Install the lock bolt.**

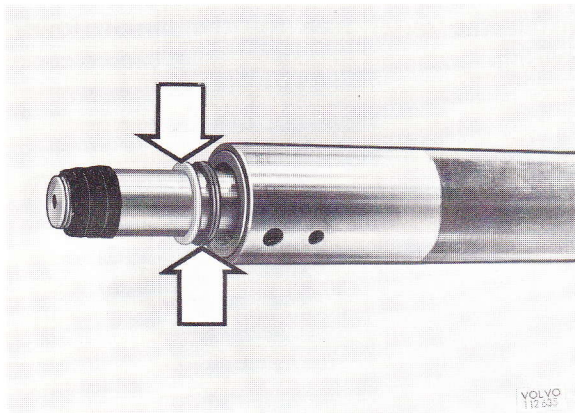
**9/16"**



**Insert the bearing sleeve in the outer tube.**

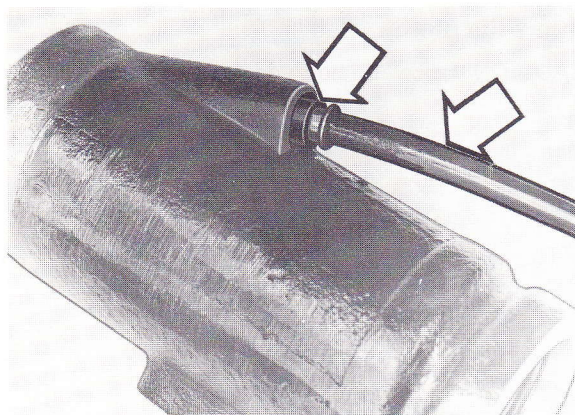
Align the hole in the sleeve so that it corresponds with the hole for the lock bolt in the housing.



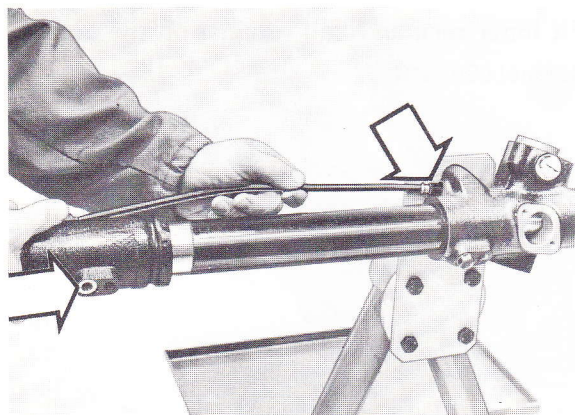


**Install seal and plastic ring in the bearing sleeve.**

Use a tape round the rock sharp edge to protect the seal.

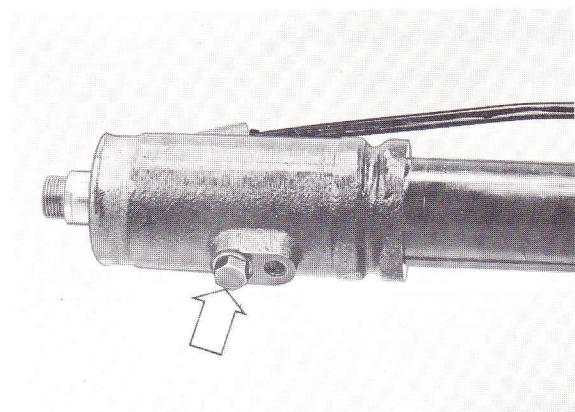


**Insert the connecting tube with rubber seal in right side housing.**



**Install right side housing, with connecting tube and rubber seal.**

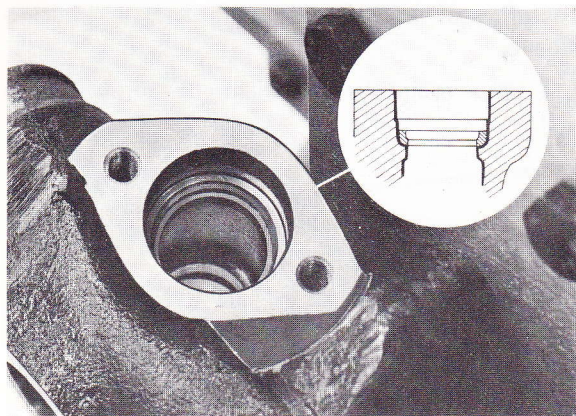
Align the hole in the housing so that it corresponds with the hole for the lock bolt in the outer tube.



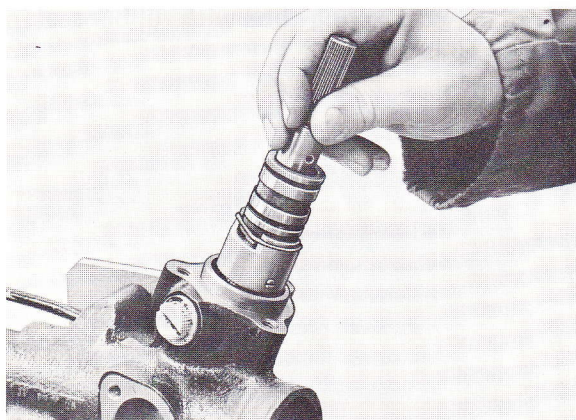
**Install the lock bolt.**

**9/16"**



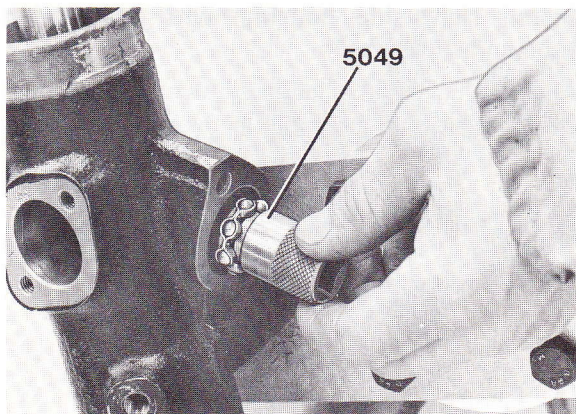


**Install the outer race for the pinion lower bearing.**



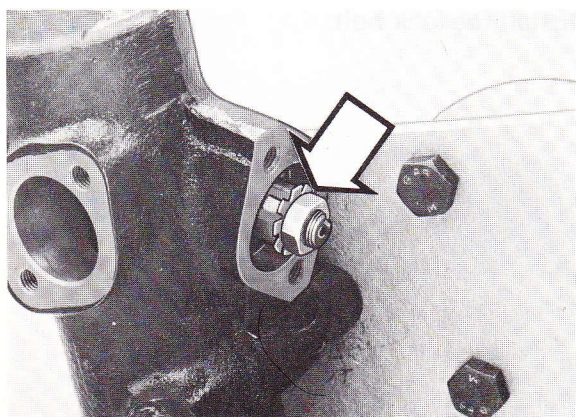
**Insert the pinion.**

**CAUTION:** be careful no to damage the valve.



**Fit inner race and ball retainer on the pinion.**

Use tool 9995049.

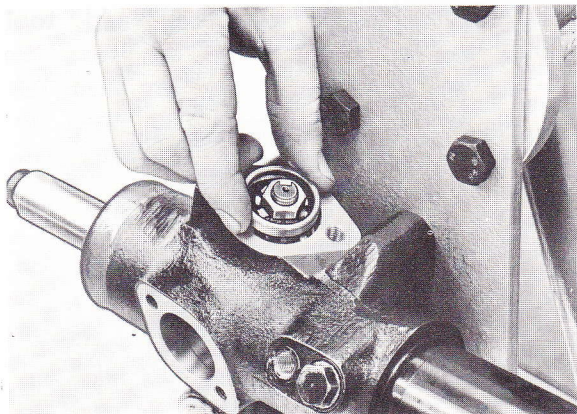


**Install lock ring and nut.**

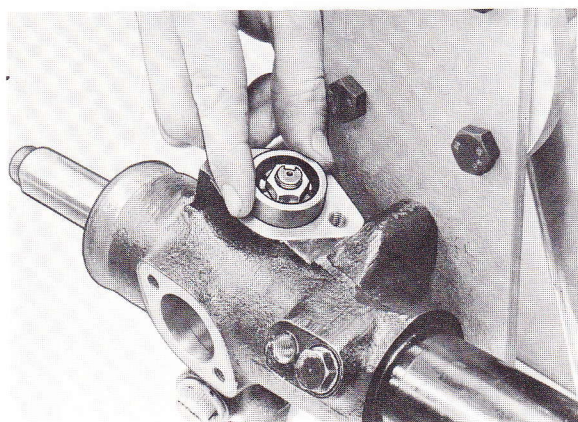
Do NOT lock the nut.

**16 mm**

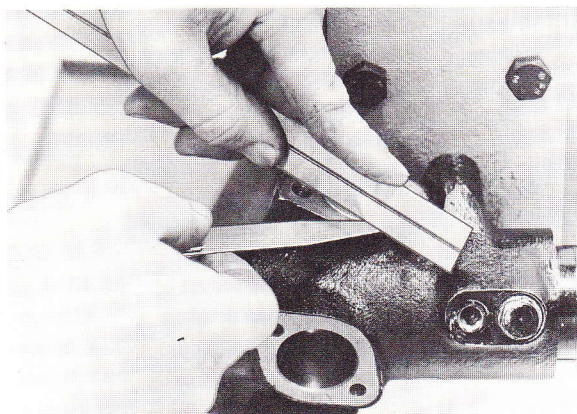




**Install outer race**



**Install spacer sleeve.**



**Measure the distance between spacer ring and housing.**

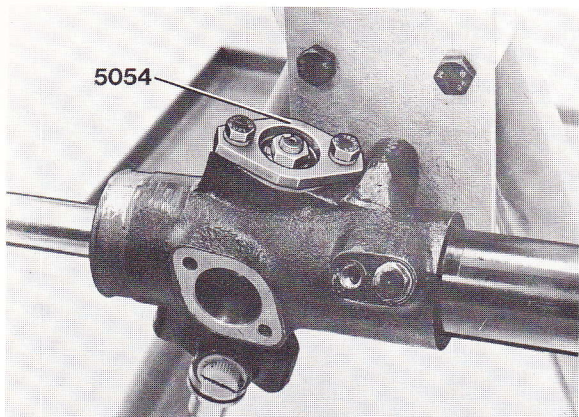
Press down the spacer sleeve so that it bottoms on the bearing race.

Use feeler gauge and steel ruler to measure.

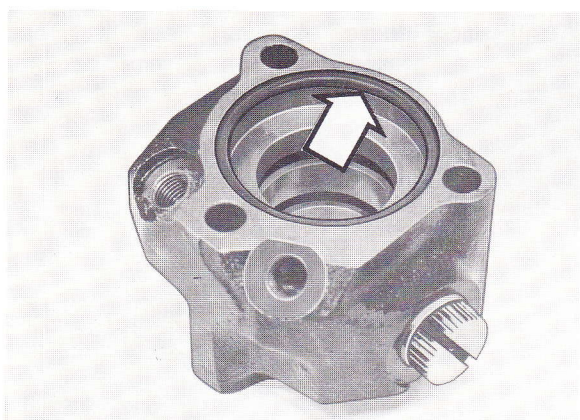
Feeler gauge	Qty	Gasket P/N
0.008–0.010"	1	1206931
0.010–0.014"	1	1206934
0.014–0.018"	2	1206931
0.018–0.024"	1	1206931+
	1	1206934
0.020–0.028"	2	1206934

**Use the chart to determine gasket of right thickness.**

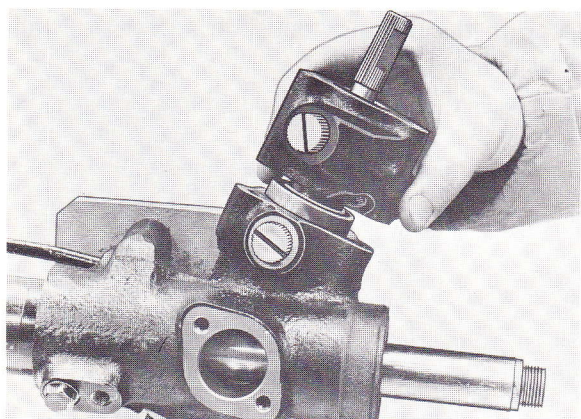




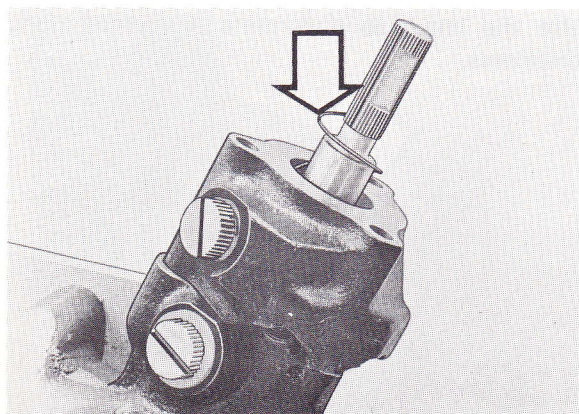
Fit gasket (gaskets) - choosen and tool 9995054.



Install the O-ring in the valve housing.



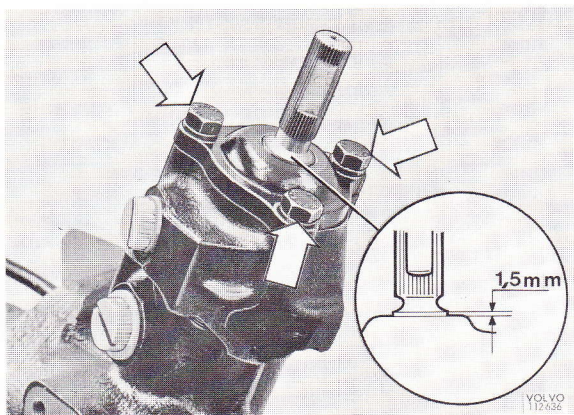
Install the valve housing.



Place the coil spring in the valve housing.

Big end in first.



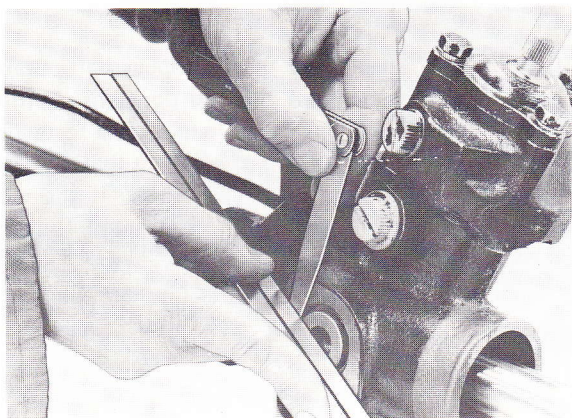


### Install the valve housing cover.

Check that the coil spring does not become squeezed between cover and valve housing.

NOTE: the input shaft shoulder should be 1.5 mm = 0.06" above the cover face. Adjust position by moving lower bearing inner race with tool 9995049.

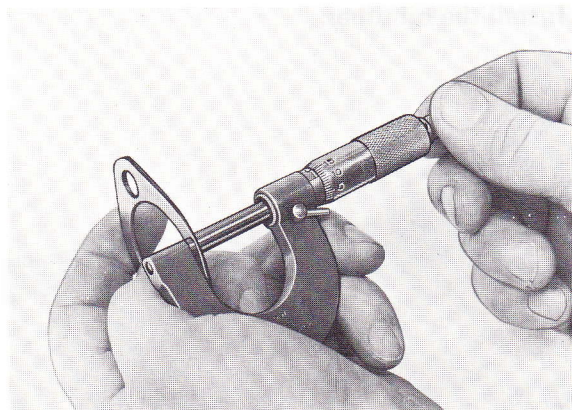
1/2"



### Place the pre-tensioning piston, without O-ring, in the housing.

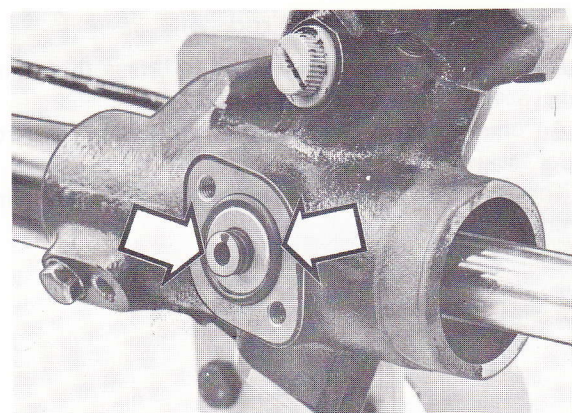
Measure the clearance between housing and piston faces.

Press the piston against the rack. Use feeler gauge and steel ruler to measure.



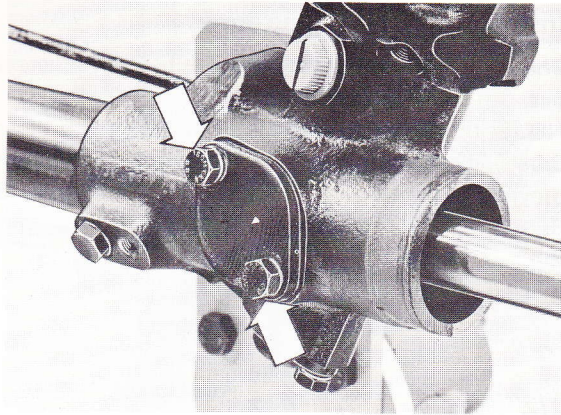
### Measure shims.

The shims chosen should equal the clearance between the pre-tensioning piston and the housing. Add one shim 0.05–0.15 mm (0.002–0.006") for correct play.



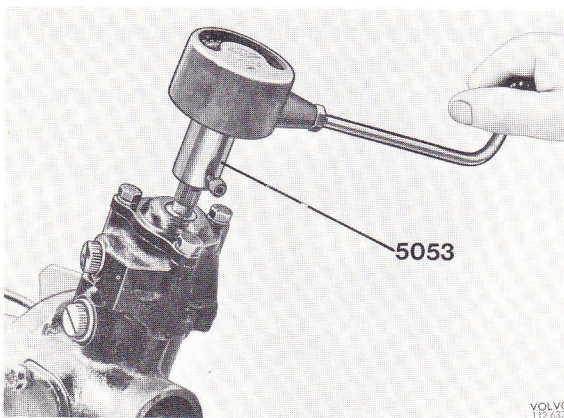
### Fit O-ring and spring for the pre-tensioning piston.





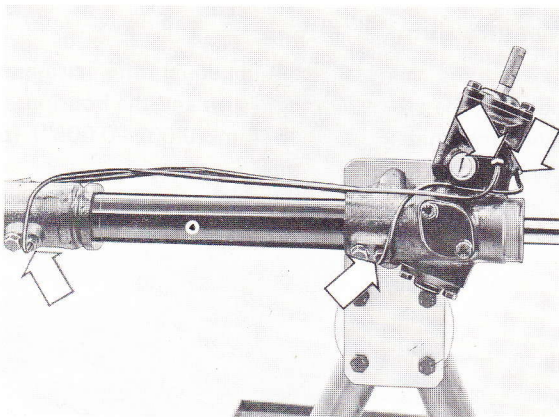
**Install shims and cover for the pre-tensioning device.**

**1/2"**



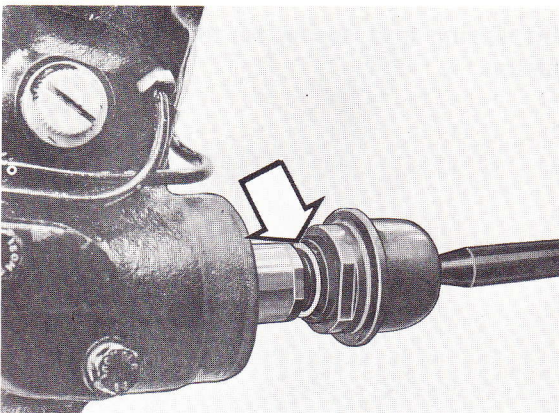
### **Check steering rod torque.**

Connect a torque gauge to the input shaft. Crank back and forth between the end positions. Torque should be 0.9–1.7 Nm 5–15 lb.in. If the torque in any place is excessive, stop the rack in that position and re-adjust the pre-tensioning device. If the rack jams with the pre-tensioning device removed, the rack is warped and should be replaced.



**Install the oil tubes.**

**7/16"**



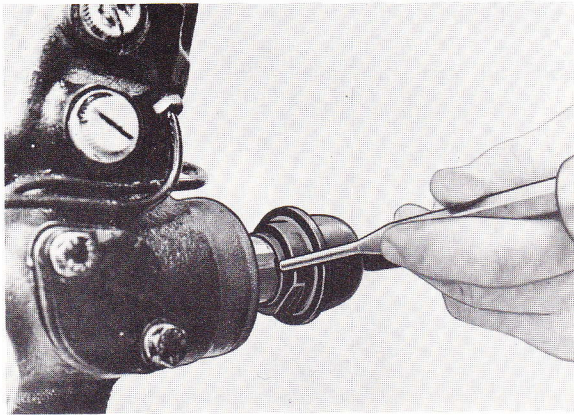
### **Install left side steering rod.**

If re-installing a previously used rod, fit a thin shim between ball joint and rack shoulder.

An unused portion of the joint can thereby be used for locking.

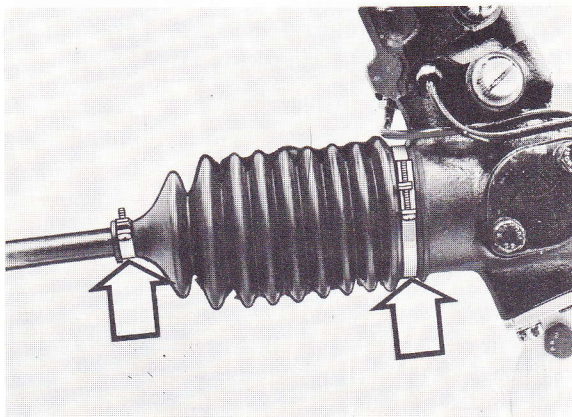
The two rods can also be swapped in order to obtain unused lock portion.



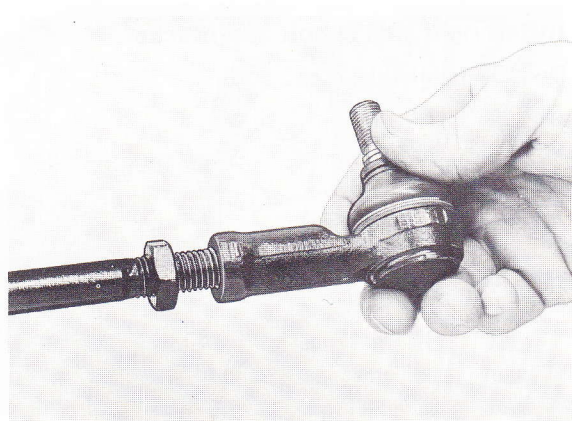


### Lock the ball joint.

Use a punch to lock the ball joint in the rack recess.

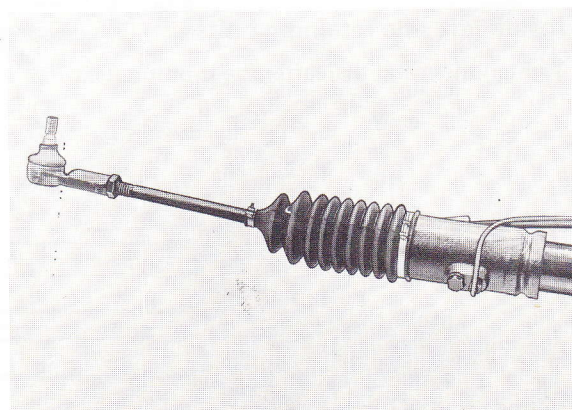


### Install left side rubber bellow and clamps.



### Install lock nut and ball stud.

22 mm



### Install right side steering rod, rubber bellow and ball stud.

Valve adjustment, filling power steering oil and lubricating oil is made after that the steering gear has been installed on the car.

(Next instruction).



## Installing power steering gear

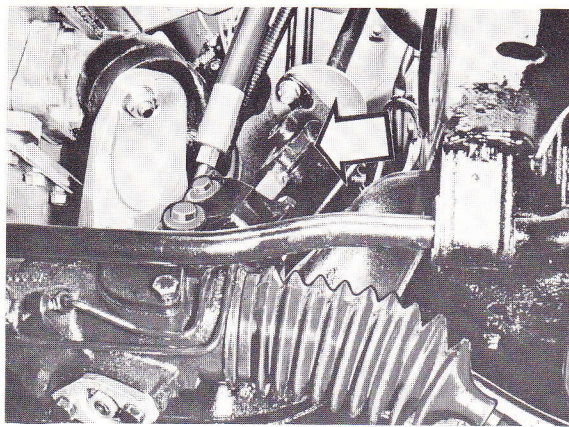
### Checking and adjusting balance

**Op. No. 64484 = Steering gear**  
install, incl. bleed

**Op. No. 64423 = Steering gear**  
adjust balance

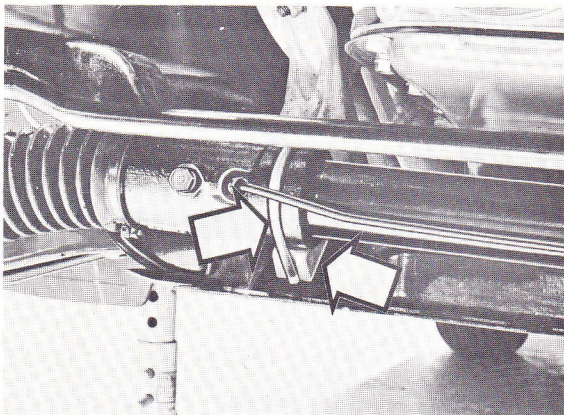
**Op. No. 64426 = Hydraulic hose**  
replace all, incl. bleed

**Op. No. 64428 = Power steering test**  
incl. test  
pump pressure & servo balance



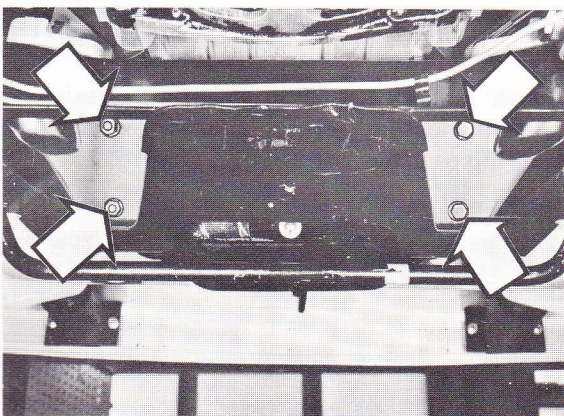
**Position the steering gear and attach the pinion shaft to the steering shaft flange.**

Align the recess for the lock bolt.



**Install right side U-bolt and bracket.**

Do NOT tighten the nuts.

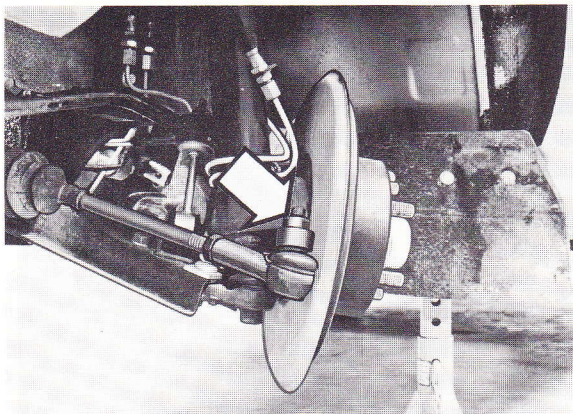


**Install left side retaining bolts.**

Tighten these and thereafter the U-bolt nuts.

12 mm and 13 mm

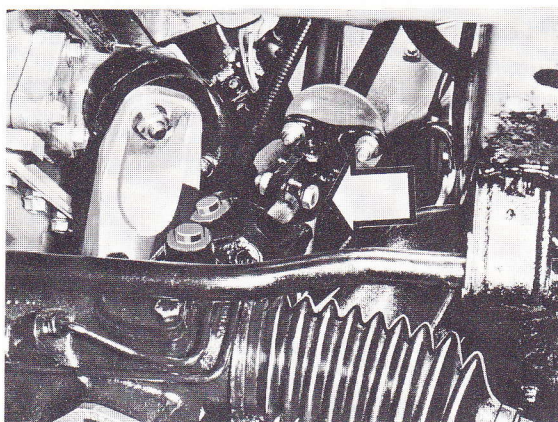




### Connect steering rods to steering arms.

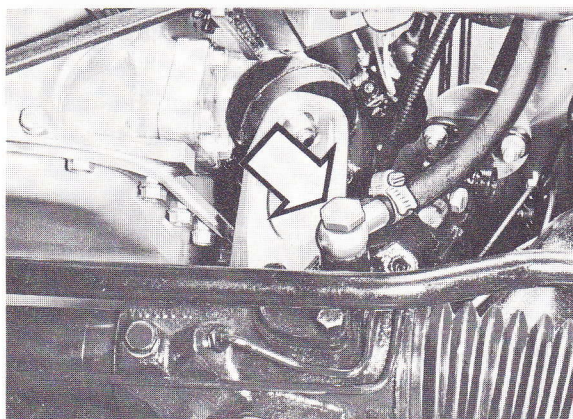
Both steering rods should be same length, difference not exceeding  $\pm 2 \text{ mm} = \pm 1/16''$ .

19 mm



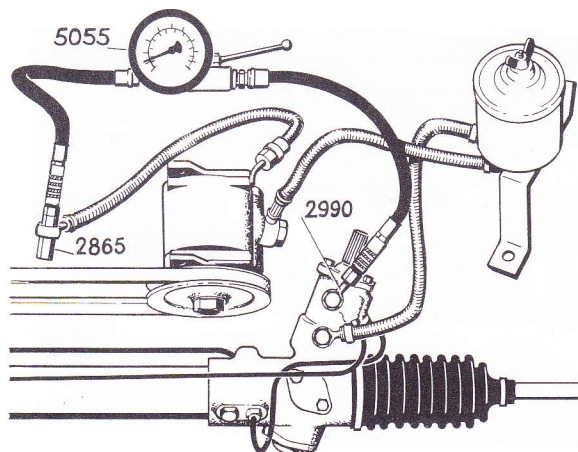
### Install the lock bolt on the flange.

13 mm



### Connect the return hose to the steering gear.

19 mm

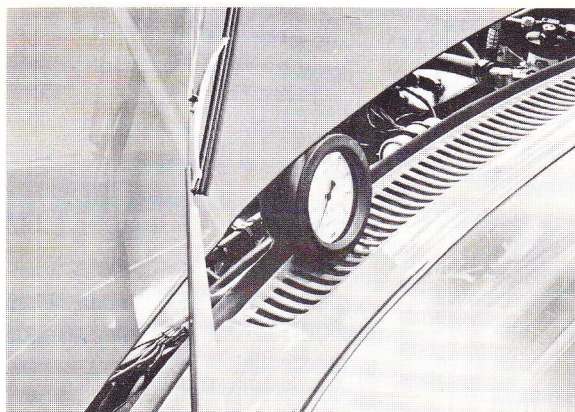


### Connect the test instrument.

Use nipples 9992865 and 9992990 to connect test instrument 9995055 to steering gear and pressure hose.

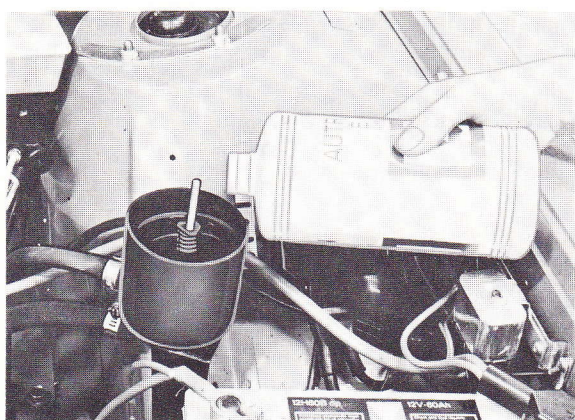
NOTE: the hose from the instrument valve should be connected to the steering gear.





**Position the pressure gauge in front of the windshield.**

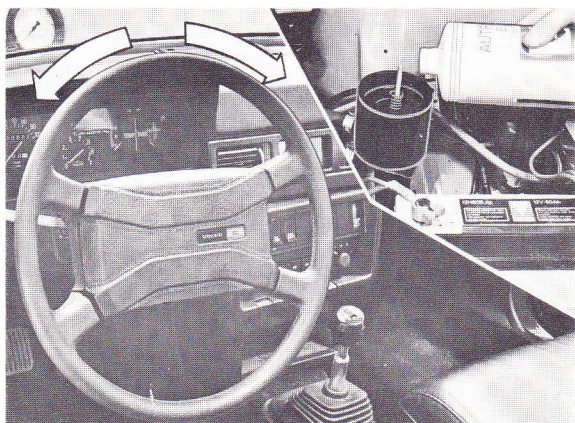
Turn the gauge so that it can be easily read from the driver's seat.



**Fill oil in the power brake oil container.**

Fill oil almost up to the edge. Start the engine and let idle. Top up with oil when the oil level drops, until the level is stabilized at the level mark.

Oil: ATF Type A or Dexron.

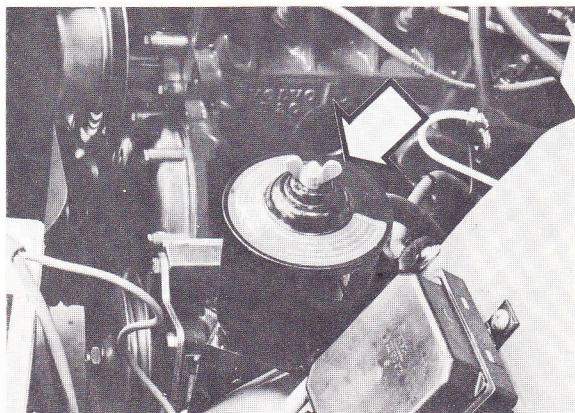


**Turn the steering wheel slowly to right side and left side end positions.**

Turn several times and with a slow motion so that the pump is working with low pressure.

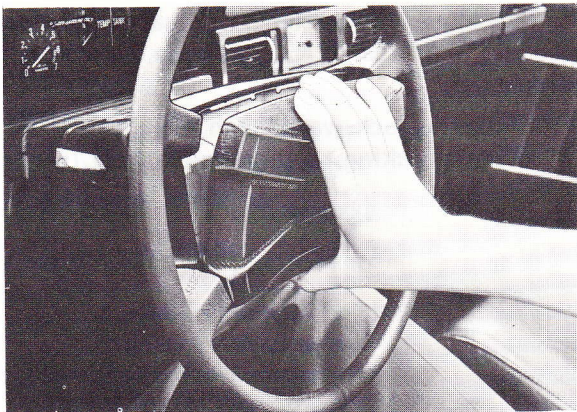
Top up with oil when necessary.

Turning the steering wheel should be continued until the oil in the container is almost free from air bubbles.



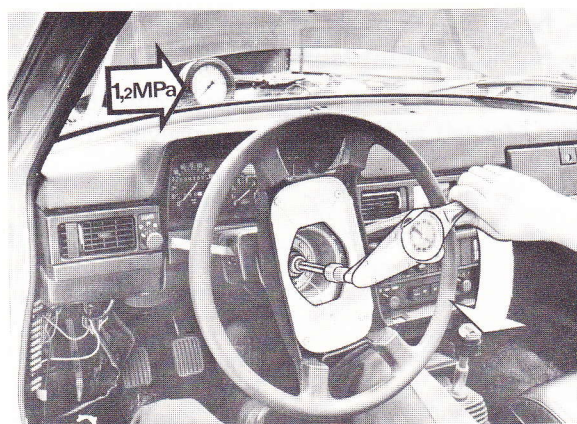
**Top up with oil if necessary.  
Install the oil container cap.**





**Remove the steering wheel impact guard.**

Compress the sides slightly.



**Check balance when turning the steering wheel to the right.**

Turn the steering wheel to almost right end position and connect a torque gauge to the steering wheel center nut. Use the torque gauge to turn slowly to the right and read the torque in the moment the pressure gauge approaches 1.2 MPa (170 psi).

NOTE: it is very important that the torque is read exactly when this pressure is reached, as the pressure will remain also if the torque is lowered in this position.

**27 mm + extension**

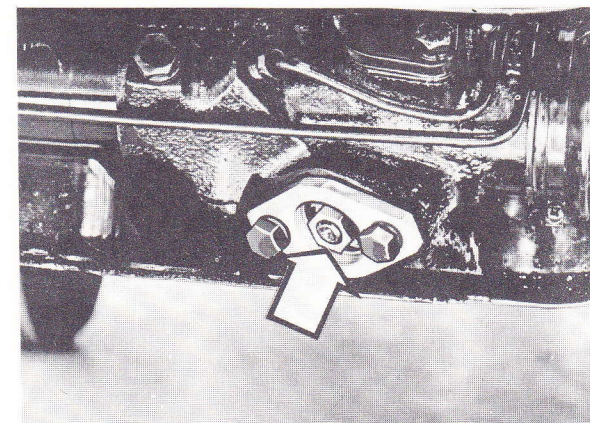


**Check balance when turning the steering wheel to the left.**

Turn the steering wheel to the left and read the torque the same way as for right side.

The torque should be 3.5–4.5 Nm (30–40 lb.in.). The difference may not exceed 1.0 Nm (85. lb.in.) between right and left sides.

**27 mm + extension**



**If the torque difference between left and right sides exceeds 1.0 Nm (85. lb.in.):**

— shut the engine and remove lock nut and lock washer from the pinion lower bearing.

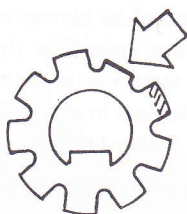
**16 mm**





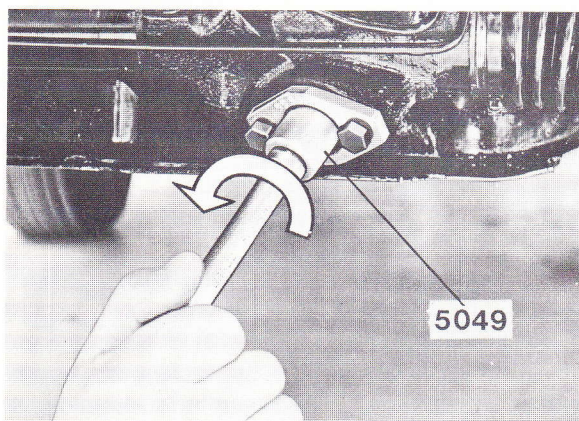
If the torque should be — increased for left side and — decreased for right side, proceed as follows:

- unfold the lock washer tab which has been bent for locking the adjustment nut (bearing race)



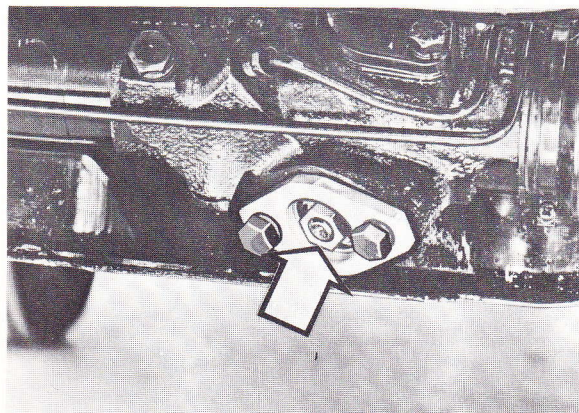
- bend in the next tab, to the left of the previously bent tab.

Changing to next left tab increases torque 0.5 Nm (4 lb.in.) for left side and decreases equally for the right side.



- turn the adjustment nut to the left

Use tool 9995049 and turn the adjustment until its groove fits the lock washer tab.



- install lock washer and lock nut.

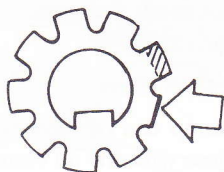
Do not bend the washer against the lock nut.





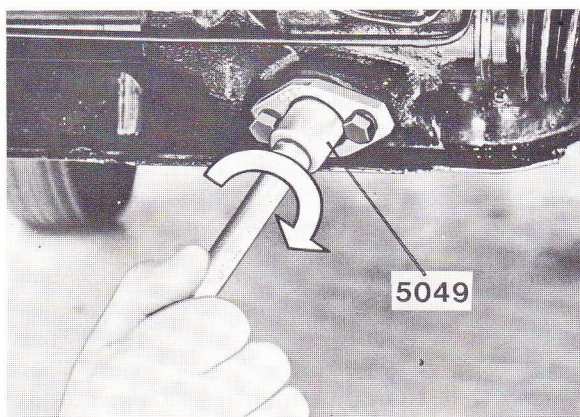
If the torque should be

- increased for right side and
- decreased for left side, proceed as follows:
- unfold the lock washer tab which has been bent to lock the adjustment nut (bearing race).



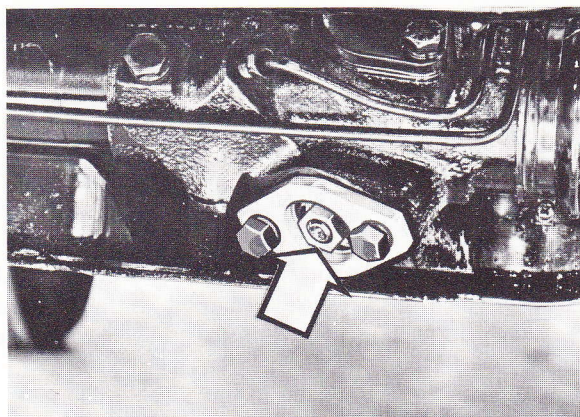
- bend in the next tab, to the right of the previously bent tab.

Changing to the next right tab increases torque 0.5 Nm (4 lb.in.) for right side and decreases equally for the left side.



- turn the adjustment nut to the right

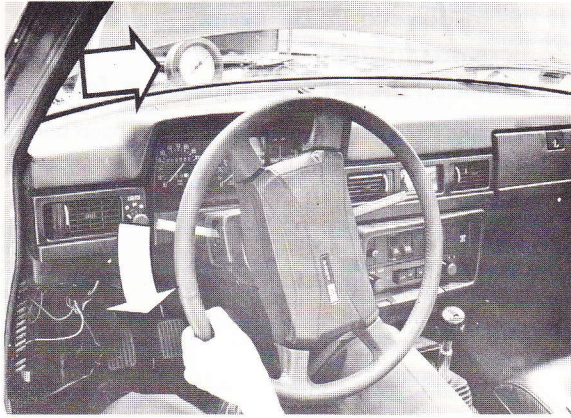
Use tool 999 5049 and turn the adjustment nut until its groove fits the lock washer tab.



- install lock washer and lock nut.

Do not bend the washer against the lock nut.



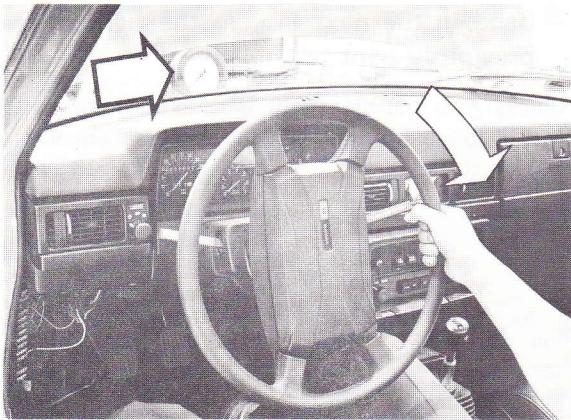


### Check the pump pressure at the left side end position.

Turn the steering wheel fully to the left. Press it into the left end position for max. 10 seconds while reading the gauge.

Correct pressures:

Pump type	6–7 MPa
Saginaw	895–995 psi
Pump type	7–8 MPa
ZF	995–1150 psi

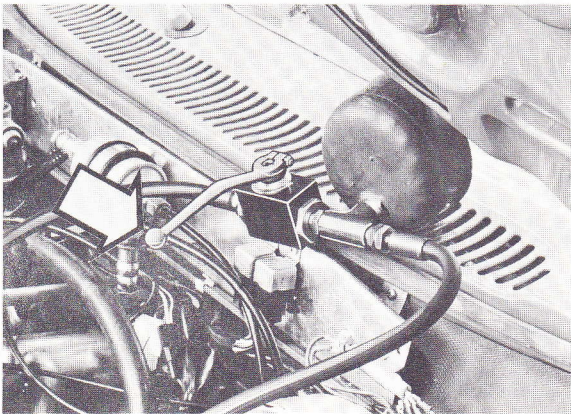


### Check the pump pressure at the right side end position.

Turn the steering wheel fully to the right. Press it into the right end position for max. 10 seconds while reading the gauge.

Correct pressures: see above.

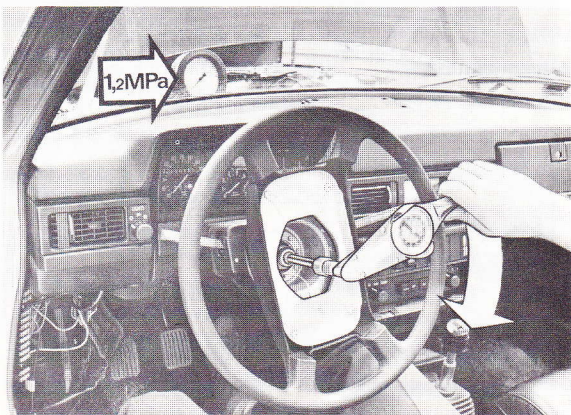
(The Saginaw pump can be recognized but that it is built into one piece with the oil container).



### If pump pressure incorrect: check pump pressure directly.

Close the pressure gauge valve and thereby block the oil flow for max. 10 seconds.

Thereby the system maximum pressure is tested. If the pressure does not reach the figures indicated above, the pump is defective.



### After that the adjustment has been completed:

start the engine and re-check.

### Check balance when turning the steering wheel to the right.

Turn the steering wheel to almost right end position and connect a torque gauge to the steering wheel center nut. Use the torque gauge to turn slowly to the right and read the torque in the moment the pressure gauge approaches 1.2 MPa (170 psi).

NOTE: it is very important that the torque is read exactly when this pressure is reached, as the pressure will remain also if the torque is lowered in this position.

27 mm + extension



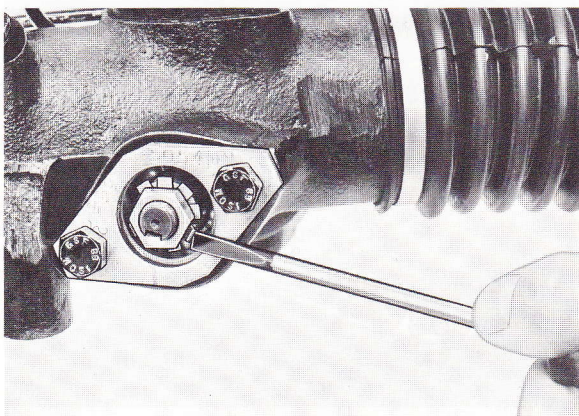


**Check balance when turning the steering wheel to the left.**

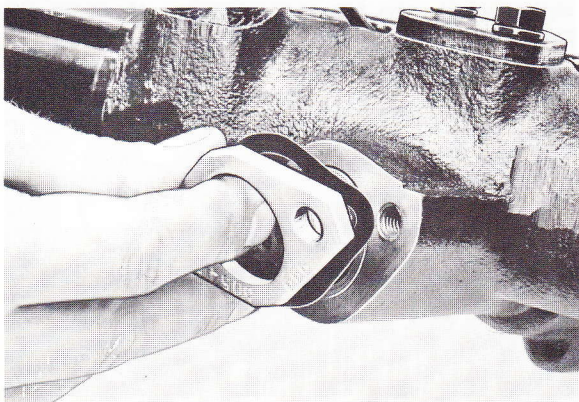
Turn the steering wheel to the left and read the torque the same way as for right side.

The torque should be 3.5–4.5 Nm (30–40 lb.in.). The difference may not exceed 1.0 Nm (8.5 lb.in.) between right and left sides.

**27 mm + extension**

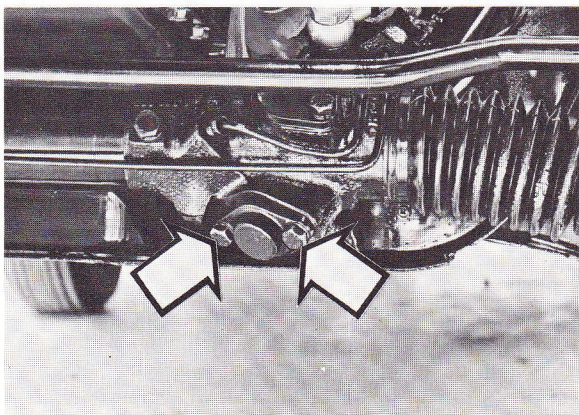


**Shut the engine and lock the nut with the lock washer.**



**Remove the adjustment ring.**

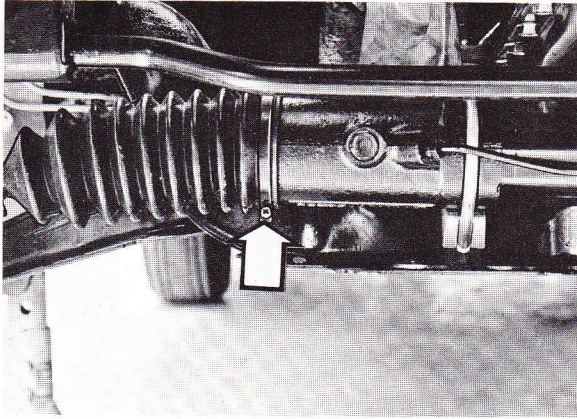
Save the gasket.



**Install pinion cover and cover gasket.**

**1/2"**



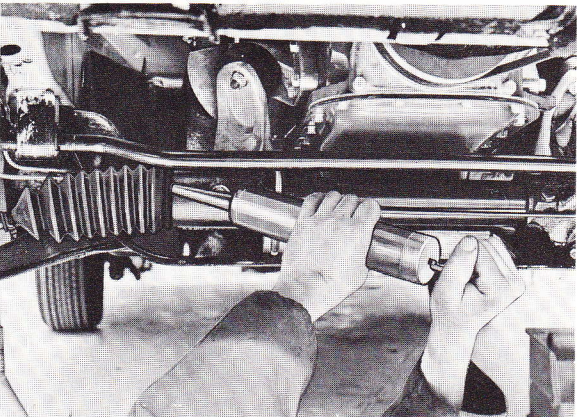


**Remove inner clamp for right side rubber bellow.**

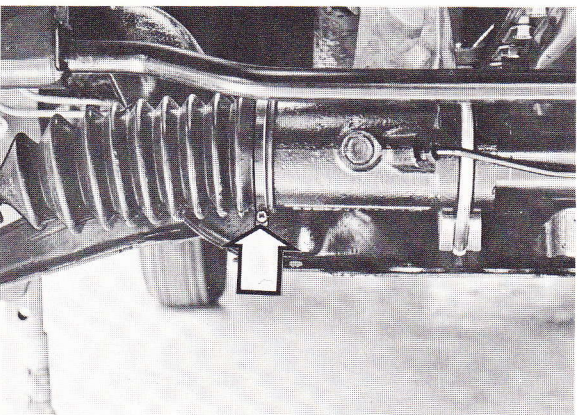


**Fill an oil suction gun with 0.2 dm<sup>3</sup> of oil (6.75 fl. oz.)**

Use engine oil SAE 20W-50, alt. SAE 20W-40.



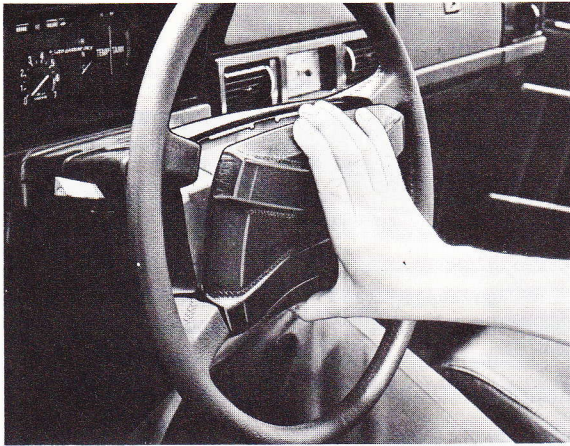
**Fill the oil into the steering gear through the rubber bellow.**



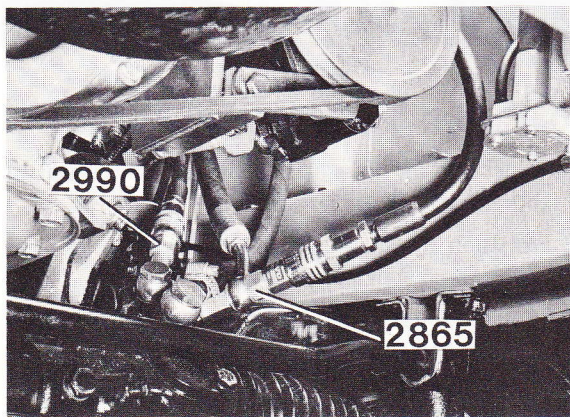
**Install the clamp for the rubber bellow.**

Then carefully compress the rubber bellow so that some oil flows to the other side.

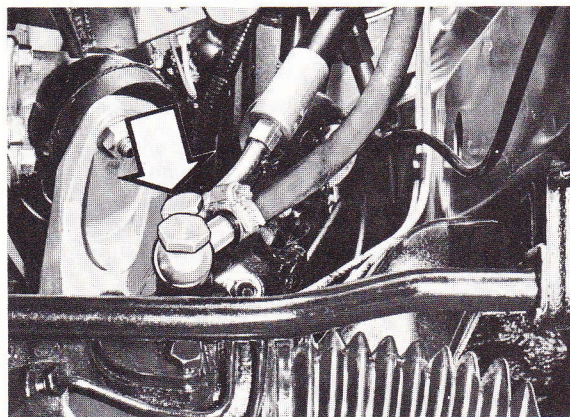




Re-install the steering wheel impact guard.

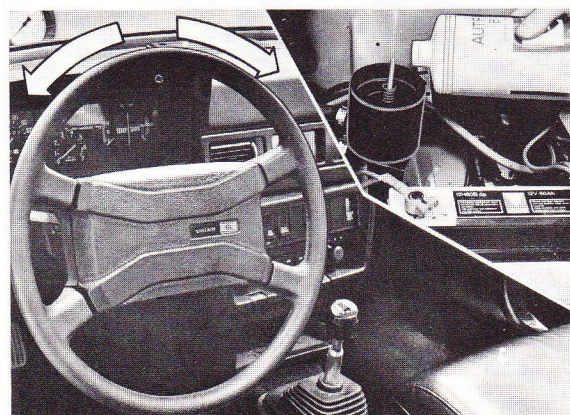


Disconnect test instrument and nipples from the steering gear.



Connect the pressure hose to the steering gear.

19 mm



Start the engine. Turn the steering wheel to left and right end positions and check the oil container level.

Turn the steering wheel several times, with a slow movement. Then check the oil level and top up if necessary.

Shut the engine.

Oil: ATF Type A or Dexron.

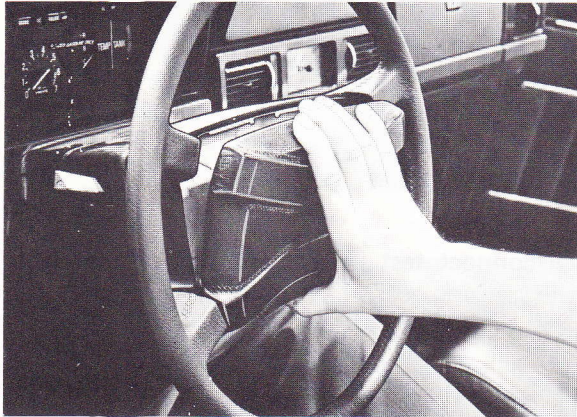
Install the wheels and lower the vehicle.



## Removing steering wheel

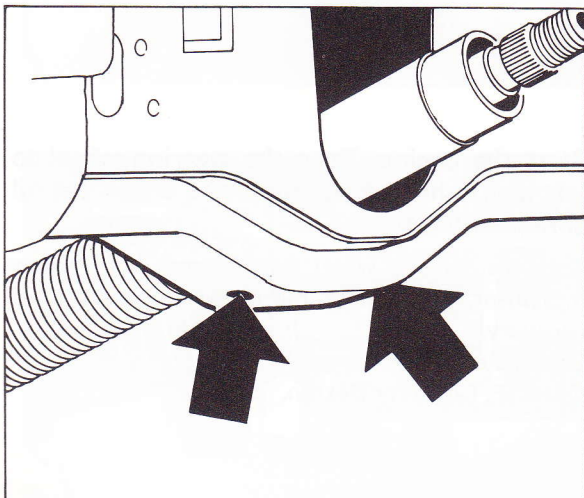
### Op. No. 64104 = steering wheel, replace

1. To remove the steering wheel padding, first compress sidewise and then unfold the upper edge.



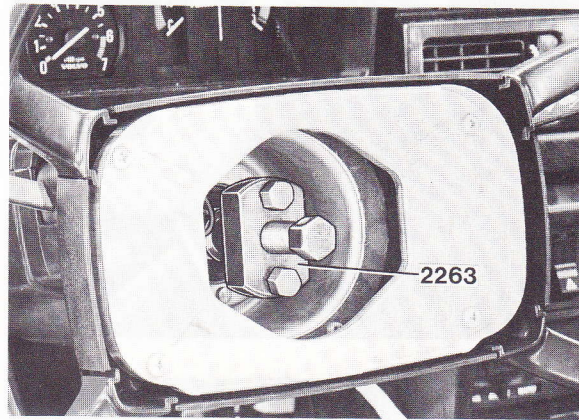
## Removing upper steering shaft and column

1. Disconnect the battery ground cable.
2. Remove the clamping screw for the upper steering shaft joint, in the engine compartment.
3. Remove steering wheel as previously described.
4. Remove upper column covers. Remove turn signal switch and wiper switch and disconnect associated wires.
5. Remove the housing which serves as a retainer for the switches. Remove spring and race for upper bearing.
6. Remove the screws for the steering lock, see Fig. First drill center holes in the screws and then use a screw extractor to remove the screws.



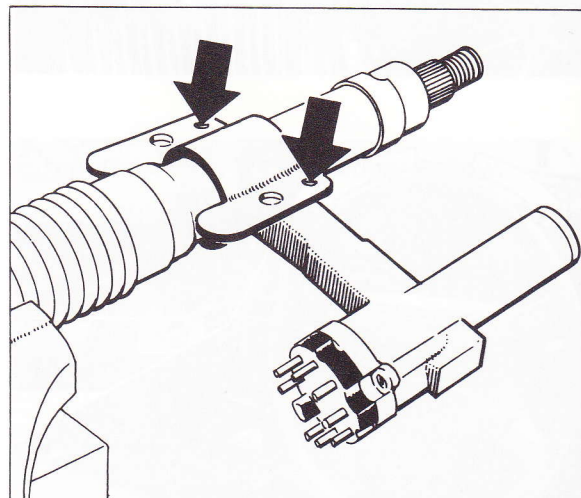
VOLVO  
115 189

2. Remove center nut (27 mm)
3. Use tool 9992263 to pull the steering wheel.



## Installing steering wheel

1. Check that the front wheels point straight forwards.
2. Position the steering wheel, spoke horizontal and turn signal activator at left.
3. Install center nut and torque to 23–29 lb.ft. = 30–40 Nm.
4. Press on the padding and check horn.
7. Remove the rubber grommet for the steering shaft in the firewall.
8. Remove the steering tube lower attachment.
9. Push the steering shaft in through the firewall until clear from the instrument panel lower part. Then pull the shaft back into the drivers compartment.
10. Disconnect the steering lock from the tube:

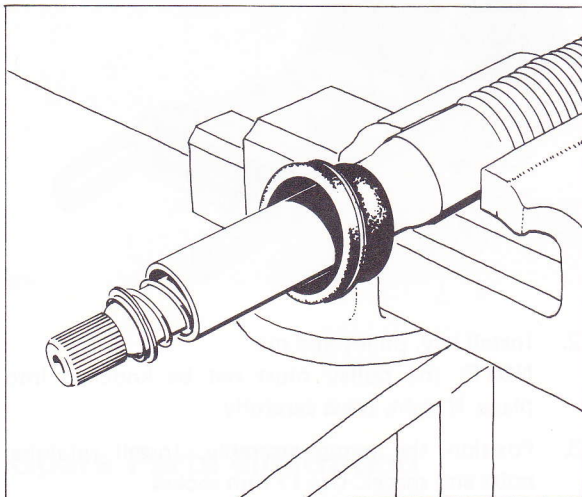


VOLVO  
115 190



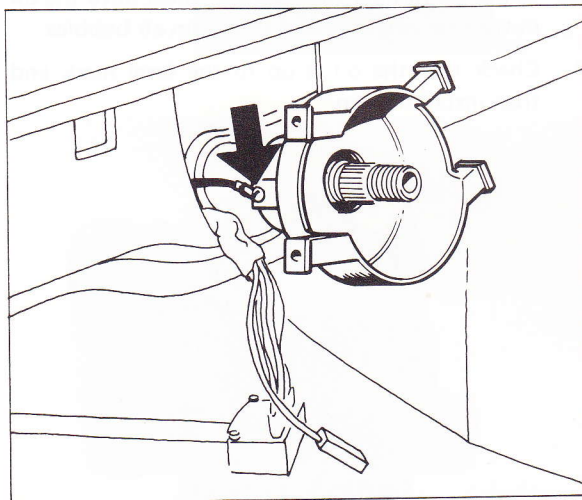
## Installing upper steering shaft and column

1. Fit the column assembly in a vise. Install the steering lock.
2. Position the rubber grommet on the column lower end.



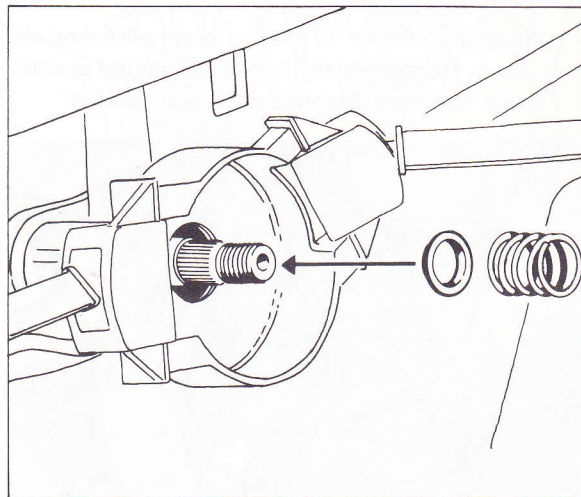
VOLVO  
115 191

3. Push the column in through the firewall. Position it under the dashboard, the steering lock protruding through the hole in the panel.
4. Attach the joint to the shaft, tighten bolt and nut.
5. Install the shear bolts. Do NOT break the bolts, later adjustments may be required.
6. Install the rubber bushing and the clamp for the lower attachment. Do not tighten the screw fully.
7. Install the rubber grommet in the firewall.
8. Install the switch bracket. Use one of the screws to the ground wire:



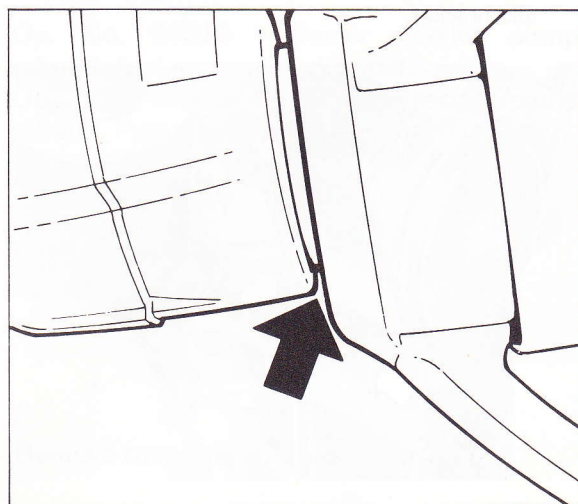
VOLVO  
115 192

9. Install turn signal switch, wiper switch and ignition switch. Reconnect the horn wire.
10. Install race and spring for upper bearing:



VOLVO  
115 193

11. Install the column covers.
12. Check that the front wheel point straight and install the steering wheel. Torque the nut to 23–29 lb.ft. = 30–40 Nm.
13. Press on the padding.
14. Turn the steering wheel and check that it can rotate freely:



VOLVO  
115 194

Then torque the lower attachment bolts. Shear the upper bolts.

15. Reconnect the battery ground cable. Check operation of horn, turn signals and wiper.

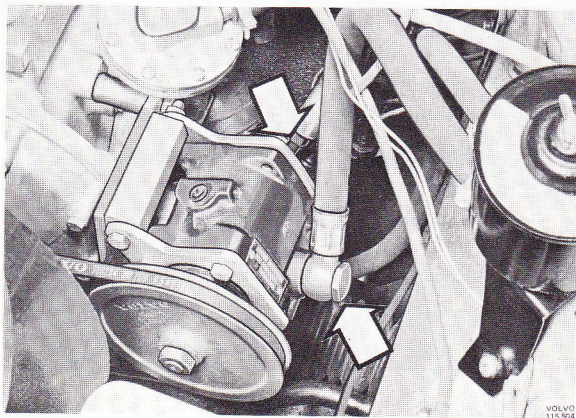


## Power pump

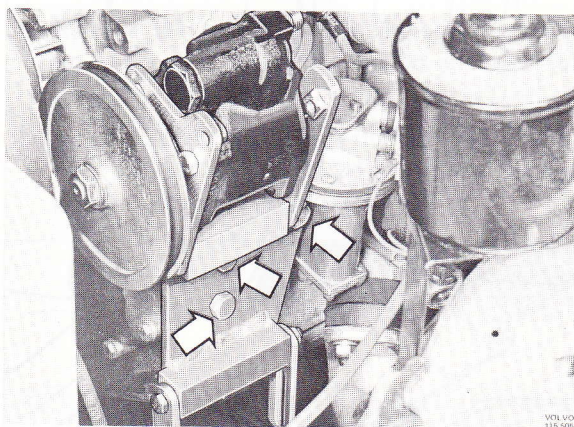
Op. No. 64570 = Power steering pump, remove  
Op. No. 64572 = Power steering pump, install

### Removing

1. Place a container to receive drain oil below the pump. Disconnect the pump hydraulic connections. Use tools 24 mm and 17 mm. See Fig.



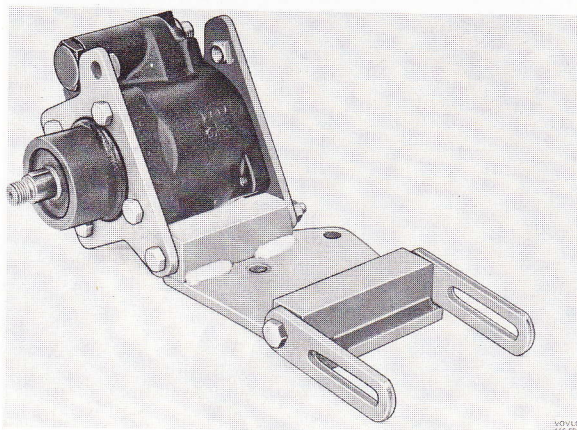
2. Remove the nuts on the two long bracket bolts (use 13 mm socket).
3. Remove the tensioner locking screws on both sides of the pump (use 13 mm socket). Remove the drive belt.
4. Turn the pump up and remove three screws retaining the bracket to the engine block. Use 17 mm socket. See Fig. below. Then remove pump and bracket.



5. Remove nut and pulley from the pump. If necessary, use puller 9992279.
6. Separate the brackets from the pump. Use 13 mm tool.

### Installing

1. Attach brackets and tensioners as shown below. Do not tighten fully.

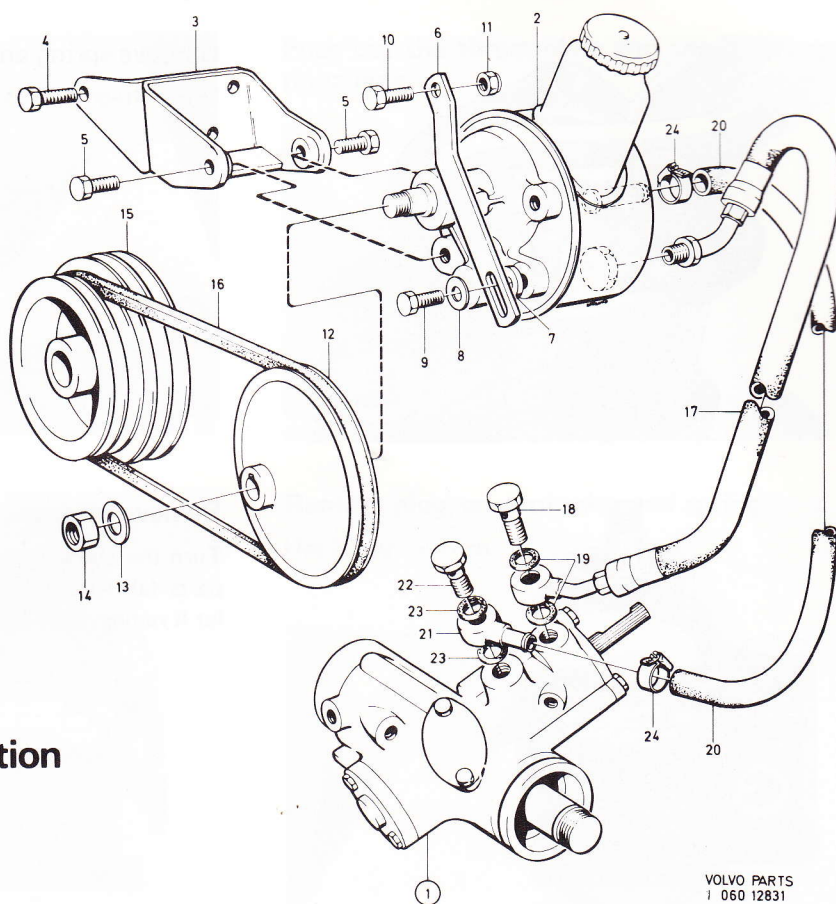


2. Install key, pulley and nut.  
NOTE: the pulley must not be knocked into place. If tight, press carefully.
3. Position the pump assembly. Install retaining bolts and spacer. Use 17 mm socket.
4. Install the drive belt. Install the lock for the tensioners. Use 17 mm socket.
5. Adjust belt tension. Then tighten the nuts of the long bolts. Use 13 mm socket.
6. Reconnect pump hoses. Use new copper washers. Use 24 and 17 mm tools.

### Filling oil bleeding

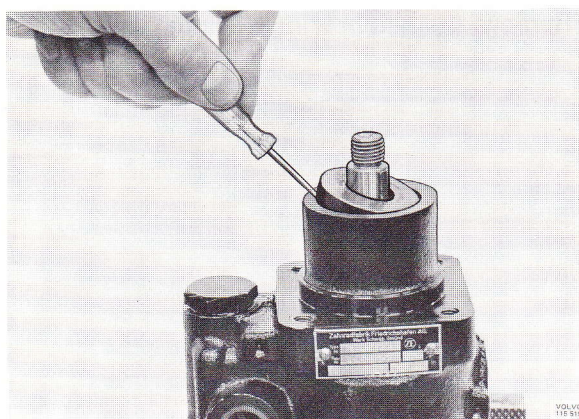
1. Fill oil in the power pump reservoir. Start the engine. Let idel and fill oil as the level drops. Use ATF oil, Type A or Dexron.
2. Turn the steering wheel slowly and evenly between left and right end positions so that the pump operates at low pressure.
3. Continue turning the steering wheel until the oil in the reservoir is almost free from air bubbles.
4. Check that the oil is up to the level mark and then install the cap.





VOLVO PARTS  
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## Spare Parts Illustration



## Power Pump

Op. No. 64520 = Power steering pump, rebuild. Incl. remove and install.

Op. No. 64512 = Power steering pump, rebuild. Pump removed.

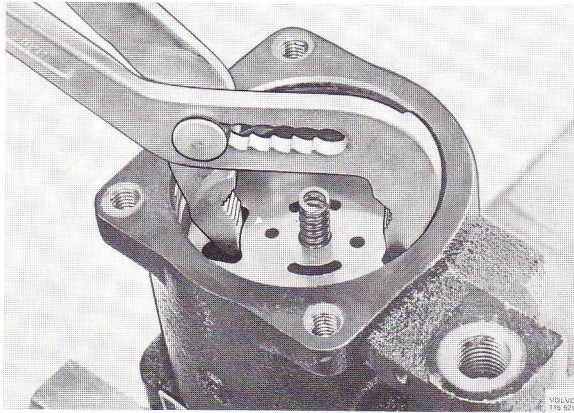
## Disassembly

Remove front seal



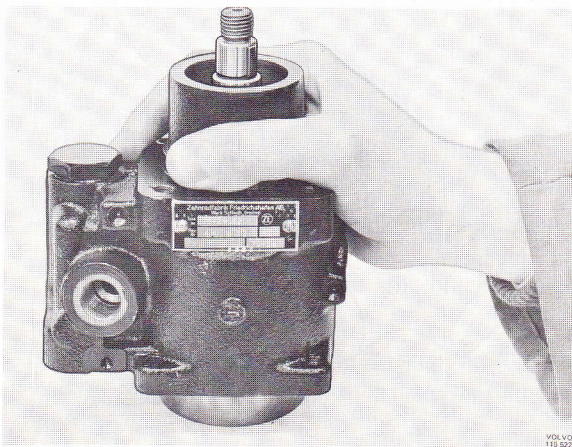
Remove snap ring and rear cover





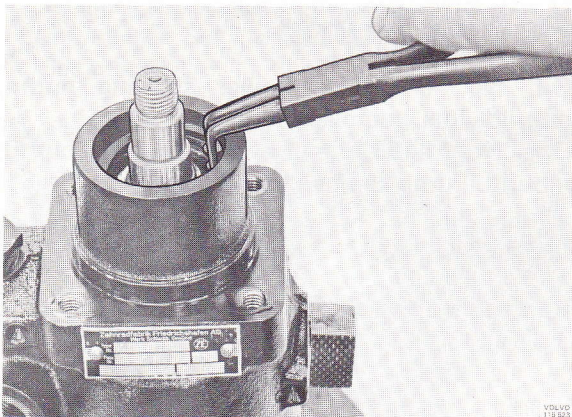
### **Remove spring and pressure plate**

Use multi-grip pliers to remove the plate.

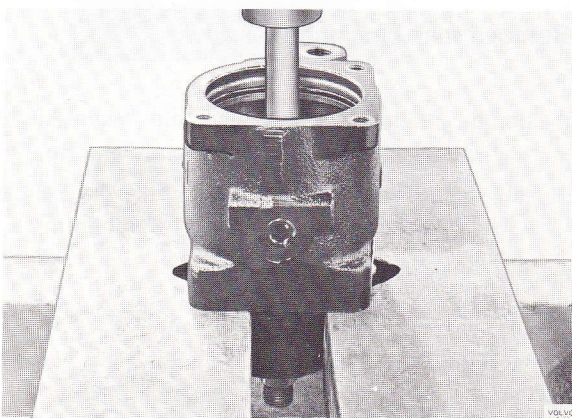


### **Remove rotor and cam ring**

Turn the pump over, tap lightly on the end until the parts fall free. If the cam ring does not come loose, let it remain until later on.

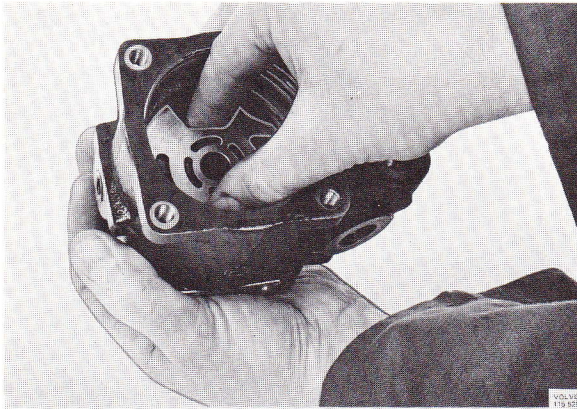


### **Remove the ball bearing retaining ring**

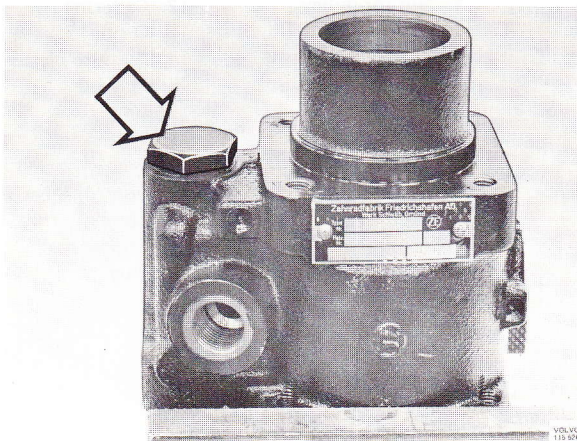


### **Push the shaft out of the housing**



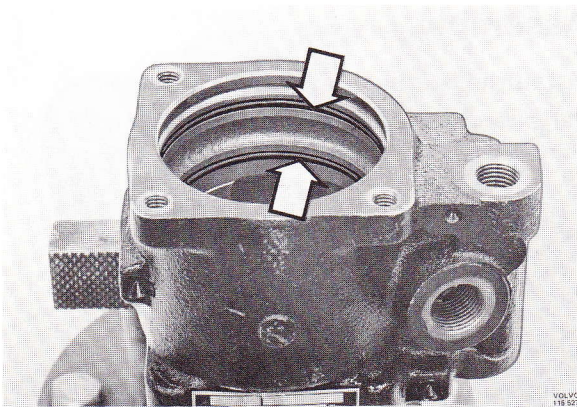


Push out the thrust plate and the cam ring, if remaining.



Remove plug, control valve and spring

Use 27 mm wrench.

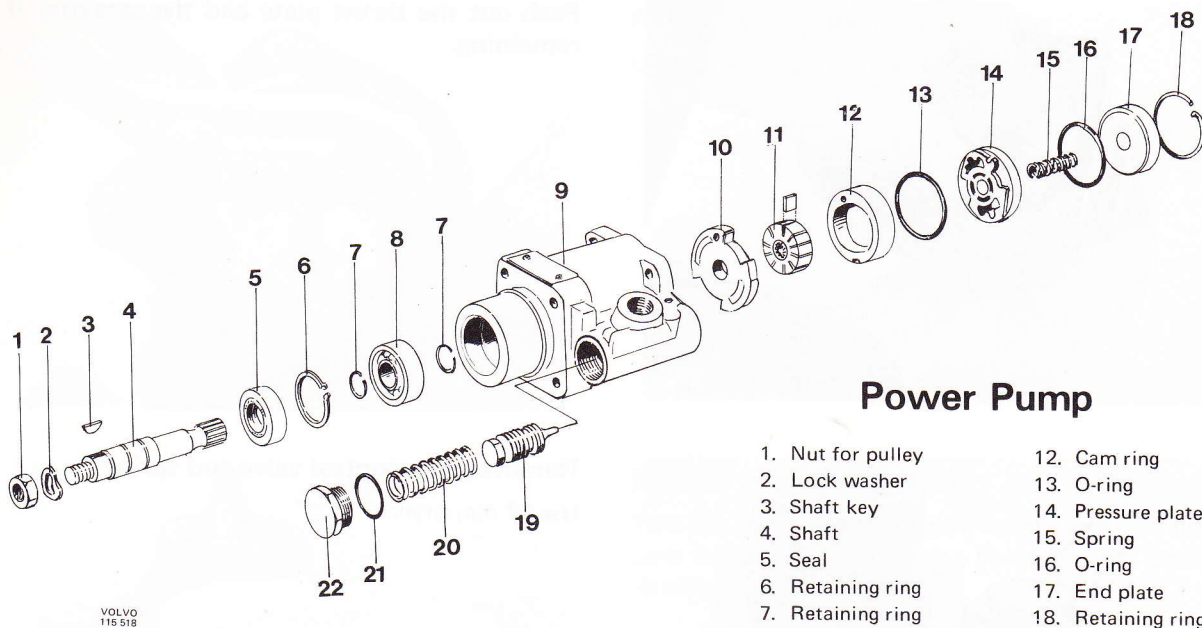


Remove O-rings

Check all parts for wear and scratches. Replace worn or damaged parts, as well as **all O-rings**.

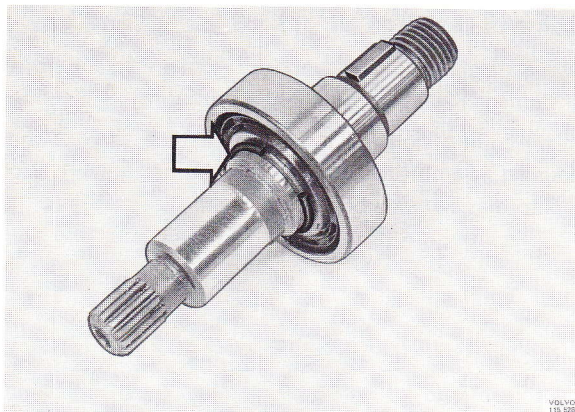
If the pump housing bushing is defect, replace the housing assembly. Rotor, vanes and cam ring are also replaced as an assembly.





## Power Pump

- |                      |                    |
|----------------------|--------------------|
| 1. Nut for pulley    | 12. Cam ring       |
| 2. Lock washer       | 13. O-ring         |
| 3. Shaft key         | 14. Pressure plate |
| 4. Shaft             | 15. Spring         |
| 5. Seal              | 16. O-ring         |
| 6. Retaining ring    | 17. End plate      |
| 7. Retaining ring    | 18. Retaining ring |
| 8. Ball bearing      | 19. Control valve  |
| 9. Housing           | 20. Spring         |
| 10. Thrust plate     | 21. Copper seal    |
| 11. Rotor with vanes | 22. Plug           |

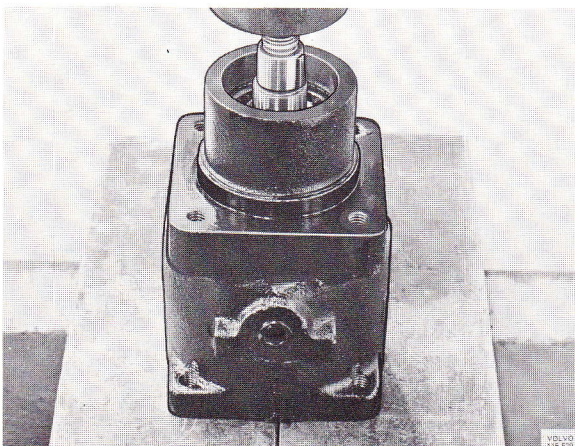


## Assembly

### Install the bearing on the shaft

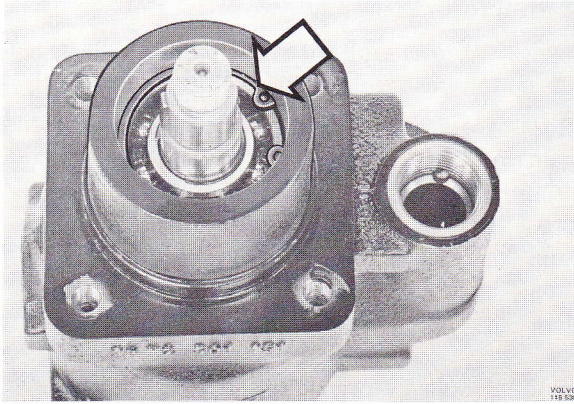
(If replaced)

The bearing is retained by rings on both sides.

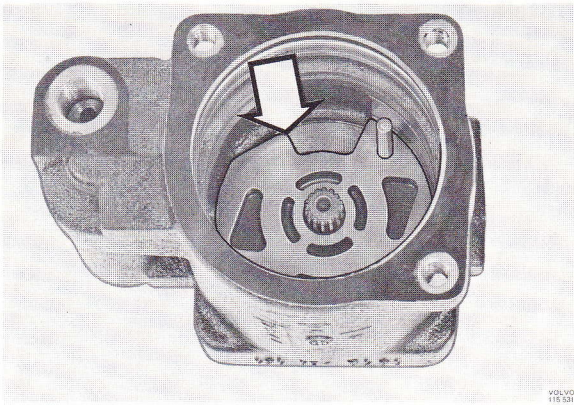


Press the shaft into the housing.



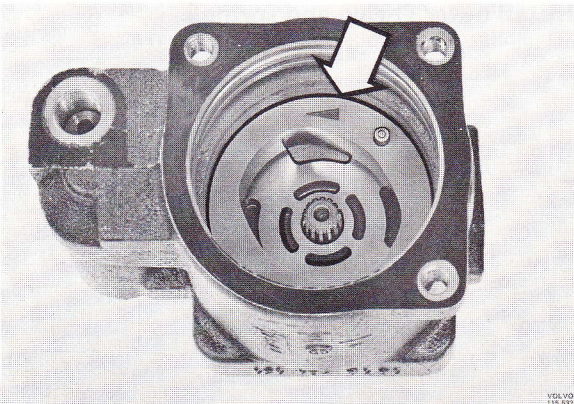


**Install the bearing retaining ring**



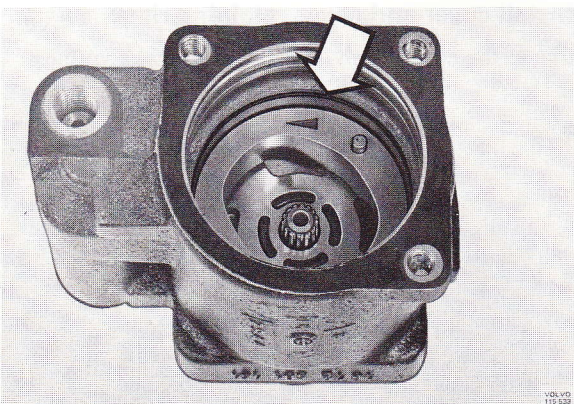
**Install the thrust plate**

Locate the thrust plate with the dowel in one of the holes.



**Install the cam ring**

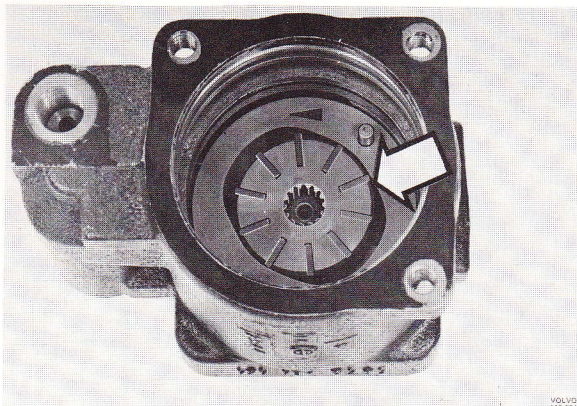
Install the cam ring on the dowel, arrow up.



**Install inner O-ring**

One of the O-rings is smaller.

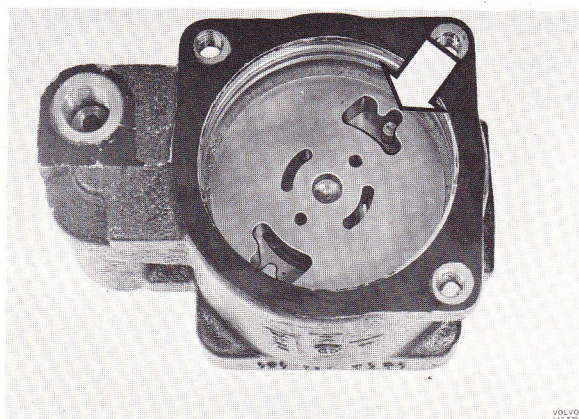




### Install rotor assembly

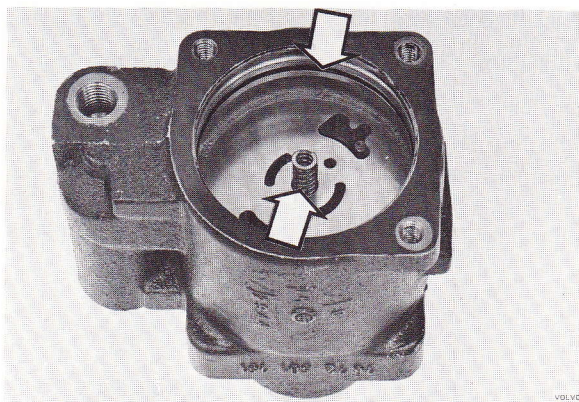
Install the rotor with the recess round the shaft hole down, towards the drive side.

Install the vanes with the rounded ends towards the cam ring.

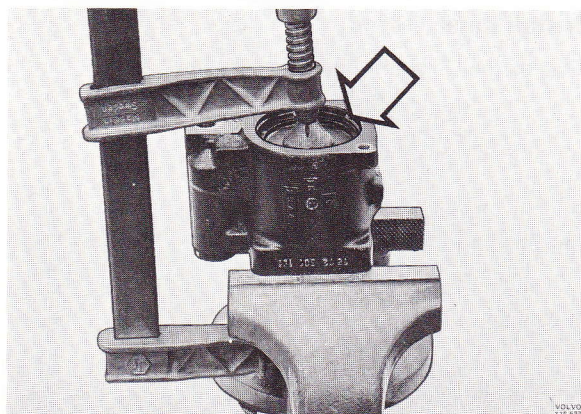


### Install pressure plate

The dowel should align in one of the holes.



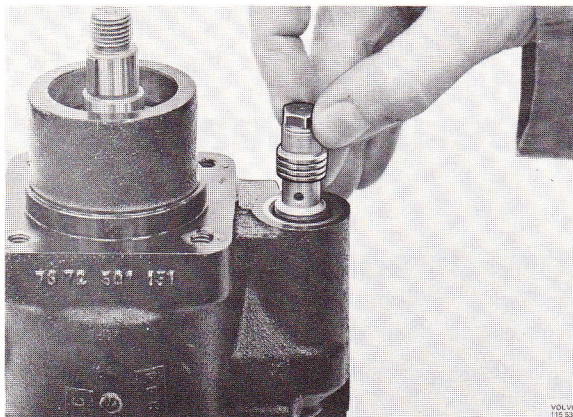
### Install outer O-ring and spring



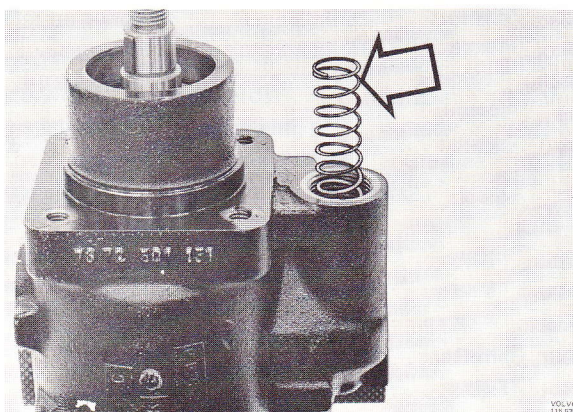
### Install cover and cover retaining ring

Clamp the cover when installing the retaining ring.

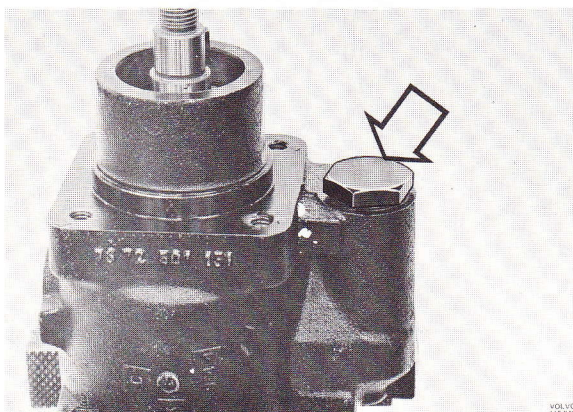




**Install the control valve**



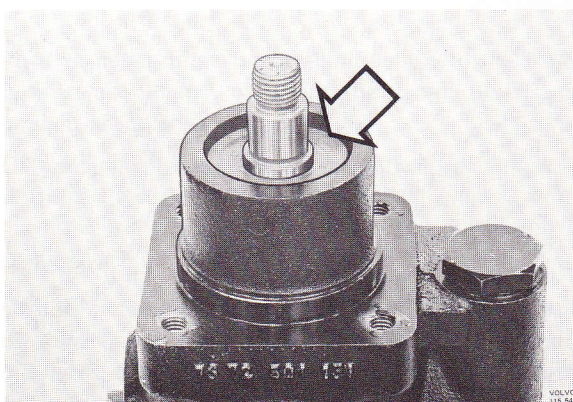
**Install the spring**



**Install plug**

Use a new copper seal.

27 mm



**Install the shaft seal**

Tap lightly until seal is properly seated.



## Section 6

# Front End and Steering Gear

## Description and theory of operation

### Index

#### Group 60: General

Steering geometry .....1

#### Group 62: Front End

Front wheel suspension .....3

Front end alignment .....4

#### Group 64: Steering

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Steering column .....6

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ZF .....7

#### Power steering:

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Oil reservoir .....11



# Group 60

## Steering Geometry

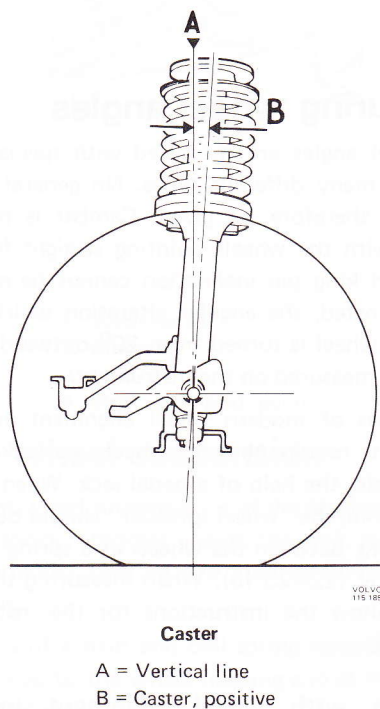
### Wheel angles

The front wheels must have certain pre-determined settings, "front end alignment", in order to achieve good steering properties and minimum of tire wear.

The "wheel angles" refer to: caster, camber, king pin inclination, toe-out and toe-in.

### Caster

Caster generally refers to the longitudinal inclination (forwards or backwards) of the king pin. As this vehicle does not have a king pin, the caster consists of the angle between a vertical line and a line through the center of the strut pivoting points.

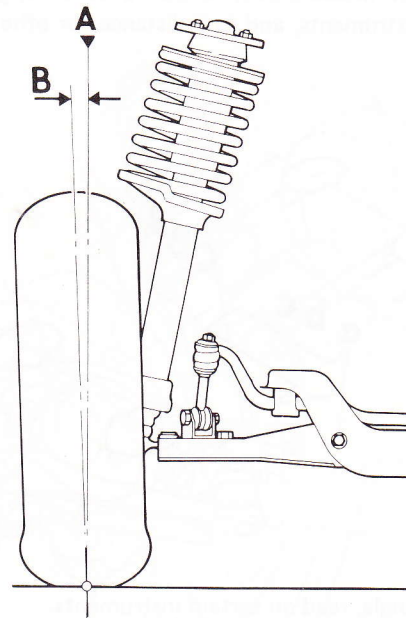


Positive caster imparts a trailing action to the front wheels and helps to keep the front wheels in straight-ahead position.

Caster cannot be adjusted on the 240 series.

### Camber

Camber is the inclination of the wheel itself outwards or inwards. It is positive if the wheel is inclined outwards and negative if the wheel inclines inwards. Incorrect camber causes uneven tire wear.



### King pin inclination

King pin inclination means the inclination of the king pin inwards. The inclination is represented by an angle made between a vertical line and a line through the center of the strut pivot points.

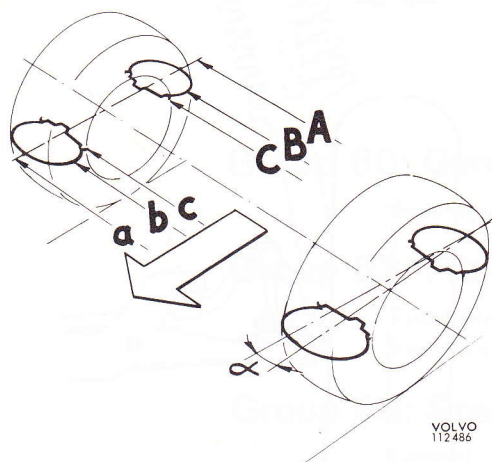
King pin inclination causes the center lines to approach each other towards the road surface. This makes the wheel easier to turn. The inclination also assists the tendency of the wheel to run straight forwards since the car lifts very slightly when the wheels are turned.



## Toe-in

The toe-in is the turning in of the front wheels, measured at hub height. The purpose of toe-in is to offset the tendency to roll outwards which is inflicted by the camber angle.

The toe-in measurement is stated as an angle for certain instruments, and as a distance for others, see below:



$\alpha$  is an angle, read on certain instruments.

A, B and C refer to tire outer diameter, tire inner shoulder and rim, respectively.

The toe-in should be set as follows:

	angle $\alpha$	A-a	B-b	C-c
240-Series Manual steering	24'±8'	4.5±1.5 mm 3/16" (0.18±0.06")	3.5±1 mm 9/64" (0.14±0.04")	2.5±1 mm 3/32" (0.10±0.04")
240-Series Power steering	16'±9'	3.0±1.5 mm 1/8" (0.12±0.06")	2.0±1 mm 5/64" (0.08±0.04")	1.5±1 mm 1/16" (0.06±0.04")

Vehicle not loaded. Measurements should be made at center (hub) height.

## Toe-out on turns

To be in correct relative alignment, when negotiating a turn, the inside front wheel travels in a circle having a smaller radius than the circle traveled by the outside front wheel.

This relationship is determined by the design of steering knuckle arms and the steering rod.

## Procedure before adjusting wheel angles

Wheel angles can be influenced by factors listed below. Therefore, before measuring and adjusting, any faults should be remedied.

1. Check tire pressure and wear.
2. Play in front wheel bearings.
3. Play in ball joints or control arm attachments.
4. Broken springs.
5. Abnormal (temporary) equipment or loading.

Other factors which can influence the steering during driving without being revealed when measuring the wheel angles are:

1. Wheel warp exceeding 0,1" = 2.5 mm.
2. Defective shock absorbers.
3. Incorrect steering gear adjustment.
4. Play in intermediate arm journaling or steering rod parts.

## Measuring wheel angles

The wheel angles are measured with special instruments of many different types. No general description can, therefore be given. Camber is measured directly with the wheels pointing straight forwards. Caster and king pin inclination cannot be measured directly. Instead, the angular alteration which occurs when the wheel is turned from 20° outwards to 20° inwards is measured on the instrument.

Many types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack. When measuring the toe-in, the "wheel spreader" should be applied at the front between the wheels at a spring force of 100–150 N (22–23 lb). When measuring the wheel angles, follow the instructions for the instruments concerned.

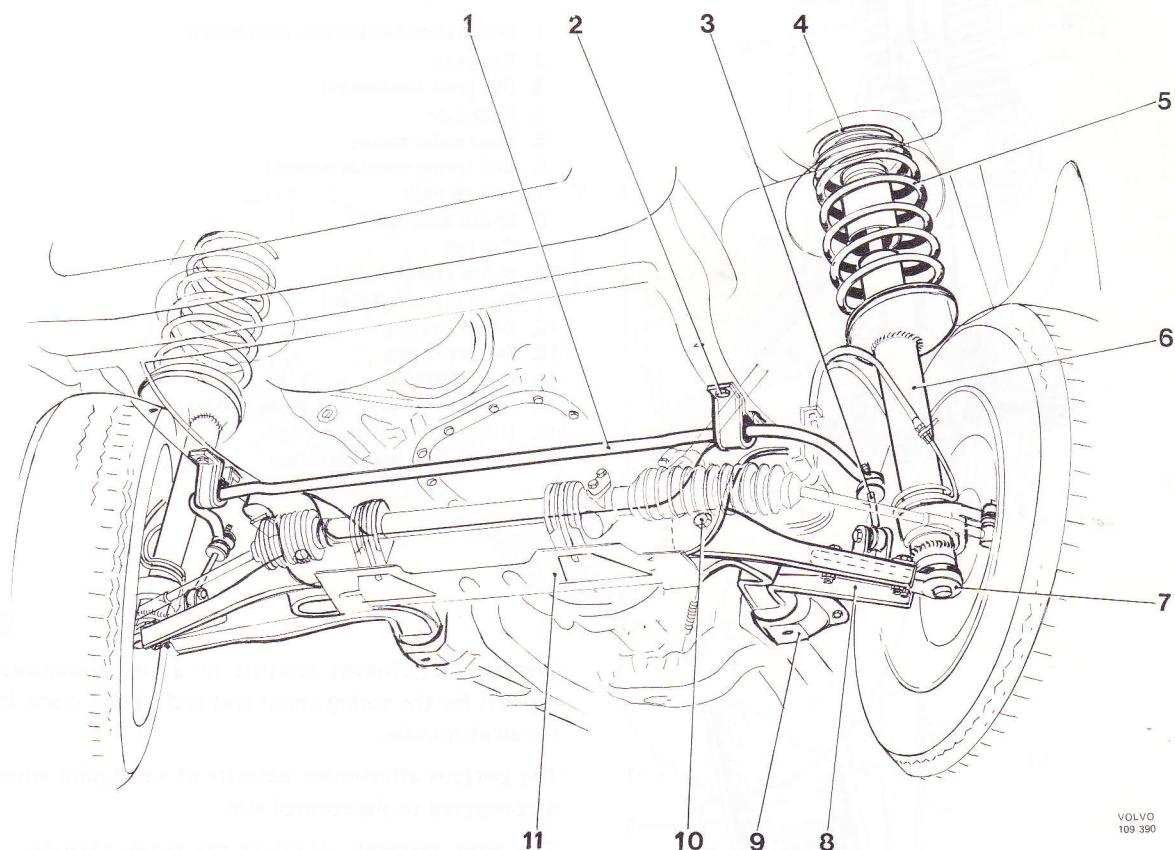
## Checking with wheel alignment indicator (Master Toe Gauge)

The wheel alignment indicator should be calibrated between -2 to +5 m/km and is used as follows: Straight line with the indicator when the car is about 2 meters (6 1/2 ft) from the indicator. **Let go** the steering wheel and slowly drive over the indicator plate (2–4 kmph = 2 1/2 miles). NOTE: The steering wheel must **not** be touched until the front wheels have come on the other side of the indicator.

If one of the red lamps lights, and a buzzer starts buzzing, then there is something wrong with the front wheel alignment and it should be adjusted.



## Group 62 Front End



VOLVO  
109 390

- |                            |                   |                                   |
|----------------------------|-------------------|-----------------------------------|
| 1. Stabilizer bar          | 5. Spring         | 9. Rear bracket for control arm   |
| 2. Bracket                 | 6. Strut assembly | 10. Front bracket for control arm |
| 3. Link                    | 7. Ball joint     | 11. Front axle member             |
| 4. Strut upper pivot point | 8. Control arm    |                                   |

### Front wheel suspension

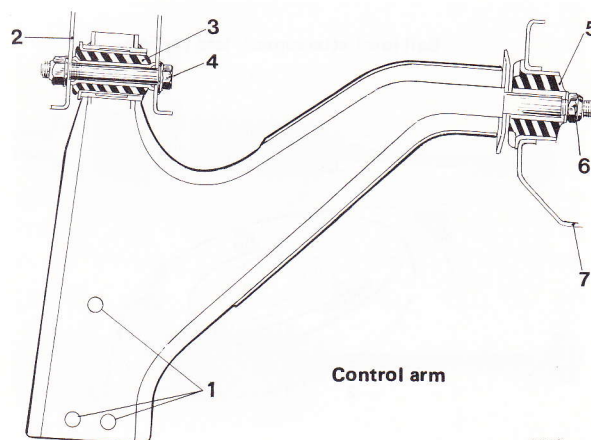
The front wheel suspension is of the McPherson type, with a shock absorber inside the coil spring. The design provides steering and absorbs forces in three directions.

It consists of a **strut and coil spring assembly**: at the **top** attached to the wheel housing and at the **bottom** to a control arm.

A **stabilizer** bar connects the control arms. The stabilizer bar is supported in two rubber bushings at the front side members. It is connected to the control arms by two rubber-mounted links.

### Control arm

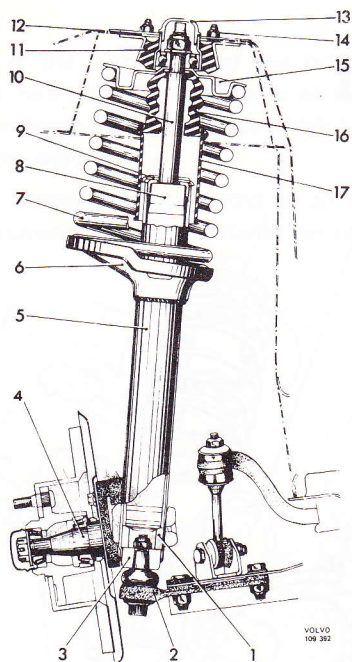
Forces sideways and forwards/backwards are on each side transferred by a **control arm**. It is at the body supported by two rubber bearings. The front bearing is attached to the control arm. The rear bearing is mounted in a bracket which is bolted to the front side member.



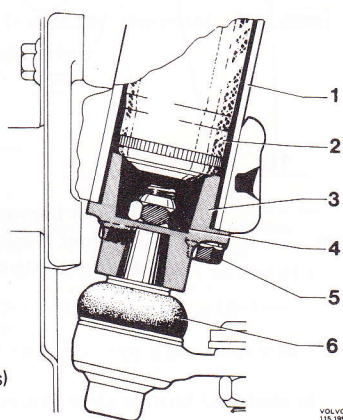
VOLVO  
109 391

- |                         |                        |
|-------------------------|------------------------|
| 1. Hole for ball joint  | 5. Rear rubber bushing |
| 2. Front axle member    | 6. Nut                 |
| 3. Front rubber bushing | 7. Rear bracket        |
| 4. Bolt                 |                        |



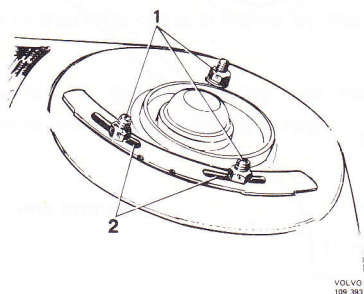


1. Shock absorber bottom attachment
2. Ball joint
3. Ball joint attachment
4. Stub axle
5. Strut outer casing
6. Coil spring bottom support
7. Coil spring
8. Shock absorber
9. Cap nut
10. Shock absorber rod
11. Strut top attachment
12. Wheel housing
13. Protective cap
14. Retaining nuts
15. Rubber-mounted coil spring support
16. Rubber bumper (end stop)
17. Shock absorber protection



1. Strut assembly
2. Shock absorber
3. Ball joint attachment
4. Ball joint nut
5. Retaining bolts (4 pcs)
6. Ball joint

Ball joint attachment, late version



Strut top attachment

1. Retaining studs
2. Slots for adjustment

The **top** attachment consists of a rubber-mounted support for the spring upper end and a pivot point for the strut spindle.

The **bottom** attachment consists of a ball joint which is connected to the control arm.

The **strut** assembly contains the shock absorber. It absorbs forces of up and down movements. The coil spring bottom support is welded to the strut outer casing. The hub is also welded to it.

The **shock absorber** is located inside the strut outer casing. It is at the upper end retained by a cap nut and at the lower end by the nut which also retains the ball stud. The shock absorber spindle functions as the strut upper guide and is pivoted in the strut upper attachment.

## Front end alignment

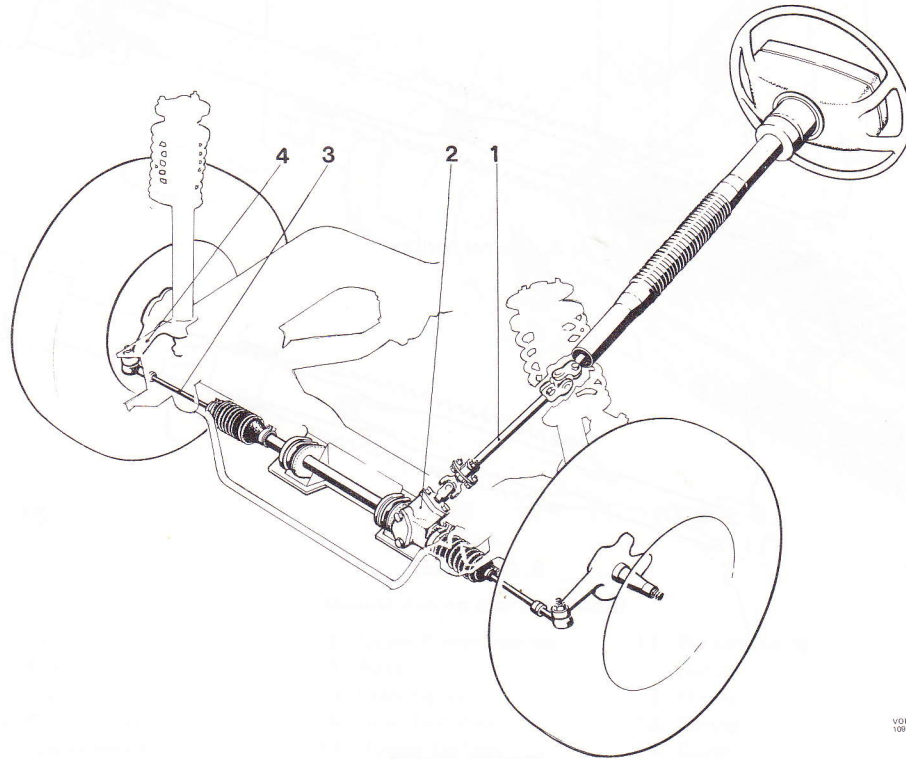
**Caster** cannot be adjusted. If it is outside specifications and camber and toe-in are correct, the front suspension should be checked for damages.

**Camber** is adjusted by moving the upper strut attachment in or out.

**Toe-in** is adjusted by turning the steering rods in or out.



## Group 64 Steering



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### Manual steering gear (ZF and Cam Gears)

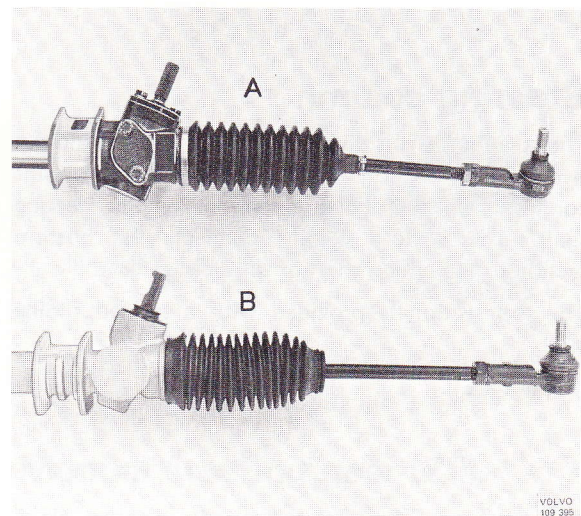
- |                   |                 |
|-------------------|-----------------|
| 1. Steering shaft | 3. Steering rod |
| 2. Steering gear  | 4. Steering arm |

### General

The steering wheel movements are transferred to the wheels via the steering shaft (1), the steering gear (2), the steering rods (3) and the steering arms (4). Wheel turning is limited by a stop in the steering gear and cannot be adjusted.

The steering gear is of the rack and pinion type. There are two versions: one manual and one power-assisted. There are two brands of the manual steering gear. One made by ZF and grease-lubricated and one made by Cam Gear and oil-lubricated.

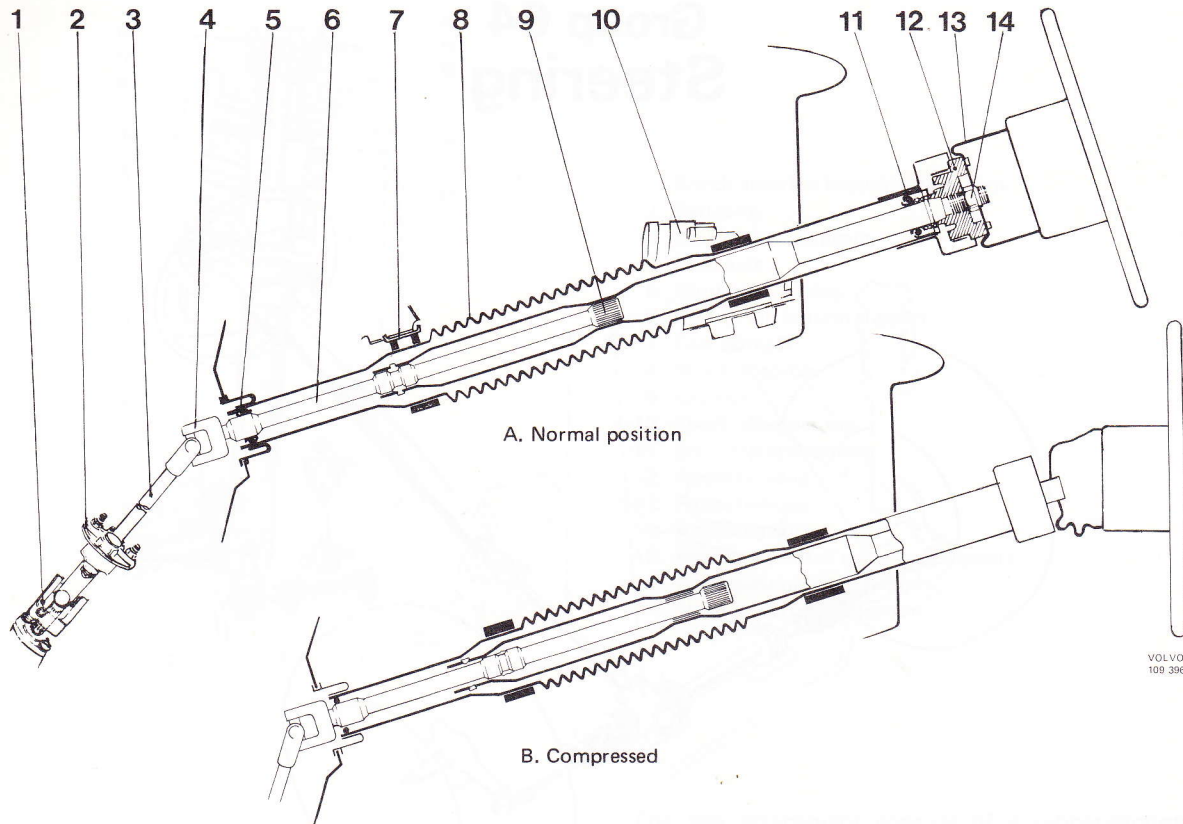
The power pump is made by ZF and is connected to the separate oil container by a hose.



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A. Cam Gear B. ZF





#### Steering column

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| 1. Lower U-joint                  | 8. Column jacket (below)            |
| 2. Flange                         | 9. Serrated sleeve                  |
| 3. Steering shaft, bottom section | 10. Upper attachment, steering lock |
| 4. Upper U-joint                  | 11. Upper bearing                   |
| 5. Lower bearing                  | 12. Steering wheel hub              |
| 6. Steering shaft, top section    | 13. Collapsible steel sleeve        |
| 7. Lower attachment               | 14. Nut, retaining the wheel        |

### Steering column

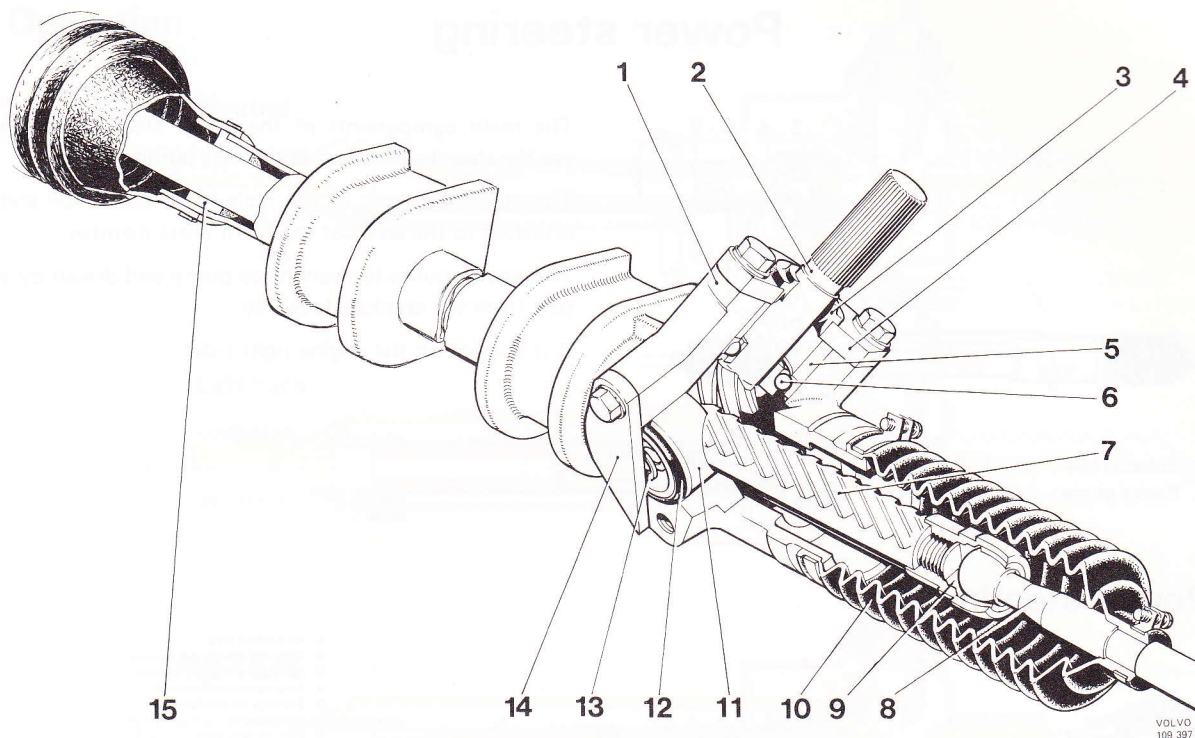
The steering shaft is divided into two sections and has two U-joints and one sliding joint. The top U-joint connects top and bottom sections of the steering shaft. The bottom U-joint connects the bottom section to the pinion shaft of the steering gear.

The top section is provided with a splined sliding

joint which, in case of accident, causes the top section to part and thus prevents possible steering shaft penetration into the passenger compartment.

Safety measures are further increased by a collapsible steering wheel design. The steering wheel is connected to the steering shaft by a steel sleeve which collapses under excessive pressures.





**Manual steering gear (Cam Gear)**

- |                  |                         |                           |
|------------------|-------------------------|---------------------------|
| 1. Housing       | 6. Upper Pinion bearing | 11. Pre-tensioning piston |
| 2. Pinion        | 7. Rack                 | 12. O-ring                |
| 3. Seal          | 8. Steering rod         | 13. Spring                |
| 4. Pinion cover  | 9. Inner ball joint     | 14. Cover                 |
| 5. Spacer sleeve | 10. Rubber bellows      | 15. Bushing               |

## Manual steering gear (Cam Gear)

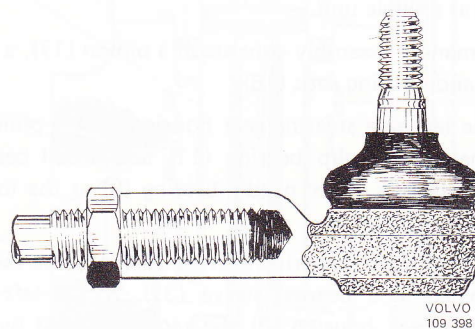
It is of the rack and pinion type and oil lubricated. When assembled, it is filled with oil. Oil check or topping up cannot be made after it has been installed. Should leakage arise, the oil must be drained completely and then new oil filled to correct quantity and with right type of oil after that the leakage has been corrected.

The steering gear is attached to the front side of the front cross member. It consists of a housing (1) in which rack (7) and pinion (2) are journaled.

The pinion is journaled in two ball bearings. The right side end of the rack is journaled in a bushing (15) while the left side end is on one side guided by the rack and on the opposite side by the pre-tensioning piston (11) which is pressed against the rack by a spring (13). Rubber bellows (10), which are held in position by clamps, provide the sealing between the steering gear housing and the steering rods.

The steering rods (8) also belong to the steering gear assembly. They are at the inner end provided with a ball joint (9) which is screwed on to the rack end and

lubricated by oil in the steering gear. The outer end, connected to the steering arms, is provided with a stud-type ball joint which is sealed and permanently lubricated. See Fig. below.



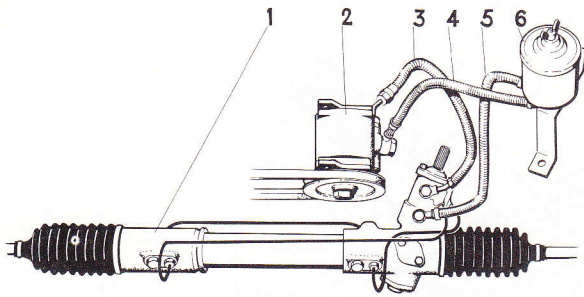
**Ball joint**

## Manual steering gear (ZF)

It is basically the same design as the Cam Gear steering gear. It is lubricated with grease instead of oil.



## Power steering



- |                  |               |                  |
|------------------|---------------|------------------|
| 1. Steering gear | 3. Oil output | 5. Return oil    |
| 2. Power pump    | 4. Oil input  | 6. Oil reservoir |

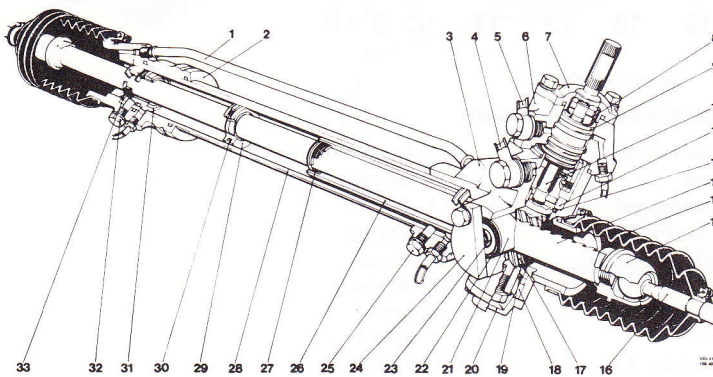
The main components of the power steering system are the steering gear and the power pump.

The steering gear is of the rack and pinion type and attached to the front of the front cross member.

The power pump is a vane-type pump and driven by a belt from the crankshaft pulley.

It is located on the engine right side.

## Power steering gear



1. Air overflow pipe
2. Right side steering gear housing
3. Left side steering gear housing
4. Return oil hose connection
5. Discharge oil connection
6. Valve housing
7. Valve housing cover
8. Needle bearing
9. Valve section on input shaft
10. Torsion rod
11. Slip bearing
12. Seal
13. Rack
14. Rubber bellows
15. Inner ball joint
16. Steering rod
17. Pinion
18. Spacer sleeve
19. Ball bearing
20. Lower rack cover
21. Pre-tensioning piston
22. O-ring
23. Spring
24. Cover
25. Stop bolt
26. Inner pipe
27. Seal
28. Outer pipe
29. Piston
30. Piston seal
31. Bearing sleeve
32. Stop bolt
33. Seal

The power steering gear is of the rack and pinion type. Manual assembly and power unit are integrally built as a single unit.

The manual assembly consists of a pinion (17), a rack (13) and steering rods (16).

In the left side steering gear housing (3) the pinion is journaled in a slip bearing (11) and a ball bearing (19). There is also a needle bearing (8) at the top in the pinion cover.

In the right side steering gear housing (2) the rack is journaled in a bearing sleeve (31). In the left side steering gear housing (3) the rack is guided by the pinion and the spring-loaded pre-tensioning piston (21).

Left side and right side steering gear housings are connected by an outer pipe (28). This pipe also serves as the operating cylinder for the power unit for the piston (29) which is fixed on the rack.

Oil from the power pump is regulated in the valve

housing (6) which is bolted at the top of the left side steering gear housing. The steering gear input shaft is linked with the pinion by a torsion rod (10).

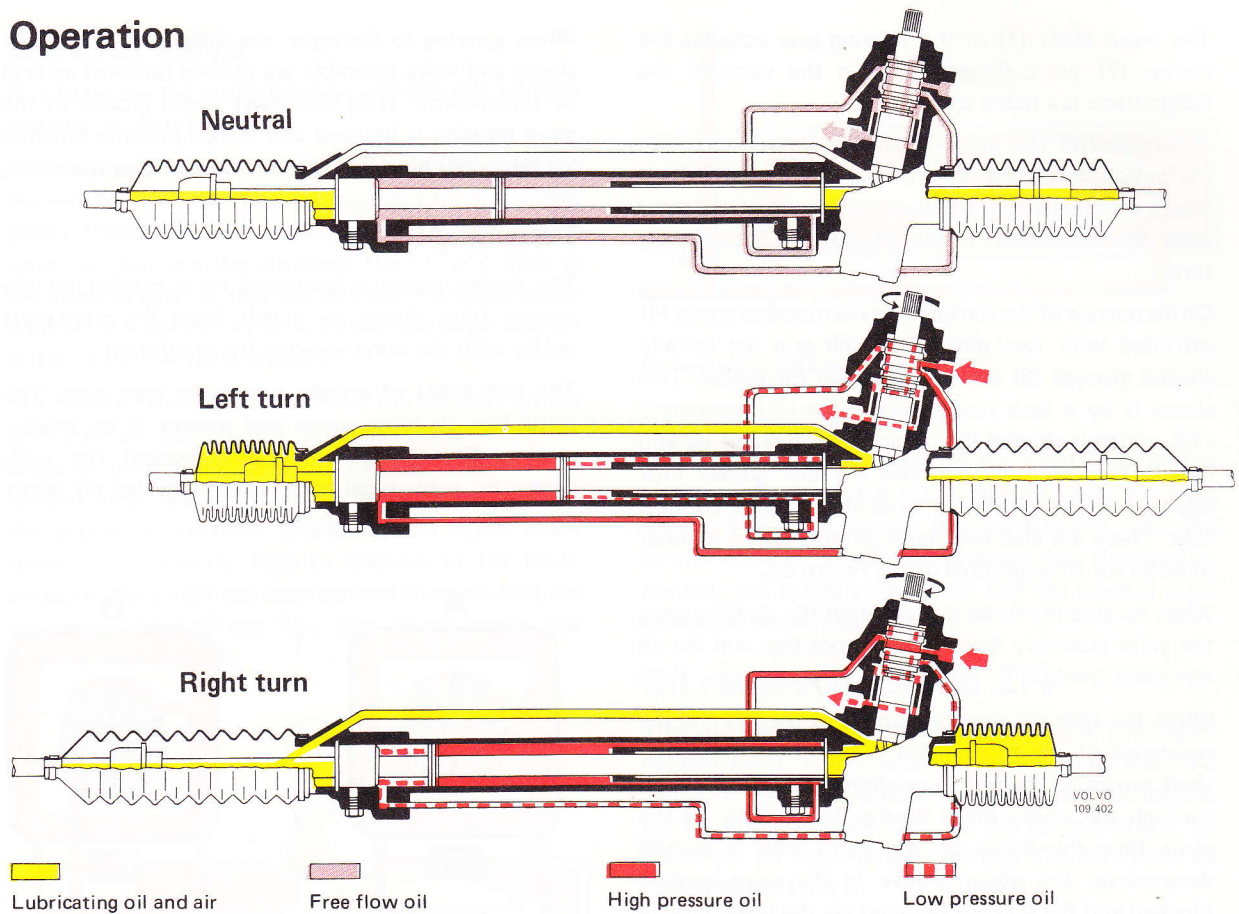
The steering rods (16) also belong to the steering gear assembly. They are at the inner end provided with a ball joint which is screwed on to the rack end and lubricated by oil in the steering gear. The outer end connects to the steering arm by a stud-type ball joint which is sealed and permanently lubricated.

The manual section of the steering gear is filled with lubricating oil and separated from the power section by seals in the left side housing (12), the inner pipe (27) and the slip ring bearing (33). Between the housings there is an air overflow pipe.

The lubricating oil cannot be checked or topped up. Should leakage arise, the oil must be drained completely and then new oil filled with right type of oil and to correct quantity after that the leakage has been corrected.



## Operation



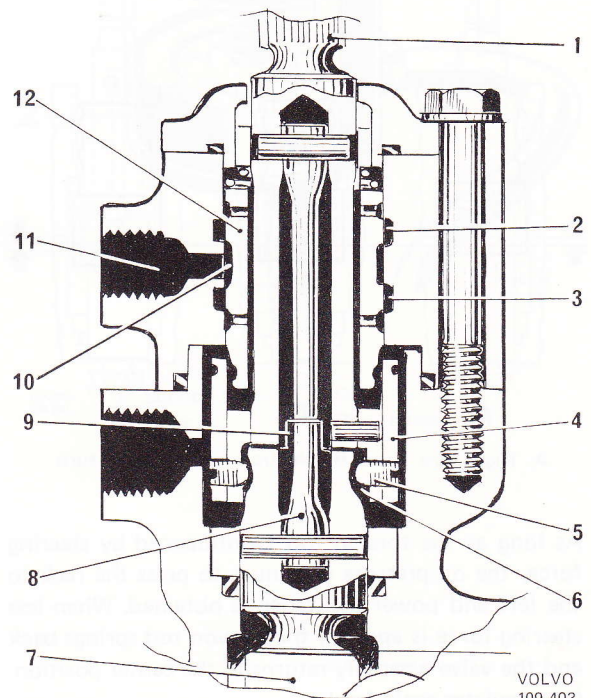
The power pump boosts the oil pressure and the pressurized oil operates the piston which is part of the rack. Oil flow to right side or left side of the piston is regulated in the valve housing. Pipes are on the outside connected to both sides of the housing. The power pump discharge hose is also connected to the valve housing.

## Valve housing

Oil flow to the right side or left side of the piston is regulated in the valve housing. The oil is conveyed to the piston sides by outside pipes. The discharge side of the power pump is also connected to the valve housing.

The valve housing contains two radial grooves, an upper (2) and a lower (3). These grooves are linked to the piston sides via the outside pipes.

- |                                  |   |
|----------------------------------|---|
| 1. Input shaft                   | 8. Torsion rod                                    |
| 2. Upper groove in valve housing | 9. Flange cam                                     |
| 3. Lower groove in valve housing | 10. Groove in valve assembly                      |
| 4. Sleeve                        | 11. Connection for discharge hose from power pump |
| 5. Stud                          | 12. Valve assembly                                |
| 6. Spiral groove                 |   |
| 7. Pinion                        |   |





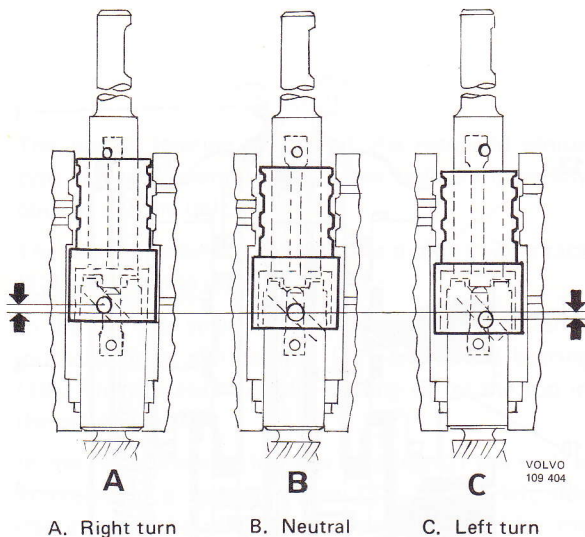
The input shaft (1) of the steering gear actuates the pinion (7) via a flange. Between the cams of the flange there is a radial cavity.

A torsion rod (8), which links the input shaft with the pinion, holds the cams of the flange in a position where the clearance is equal on both sides of the cams when the input shaft is not actuated by any steering forces.

On the outside of the flange there is a movable sleeve (4) provided with two pins (5) which grip the spirally shaped grooves (6) at the top end of the pinion. This sleeve is by a lock ring joined to the valve assembly (12) which is shaped like a pipe and movable up and down. The assembly contains a radial groove (10) opposite the channel (11) from the pressure connection. There are also two more grooves and a number of holes for through-flow of the return oil.

When no steering force is exerted on the steering gear, the valve assembly is in its center position and the oil circulates freely.

When the steering wheel is turned to the left and the resistance of the torsion rod is overcome, the input shaft moves to the left in relation to the pinion, and through the cavity made by the flange cams. At the same time the sleeve on the input shaft is pushed downwards, the upper groove in the valve housing blocked and the oil flow directed via the lower groove to the right side of the piston. The oil on the left side of the piston is pressed out of the way and via the valve assembly to the oil container.



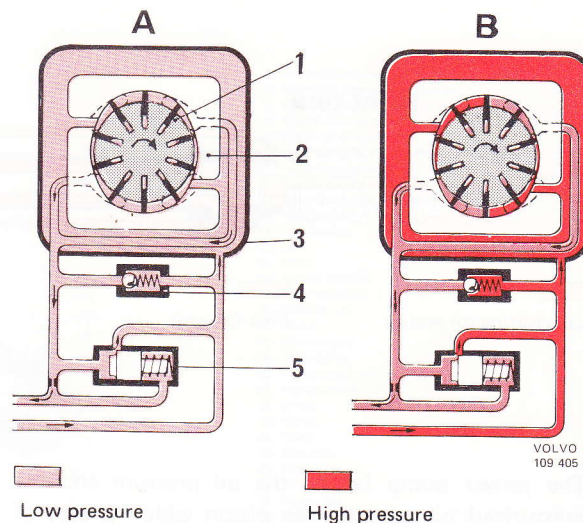
As long as the torsion rod is influenced by steering force, the oil pressure continues to press the rack to the left and power assistance is obtained. When less steering force is applied, the torsion rod springs back and the valve assembly returns to the center position. Oil circulates again freely.

When steering to the right, the difference is that the sleeve and valve assembly are pushed upwards instead of downwards. Thus the lower radial groove in the valve housing is blocked and the oil pressure directed via the upper groove to the left side of the piston.

## Power pump

The power pump is mounted on a bracket on the engine. It is driven by a belt from the crankshaft pulley with the same speed as the crankshaft.

The two types of pumps are of the vane type. The rotor has 10 loose vanes and rotates in an angular section. The blades are pressed against the walls partly by centrifugal force and partly by oil under pressure.



A. Steering gear neutral  
B. Steering either side

- 1. Rotor
- 2. Stator
- 3. Housing
- 4. Safety valve
- 5. Control valve

When the vanes move on the suction side, more room is provided between the vanes and oil is sucked in. On the discharge side the room between the vanes decreases and oil is forced out into the discharge line.

The pump has double capacity due to the fact that there are two suction and two discharge channels.

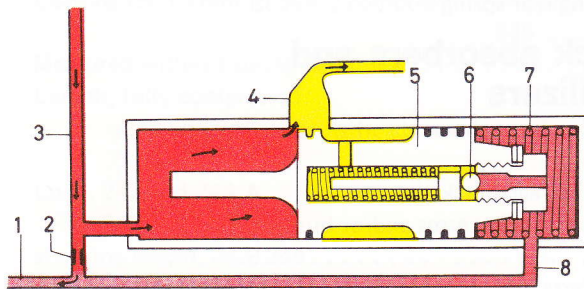


## Control valve

It is fitted on the pump housing and controls oil flow and maximum pressure.

When the pump starts, a spring (7) holds the valve (5) pressed to the left. The oil supplied by the pump passes through the discharge channel (3) via the orifice valve (2) out into the discharge line (1) and then to the steering gear. A channel (8) links the space to the right of the control valve with the discharge line (1) and thus has the same pressure.

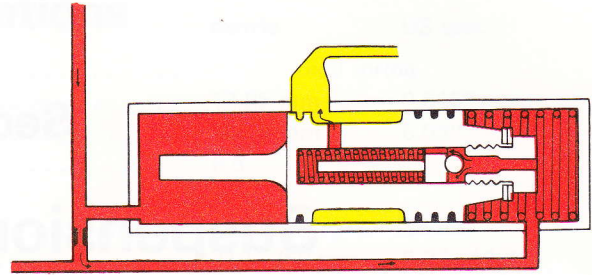
The orifice valve (2) ensures that the pressure on the left side of the control valve is higher than the pressure in the line and on the right side of the control valve. When the spring pressure is overcome, the piston is therefore pushed to the right. When speed is sufficiently high in relation to the back-pressure, the piston has been pushed so much that the ensuring surplus oil can flow back to the intake side of the pump. See Fig.



Control valve, normal position

- |                      |                       |
|----------------------|-----------------------|
| 1. Discharge line    | 5. Control valve      |
| 2. Orifice valve     | 6. Safety valve       |
| 3. Discharge channel | 7. Spring             |
| 4. Return channel    | 8. Connection channel |

If the pump flow through the outlet is stopped, for instance because the steering cannot be turned further, the pressure in the line (1) rises and the pressure on both sides of the control valve is equalized. This pushes the spring to the left. The connection with the return channel closes and the pressure rises still more. At approx. 7.5 MPa = 1066 psi the spring pressure on the safety valve (6, the inner part of the control valve) is overcome and oil flows out through the return channel (4). See Fig.

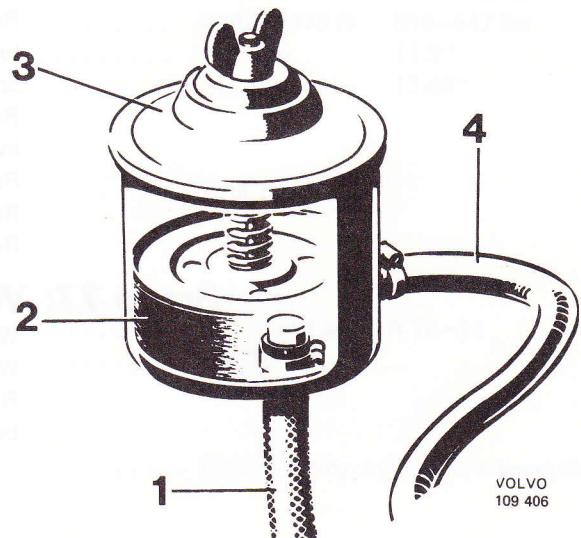


Control valve, maximum pressure

This causes the pressure on the right side of the piston to drop and the entire control valve is pushed to the right and opens the connections with the return channel. When the pressure has dropped to normal, the safety valve closes and the control valve returns to its normal position.

## Oil reservoir (pump ZF)

The oil reservoir is conveniently located in the engine compartment. The oil is sucked to the pump from the center of the filter. Should the filter become clogged, the oil flows past the filter via the by-pass valves. To check the oil level, remove the cap. The oil should be up to the level mark.



- |                 |                |
|-----------------|----------------|
| 1. Suction line | 3. Cover       |
| 2. Filter       | 4. Return line |