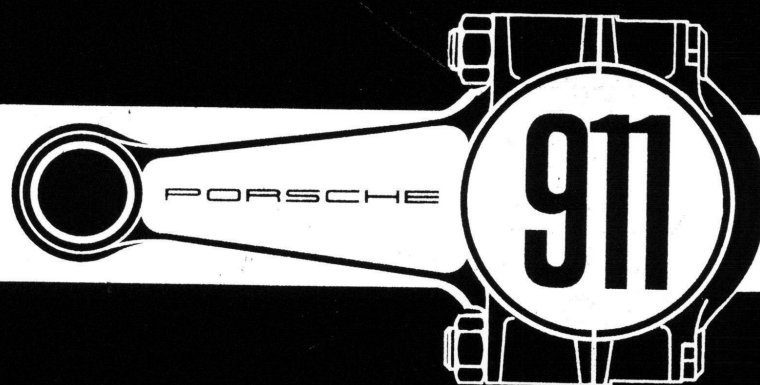


REPARATURLEITFADEN
WORKSHOP MANUAL
MANUEL DE RÉPARATION



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F Fuel System

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DESCRIPTION OF FRONT AXLE

General:

Each front wheel is independently suspended by means of the so-called shockabsorber strut mounted in a permanently lubricated ball joint, and a transverse control arm attached to a reinforcing crossmember.

Wheel suspension front, left side

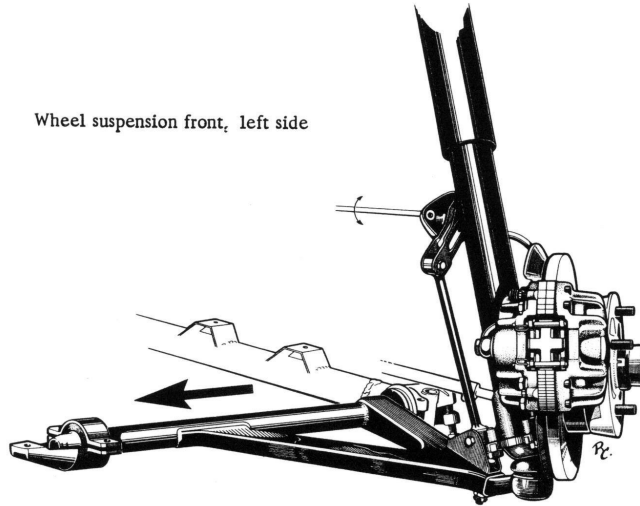


Fig. 1

Front wheel springing is effected through an adjustable, longitudinal torsion bar at each wheel. Complementing the springing is a progressively-acting rubber buffer installed in each of the two double-action hydraulic shockabsorber struts.

The cornering qualities are further enhanced by a transverse stabilizer which is connected to the suspension component of both front wheels through levers and shackles.

Lubrication:

The front axle has no lubrication points although it is necessary to properly refill the front wheel bearings with new grease when repairs are being made.

Maintenance:

All front axle joints are permanently lubricated and require no attention. To maintain the good road handling qualities and mechanical safety of the vehicle, it is necessary to carry out the periodic inspections prescribed in the maintenance schedule, including the following:

1. Checking and adjusting front wheel bearings.
2. Checking wheel nuts for tightness.
3. Checking and correcting tire pressure.

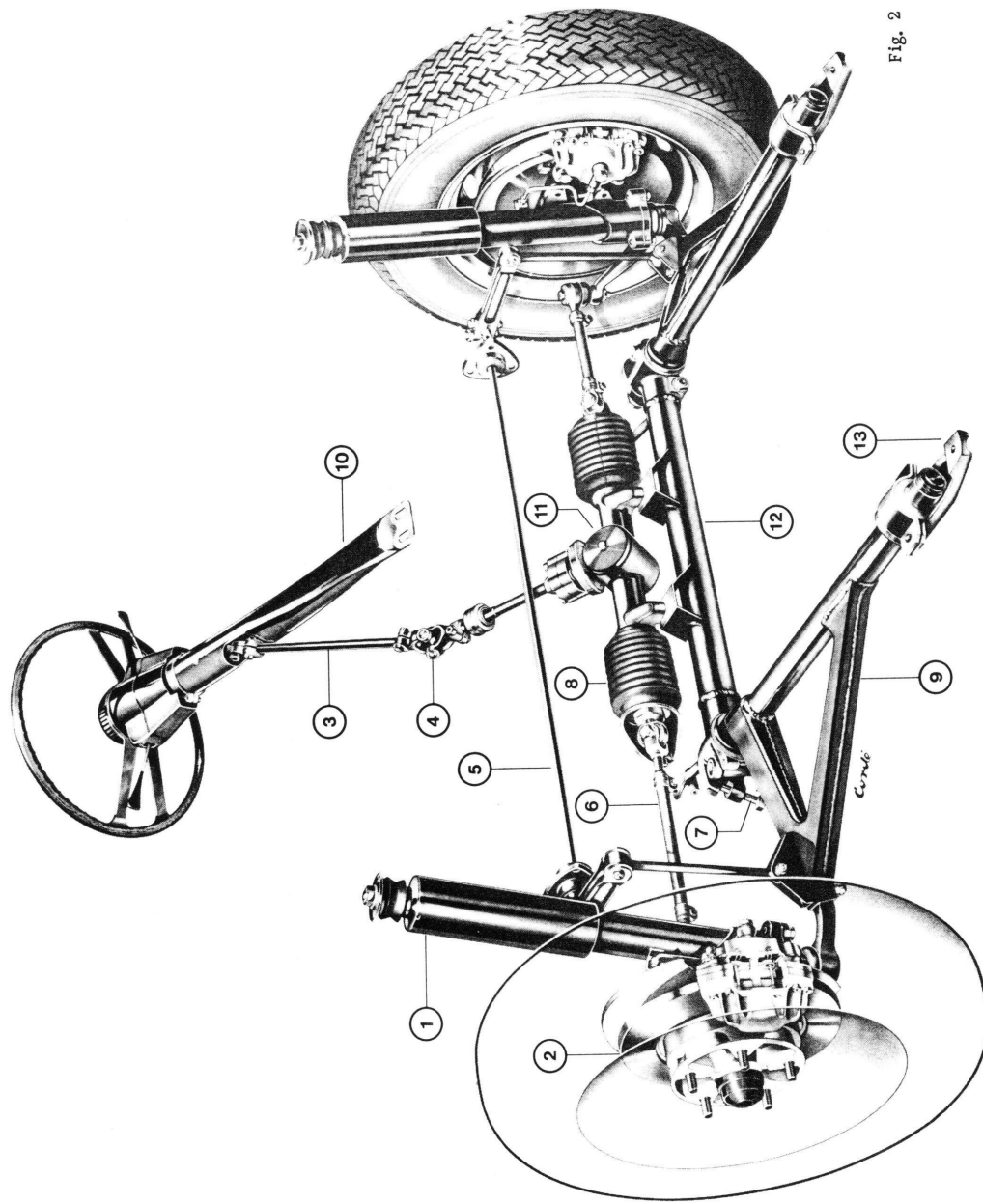


Fig. 2

- 1 Shock absorber strut
- 2, Brake disc
- 3 Steering intermediate shaft
- 4 Universal joint
- 5 Stabilizer
- 6 Steering tie rod
- 7 Adjusting screw
- 8 Bellows
- 9 Transverse control arm
- 10 Steering Post
- 11 Steering gear assembly
- 12 Reinforcing crossmember
- 13 Bearing support

DISASSEMBLING AND REASSEMBLING FRONT AXLE

Special Tools:

P 261	Torquemeter, 0 - 25 cmkp (0-22 lb/in)	VW 266h	Tie rod ball joint puller
P 281	Lightswitch wrench	VW 401	Pressure plate
P 282	Puller	VW 407	Punch
P 283	Pressure block	VW 410	Punch
P 284	Steering lever testing fixture	VW 418	Pipe, 32,5 mm dia.
P 285	Steering gear adjustment gauge	VW 421	Pipe, 28,0 mm dia.
P 286	Wheel spindle testing fixture	VW 433	Pressure block
P 287	Press adapter	VW 447f	Pressure ring
P 288	Transverse control arm testing fixture	VW 447g	Pressure ring
P 293	Puller	VW 447h	Pressure ring
Shop press		VW 447i	Pressure ring
VW 261	Angle indicator		

REMOVING SHOCKABSORBER STRUT

1 ST

Special Tools:

VW 266h Tie rod ball joint puller

1. Raise car and remove both wheels.
2. Unscrew cover shroud retaining bolts and remove shroud.
4. Detache brake line from brake hose supporting bracket, pull the hose out and withdraw line together with the retaining spring.

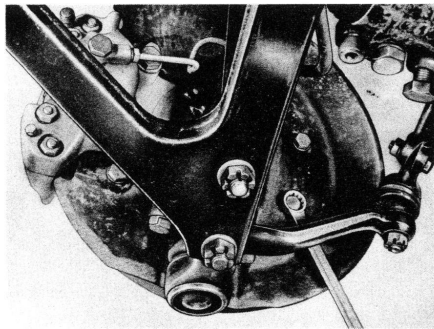


Fig. 3

3. Unscrew hydraulic line gland nut from brake caliper; use pedal prop to hold brake pedal slightly down to keep hydraulic fluid from running out of the fluid reservoir.
5. Remove brake caliper retaining bolts and remove entire caliper assembly.

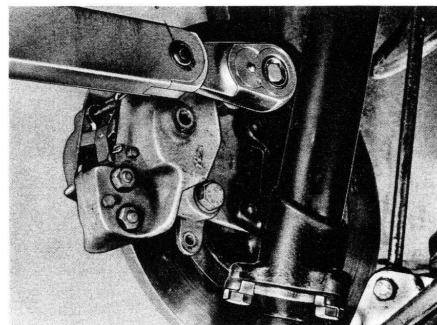


Fig. 4

6. Remove grease cap from front wheel hup by prying evenly on all sides.

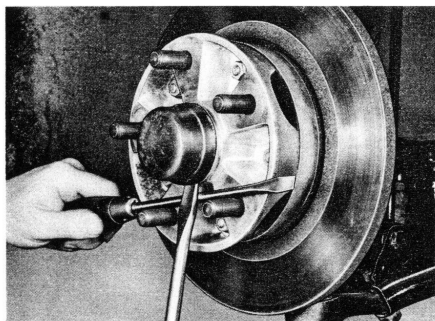


Fig. 5

9. Unlock and remove brake carrier retaining bolts, withdraw carrier.

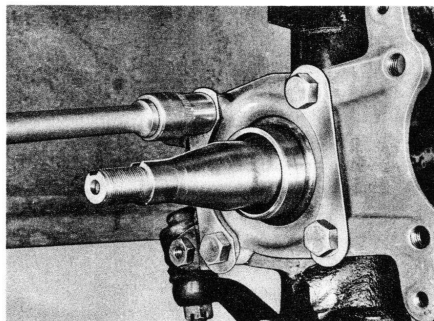


Fig. 7

7. Loosen Allen bolt in wheel bearing clamping nut, unscrew nut and withdraw bearing washer.

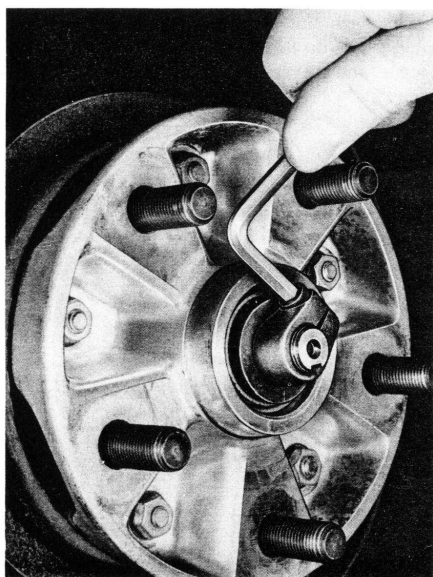


Fig. 6

10. Unlock and remove ball stud castellated nut, withdraw ball joint from steering arm using special tool VW 266h.

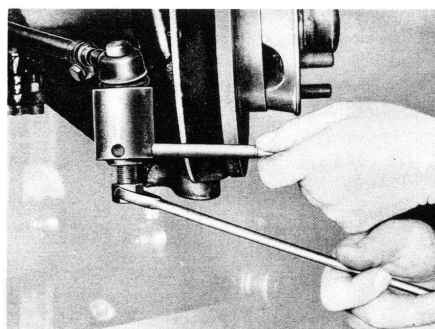


Fig. 8

8. Remove wheel hub with brake disc and bearing.

11. Unlock and remove castellated nuts from bolts in transverse control arm, pull the bolts out.

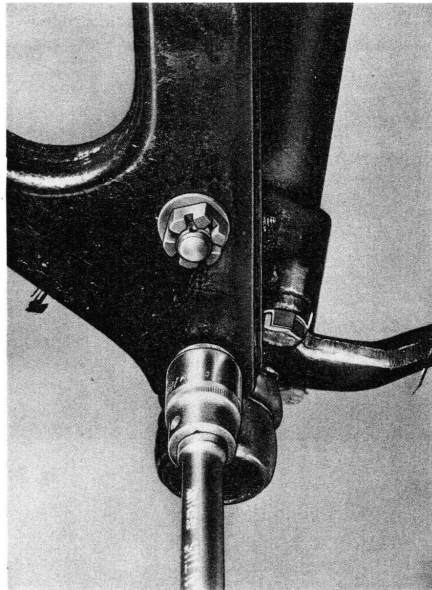


Fig. 9

12. Unlock and unscrew hex nut at top of shock-absorber strut, remove strut.

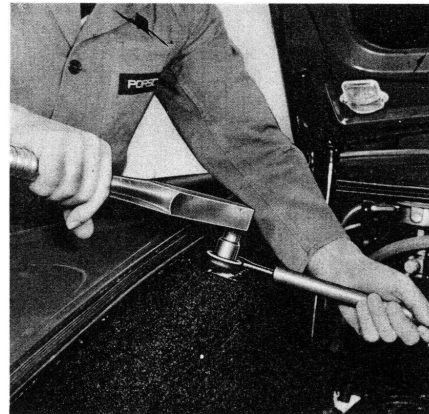


Fig. 10

DISMANTLING SHOCKABSORBER STRUTS AND INSPECTING PARTS

2 ST

Special Tools:

Shop press

P 284 Steering lever testing fixture,

P 286 Wheel spindle testing fixture.

1. Mount shockabsorber strut in a bench vise; use protective vise jaw covers.
2. Remove shielding tube and withdraw rubber buffer.
3. Unlock and remove steering lever hex bolts, remove the steering lever and ball joint assembly (take care not to loose the bushing).

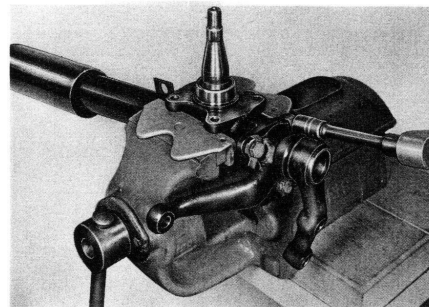


Fig. 11

4. Mount the steering lever and ball joint assembly in a bench vise, unlock and remove castellated nut.

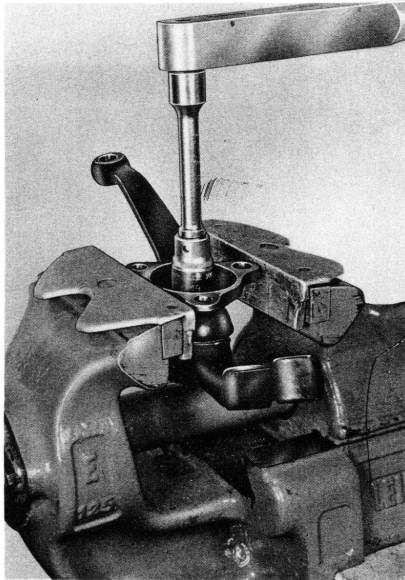


Fig. 12

5. Press the ball joint out of seat in steering lever using shop press (Matra M 30) or a suitable puller.

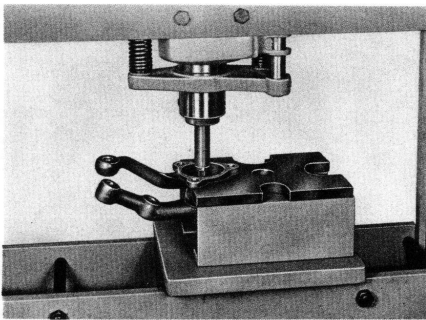


Fig. 13

6. Drive distance ring off wheel spindle striking with drift punch at different place.

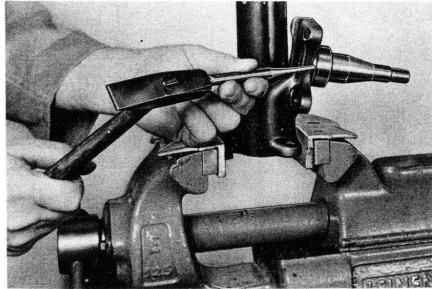


Fig. 14

Checking Component Parts:

1. Check the shockabsorber strut and wheel spindle assembly using special tool P 286.

Note:

When checking Koni shockabsorbers, the 2 caps and 2 bushings must be removed from the reference studs.

- a) With the distance ring in place, insert the wheel spindle of the shockabsorber strut into special tool P 286.

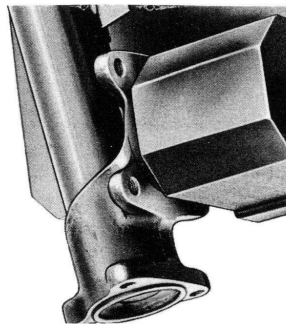


Fig. 15

If it is not possible to insert the spindle fully to the base of the flange, it is an indication that the spindle is bent necessitating replacement of the shockabsorber strut.

- b) Mount the shockabsorber strut in special tool P 286 by securing the spindle with the clamping nut, and turn the strut into position between the reference studs.

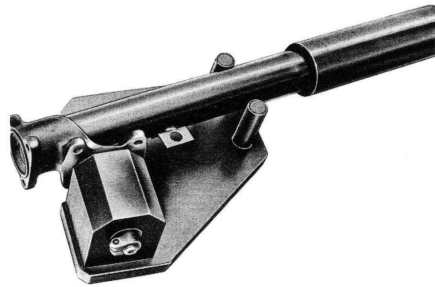


Fig. 16

If the snugly tightened but still movable shockabsorber strut can not be positioned between the 2 vertical reference studs, it must be replaced. In addition, the difference in values measured between the strut tube and the reference studs cannot exceed 0,8 mm (1/32"). Struts exceeding this specification must be replaced. When measuring standard-version struts, keep the caps and bushings on the reference studs; remove the caps and bushings when checking Koni struts.

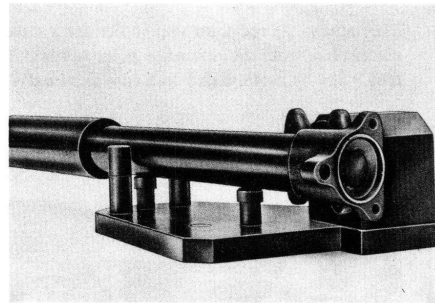


Fig. 16a

2. Check the shockabsorber strut for hydraulic action and possible leaks,

- a) Visually inspect the strut for possible oil deposits. If the strut is covered with oily dirt, it will have to be replaced.
- b) Mount the shockabsorber strut in a bench vise, keeping it in vertically upright position. Pump the strut a few times, to fill its cylinder with oil, and check for free travel through quick movement in the opposite direction. If the free travel is unusually long, replace the strut.

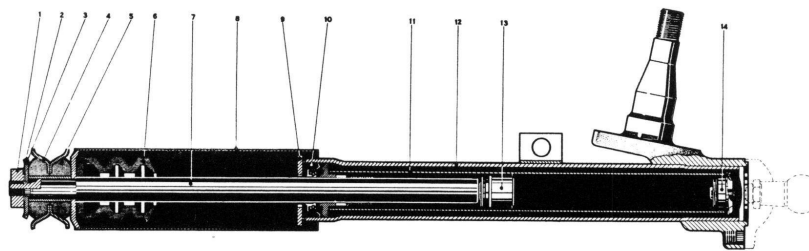


Fig. 17

FRONT SHOCKABSORBER STRUT

- | | | | |
|----------------|------------------------|------------------|---------------|
| 1 Hex nut | 4 Bracket (on vehicle) | 7 Piston rod | 10 Oil seal |
| 2 Safety plate | 5 Rubber bushing | 8 Shielding tube | 11 Cylinder |
| 3 Washer | 6 Rubber buffer | 9 Stop disc | 12 Strut tube |
| | 13 Piston | | |
| | 14 Bottom valve | | |

3. Check steering lever with special tool P 284.

The tapered tie rod joint seat in the lever must not deviate from the reference point in special tool P 284 by more than 1 mm (check visually).

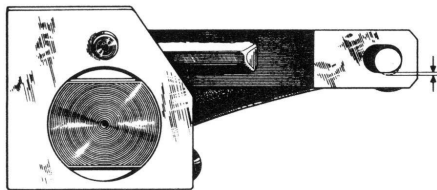


Fig. 18

In checking the height alignment of the steering lever, a maximum deviation (from the parallel) of 0,5 mm is permissible (visual check).

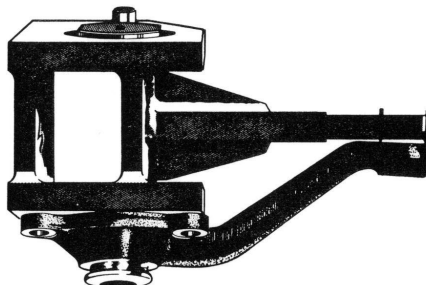


Fig. 19

4. Check ball joint.

A slight drag must be perceptible at the ball stud when it is being moved. If the ball stud can be moved freely and axial play is in evidence, replace the ball joint.

Check the rubber dust cover and replace if defective.

3 ST

ASSEMBLING AND INSTALLING SHOCKABSORBER STRUT

Assemble and install the strut in reversed order of the above by noting the following points:

1. An O-ring R32-2,5 must be installed between the distance ring and wheel spindle to prevent rust formation.
2. Heat distance ring to approx. 150°C (300°F) and push it into place (see Fig. 14).
3. Prior to installation of new ball joints, fill the rubber boot with 6,5 g (0,2 oz.) of multi-purpose MoS₂ grease. The tapered end of the ball stud must, however, be free of grease.
4. Install ball stud castellated nut and torque to 4,5 mkp (32,5 lb-ft). If the cotter pin orifice appears above the top of the castellated nut, place a spacer under the nut (see Fig. 12).
5. Install steering lever attaching hex bolts and torque to 4,7 mkp (34 lb-ft); use new safety plates (see Fig. 11).
6. Install rubber buffer dry, without lubricants.
7. Install hex nut on the shockabsorber strut and torque to 8,0 mkp (58 lb-ft); use new safety plate and make sure that its lip points up (see Fig. 10).

7. Install castellated nuts in transverse control arm and torque to 7, 5 mkp (54, 2 lb/ft); use washers, secure with cotter keys (see Fig. 9).
8. Install castellated nut on tie rod ball stud, torque to 4, 5 mkp (32, 5 lb/ft) and secure with cotter key.
9. Install brake carrier retaining bolts and torque to 4, 7 mkp (34 lb/ft) use new safety plates (see Fig. 7).
10. Install front wheel bearings and adjust according to 4St.
11. Install brake caliper retaining bolts with spring washers and torque to 7, 0 mkp (50, 6 lb/ft) (see Fig. 4).
12. Torque gland nut of brake line at brake caliper to 2, 0 mkp (14, 5 lb/ft).
13. Torque cover shroud retaining bolts to 2, 5 mkp (18 lb/ft) (see Fig. 3).
14. Bleed brake system (refer to Group B).
15. Check and adjust wheel alignment on optical alignment ramp (refer to Group R).

ARRANGEMENT OF FRONT WHEEL BEARINGS

Cross - sectional View

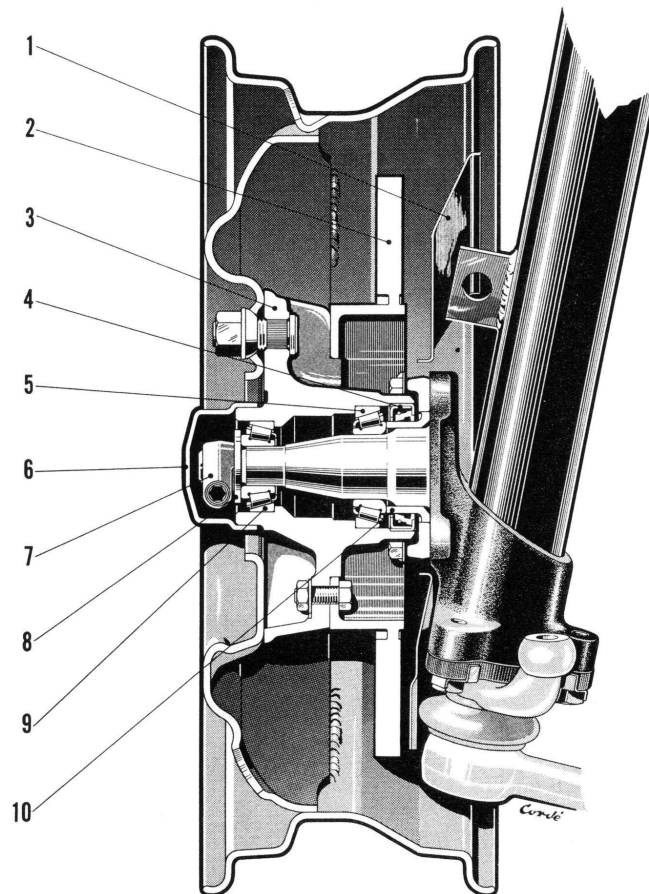


Fig. 20

- 1 Cover shroud
- 2 Brake disc
- 3 Front wheel hub
- 4 Seal
- 5 Tapered roller bearing

- 6 Grease cap
- 7 Clamping nut
- 8 Washer
- 9 Tapered roller bearing
- 10 Distance ring

REMOVING AND INSTALLING FRONT WHEEL BEARINGS

4 ST

Special Tools

Shop press

VW 401	Pressure plate	VW 433	Pressure block
VW 407	Punch	VW 447f	Pressure ring
VW 410	Punch	VW 447g	Pressure ring
VW 418	Pipe, 32,5 mm dia.	VW 447h	Pressure ring
VW 421	Pipe, 28,0 mm dia.	VW 447i	Pressure ring

Removal:

1. Unscrew hydraulic line gland nut from brake caliper; use pedal prop to hold brake pedal slightly down to keep hydraulic fluid from running out of the fluid reservoir.
2. Remove brake caliper retaining bolts and remove entire caliper assembly.
3. Remove dust cap from front wheel hup by prying evenly on all sides.

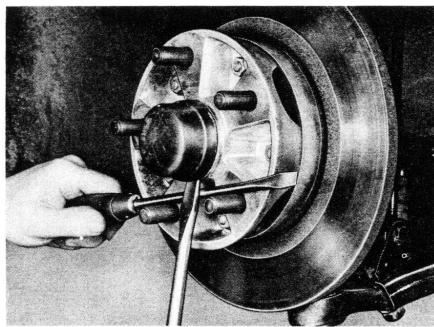


Fig. 21

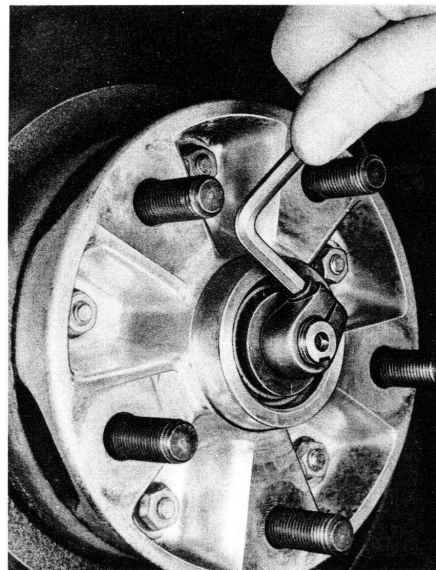


Fig. 22

4. Loosen Allen bolt in wheel bearing clamping nut, unscrew nut and withdraw bearing washer.

5. Remove wheel hub with brake disc and bearings.
6. Using a shop press, press wheel bearings out; depending on the type of press used, it may become necessary to remove the brake disc from the wheel hub.
 - a) Mark brake disc and wheel hub, remove disc retaining bolts, and remove wheel hub.
 - b) Heat wheel hub to $120 - 150^{\circ}\text{C}$ ($250 - 300^{\circ}\text{F}$).
 - c) Press out inner tapered roller bearing and the seal on a shop press using special tools VW 407, VW 421 and VW 447 g.

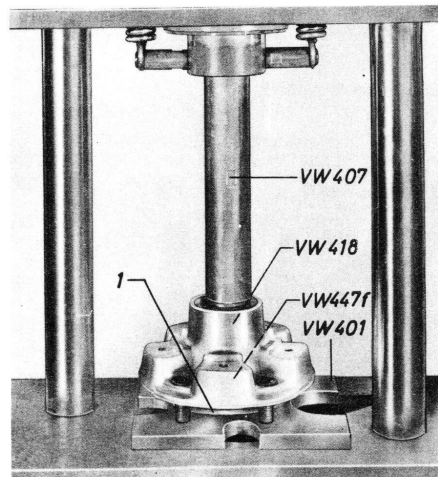


Fig. 24

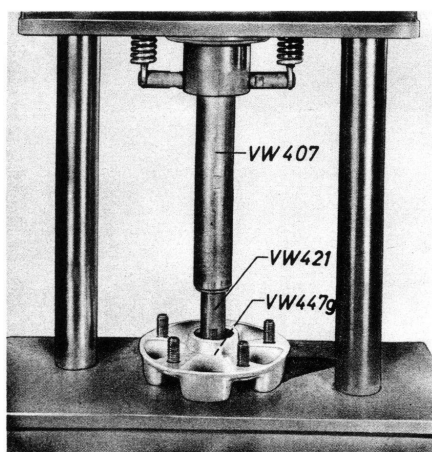


Fig. 23

Sketch for local manufacture of Spacer 1.

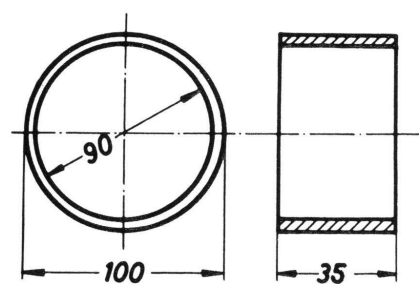


Fig. 25

- d) Press out outer race of the outer tapered roller bearing on shop press using special tools VW 407, VW 418, VW 447f, Spacer 1, and VW 401.

Installation:

Note the following points during installation:

General:

Tapered roller bearings of various brands (SKF, FAG and Timken), are installed during assembly at the plant.

New bearing parts, such as the outer race, inner race and roller are interchangeable within a given brand but care must be taken that the complete bearing consists of one-brand parts.

1. Thoroughly clean both tapered roller bearings and check for wear or damage, replace if necessary.
2. Heat wheel hub to 120 - 150°C (250-300°F).
3. Press in the outer race of the inner roller bearing on shop press using special tools VW 407, VW 477i, Spacer 1, and VW 401.

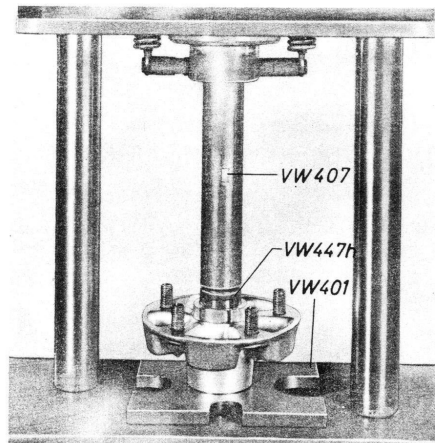


Fig. 26

4. Insert the inner race into the inner tapered roller bearing and press oil seal in with the help of special tools VW 410, VW 433, Spacer 1, and VW 401 until the oil seal is flushed with the wheel hub housing.

5. Press in the outer race of the outer tapered roller bearing with special tools VW 407, VW 447h, and VW 401.

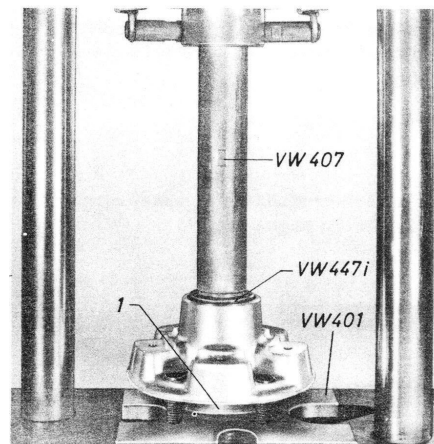


Fig. 27

6. Place brake disk on the wheel hub so that the markings line up.
7. Torque brake disc/wheel hub retaining bolts to 2,3 mkp (16,6 lb/ft). Make certain that the bolts are installed from inside to outside so that bolt heads come to rest against the brake disc; place new spring washers under the nuts.
8. Pack the hub with approx. 50 c.c. or 45 g (1,6 oz.) of lithium base multipurpose grease. From 69 models on use 65 c.c. or 60 g (2,1 oz.) of grease. Make sure that the bearings are thoroughly coated with grease. The space between the sealing lips of the sealing ring should also be filled with grease so that the outer sealing ring does not run without lubrication.

9. Adjust front wheel bearings.

- a) Lightly tighten the clamping nut (approx. 1,5 mkp or 10,8 lb/ft) while turning the wheel or hub to well seat the tapered rollers in their races.
- b) Loosen clamping nut so that the thrust washer can be moved sideways under light pressure of a screwdriver yet not bearing play felt when shaking the wheel hub axially.

Note:

The screwdriver should not be pressed against the hub for this purpose but held free for better feel.

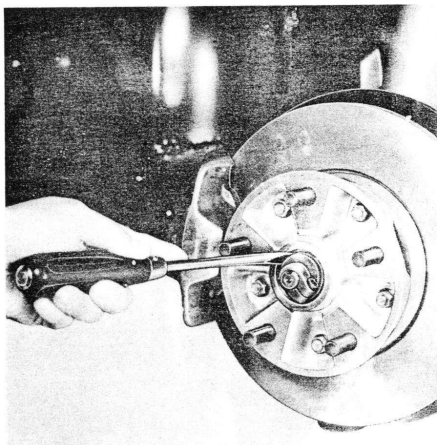


Fig. 28

- c) Torque Allen bolt in clamping nut to 1,5 mkp (10,9 lb/ft) making sure that the clamping nut remains in the adjusted position. Recheck adjustment by moving the thrust washer, readjust if necessary.

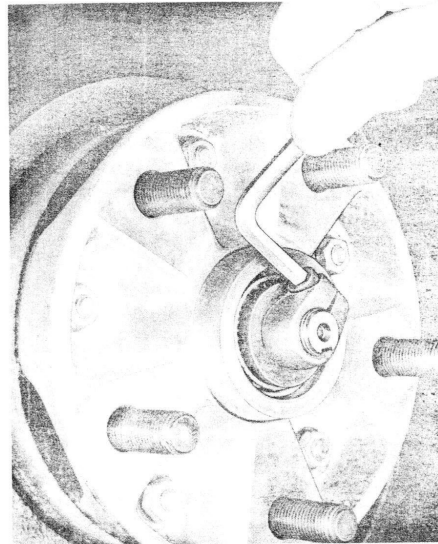


Fig. 29

- d) Lightly coat the clamping nut and thrust washer with Lithium grease. Install grease cap (without filling it with grease) with the aid of a plastic hammer or similar tool.

10. Install brake caliper retaining bolts with spring washers and torque to 7,0 mkp (50,6 lb/ft).

11. Torque gland nut of brake line at brake caliper to 2,0 mkp (14,5 lb/ft).

REMOVING AND INSTALLING TRANSVERSE CONTROL ARM

5 ST

Special Tools :

P 287 Press adapter

P 288 Transverse control arm testing fixture

VW 261 Angle indicator

Removal:

1. Unscrew hex bolts and nuts from undershield and remove it,

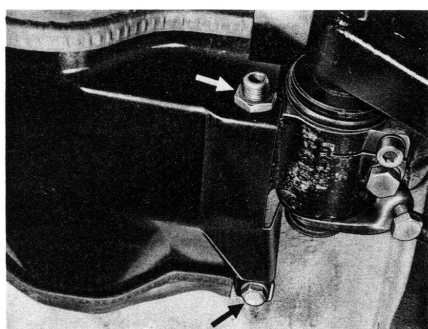


Fig. 30

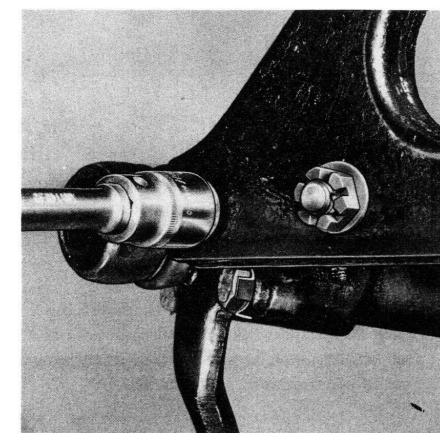


Fig. 32

2. Turn the torsion bar adjusting screw back.

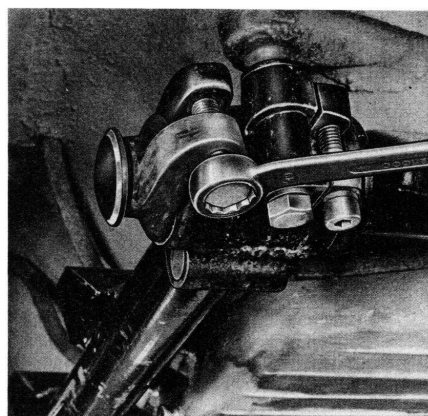


Fig. 31

4. Remove retaining bolts from control arm bushing bracket, remove bracket and bracket cap.

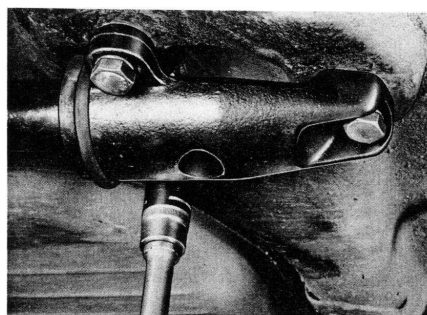


Fig. 33

5. Remove both torsion bar dust caps and locking ring in the forward part of the transverse control arm.

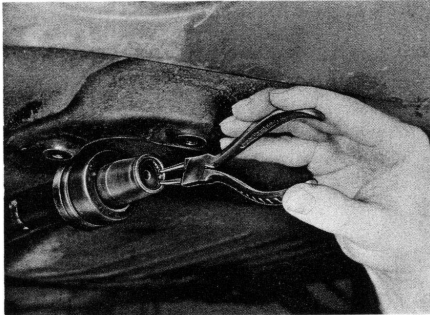


Fig. 34

6. Drive torsion bar forward and out of the transverse control arm using an appropriate punch.

7. Loosen Flanbloc retaining bolt in reinforcing crossmember and withdraw transverse control arm with Flanbloc by pushing the control arm forward and turning it about its axis.

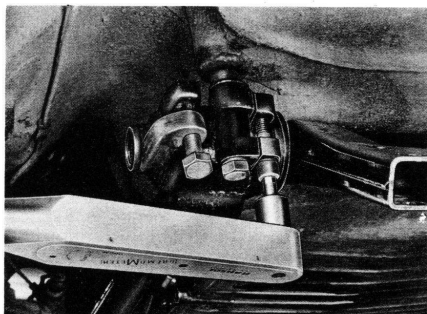


Fig. 35

Note :

It is not possible to press the Flanbloc off the transverse control arm without damaging the arm. The control arm and Flanbloc must always be replaced together.

8. Drive the torsion bar adjusting lever out by striking it with a punch inserted through the orifice in the reinforcing crossmember.

Caution !

Avoid damaging the torsion bar splines.

Inspecting parts

1. Check transverse control arm with the aid of the P 288 testing fixture.

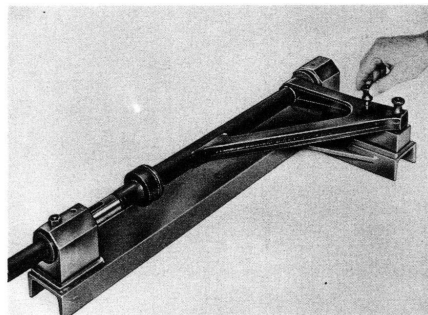


Fig. 36

Install the control arm, with the Flanbloc in place, into the guide bore of the P 288 testing fixture, and support at the other end by the mandrel. When the control arm is turned into place on the base plate of the fixture, both reference pieces must fully enter into the corresponding points.

Deformed control arms must be replaced.

2. Visually check the rubber bushing and Flanbloc for evidence of wear, replace if necessary.
3. Check torsion bar for damage to splines or protective paint, especially for evidence of rust, and replace if necessary.

Reassembly :

The following points should be noted during reassembly:

1. Install the flambloc with the aid of P 287 press adapter.
 - a) Coat mating surfaces with MoS_2 grease or similar lubricant to prevent scoring during assembly.
 - b) Place Flambloc spacer onto the thinner journal of the control arm, with the chamfered side facing the journal root, and press Flambloc into place.

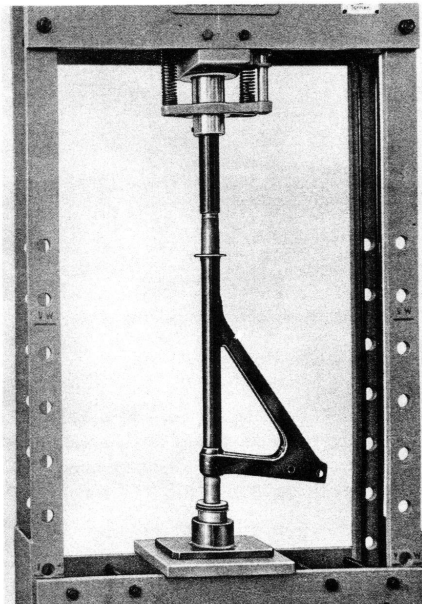


Fig. 37

2. Insert the control arm, with installed Flambloc into the receiving and within the reinforcing crossmember and push fully in.

3. Position the control arm end, which carries the ball support, at 10° inclination in relation to the reinforcing crossmember, and tighten the Flambloc clamping bolt to 4,7 mkp (34 lb/ft) (see illustration).

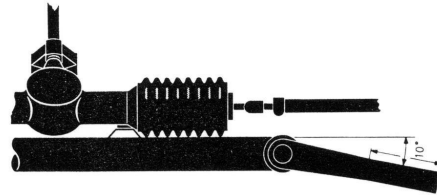


Fig. 38

This adjustment must definitely be carried out to ensure that the Flambloc is not twisted beyond its rotational limits, and no uneven springing conditions are created. The angle indicator VW 261 or VW 245a may be used for this purpose.

4. Lightly coat the torsion bar with Lithium grease, taking special care to well grease the mounting splines, and install the torsion bar by inserting it into the forward end of the control arm (do not fail to install the lock ring and dust cap).

Note !

The torsion bars are pre-stressed in manufacture. Care must be taken that the right and left bars are not switched inadvertently. For this reason, each torsion bar has an identifying letter stamped on one of its end flanks, i. e. , "L" for left side and "R" for right side (see illustration).

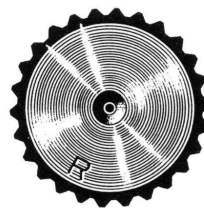


Fig. 39

5. Properly install the bracket cap (see illustration).

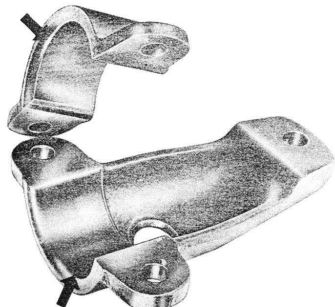


Fig. 40

6. Insert the rubber bushing on the control arm so that the narrow collar comes to rest against the thrust washer of the control arm. Prior to assembly, coat the rubber bushing with glycerine paste (such as Conti-Fix); also make sure that the rubber bushing is not pinched along the sides between the bracket cap and bracket at time of tightening. It is of advantage to lightly tighten the forward bolt first, and then install the rear bolts. Torque the bolts to 4,7 mkp (34 lb/ft).

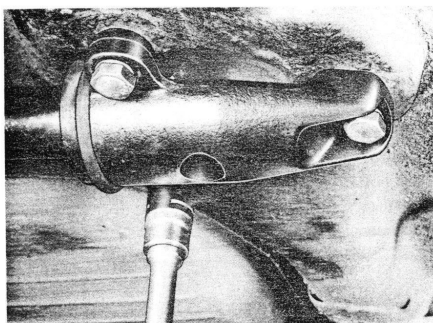


Fig. 41

7. Torque castellated nuts on the transverse support arm to 7,5 mkp (54,2 lb/ft); use washers and secure nuts with cotter keys. (See Fig. 32).

8. Install the torsion bar adjusting lever into the reinforcing crossmember as follows:

a) With the shock strut attached to the transverse control arm, push the control arm down to stop in shock strut (use a tire tool or similar lever) and insert the torsion bar adjusting lever, with the adjusting screw turned all the way back, into the reinforcing crossmember and onto the splined torsion bar end, leaving as little clearance at the lever adjusting point as possible; coat the lever with graphite grease prior to installation into the support arm.

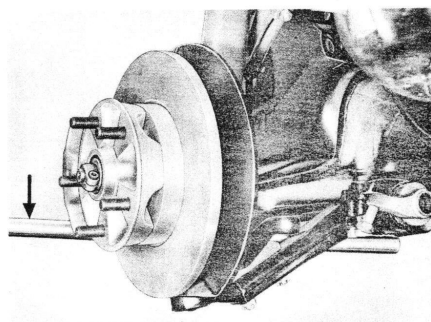


Fig. 42

b) Slightly tighten the adjusting screw.

c) Install lock ring and dust cover. Adjust height of front end and check wheel alignment on the optical alignment ramp. (see Group "R").

Removal:

1. Remove hex bolt from brace of reinforcing crossmember.
2. Loosen hex bolts which hold reinforcing crossmember, knock the crossmember off the aligning studs, turn the screws out, and remove crossmember.
2. Determine as well as possible the distance differential at top and bottom between a and b. Maximum permissible difference is 2,0 mm. Greater deviations necessitate the replacement of the reinforcing crossmember.

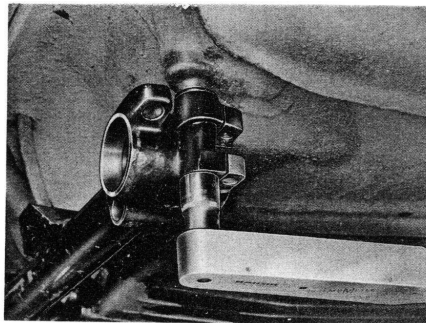


Fig. 43

Checking Crossmember:

1. Insert 2 alignment measuring tubes into the Flanbloc seating holes in the reinforcing crossmember and tighten the clamping bolts.

Sketch showing configurations of alignment measuring tubes for loca manufacture (Steel tubing 55 x 5).

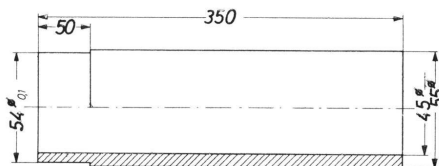


Fig. 44

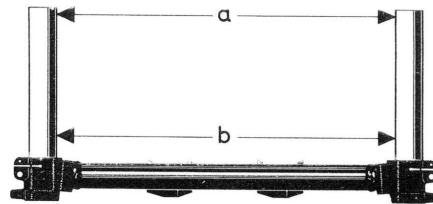


Fig. 45

3. Place the reinforcing crossmember onto a flat surface (straightening plate). With one alignment measuring tube laying perfectly flat, check for twist at the other tube with the aid of a feeler gauge. Maximum permissible difference between the flat surface and either end of the tube is 2 mm. Greater deviations necessitate replacement of the reinforcing crossmember.

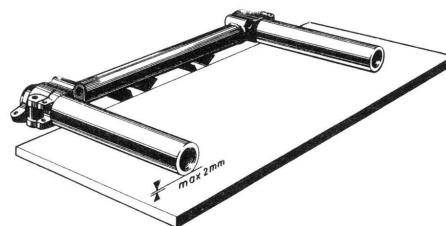


Fig. 46

4. Visually check the steering mounting brackets for deformation or damage, replace the reinforcing crossmember if necessary.

INSTALLATION:

The following points should be noted during installation:

1. Care must be taken to ascertain that the reinforcing crossmember rests well in the aligning studs located in the body.
2. Torque hex bolts to 9,0 mkp (65,1 lb/ft).

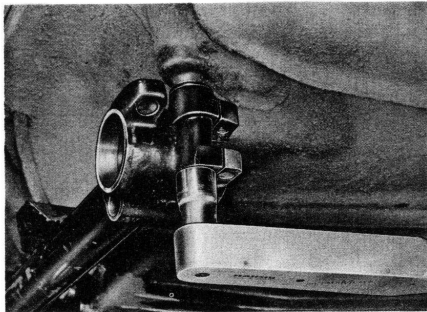


Fig. 47

3. Install the crossmember brace without binding forces. Torque hex nuts to 6,5 mkp (47 lb/ft), and hex bolts to 4,7 mkp (34 lb/ft).

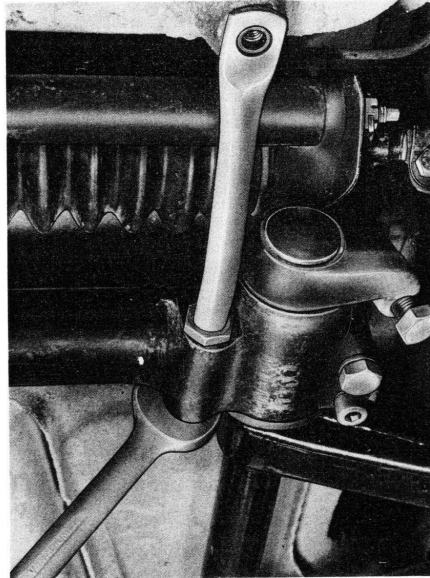


Fig. 48

Removal:

1. Loosen stabilizer lever clamping bolts and withdraw lever.

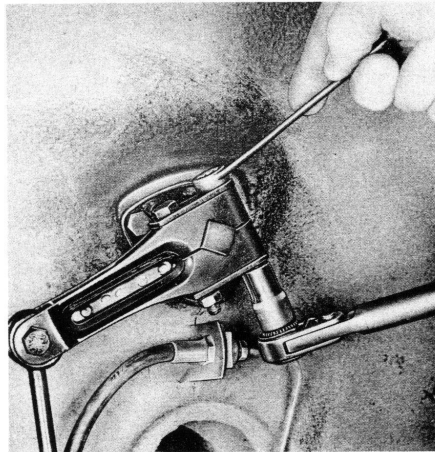


Fig. 49

2. Remove bush support retaining bolts, squirt a little rust solvent or penetrating oil onto the bush support and rubber bush, and pry both parts loose with 2 large screwdrivers, then remove.

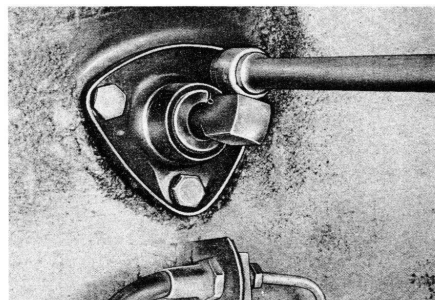


Fig. 50

3. Remove bush support retaining bolts on the other side and pull out stabilizer together with bush and its support.
4. Using a shop press, remove the stabilizer from the support or the rubber bush (use penetrating oil).
5. Remove shackle attaching bolt (below) and remove shackle with stabilizer lever.

Inspecting parts:

Visually check rubber grommets in the stabilizer shackle for wear and replace if necessary.

Installation:

Note the following points during installation:

1. Treat the stabilizer and rubber bush with glycerine paste or similar rubber lubricant.
2. Lightly tighten both bush supports, center the stabilizer, and torque hex bolts to 2, 5 mkp (18, 1 lb/ft). (see Fig. 50)

3. Position each stabilizer lever on the square end of the stabilizer so that the stabilizer end protrudes approx. 1 mm beyond it (see illustration).

4. Torque nuts of shackle retaining bolts to 2,5 mkp (18,1 lb/ft).

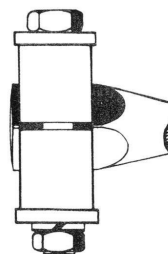


Fig. 51

8 ST

REMOVING AND INSTALLING TORSION BAR

Removal:

1. Unscrew hex bolts and nuts from undershield and remove it.

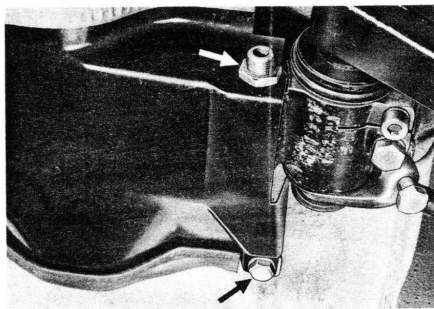


Fig. 52

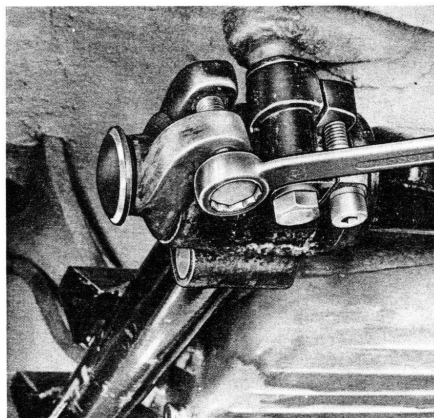


Fig. 53

2. Turn the torsion bar adjusting screw back.

3. Remove retaining bolts from the control arm bushing bracket, remove bracket and bracket cap.

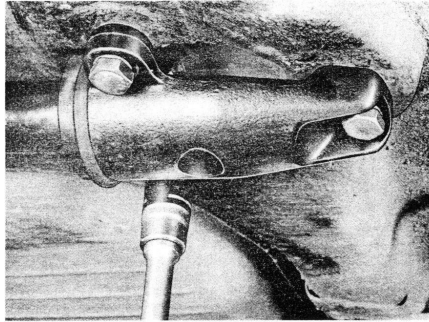


Fig. 54

4. Remove both torsion bar dust caps and locking ring in the forward part of the transverse control arm.

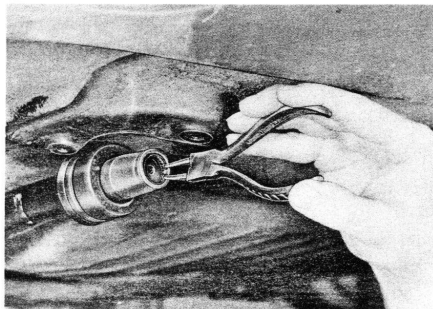


Fig. 55

5. Drive torsion bar forward and out of the transverse control arm using an appropriate driver.
6. Drive the torsion bar adjusting lever rearward and out of the transverse control arm.

Caution!

Avoid damaging the torsion bar splines.

Inspecting parts:

Check torsion bar for damage to splines or protective paint, especially for evidence of rust, and replace if necessary.

Installation:

Note the following points during installation:

1. Lightly coat the torsion bar with Lithium grease taking special care to well grease the mounting splines, and install the torsion bar by inserting it into the forward end of the control arm (do not fail to install the lock ring and dust cap).

Note!

The torsion bars are pre-stressed in manufacture. Care must be taken that the right and left bars are not switched inadvertently. For this reason, each torsion bar has an identifying letter stamped on one of its end flanks, i. e., "L" for left side, and "R" for right side (see illustration).

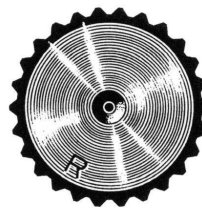


Fig. 56

2. Properly install the bracket cap (see illustration).

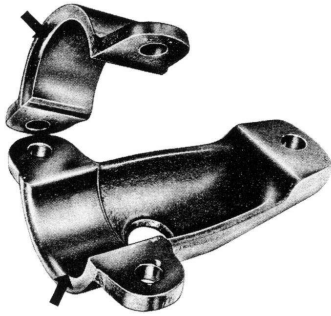


Fig. 57

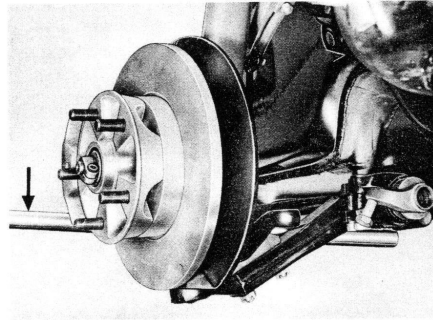


Fig. 58

- b) Slightly tighten the adjusting screw.

- c) Install lock ring and dust cover.

3. Prior to assembly, coat the rubber bushing with glycerine paste and make sure that the rubber bushing is not pinched along the sides between the bracket cap and bracket at time of tightening. It is of advantage to lightly tighten the forward bolt first, and then install the rear bolts. Torque the bolts to 4,7 mkg (34 lb/ft). (see Fig. 54).

5. Adjust height of front end and check wheel alignment on the optical alignment ramp (see Group "R").

4. Install the torsion bar adjusting lever into the reinforcing crossmember as follows:

- a) With the shock strut attached to the transverse control arm, push the control arm down to stop in shock strut (decompression) and insert the torsion bar adjusting lever, with the adjusting screw turned all the way back, into the reinforcing crossmember and onto the splined torsion bar end, leaving as little clearance at the lever adjusting point as possible; coat the lever with graphite grease prior to installation into the support arm.

General:

The rebound damping is adjustable in Koni shockabsorber struts.

Type 912 vehicles are fitted with shockabsorber struts adjusted to the softest setting; Type 911 vehicles have shockabsorber struts set one turn harder (360° to the right).

Should it in the course of time become necessary to readjust the shockabsorber damping action, proceed as follows:

1. Mount the shockabsorber strut in a vise, positioning it vertically with the plunger rod pointing up, and gripping it at the steering lever attaching flange (see Fig. 59).
2. Press plunger rod and shielding tube fully down and turn plunger rod to the left, without forcing, until the adjusting lug engages the mating recess in the bottom valve (see Fig. 59 and 60).



Fig. 59

- a) When adjusting the shockabsorber in the vehicle, first raise front of car and remove both wheels.
- b) Unlock hex nut at top of strut and remove nut while supporting the transverse control arm with a shop jack,

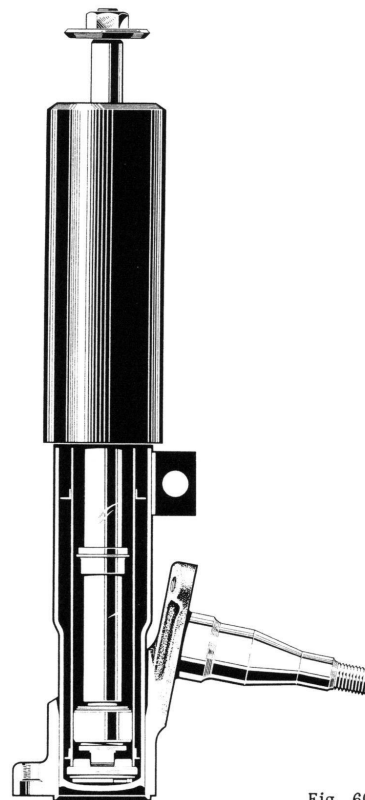


Fig. 60

3. Mark the engagement point of the adjusting lug on the shielding tube and the shockabsorber body.

4. Turn the shielding tube farther to the left to determine if an adjustment has been made (harder setting) and if so, by how much.

5. Starting from the original position, turn the tube one-half or more turns to the right until the desired damping action has been reached (see Fig. 61). Pull plunger rod up again to disengage the adjusting components. Maximum adjustment range is 2 1/4 turns.

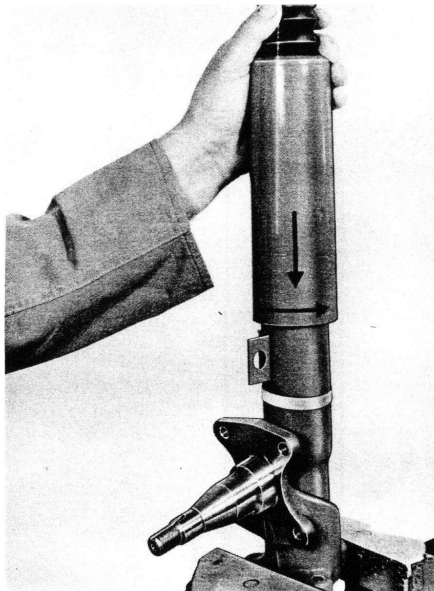


Fig. 61

6. Make certain that the left and right shockabsorber struts are adjusted to an equal degree. The degree of damping action can easily be felt by "pumping" the plunger rod.

7. If work is performed on an installed strut, torque hex nut at top of strut to 8,0 mkp (57,9 lb/ft). Use new safety plate and note that the safety plate tab should be pointing up at time of installation.



Fig. 62

RACK - AND - PINION STEERING

Description:

The steering rack rides in a replaceable bushing installed at each outer end of the housing. A floating pinion carrier, located in the housing, supports the pinion which turns in two ball bearings. The steering pinion presses against the steering rack through a pressure block, spring, and adjusting nut, which results in play-free steering action. A certain amount of torque drag in the steering pinion is obtained through the steering adjusting nut in the housing.

The steering gear assembly requires no maintenance.

The steering is filled with a special, permanent lubricant at time of manufacture.

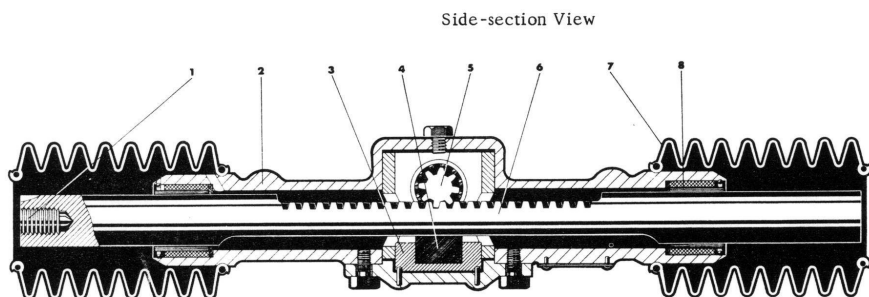


Fig. 63

- | | | | |
|----------------------------|------------------|-------------------|---------------|
| 1 Thread for tie rod joint | 3 Adjusting nut | 5 Steering pinion | 7 Rubber boot |
| 2 Housing | 4 Pressure block | 6 Steering rack | 8 Bushing |

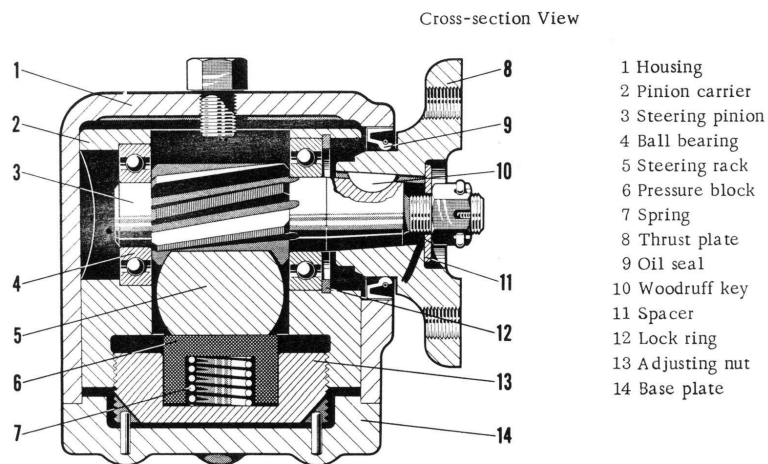


Fig. 64

- | |
|-------------------|
| 1 Housing |
| 2 Pinion carrier |
| 3 Steering pinion |
| 4 Ball bearing |
| 5 Steering rack |
| 6 Pressure block |
| 7 Spring |
| 8 Thrust plate |
| 9 Oil seal |
| 10 Woodruff key |
| 11 Spacer |
| 12 Lock ring |
| 13 Adjusting nut |
| 14 Base plate |

Removal:

1. Remove front compartment carpeting, detach heating duct of auxiliary heater from the steering post and lay duct to the side. Open access door and remove intermediate shaft cover. It is of advantage to pry up one of the two prongs in the spring clip with the help of a small screwdriver ---see illustration,

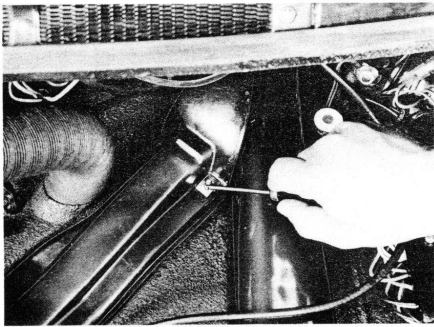


Fig. 65

2. Remove the three heater fuel pump retaining bolts and lay pump to the side.

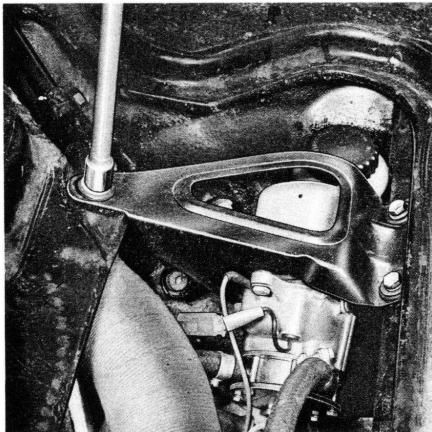


Fig. 66

3. Remove cotter pin from lower hex bolt of the universal joint, loosen castellated nut, and pull universal joint off the steering shaft. Remove Allen bolts from steering shaft bushing cap, remove cap, pull out bushing and dust boot.

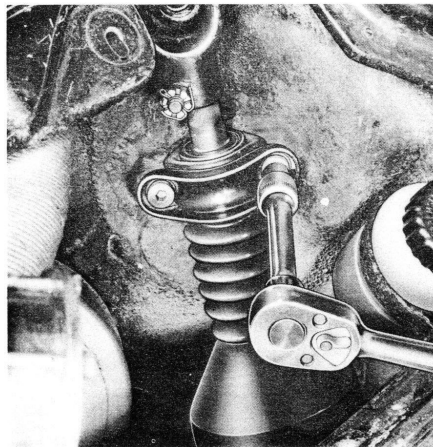


Fig. 67

4. Unlock and remove steering coupling retaining bolts.

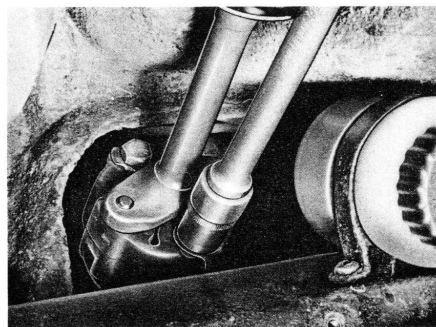


Fig. 68

5. Unscrew undershield retaining bolts and nuts, remove undershield.

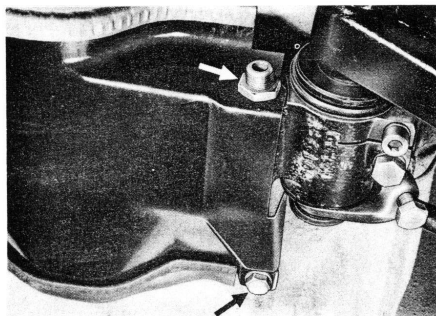


Fig. 69

6. Unlock and remove tie rod ball joint retaining nut, detach ball joint from tie rod with special tool VW 266h or a similar tool.

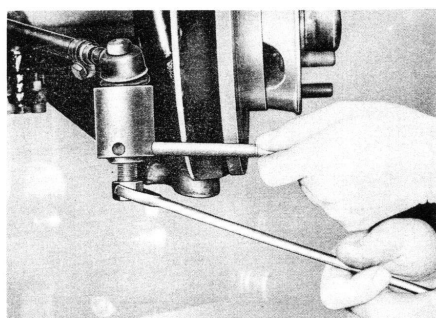


Fig. 70

7. Unscrew steering housing retaining bolts.

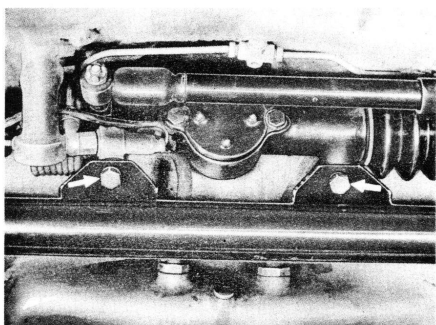


Fig. 71

8. Remove right reinforcing crossmember brace.

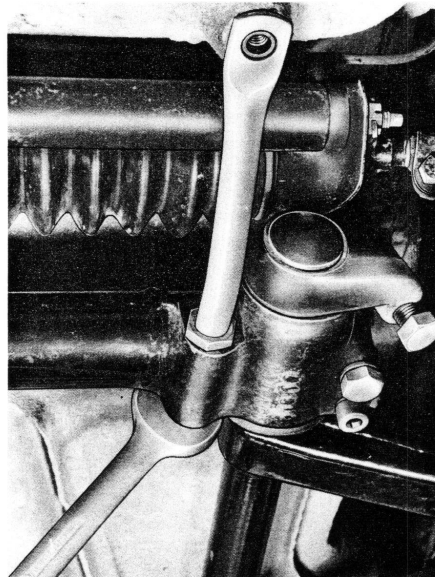


Fig. 72

9. Withdraw, to the right, the entire steering housing assembly.

10. Unlock and remove bolt from tie rod yoke, remove tie rod.

Installation

Note the following points during installation:

1. Check tie rods for damage or deformations.
Check tie rod ball joints for serviceable condition: when moving the ball stud, slight friction must be felt. If the ball stud can be moved freely and axial play is detectable, the ball joint will have to be replaced.
2. Coat the yoke bolt with MoS_2 paste, install, and torque to 4,7 mkp (34 lb/ft).
3. Install crossmember reinforcing brace without binding. Torque hex nuts to 6,5 mkp (47 lb/ft), and hex bolts to 4,7 mkp (34 lb/ft). (see Fig. 69).
4. Using new lockwashers, install and torque steering housing retaining bolts to 4,7 mkp (34 lb/ft). See Fig. 71.
5. Torque tie rod ball joint castellated nuts to 4,5 mkp (32,5 lb/ft), secure with cotter key.
6. Torque Allen bolts for cap of steering bushing to 2,5 mkp (18,1 lb/ft).
7. Install steering coupling retaining bolts, using new safety washers, and torque to 2,5 mkp (18,1 lb/ft). See Fig. 68

REMOVING AND INSTALLING SILENTBLOC EYEBOLTS

11 ST

Special tools: P 285 Steering Gear Adjustment Gauge

Caution:

The Silentbloc eyebolts must be installed in a precise position to ensure free movement of the steering components and exact guiding of the tie rods (see illustration).

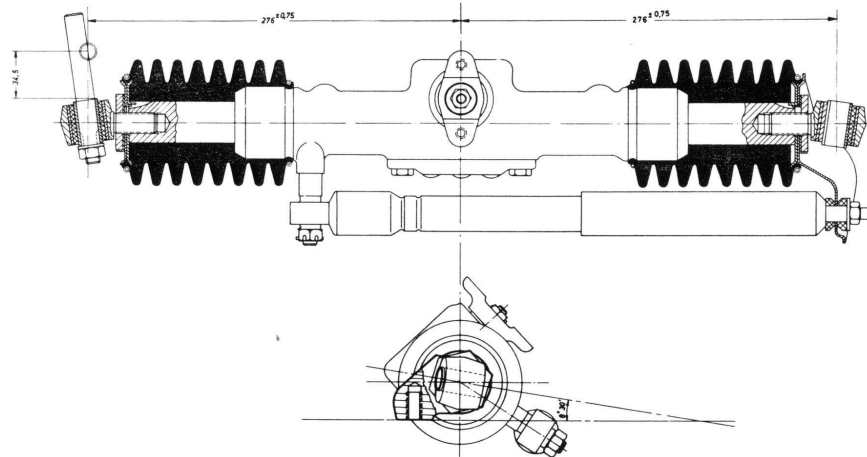


Fig. 73

Removal:

1. Unlock safety washer at the eyebolt lock nut, place steering housing into special tool P 285 or mount in a bench vise (use protective vise jaw inserts), and loosen eyebolt locknut.

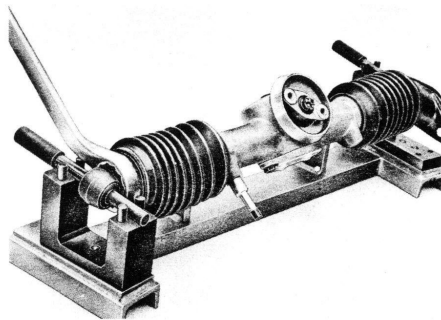


Fig. 74

2. Unscrew eyebolt, remove stop plate and bellows.

Checking parts:

1. Visually check the Silentbloc for wear and replace if necessary.
2. Inspect bellows for cracks or tears, replace if necessary.

Installation:

1. Install both bellows on steering gear housing.
2. Apply a coat of gasket paste (such as Teroson-Atmosit) to the eyebolt threads, steering rack end flanks, and both sides of the stop plate and safety washer, and install eyebolts.
3. Mount the steering housing in special tool P 285, set eyebolts according to tool P 285, and tighten hex nuts with a SW 41 box wrench; torque to approx. 6,5 mkg (47 lb/ft).
4. Secure eyebolt locknut.

Special tools:

P 282 Puller
P 283 Pressure block

P 293 Puller

Disassembly:

1. Mount steering housing in a bench vise (use protective vise jaw covers) and remove base plate retaining bolts.

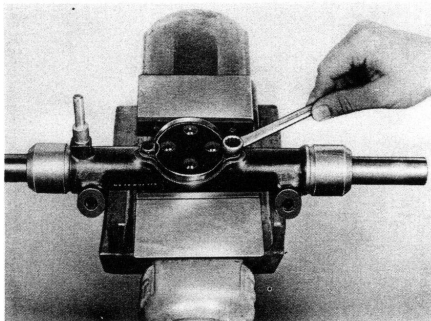


Fig. 75

2. Unscrew adjusting nut; the base plate may be used as a wrench in that the plate is placed on the adjusting nut allowing the pins in the plate to engage the teeth in the nut.

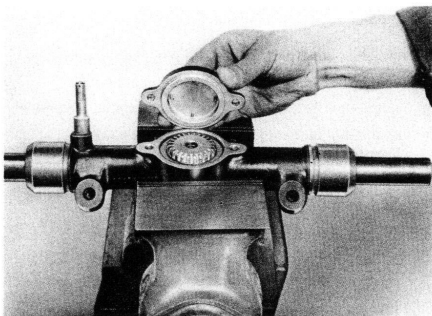


Fig. 76

3. Remove pressure block and spring.

4. Mount steering housing in a vise, remove cotter key and castellated nut; the steering rack may be moved into end-position for this purpose.

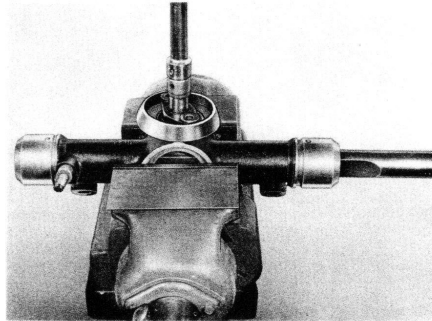


Fig. 77

5. Using puller P 293, remove flange from pinion; exercise care as not damage the pinion threads.

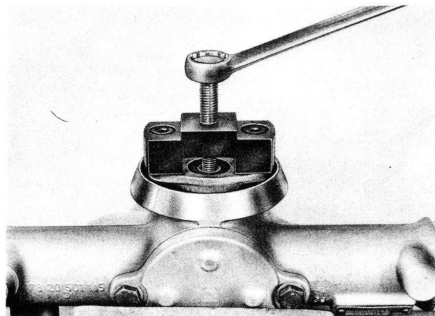


Fig. 78

6. Extract oil seal with the help of a screwdriver.

7. Remove lock ring and spacer.

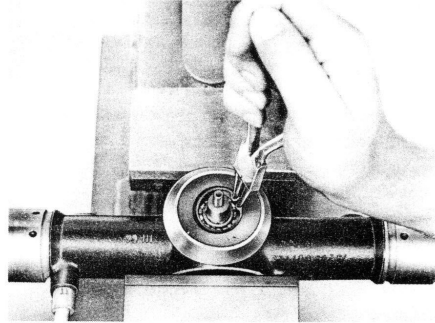


Fig. 79

8. Using puller P 282, remove steering pinion from pinion carrier. Caution! Make sure that the ball bearing does not bind against the steering housing.

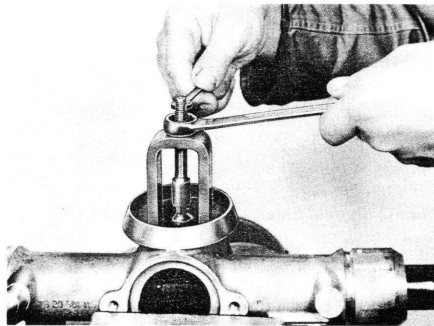


Fig. 80

9. Remove Woodruff key from its seat in the pinion, press ball bearing off pinion.

10. Mark steering rack for reassembly, slide it out of the housing, and withdraw pinion carrier.

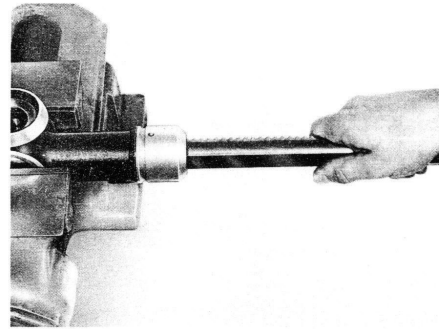


Fig. 81

11. Press ball bearing out of the pinion carrier.

12. Remove rack bushing spring retainer with a punch and a screwdriver (see illustration).

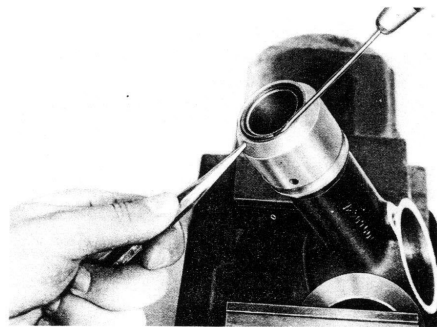


Fig. 82

13. Withdraw supporting ring and drive the rack bushing out by means of the pressure block P 283 and an appropriate pipe.

14. Clean all parts.

Checking parts

1. Check rack and pinion, replace if necessary.
2. Check ball bearings for wear, replace if necessary.
3. Visually check rack bushings for traces of wear and replace if necessary.

Reassembly:

Reassembly is accomplished in reversed order of the above by noting the following points:

1. Insert the wide supporting ring into housing.
Using pressure block P 283, drive the rack bushing into the housing with the recessed flank facing outward. (Lightly coat with grease the outer surface of the bushing).

Place the narrow supporting ring onto the rack bushing and install the spring retainer so that its gap is about 90° in relation to the bore.
2. Coat pinion carrier with multipurpose grease LM-KFZ3 or LM-47L and insert into the steering housing.

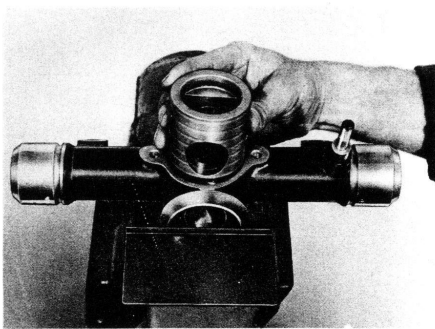


Fig. 83

Note!

During assembly, the steering must be greased with 40 g of multi-purpose grease containing MoS_2 , LM-KFZ3, or LM-47L manufactured by Liqui-Moly GmbH, Ulm/Donau, W-Germany.

3. Coat the rack well with the above mentioned grease and slide it into the housing. (When reinstalling a used rack, note the original position prior to disassembly).
4. Paste the remainder of the 40 g grease into the housing and insert the pinion, with ball bearing and Woodruff key, so that it comes to rest in its seat.
5. Using spacers, adjust axial play of pinion to zero. The following spacer thicknesses are available: 0.1; 0.12; 0.15; and 0.3 mm.
6. Install the shaft sealing ring with the sealing lip facing outwards in the housing. (Shaft sealing ring with part number 901.347.936.02 must be installed with the sealing lip facing inwards.)
7. Install the flange, and make sure that the flat disc spring seats correctly. Coat both sides of the washer with sealing compound, tighten the castellated nut to 2,5 mkp (18 lb/ft) torque, and secure with split pin. (On drive pinions with paper shaft for flange, install the O-ring before the flange, then tighten with self-locking hex nut (M10) to 4,7 mkp = 34 lb/ft.)
8. Install pressure block, spring, and adjusting nut.
9. See paragraph 13 St for adjusting procedure pertaining to the nut and steering gear.
10. Install the paper gasket and the housing cover, and tighten the hexagon bolts to 1,5 mkp (10,8 lb/ft.) torque.

Note:

The special grease filling can also be pressed in after the assembly, i.e., through the hex bolt across from the base plate. Coat hex bolt with gasket compound and install.

Special tools:

P 261 Torquemeter, 0-25 cmkp (0-22 lb/in)

Note:

The steering gear adjusting methods vary according to the type of steering rack pressure block.

Method 1

Method 1 applies to steel pressure blocks with DELRIN (plastic) contact surface. External distinguishing features on the steering housing are: Steering gear with dust boot seat, (see illustration).

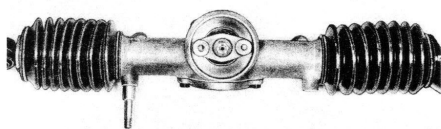


Fig. 84

1. Remove hex retaining bolts from base plate and withdraw plate.

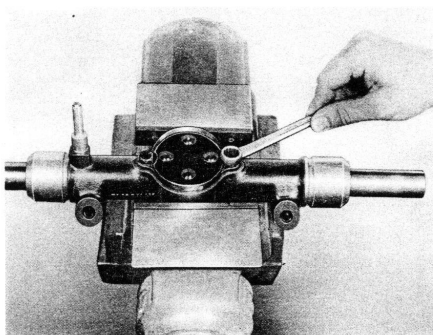


Fig. 85

2. Tighten adjusting nut to seating contact; the base plate may be used as a wrench in that the plate is placed on the adjusting nut allowing the pins in the plate to engage the teeth in the nut.

3. Back the nut off by three teeth.

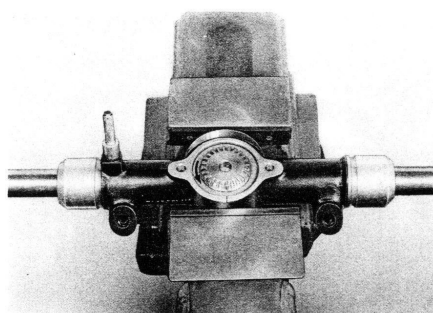


Fig. 86

4. Check steering gear drag at pinion flange using torquemeter P 261 over the entire working length of the steering rack. If the measured values are beyond 8 cmkp, loosen the adjusting nut until a drag of 8 cmkp is obtained.

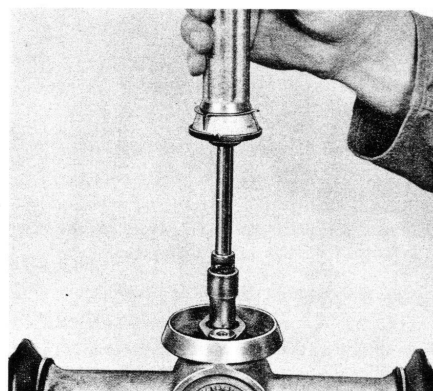


Fig. 87

It is possible that after backing the nut off by three teeth a drag of not less than 4 cmkp will be noted; in such cases the adjusting nut should not be retightened.

The maximum steering adjustment is:

- a. Adjustment nut backed off by three teeth from its point of contact,
- b. A maximum drag of 8 cmkp in evidence at the pinion flange with tie rods and steering damper disconnected,
- c. A maximum drag of 10 cmkp in evidence at the steering shaft or steering wheel retaining nut, with tie rods and steering damper disconnected.

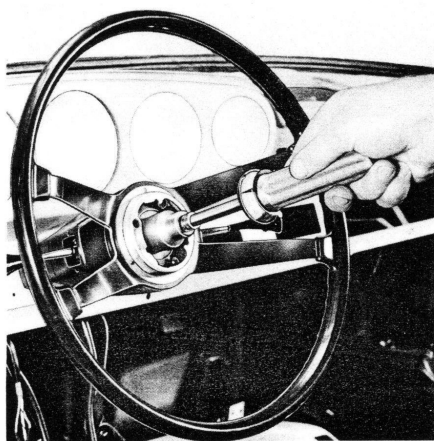


Fig. 88

5. Install base plate and paper gasket, torque hex bolts to 1.5 mkp (10.9 lb/ft)

Note!

When installing the base plate, the four pins in the plate must easily fit into teeth of the adjusting nut; if necessary move the nut a little,

Method 2

Method 2 applies to DELRIN (plastic) pressure blocks. External distinguishing features on the steering housing are: Steering gear without dust boot seat, see illustration.

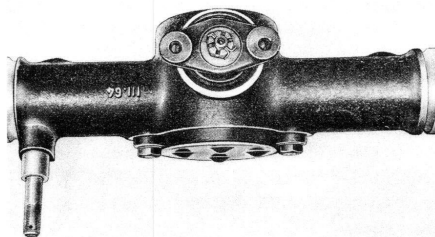


Fig. 89

1. Remove hex retaining bolts from base plate and withdraw plate.
2. Tighten adjusting nut so that a drag of maximum 8 cmkp is obtained over the entire working length of the steering rack, measured with the torquemeter P 261 at the pinion flange.

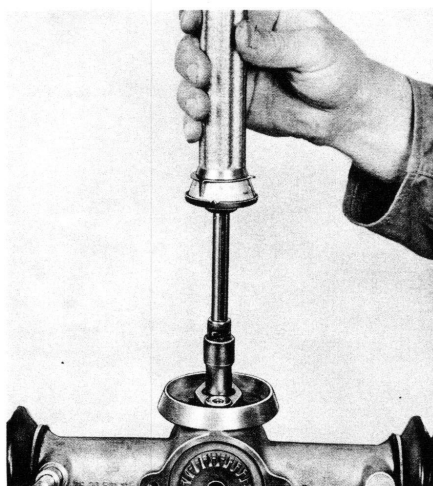


Fig. 90

Adjustment values:

- a. A maximum drag of 8 cmkp in evidence at the pinion flange with tie rods and steering damper disconnected.
- b. A maximum drag of 10 cmkp in evidence at the steering shaft or steering wheel retaining nut, with tie rods and steering damper disconnected.

- 3. Install base plate and paper gasket, torque hex bolts to 1,5 mkp (10,9 lb/ft).

Note :

When installing the base plate, the four pins in the plate must easily fit into teeth of the adjusting nut; if necessary, move the nut a little.

Removal

1. Disconnect battery.
2. Turn horn button to left and withdraw.

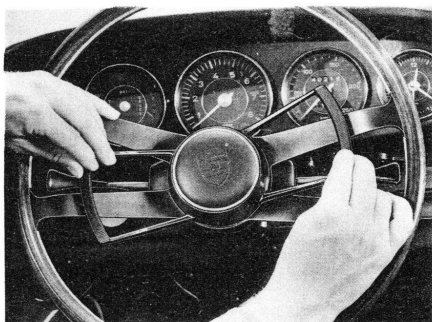


Fig. 91

3. Pull out contact pin.
4. Unscrew steering wheel retaining nut.

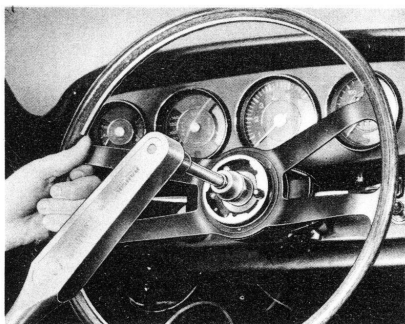


Fig. 92

5. Mark relative position of steering wheel and steering upper shaft and withdraw steering wheel (watch for the bearing support ring and spring).

Installation

Note the following points during reassembly:

1. Place spring and support ring onto steering wheel hub.

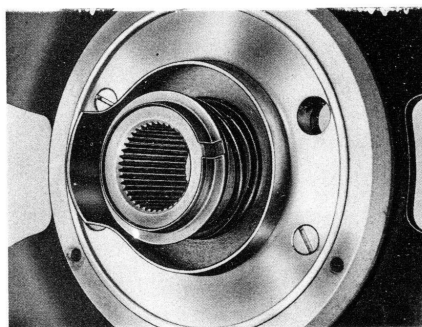


Fig. 93

2. Install steering wheel, with road wheels in straight ahead position, so that the return striker points to the left towards the blinker switch, and the steering wheel spokes are in horizontal position; or place wheel according to markings made at time of disassembly.
3. Torque steering wheel retaining nut to 8,0 mkp (57,9 lb/ft); insert spring washer under nut.
4. Check blinker return striker for proper functioning.
5. Lightly lubricate horn contact ring.
6. Insert contact pin, position horn button and depress, turn right to lock.

REMOVING AND INSTALLING SWITCH ASSEMBLY WITH STEERING SHAFTS

Special tools:

15 ST

P 281 Lightswitch wrench

Removal

1. Disconnect battery.
2. Remove front compartment carpeting and open access door.
3. Detach auxiliary heater duct from the steering post and bend duct to the side.

5. Remove heater pump retaining bolts and lay pump to the side.

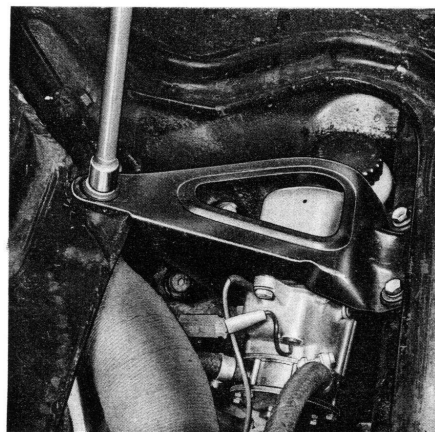


Fig. 95

4. Remove intermediate shaft cover. (It is of advantage to pry up one of the two prongs in the spring clip using a small screwdriver); (see illustration).

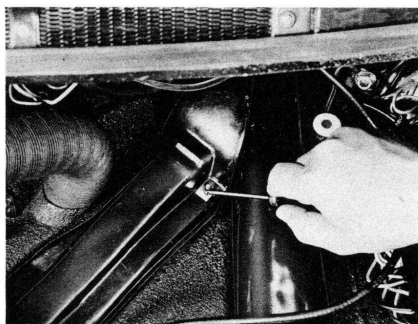


Fig. 94

6. Remove cotter key from the lower clamping bolt in each of the two universal joints and loosen the retaining nuts.

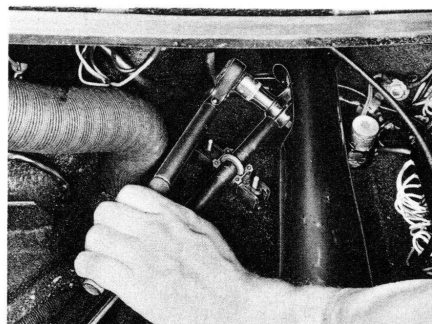


Fig. 96

7. Remove retaining Allen bolts from bushing cap in steering lower shaft and remove cap.



Fig. 97

8. Pull universal joint off the steering lower shaft, drive steering intermediate shaft out of the upper universal joint, and remove the intermediate shaft together with the lower universal joint.

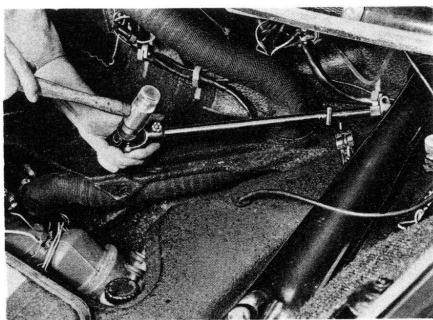


Fig. 98

9. Remove steering wheel (see 14 St).

S 40

NOTE:

Points 10 and 11 apply only when the car is equipped with a steering lock.

10. Remove steering lock cover, drill shearing bolts out, and remove steering lock with safetying spacer (do not disconnect electrical cables).

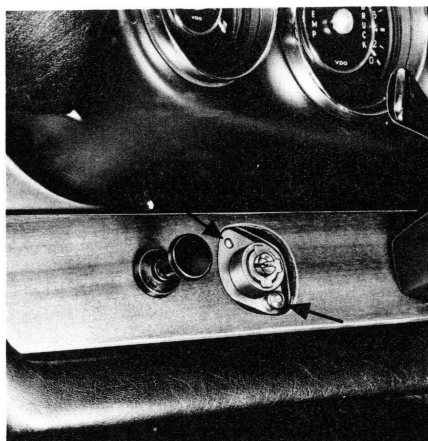


Fig. 99

11. Using special tool P 281, remove light switch and let hang on wires.

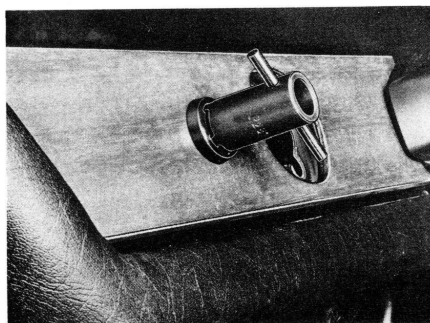


Fig. 100

12. Loosen Allen bolt in switch assembly retaining clamp.

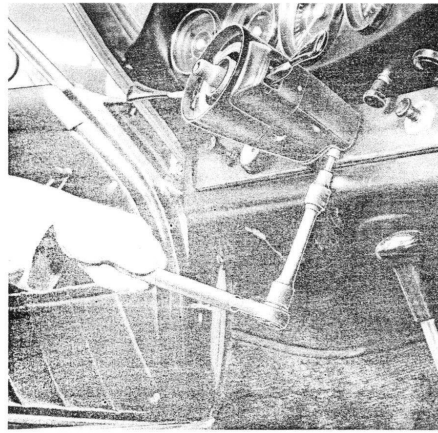


Fig. 101

13. Turn clamp joint down and pull out locking pin with pliers.

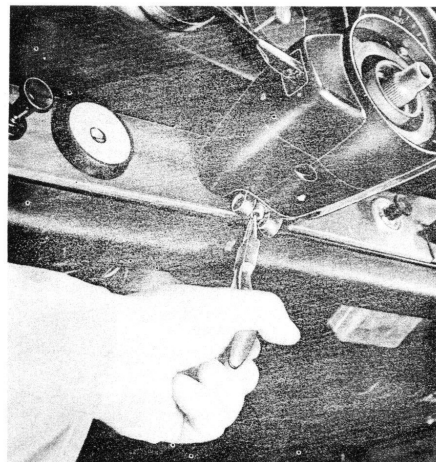


Fig. 102

14. Disconnect cables leading to the switch assembly by detaching plug-in connectors. Mark cables for reassembly.

15. Withdraw switch assembly with steering upper shaft and universal joint, at the same time guide electrical cables through space at the instrument panel.

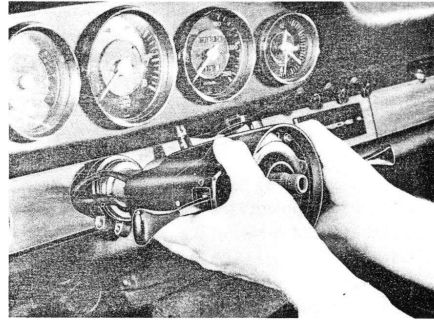


Fig. 103

16. Unlock and remove steering post attaching bolts.

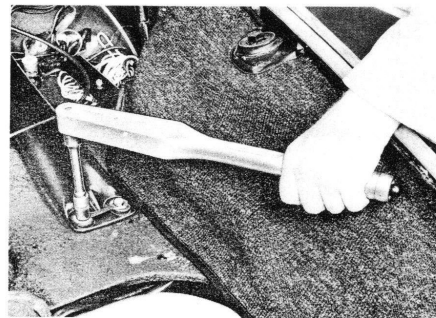


Fig. 104

17. Squirt glycerine or similar lubricant between the grommet and steering post, loosen post by twisting, remove.

Checking parts:

Universal joints: The universal joints should be snug. If play is in evidence, replace joints.

Installation

Note the following points during installation:

1. Treat large grommet (for steering post) and joining end of post with assembly paste (Conti-Fix or similar), push post into place, lightly tighten hex bolts, with washers and safety plate installed.
2. Prior to assembling the switch assembly, place retaining clamp onto the steering post end so that the threaded part of the clamp (threaded seat for clamping screw) comes to rest on right side permitting installation of the Allen bolt from the bottom.
3. Coat sealing ring, on the steering post extension, with assembly paste (Conti-Fix or similar), push switch assembly into the steering post while at the same time guiding the electrical cables through the right and left sides of the instrument panel. Place steering lock into place, insert protective plate, and slightly tighten the shearing bolts.
4. Install locking pin.
5. Turn clamp to the right, over the locking pin, torque clamping Allen bolt (use spring washer) to 2, 5 mkp (18,1 lb/ft). See Fig. 101.
6. There should be a clearance of approx 2 mm between the switch assembly and the instrument panel; if necessary, move the steering post.
7. Torque steering post retaining bolts to 2, 5 mkp (18,1 lb/ft) and secure (see Fig. 104).
8. Uniformly tighten the steering lock shearing bolts until the heads break off.
9. Use new universal joint hex bolts, place "Schnorr" profiled lockwashers (Spare part 999, 523, 102, 01) under the castellated nuts, torque to 3, 5 mkp (25,3 lb/ft) and secure with cotter keys.
10. Place spring washers onto Allen bolts which retain bushing cap of steering lower shaft, torque to 2, 5 mkp (18,1 lb/ft). See Fig. 97.

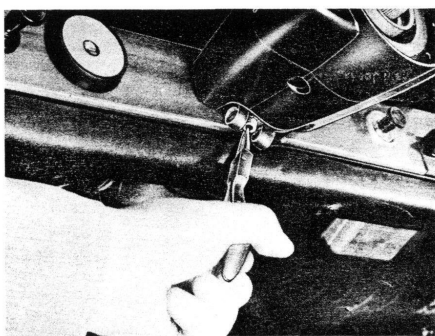


Fig. 105

1. Unlock and remove universal joint hex bolt and pull the universal joint off.



Fig. 106

3. Remove Allen retaining bolts which secure the steering post extension and drive the post extension out of the switch assembly.



Fig. 108

2. Remove ring seal retainer with a scriber or similar tool, remove ring seal washer, seal, and second seal retainer.

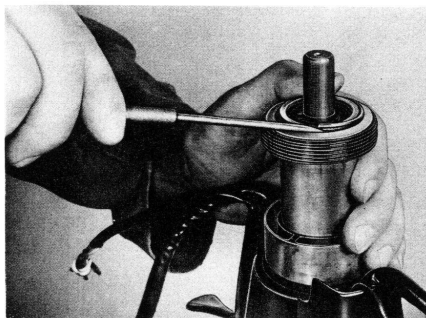


Fig. 107

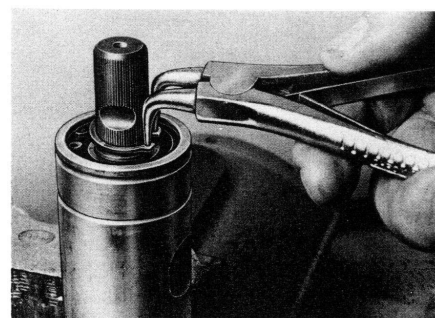


Fig. 109

4. Remove bearing lock ring from upper shaft and drive shaft out of the bearing.

5. Pry bearing retainer out of the post extension,



Fig. 110

6. Drive ball bearing out of the post extension using an appropriate punch.
7. Mount post extension in a vise (use vise jaw covers) and drive spindle bearing out with a dull driver, alternating the impact points.

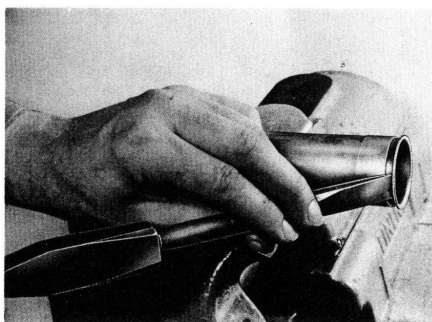


Fig. 111

Checking

Check spindle bearing and ball bearing, replace if necessary. Check universal joints; the universal joints should fit snugly; if play is in evidence, replace joints.

Installation:

Note the following points during installation:

1. Pack ball bearing with multipurpose Lithium grease and install in the post extension so that the bearing shield points out.
2. Push post extension into the switch assembly and align it so that the rectangular steering lock opening in the post extension is in center; see illustration.

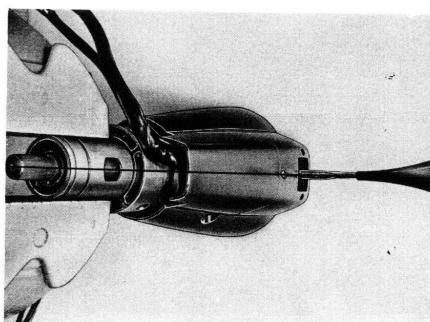


Fig. 112

3. Align post extension along the axis to value A;
value A = 7 mm.

4. Torque post extension Allen bolts to 2,5 mkp
(18,1 lb/ft). See Fig. 108.

5. Use new universal joint hex bolt, place
"Schnorr; profiled lockwasher (Spare Part
999, 523, 102, 01) under the castellated nut,
torque to 3,5 mkp (25,3 lb/ft) and secure
with cotter key.

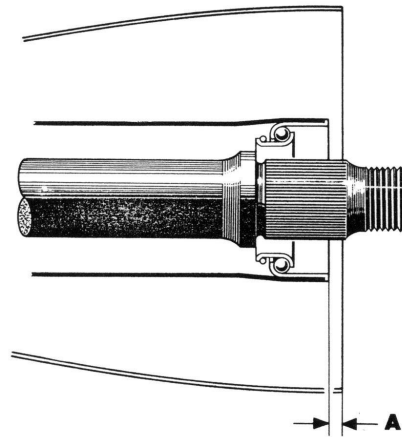


Fig. 113

1. Unlock and remove universal joint off intermediate shaft.
2. Pull the universal joint off intermediate shaft.
2. Drive the universal joint onto one end of the intermediate shaft so that the dowel pin enters the notch in the universal joint.

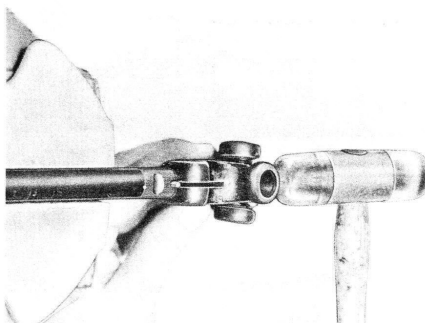


Fig. 114

Checking

1. The universal joint should fit snugly. If play is in evidence, replace joint.
2. Inspect intermediate shaft for damage and replace if necessary.
3. Use a new universal joint hex bolt, place "Schnorr" profiled lockwasher (Spare Part 999, 523, 102, 01) under the castellated nut, torque to 3,5 mkgp (25,3 lb/ft) and secure with cotter key.

Reassembly

1. Drive grooved dowel pins, with the grooves towards the bore into the intermediate shaft (install ring seal first).

INSTALLING STEERING COUPLING

18 ST

When installing the steering coupling it should be ascertained that the large orifices in the coupling flanks (see illustration) always contact the flanges; that is, the flange of the pinion or the flange of the lower shaft. In no case should the safety plates and bolt heads come to rest against the large orifices since the plates and bolt heads could chaff and damage the steering coupling.

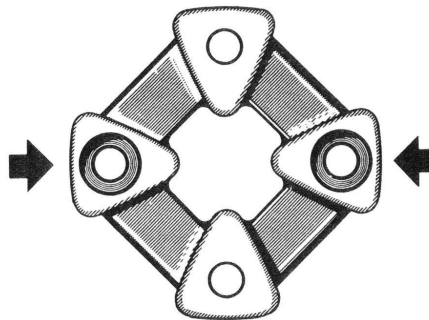


Fig. 115

UNIVERSAL JOINT WITH INTERNAL SPLINES

19 ST

Beginning with Chassis 305 101, 354 001, and 458 101, internally splined universal joints have been introduced. The steering upper shaft, intermediate shaft, and lower shaft have been provided with splines which mate with those in the universal joints.

The splined universal joints and shafts are not interchangeable with joints and shafts without splines or knurling.

When installing internally splined universal joints, it is necessary to install splined upper, intermediate, and lower shafts.

When installing the universal joints note the following:

1. Push the splined universal joints onto the shafts so that the hex bolts enter easily.
2. Torque hex bolts to 2, 5 mkp (18,1 lb/ft).

SUPPLEMENTS

GROUP **S**

STEERING GEAR AND FRONT AXLE

CONTENTS

Supplements to Group S: Front axle and steering

Front axle modifications, 68 Model	SS 1
Schematic of transverse control arm with reinforcing crossmember, 68 Model	SS 2
Alterations to front axle from 69 Model on	SS 11
Description of self-leveling hydropneumatic suspension strut	SS 15
Cross-section of self-leveling hydropneumatic suspension strut	SS 19
Function schematic of self-leveling hydropneumatic suspension strut	SS 21
Cross-section of steering and control switch components	SS 39
Rack and pinion steering from 69 Model on	SS 41
Modified ZF rack and pinion steering	SS 45
Repair operations:	
Removing and installing transverse control arm	SS 3
Removing and installing torsion bar	SS 6
Removing and installing reinforcing crossmember	SS 8
Checking self-leveling hydropneumatic suspension struts	SS 23
Remove and re-install suspension strut or shock absorber strut	SS 25
Remove and re-install wishbone (from 69 Model on)	SS 30
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Remove and install track rod tube	SS 35
Remove and re-install joint bushes on rack and pinion (from 69 Model on)	SS 41
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Shockabsorber strut replacement kit	SS 51

1968 MODEL FRONT AXLE MODIFICATIONS

General

The following changes have been made in front axles of all Type 912 and 911 vehicles effective with the 1968 models:

1. Front track widened by 14 mm to 1367 mm (53.82") through modified front wheel hubs. (New grease caps without expansion slots have to be used in the new wheel hubs to prevent loss of grease.)

2. Redesigned reinforcing support member.

3. Redesigned transverse control arms with integral rubber mounts.

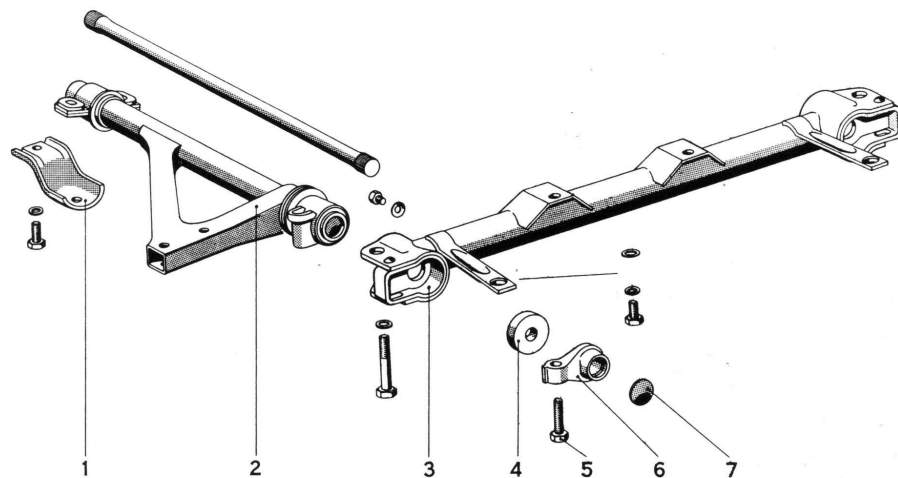
4. Front axle stabilizers:

Type 911 L (except USA) = 11 mm dia (.433")
Type 911 L-USA and 911 S = 15 mm dia (.591")

(Make sure during installation that rubber mounts of a size matching the stabilizer diameter are used.)

5. Other front axle modifications are shown in Fig. 1.

Work procedures which differ from those previously published are outlined herein.



- 1 Cover bracket
- 2 Transverse control arm (left)
- 3 Reinforcing crossmember
- 4 OWA-seal

- 5 Adjusting screw
- 6 Adjusting lever
- 7 End cap

Fig. 1

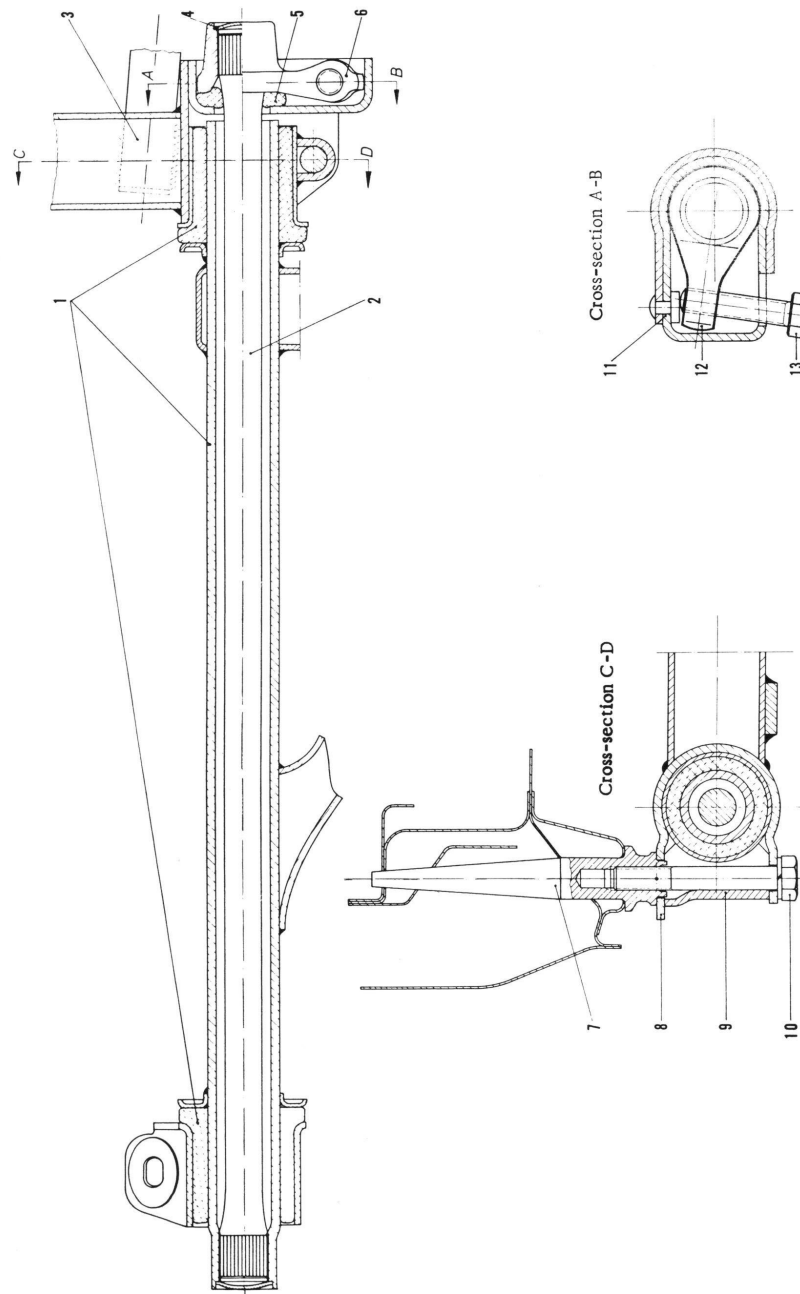


Fig. 2

- | | | | |
|---------------------------------------|-------------------|---|-------------------------------|
| 1 Left transverse control arm, compl. | 4 End cap | 7 Mounting point for support member, welded to body | 10 Hex bolt |
| 2 Torsion bar | 5 OWA-seal | 8 Reinforcing support member | 11 Reinforcing support member |
| 3 Reinforcing support member | 6 Adjusting lever | 9 Transverse control arm | 12 Adjusting lever |
| | | | 13 Adjusting screw |

REMOVING AND INSTALLING TRANSVERSE CONTROL ARM

Special Tools:

P 288 Transverse control arm testing fixture

Removal

1. Unscrew torsion bar adjusting screw.

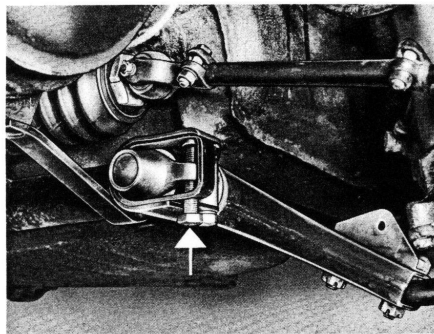


Fig. 3

2. Unlock and remove castellated nuts from transverse control arm, take bolts out, and slide the shockabsorber strut and ball joint assembly out of the control arm.

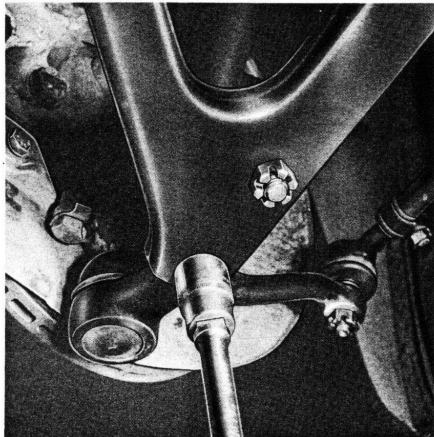


Fig. 4

3. Pull adjusting lever off torsion bar and remove OWA-seal.

4. Remove transverse control arm and reinforcing support member hex bolt.

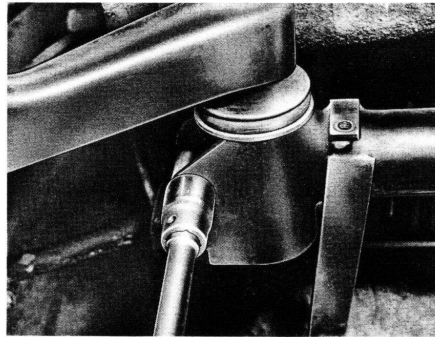


Fig. 5

5. Remove retaining bolts from control arm rubber mount cover bracket and remove bracket.

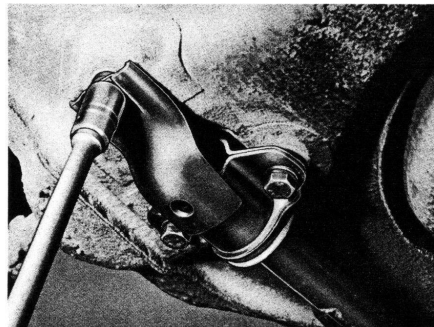


Fig. 6

6. Press the transverse control arm and torsion bar out of the reinforcing support member and remove.

Note: If both transverse control arms are to be removed, first remove one arm and lightly fasten the loose end of the reinforcing support member with the hex bolt to keep the member in place.

2. Visually check rubber mount in control arm for damage. Damaged rubber mounts require replacement of the entire control arm.

3. Check torsion bar for damaged splines or chipped lacquer finish, especially for traces of rust, replacing the bar if necessary.

Inspecting Parts

1. Check transverse control arm with the P 288 testing fixture.

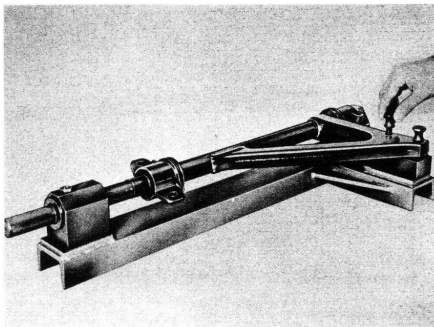


Fig. 7

- a. Using an appropriate punch, drive the spline-covering end cap out of the transverse control arm.
- b. Using a new transverse control arm, align adapter and tighten it.
- c. Place control arm in special tool P 288. If both reference pins cannot be fully inserted, or if the control arm ends do not fit into the reference journals of the special tool, the transverse control arm will have to be replaced.
- d. Insert end cap in transverse control arm, with the bulging part facing out, and drive into position with a suitable punch.

Installation

Note the following points during installation:

1. Lightly coat the torsion bar with Lithium grease, coating the splines especially well, and insert the bar into the transverse control arm. (Make sure that end cap is not knocked out of the control arm.)

Note: The torsion bars are pre-stressed in manufacture. Care must be taken that the right and left bars are not switched inadvertently. For this reason, each torsion bar has an identifying letter stamped into the flank, i.e., "L" for left and "R" for right (see illustration).

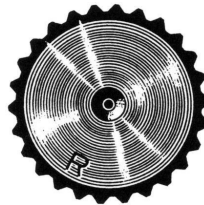


Fig. 8

2. Insert transverse control arm and torsion bar assembly into the reinforcing support member and torque hex bolts at front rubber mount to 4.7 mkp (34 lb-ft). Torque support arm and crossmember retaining hex bolt to 9.0 mkp (65 lb-ft).

3. Slide ball joint attaching end into the transverse control arm and torque castellated nuts of hex bolts to 7, 5 mkp (54 lb-ft). Secure nuts with cotter pins.

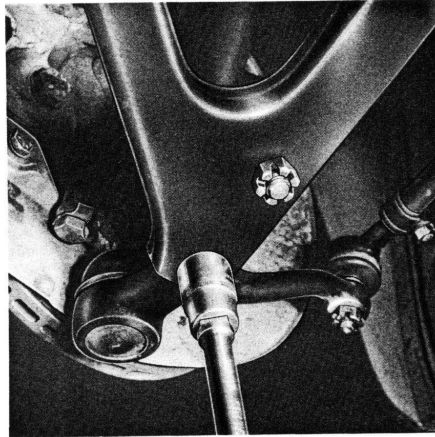


Fig. 9

4. Slide the OWA-seal onto the torsion bar from the open pocket side of the reinforcing support member.

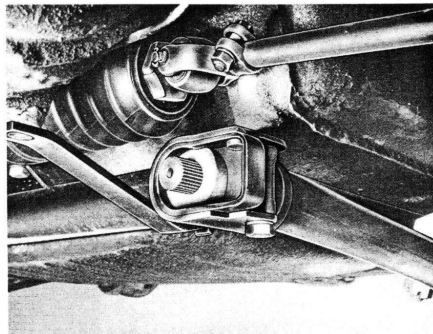


Fig. 10

5. Slide the adjusting lever onto the torsion bar as follows:
 - a. Using a tire tool or similar lever, push the transverse control arm down as far as the attached shockabsorber strut will allow, then

slide the torsion bar adjusting lever onto the torsion bar splines, leaving as little clearance at the lever adjusting point as possible. (The end cap must already be installed in the adjusting lever.)

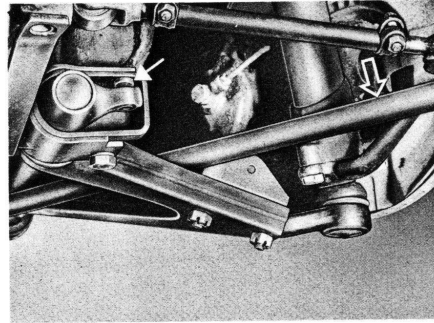


Fig. 11

- b. Coat threads of adjusting screw with MoS₂ grease and lightly tighten the screw in place.

6. Check end cap for proper seating in control arm, install rubber mount cover bracket, torque bolts to 4, 7 mkp (34 lb-ft).

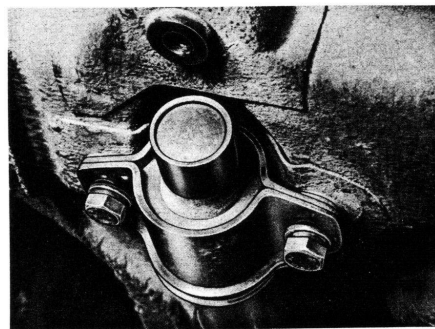


Fig. 12

7. Adjust front-end height and check wheel alignment on optical alignment ramp. (See Group W).

REMOVING AND INSTALLING TORSION BAR

Removal

1. Remove torsion bar adjusting screw.

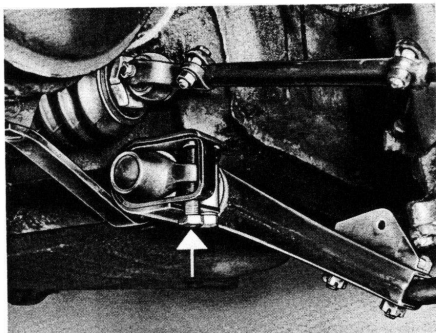


Fig. 13

2. Pull adjusting lever off torsion bar and withdraw OWA-seal.

3. Remove hex bolts from forward rubber mount cover bracket and remove bracket.

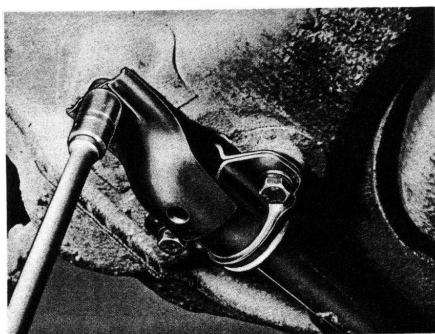


Fig. 14

4. Using an appropriate punch, drive torsion bar forward out of the transverse control arm.
Caution: Do not damage torsion bar splines!

Inspecting Parts

Check torsion bar for damaged splines or chipped lacquer finish, especially for traces of rust, replacing the torsion bar if necessary.

Installation

Note the following points during installation:

1. Lightly coat the torsion bar with Lithium grease, coating the splines especially well, and insert the bar into the transverse control arm from the front.

Note: The torsion bars are prestressed in manufacture. Care must be taken that the right and left bars are not switched inadvertently. For this reason, each torsion bar has an identifying letter stamped into the flank, i.e., "L" for left and "R" for right (see illustration).

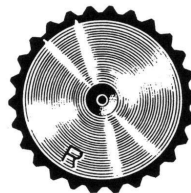


Fig. 15

2. Insert end cap into the transverse control arm, with the bulging side facing out, and drive into place with an appropriate punch.
3. Torque hex bolts at forward transverse arm rubber mount bracket to 4, 7 mkg (34 lb-ft).

4. Slide the OWA-seal onto the torsion bar from the open pocket side of the reinforcing support member.

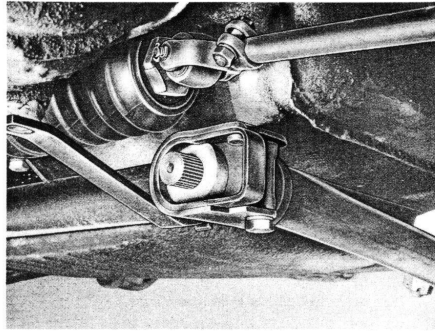


Fig. 16

5. Slide the adjusting lever onto the torsion bar as follows:

- a. Using a tire tool or similar lever, push the transverse control arm down as far as the attached shockabsorber strut will allow, then slide the torsion bar adjusting lever onto the torsion bar splines, leaving as little clearance at the lever adjusting point as possible. (The end cap must already be installed in the adjusting lever.)

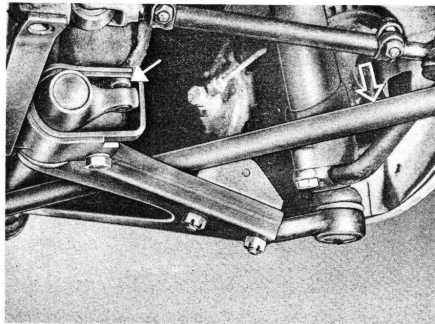


Fig. 17

- b. Coat threads of adjusting screw with MoS₂ grease and lightly tighten the screw in place.

6. Check end cap for proper seating in control arm, install rubber mount cover bracket, torque bolts to 4.7 mkp (34 lb-ft).

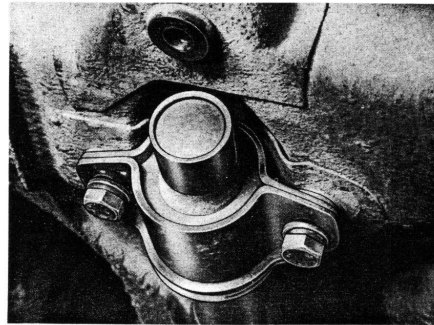


Fig. 18

7. Adjust front-end height and check wheel alignment on optical alignment ramp (see Group W).

REMOVING AND INSTALLING REINFORCING CROSSMEMBER

Removal

1. Remove transverse control arm (see page SS 3).
2. Detach front axle undershield.

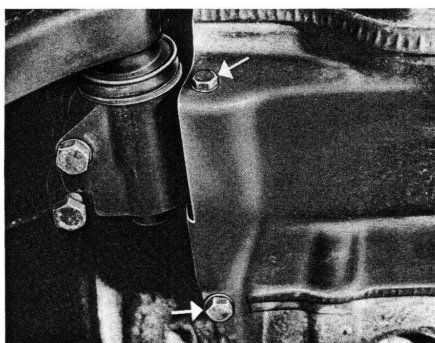


Fig. 19

3. Remove steering box attaching bolts from the reinforcing crossmember.

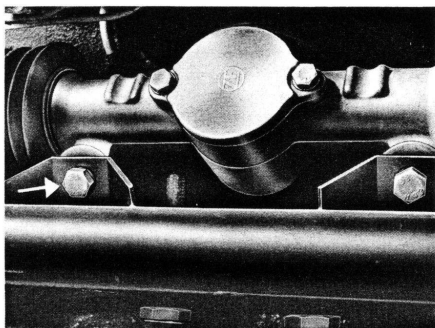


Fig. 20

4. Remove reinforcing crossmember attaching bolts and withdraw crossmember.
-

Inspecting Crossmember

1. Place the reinforcing crossmember onto a flat surface, such as a straightening plate, and check for deformation. See Figure 21 for test dimensions.
The crossmember must be replaced whenever deformations or excessive deviations from specified values are noted.

2. Inspect the crossmember for cracks or visible damage and replace if necessary.
-

Installation

Note the following points during installation:

1. Make sure that the crossmember is seating properly in the aligning studs in the body.
 2. Torque steering box attaching hex bolts to 4,7 mkp (34 lb-ft), use new spring washers.
 3. Install transverse control arm (see page SS 4).
-

REINFORCING CROSSMEMBER ALIGNMENT TEST DIMENSIONS

converging angle of 4 axes max. 20°

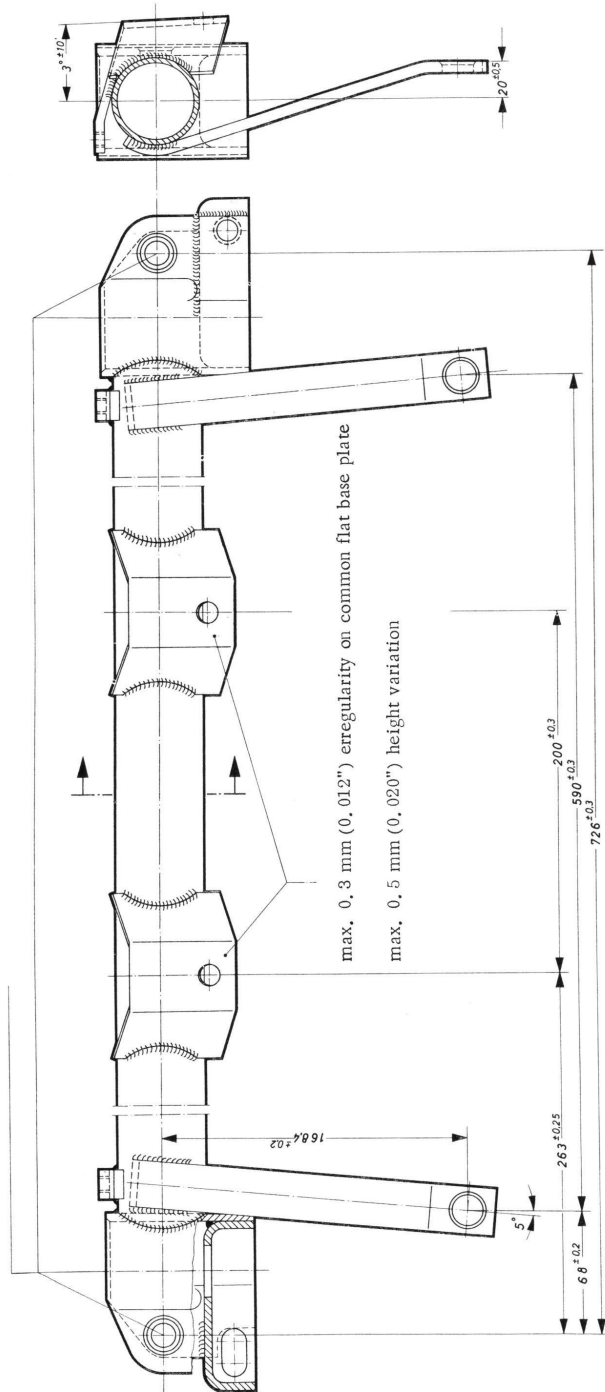


Fig. 21

1. Self-leveling hydropneumatic suspension strut for model 911 E (option on 911 T and 911 S)

These suspension struts support the weight of the car and act as shock absorbers. The torsion bars with adjusting devices are no longer fitted.

The knuckle joint and steering arm is welded to the lower end of the suspension strut.

For a description of the self-leveling hydropneumatic suspension strut in operation see page SS 15.

To check operation of the self-leveling hydropneumatic suspension struts, see page SS 23.

Warning:

When the car is lowered on to its wheels, note ground clearance. Important when driving over car hoists or similar equipment.

If the car is equipped with self-leveling hydropneumatic suspension struts, pressure is equalised in the struts by means of the control apertures as soon as the strut is extended or the weight of the car lifted from the wheels. When the car is next lowered, the suspension strut will support only the designed basic load, and the car will therefore fall below its nominal static load position.

The height adjustment devices previously fitted to the front axle are not used.

For wheel alignment procedure on cars using self-leveling hydropneumatic suspension struts see page SW 3.

2. Shock absorber struts (new version) with welded-on knuckle joint and steering arm

3. New wishbone with rubber bushes and new type of ball joint in position

4. Modified rack and pinion steering (see page SF 41)

5. Anti-sway bars on front axle

Standard equipment on model 911 S = 15 mm diameter (does not apply to cars with self-leveling hydropneumatic suspension struts).

6. Front track width

5 1/2 J x 15 wheels (steel disc) = 1362 mm (53,622")

6 J x 15 wheels (light alloy) = 1374 mm (54,095")

5 1/2 J x 14 wheels (light alloy) = 1364 mm (53,701")

7. Wheel alignment data unchanged

We now describe the corresponding assembly procedures:

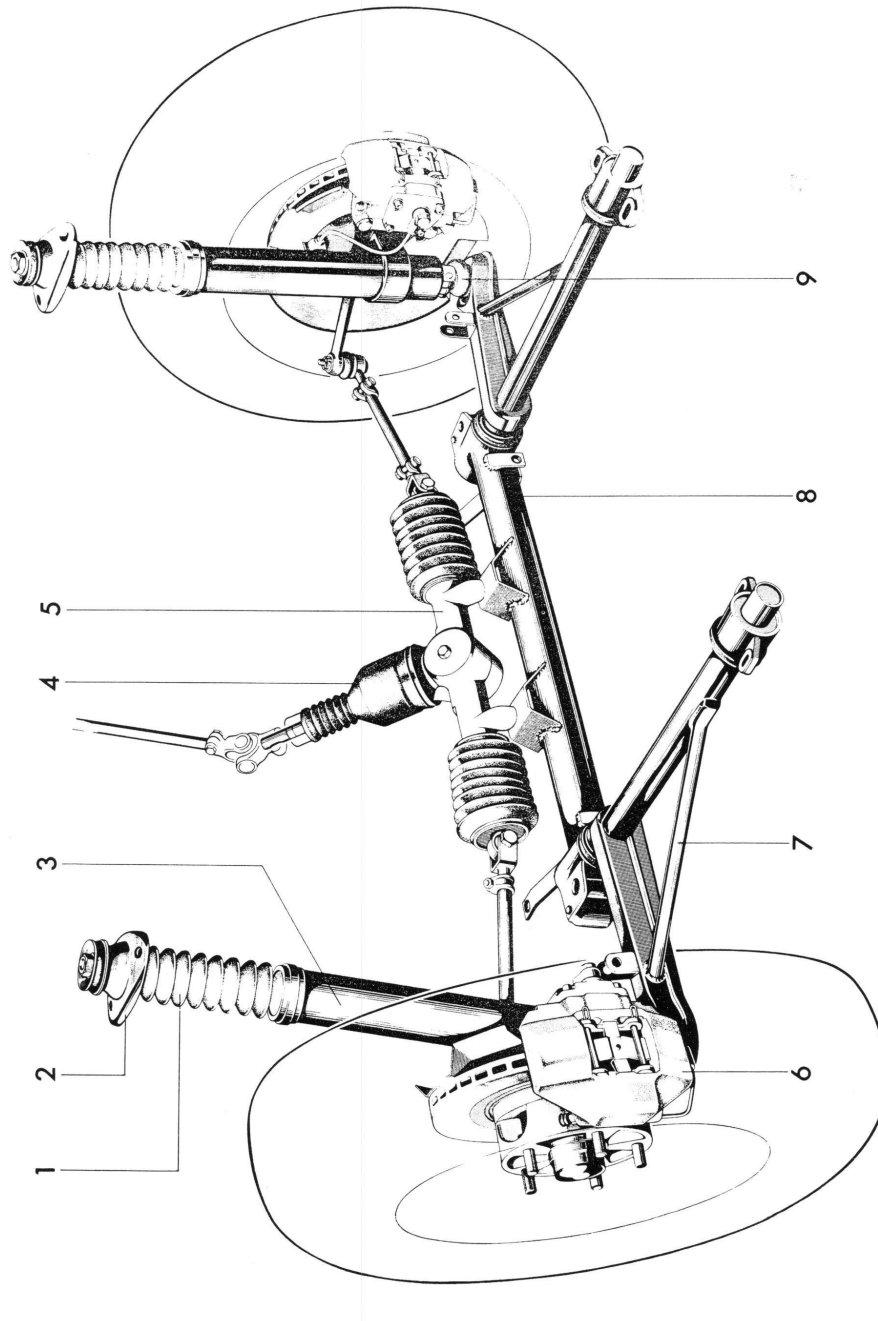


Fig. 1

- | | |
|---|---------------------------|
| 1 Vukollan-spring | 7 Transverse guiding link |
| 2 Step bearing with rubber bearing | 8 Auxiliary support |
| 3 Self-leveling hydropneumatic suspension strut | 9 Ball joint |
| 4 Rubber sleeve | |
| 5 Steering gear | |
| 6 Brake calliper | |

DESCRIPTION OF THE SELF-LEVELING HYDROPNEUMATIC SUSPENSION STRUT

General

Beginning with the '69 models, self-leveling hydropneumatic suspension struts are being introduced for Type 911 E cars as standard equipment, and are optional in Types 911 T and 911 S.

Particular emphasis was placed in the 911 E on attaining the highest possible degree of comfort. In normal designs, riding comfort was closely related to soft suspensions with deep spring deflection from the empty to fully laden condition. Another disadvantage in such systems is the diminished ground clearance and misalignment of headlamp adjustment under load.

One of the various alternatives to the above is to reduce static spring deflection through the application of pneumatic or hydropneumatic suspension components. As a result of considerable progress made in the development of hydropneumatic suspensions of the self-contained and self-leveling type, there has become available a hydropneumatic suspension strut of outer configurations closely resembling a heavy-duty telescopic shockabsorber.

Function and Design

When passengers or baggage add to the weight of the car, the hydropneumatic front suspension struts will initially deflect, lowering the car's standing height to an extent directly proportional to the load differential. As soon as the car begins to move, wheel oscillations caused by road bumps result in a pumping action in the strut, raising the car's height to a predetermined level.

The struts will bring the car to normal level after covering a distance of anywhere between 300 and 1500 yards, depending on the road irregularities encountered. On rougher roads with vigorous wheel oscillations, normal height might be attained already after approx. 10 mm of travel. The adjusted car height will remain constant when stopping in traffic. In fact, the level will remain constant overnight providing that the load is not increased after the car has been parked. Upon removal of any load from the car, the suspension will first rebound, as in conventional systems, but will quickly proceed to adjust itself to the former height where it then will remain.

Should the axle load be increased to beyond the permissible maximum, the pumping effect will automatically be relieved and height compensation stopped to prevent any overstressing of the system. Consequently, an overload condition can be readily spotted due to the reduced ground clearance, similar to cars with conventional suspensions.

The strut performs its functions with oil and gas. It has an oil-filled cylinder with a damping piston on a hollow rod. Surrounding the damping cylinder is a hydraulic accumulator filled with oil and gas, and divided into a high and low pressure chamber. Gas in the high pressure chamber is isolated from the oil by means of a diaphragm. In the low pressure chamber the gas and oil are not separated. A constant pressure, created by the gas charge, prevails in the strut and equals approx. 90 % of the empty car weight, being the force exerted by the gas in both chambers upon the piston rod area.

Anchored to the top of the damping cylinder is a pump rod which projects into the hollow piston rod forming a hydraulic pump.

Strut oscillations caused by road bumps move the hollow piston rod against the stationary pump rod and, through appropriate inlet and outlet valves, transfer oil from the low pressure cylinder to the high pressure cylinder. As a result, the pressurized gas cushion is further compressed, the pressure in the cylinder increased, and the car thus raised to its predetermined level. The pumping action also provides additional damping force in support of the action accomplished by the damping piston. This damping effect is load-biased, being low under light weight conditions, and high under heavy.

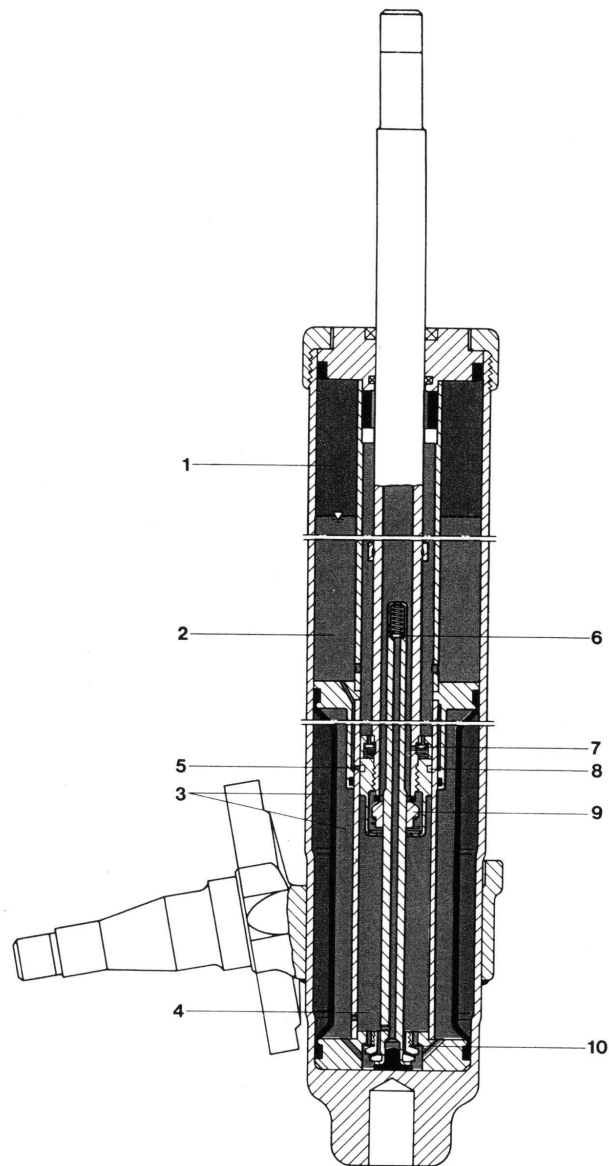
The adjustment of height is brought about through the cycling of oil between the low and high pressure chambers. The adjustment begins with the pumping of oil from the low pressure to the high pressure cylinder when the car is being raised to proper level. It terminates with the relief action once the predetermined height has been reached, at which time the damping piston clears the pressure relief ports in the cylinder. The relief ports are relatively small and do not interfere with the dynamic cushioning process. During the relief cycle, oil returns through the relief ports at the same rate as that of the oil pumped up. When the strut oscillations occur while the car is at its proper height, the relief ports are open for only half the time. As a result, more oil will be pumped up than can flow back when the car is driven on rough roads. Desirably, the car's level will automatically be higher when driving over bumpy stretches. However, to keep the system from lifting the suspension higher than is desired, the pump rod is beveled at one point so that the pumping effect is completely neutralized when the strut extends more than 10 mm beyond its regular height.

The strut has been designed to maintain an exact suspension level while also acting as a shock absorber. Compared with conventional steel-spring-and-shockabsorber suspensions, the hydropneumatic solution provides a marked improvement in comfort throughout the entire load range.

Mechanically, the damping piston divides the cylinder into a low and high pressure cylinder, each of which is hydraulically connected with a low or high pressure chamber within the hydraulic accumulator. In the raised condition, pressure in the high pressure chamber and cylinder always is greater than that in the low pressure chamber and cylinder. When the damping piston moves through the cylinder, one gas cushion is compressed while the other is decompressed. This provides a reciprocally-acting cushioning force which always attempts to push the piston back to its starting position; contained in the high pressure chamber are positive forces, while in the low pressure chamber are negative forces.

As the piston moves back or forth, hydraulic drag results from the displacement of oil from the given cylinder into the respective pressure chamber, and vice versus, providing the double-action shock-absorbing effect.

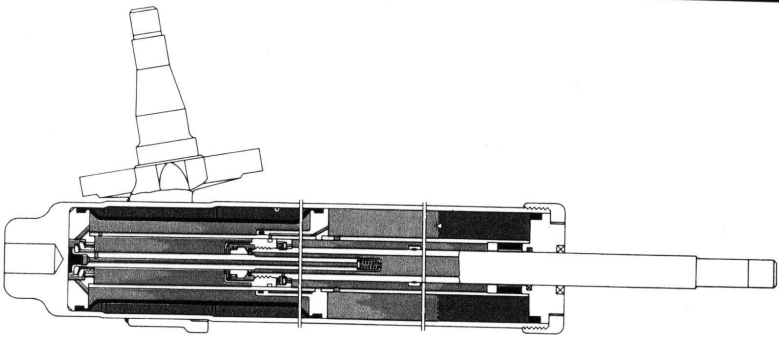
CROSS-SECTION OF SELF-LEVELING HYDROPNEUMATIC SUSPENSION STRUT



- 1 Low pressure chamber
- 2 Low pressure cylinder
- 3 High pressure chamber
- 4 High pressure cylinder
- 5 Relief port orifice

- 6 Overload valve
- 7 Suction valve
- 8 Piston ring seal
- 9 Pressure valve
- 10 Damping valve

Fig. 2



Porsche-Version

Action in Pressure Cylinders A and B:

A" expands through oil flow A' to A.
B" compresses through oil flow B to B'.

Oil drains from A to B' as long as relief port R is open.

A" compresses through oil flow A to A'.
B" expands through oil flow B' to B.

All passages from A to B are closed.

Action as in Position 1

A" expands through oil flow A' to A.
B" compresses through oil flow B to B'.

Action in the Pump:

Suction B to P with suction valve S open.

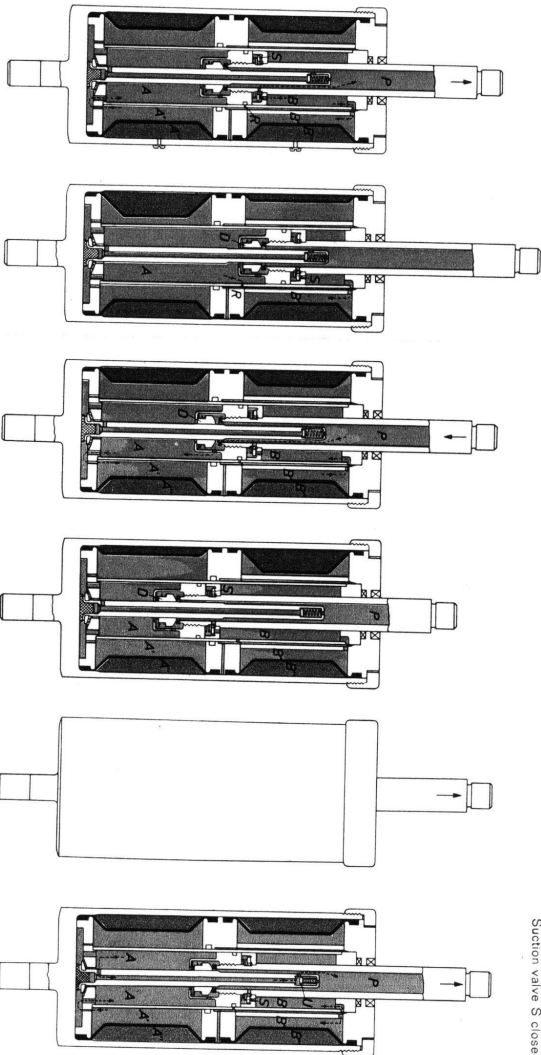
Suction valve S closed.
Pressure valve D closed.

Pressure from P to A.
pressure valve D open.

Suction valve S closed.
Pressure valve D closed.

Action as in Position 1.

Suction A to P.
Overload valve U open.
Suction valve S closed.



1 Rebound 2 Outer Point of Reversal 3 Compression 4 Inner Point of Reversal 5 Rebound Rebound in Overload

A, A', B, B" Oil cylinders (Porsche version without dividing diaphragm in low pressure chamber)
A", B" Gas pockets
P Pump cylinder
R Relief port
D Pressure valve
S Suction valve
U Overload valve

Function Schematic of the Self-Leveling Hydropneumatic Suspension Strut

CHECKING SELF-LEVELING HYDROPNEUMATIC SUSPENSION STRUTS

Special tools:

P 301b Plug gauge

1. Load the front axle with 100 kp (220 lbs) in such way that both wheels are evenly weighted (spread the load evenly in the luggage compartment).
2. a. The best way to test the pumping action is by driving the car.

Drive car onto level surface and push measuring mandrels (special tool P 301b), from within the compartment of the reinforcing support member, to the stop into the left and right transverse support arm (grease the mandrels slightly to provide some adhesion).

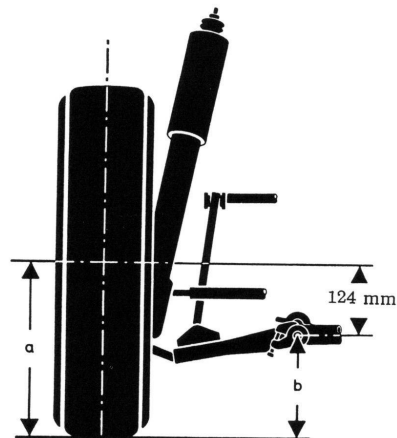


Fig. 4



Fig. 3

Measure distance "a" - from the ground vertical to the front wheel center (Fig. 4). Distance "b" results from distance "a" less 124 mm. Raise the car by the front center with a jack, until distance "b" is attained at the measuring mandrels.

Measure and note the distance from the ground to the bottom edge of the fender across the front wheel center on left and right side. Remove measuring mandrels (special tool P 301b).

NOTE: Before lowering the jack, measure the distance from the wheel flange to the ground, then measure again after lowering the jack to determine the static deflection of the tires on both sides of car. The difference must be deducted from measurements obtained between the ground and lower edge of fender.

Drive car on a relatively rough road surface over a distance of approx. 2 km (1 1/4 miles), without hard braking and bring car to a halt on a smooth surface again. Car-occupants remain inside, and, by second person, measure comparative values at both front fenders. The values must not differ from the determined nominal values by more than ± 10 mm.

2. b. Another way to perform this test is in the workshop by rocking the front end by about 20 times. This is best done by one mechanic who rocks the car by the front bumpers and lets it come up by itself. The body must not be lifted at any time since this could bring the level to the point of the hydro-pneumatic relief cycle, nullifying the pumping effect. The rocking deflection strokes should be at least 30-40 mm (1.25 - 1.60").

If the struts were in use for a considerable distance, it might be necessary to deflect the front end by up to 40 strokes before the car attains its specified height.

This test method also requires that height measurements be taken at the front axle upon weighting it, as outlined under Pt 1, above, before and after the rocking action.

3. Upon completion of the rocking action and measurement of the front axle height, wait for 2 - 5 minutes and then take the measurements again. The body must not drop by more than 10 mm (.4") during that time. Make sure that nothing affects the weight attitude of the vehicle during the above mentioned waiting time.

4. When the specified height cannot be reached, considering the permissible weight limit, and when the car's height decreases within a short time after repeated pumping and testing, replace the defective strut with a new unit.

Loss of height overnight is insignificant.

When new struts are installed, improper storage of the parts (the strut must be stored in upright position) may call for a relatively longer road travel distance before attaining the specified suspension height.

5. When the front axle load exceeds the permissible weight, proper suspension height cannot be reached despite any rocking action and the level will continue to drop with increasing loads, similar to the overload effect in conventional suspensions.

6. When the body swings excessively on rebound, the shock damping part of the suspension strut is defective. This will also be frequently felt through considerable steering wheel shock or front wheel wobble.

7. Prior to salvaging, the hydro-pneumatic suspension struts must first be freed of their static gas charge. To accomplish this, remove both filling plugs from the outer sleeve.

REMOVE AND RE-INSTALL SUSPENSION STRUT OR SHOCK ABSORBER STRUT

Special tools:

P 284b Test gage for steering arm
P 286b Test gage for steering knuckle

VW 266h Puller for track rod ball joint

Removal

1. Raise front of car and take off both front wheels.
2. Detach brake line from clip on suspension strut.
(First depress the brake pedal a short distance with a pedal clamp to prevent brake fluid from escaping from the reservoir.)
3. Loosen bolts holding brake caliper and take off the complete caliper.
4. Use a plastic-headed hammer to loosen the front wheel hub cap slightly, and push it off using a lever on alternate sides.
5. Loosen fillister head screw holding wheel bearing clamp nut, screw out the clamp nut and take off the peg washer.
6. Take off front wheel hub with brake disc and wheel bearing.
7. Loosen the hexagon bolts holding the shield plate, and take off the shield plate.

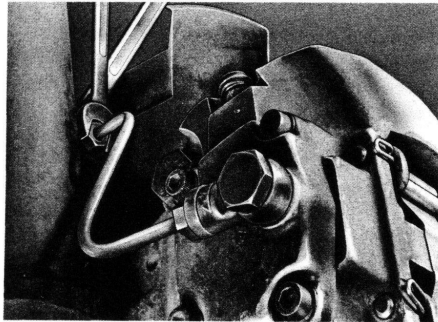


Fig. 1

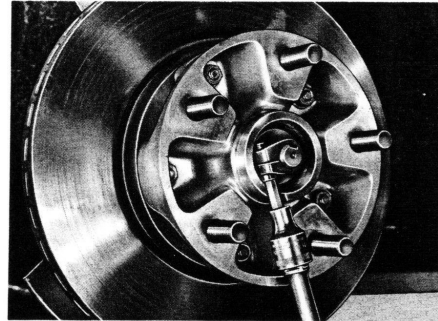


Fig. 3

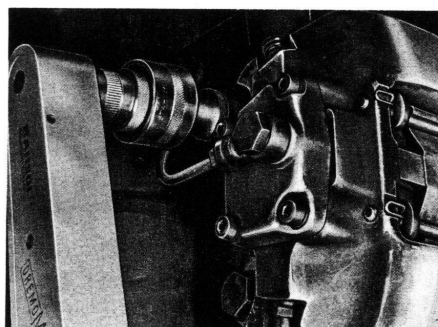


Fig. 2

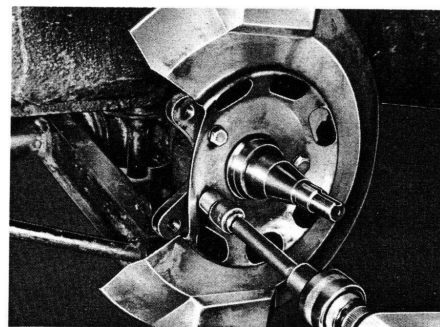


Fig. 4

8. Remove the split pin from the castellated nut on the track rod joint and pull off the ball joint with special tool VW 266h.

9. Loosen the hexagon bolt (M 10x30 - 10 K) for the ball joint on the suspension or shock absorber strut, and pull the ball joint out of the strut by pressing the wishbone downwards.

Warning:

If the car is fitted with shock absorber struts, the torsion bar adjusting screw must first be loosened and the adjusting arm removed.

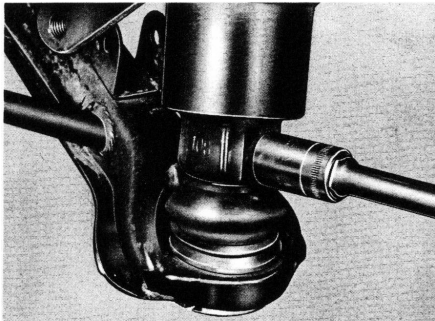


Fig. 5

10. Remove the keeper for the hexagon nut on top of the suspension strut or shock absorber strut, unscrew the nut and remove it together with the keeper plate, peg washer and the strut itself. (The trunk side panel must be pulled away.)



Fig. 6

11. If necessary, pull off the spacer ring with a claw-type extractor.

Checking condition of parts

1. Use special tool P 286b to check condition of suspension or shock absorber strut with steering knuckle.

Warning:

Assemble special tool P 286b as follows:

Boge suspension strut (outer tube 64 mm/2.52" diameter) = without sleeves or cap.

Koni shock absorber strut (outer tube 58 mm/2.28" diameter) = thin sleeves and thin cap to be used.

Boge shock absorber strut (outer tube 52 mm/2.05" diameter) = thick sleeves and thick cap to be used.

Note:

Some early models were supplied with Koni shock absorber struts with outer tube diameter 56 mm/2.20". When checking these shock absorber struts a 1 mm (0.39") thick spacer must be fitted at each of the measuring points. The special tool should be used in the version for Koni shock absorber struts with outer tube diameter 58 mm/2.28".

- a. Clamp special tool P 286b in the vise. Push the bearing journal of the suspension or shock absorber strut, with spacer ring in position, into the gage holes on special tool P 286b. (See Fig. 7.)

If the bearing journal cannot be pushed in as far as the limit position next to the flange, it is distorted and the suspension or shock absorber strut must be replaced.

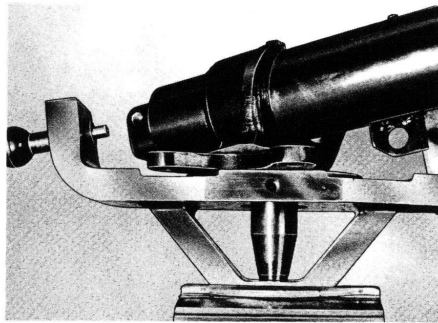


Fig. 7

If the suspension or shock absorber strut cannot be turned between the two measuring pins, it should be replaced. In addition a max. spacing of 2.2 mm (0.087") is permitted between the outer tube and the front measuring space on the measuring pin. If this distance is exceeded, the suspension or shock absorber strut must be replaced. (See Fig. 9.)

2. Checking self-leveling hydropneumatic suspension strut - see page SS 23.

- b. Turn the suspension or shock absorber strut between the measuring pins and hold in position with the retaining pin.

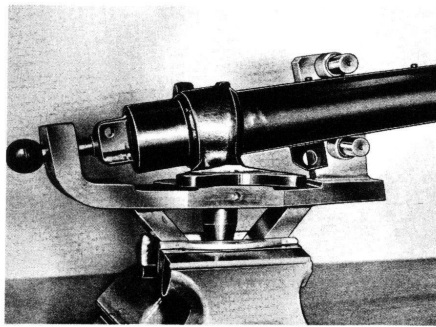


Fig. 8

3. Check hydraulic action and sealing of shock absorber strut.

- a. Examine the exterior of the shock absorber strut for oil leaks. If the complete shock absorber tube is covered with oil and dirt, the shock absorber strut must be replaced.
- b. Clamp the shock absorber strut vertically into the vise with the piston rod upwards. Compress the shock absorber completely several times so that oil enters the cylinder, then move the shock absorber a short distance in the opposite direction to establish the amount of free travel. If this free travel is excessive, the shock absorber strut must be replaced.

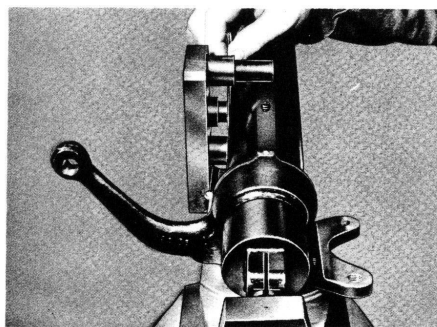


Fig. 9

4. Check the steering arm with special tool P 284b.

- a. It must be possible to bolt special tool P 284b to the steering knuckle using three M 8x25 bolts, so that the steering arm lies between the test gage holes. (See Fig. 10.)

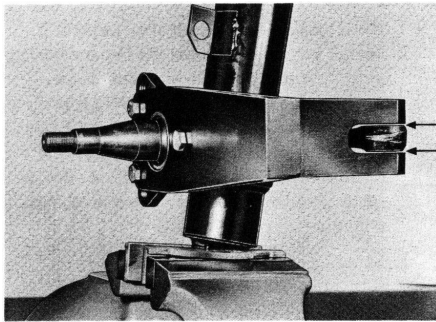


Fig. 10

- b. The larger diameter of the hole in the steering arm for the track rod joint should not lie outside the test hole in special tool P 284b. (Visual check.)

If excessive alignment variations are found, an exchange suspension or shock absorber strut should be installed.

Re-installing

Note the following points when re-installing:

1. If necessary, install with spacer ring. The spacer ring must be heated to about 150°C (300°F) and pushed on.

Warning:

Always install a cord ring seal (OR 25.3x2.4) between the spacer ring and the steering knuckle to prevent the development of corrosion.

2. Do not apply any lubricant to the hollow rubber spring before installing.

3. Tighten the hexagon nut on the suspension or shock absorber strut to 8.0 mkp (58 lb/ft). Use a new keeper plate and make sure that the peg on the keeper plate points upwards.

4. Install ball joint hex bolt (M10 x 30 - 10.9) without lubrication and torque to specification.

Use new hex bolt and new Schnorr lock washer.

Warning:

Do not forget to re-install the steel washer between the ball joint sealing bellows and the suspension or shock absorber strut.

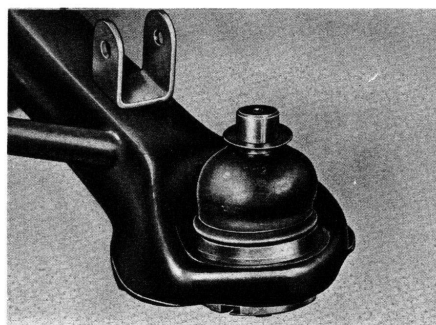


Fig. 11

5. (Shock absorber strut only:)
Install the adjusting lever on the torsion bar as described below.

- a. Press down the wishbone (with shock absorber strut attached) with a tire lever or similar tool until the strut is fully extended and in contact with the lower limit stop. Then push the adjusting lever onto the torsion bar as close as possible to the stop for the adjusting screw on the sub-frame. (The adjusting lever must be provided with a cap.)

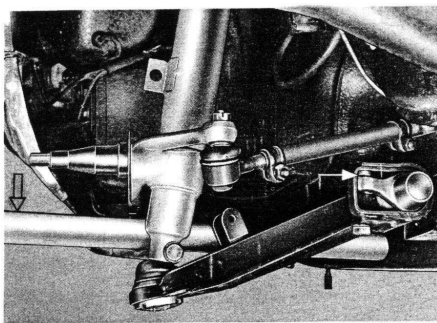


Fig. 12

- b. Coat the thread of the adjusting screw with MoS₂ paste and screw up a few turns.
- c. Check that the cap is correctly located in the wishbone. If the adjusting lever is incorrectly installed the front of the torsion bar may escape from the splines in the wishbone.
6. Tighten the castellated nut on the track rod joint to 4.5 mkp (32.5 lb/ft).

7. Tighten the hexagon bolts for the shield plate to 2.5 mkp (18 lb/ft).

8. Install and adjust the front wheel bearing (see 4 ST).

9. Tighten the brake caliper retaining bolts to 7.0 mkp (50 lb/ft), using spring washers.

10. Bleed the brake system and check for leaks (see group "T").

11. Carry out optical wheel alignment of the car and adjust if necessary (see group "W").

REMOVE AND RE-INSTALL WISHBONE

Special tools:

P 280b Slotted nut wrench

P 288b Wishbone test gage

Removal

1. Lift front of car and take off both front wheels.
2. Unscrew the hexagon bolt (M 10x30 - 10 K) for the ball joint on the suspension or shock absorber strut. Pull the ball joint out of the strut by pushing the wishbone downwards.
Warning:
On cars with shock absorber struts, the torsion bar adjusting screw must first be taken out and the adjusting lever and OWA gasket removed.
3. Loosen the hexagon bolts on the protection bar and the front wishbone bearing, and remove the protection bar.



Fig. 13

4. Unscrew the hexagon bolt holding the wishbone and sub-frame, and pull the wishbone out towards the front.

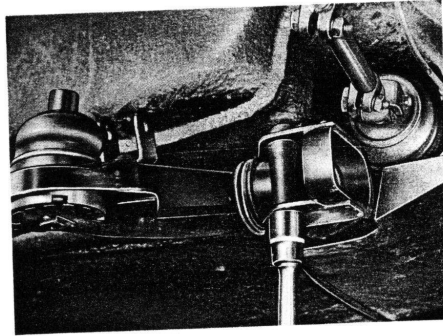


Fig. 14

5. Clamp the wishbone in a vise (use protective jaws). Remove the keeper from the slotted nut and unscrew the nut using special tool P 280b.

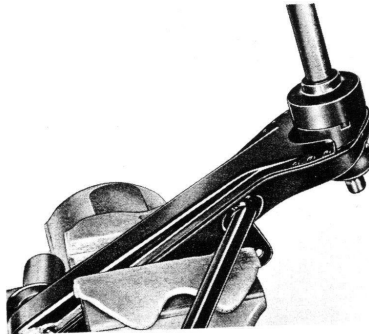


Fig. 15

Warning:

To remove both wishbones, take off the wishbone on one side and screw in the hexagon bolt for the wishbone and sub-frame hand tight, so that the sub-frame is held firmly in position.

Checking condition of parts

1. Check wishbone with special tool P 288b.

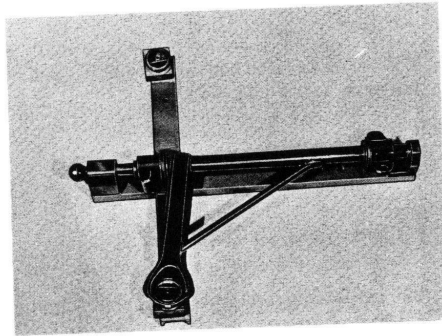


Fig. 16

- a. Use a suitable piece of metal tube to drive the cap for the torsion bar splines out of the wishbone.

- b. Mount the wishbone in special tool P 288b.

- c. With the mounting hole for the ball joint placed on the test journal on special tool P 288b, the wishbone should rotate easily and the contact surface for the ball joint should touch the shoulder on the test journal all round its edge.

Distorted or damaged wishbones must be replaced.

- d. Install the cap with the domed side outwards in the wishbone, and drive it in firmly with a suitable drift.

- e. Check the wishbone rubber bushes for visible signs of wear. If the bushes are defective, the complete wishbone must be replaced.

2. Check the ball joint. A small amount of friction should be present when the ball journal is moved. If the journal can be moved without resistance, and axial play is detected, the ball joint must be replaced. If the sealing bellows is damaged it can be replaced as follows:

- a. Use a chisel to separate the damaged bellows from the ball joint.

- b. Force on the new sealing bellows with a suitable length of tube.

3. (Cars equipped with shock absorber strut only:) Check for damage to splines on torsion bar. Inspect the painted surface for traces of rust, and replace if necessary.

Re-installing

Note the following procedures when re-installing:

1. Tighten the slotted nut for the ball joint to 15 mkp (108 lb/ft) and prevent from turning by bending over one of the pegs on the keeper plate.

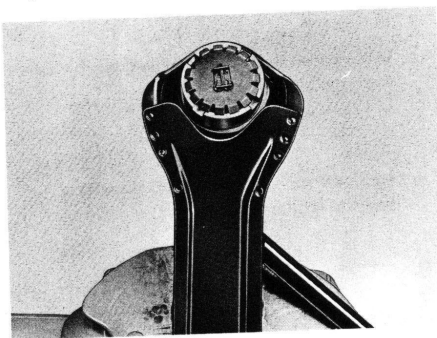


Fig. 17

2. (Shock absorber strut only:) Coat the torsion bar lightly all over with lithium-base grease, in particular the splines. Push the torsion bar into the wishbone. (Do not force out the end cap from the wishbone.)

Insert the wishbone and torsion bar into the sub-frame.

Warning:

The torsion bars are pre-loaded during production. Never interchange right or left wishbones. Wishbones for fitting on left side are marked on the end with an "L", wishbones for fitting on the right with an "R" (see picture).

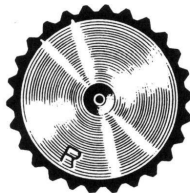


Fig. 18

3. Tighten the hexagon bolt for the wishbone front bearing and protection bar to 4, 7 mkp (34 lb/ft).

4. Tighten the hexagon bolt for the wishbone and sub-frame to 9, 0 mkp (65 lb/ft).

5. Install ball joint hex bolt (M 10 x 30 - 10.9) without lubrication and torque to specification.

Use new hex bolt and new Schnorr lock washer.

6. (Shock absorber strut only:)

Push the OWA gasket from the space in the sub-frame onto the torsion bar, and mount the adjusting lever on the torsion bar as described below:

- a. With the shock absorber strut attached, push the wishbone down until the limit stop in the shock absorber strut is reached, using a tire lever or similar tool. Push the adjusting lever onto the torsion bar as close as possible to the adjusting screw stop on the sub-frame. (The adjusting lever must be provided with an end cap.)

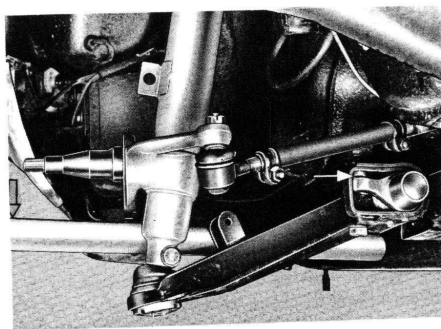


Fig. 19

b. Coat the adjusting bolt thread with MoS_2 paste and screw it in slightly.

c. Check that the end cap is seating correctly in the wishbone. If the adjusting lever is not correctly installed the front end of the torsion bar may be driven out of the splines in the wishbone.

7. (Shock absorber strut only:)
Set up front axle to correct height.

8. Carry out optical wheel alignment and adjust as necessary (see group "W").

REPLACING THRUST BEARING WITH RUBBER PAD

Special tools:

P 291 Internal socket head wrench

1. Raise front of car and take off both front wheels.
2. Pull away the trunk side panels in the area of the suspension or shock absorber strut mounting.
3. Remove the keeper from the hexagon nut at the top of the suspension or shock absorber strut, unscrew the nut and take off the keeper plate and peg washer.

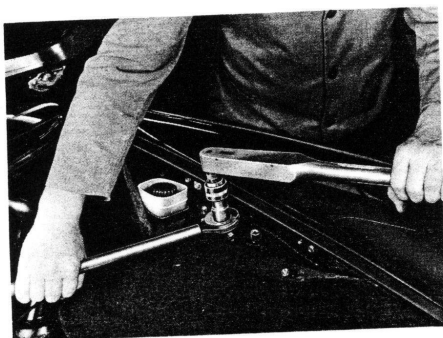


Fig. 20

4. Press down the wishbone with the suspension strut and extract the piston rod from the rubber pad.
5. Remove all sealing compound from the pressure plates.
6. Mark the position of the single hole and double hole pressure plates. Unscrew the fillister head bolts with special tool P 291 and remove the thrust bearing with its rubber pad.

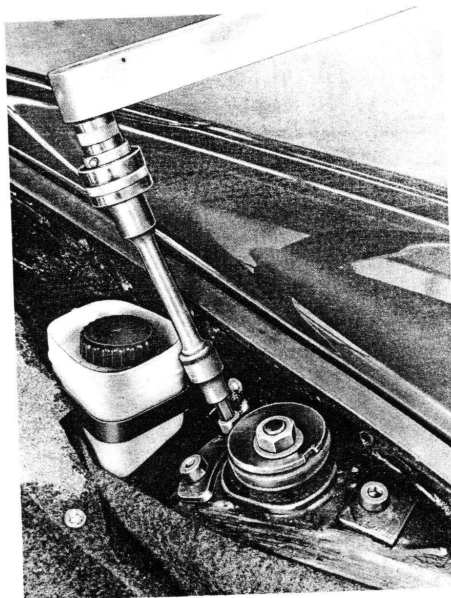


Fig. 21

7. Install the new thrust bearing with rubber pad. Tighten the fillister head bolt to 4,7 mkp (34 lb/ft).
8. Tighten the hexagon nut on the suspension or shock absorber strut to 8,0 mkp (58 lb/ft), and fit a keeper. A new keeper plate should be used. Make sure that the peg on the keeper plate faces upwards.
9. Carry out optical alignment check and adjust if required (see group "W").
10. Reseal the pressure plates and thrust bearing with permanently elastic sealing compound, for example "National-Kleber 670".

REMOVE AND RE-INSTALL TRACK ROD TUBE

Removal

1. Disconnect batteries.
2. Take out front trunk mat and open compartment lid.
3. Remove trunk paneling in front of fresh air plenum box.
- b. Unscrew the two Phillips-head screws holding the fresh air plenum chamber.

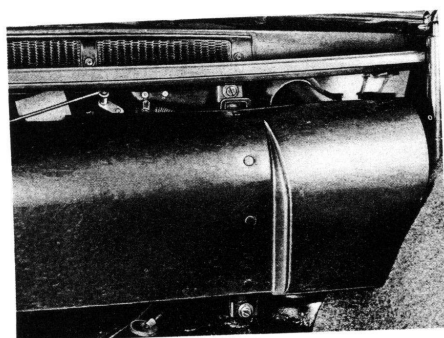


Fig. 1

4. Remove fresh air box with blower:

- a. Unscrew the four Phillips-head screws on the air grill frame, and pull out the frame with the grill.

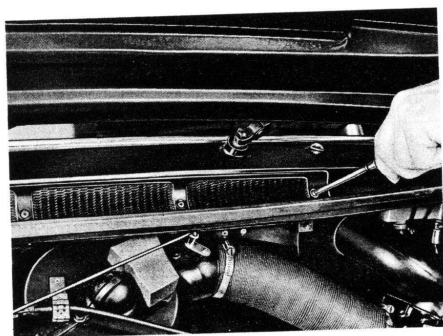


Fig. 2

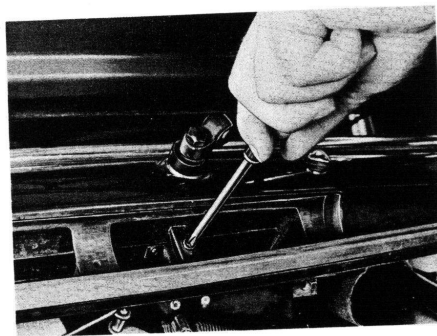


Fig. 3

- c. Detach the left and right connecting hoses on the control boxes.

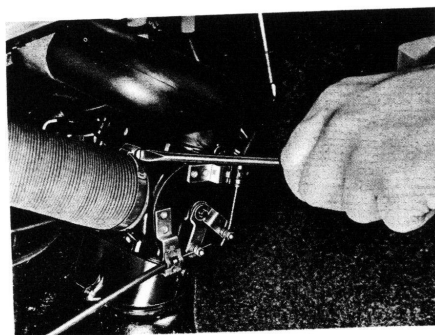


Fig. 4

- d. Disconnect the electrical plugs from the fresh air box.
- e. Disconnect the wire cable from the flap lever on the fresh air box, and push off the retaining clip for the outer cover. (See Fig. 5.)

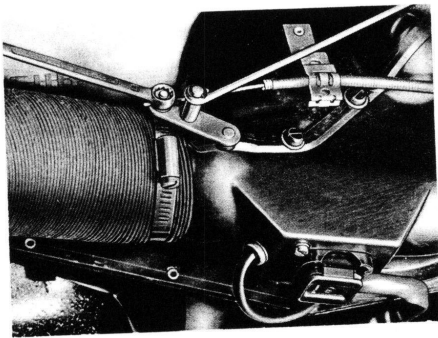


Fig. 5

5. Take off the cover plate for the intermediate steering shaft. (To simplify this job, bend up one of the retaining tongues of the spring nut with a small screwdriver - see Fig. 6.)

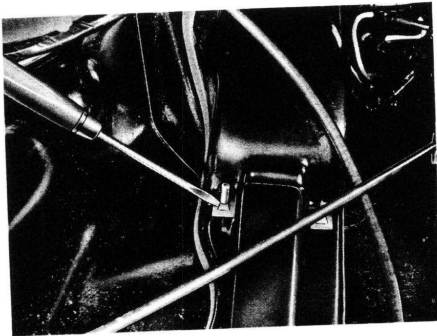


Fig. 6

6. Loosen the self-locking hexagon nut on the upper hexagon bolt of the upper universal joint, and the hexagon nut on the lower hexagon bolt of the lower universal joint. Pull out the hexagon bolts.

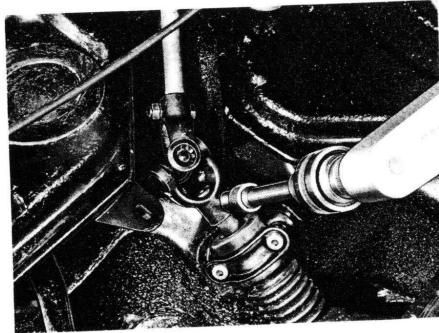


Fig. 7

7. Unscrew the fillister head bolts on the steering shaft bearing cap, and take off the bearing cap.



Fig. 8

8. Pull the lower universal joint out of the steering shaft and remove the intermediate steering shaft with both universal joints.

9. Take off the steering wheel (see 14 ST).

10. Pull out the steering column bearing with a small claw-type extractor.

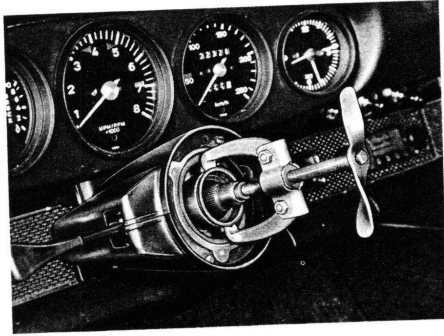


Fig. 9

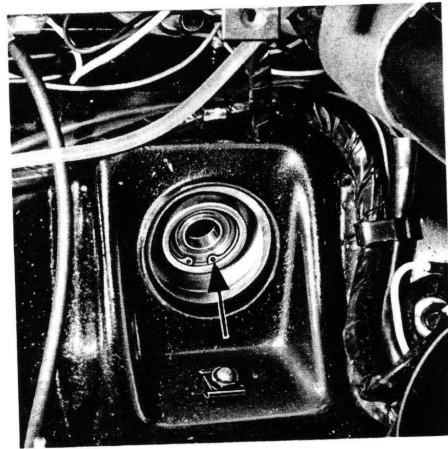


Fig. 11

11. Take off the circlip from the steering shaft and drive the shaft out upwards.

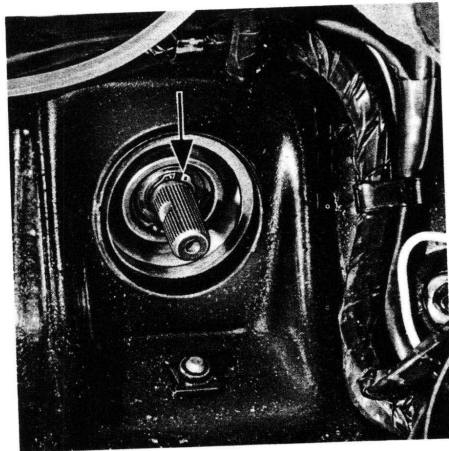


Fig. 10

12. Lever the circlip for the grooved ball bearing out of the steering outer tube, and drive out the ball bearing downwards with a suitable drift.

Checking

1. Check the splines on the steering shaft and replace the shaft if the splines are damaged.
2. Check the grooved ball bearing and the steering column bearing, and replace if necessary.
3. Check the universal joints; no play should be detected. If noticeable play is present, replace the universal joints.

Re-installing

When re-installing, note the following procedures:

1. Pack the grooved ball bearing with lithium-base grease (multi-purpose) and drive the bearing into the steering shaft so that the cover disc on the bearing faces outwards.
2. Tighten the cheese head bolts for the bearing cap on the steering shaft to 2, 5 mkp (18 lb/ft).
3. Use new self-locking hexagon nuts for the hexagon bolts on the universal joints. Tighten to 2, 5 mkp (18 lb/ft). (To prevent stresses within the intermediate steering shaft and universal joints the steering shaft bearing cap must be tightened first.)
4. Re-install the steering wheel (see 14 ST).
5. Re-install the fresh air plenum box with blower:
 - a. First insert the air inlet aperture of the fresh air box with blower.
 - b. Insert the water drain hose into the drain tube in the trunk floor.
 - c. Make sure that the fresh air box and the inlet aperture in the center part of the bulkhead are correctly aligned.
 - d. Adjust the wire cable so that the air flaps open and shut completely.

CROSS-SECTION OF STEERING AND CONTROL SWITCH COMPONENTS

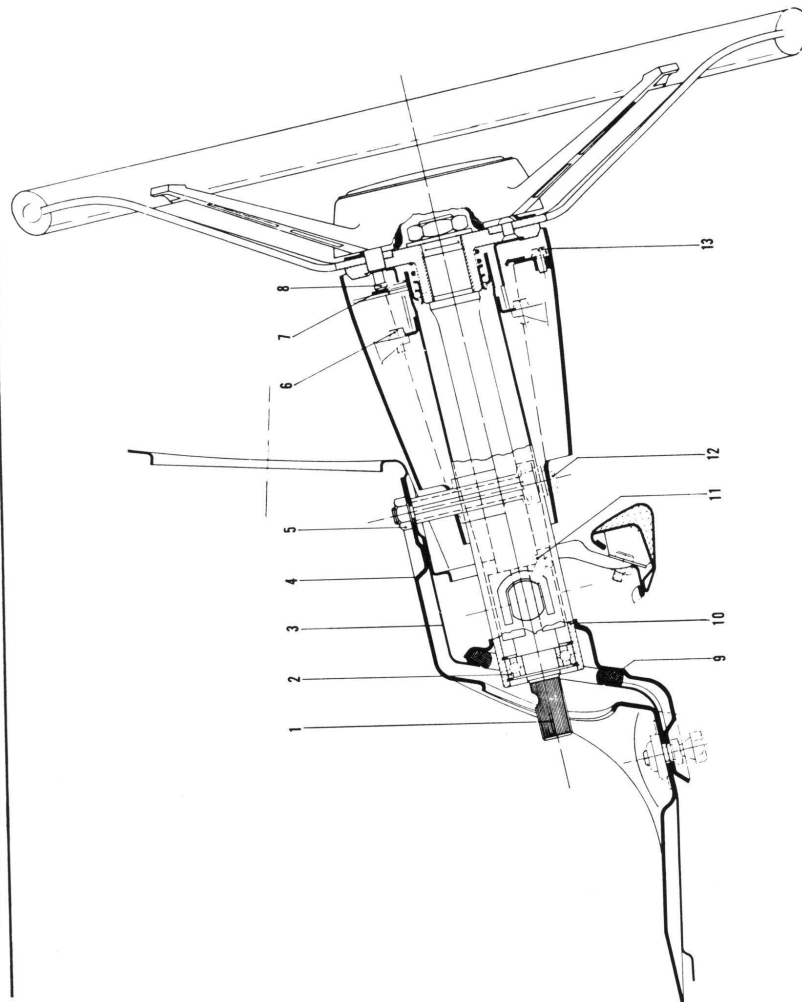


Fig. 12

- | | | | |
|--------------------------|--|---------------------------------|-------------------------------------|
| 1 Steering upper shaft | 5 Caged nut | 8 Contact finger | 12 Shear bolt |
| 2 Ballbearing | 6 Fillister screw for switch shroud halves | 9 Seal | 13 Fillister screw for contact ring |
| 3 Front compartment wall | 7 Contact ring | 10 Steering post extension | |
| 4 Reinforcing panel | | 11 Countersunk screw (M 6 x 10) | |

RACK AND PINION STEERING, FROM 69 MODEL ON

General

From the 69 Model on, a modified rack and pinion mechanism has been used.

Primary modifications:

1. Modified steering box housing; the center line of the rack is now 3 mm (0.12") higher in relation to the front axle.
2. Longer steering rack (previously 485 mm/19.09", now 501 mm/19.72").
3. Number of turns of steering wheel from lock to lock; 3.1 (previously 2.8).

Adjusting values for the rack and pinion steering mechanism have not changed.

REMOVE AND RE-INSTALL JOINT BUSHES ON RACK AND PINION STEERING (FROM 69 MODEL ON)

Special tools:

P 285a Adjusting gage for steering mechanism

Warning:

The joint bushes must be installed in a certain position to ensure correct steering geometry and accurate track rod location (see page S 31, Fig. 73).

Removal

1. Mount the steering mechanism on special tool P 285a, without using the 3 mm (0.12") thick spacing washers.
2. Take off the outside retaining clip from the flexible bellows. Pull the bellows away from its holder. Use a 42 mm wrench to loosen the bellows holder and unscrew the joint bush together with the bellows holder.

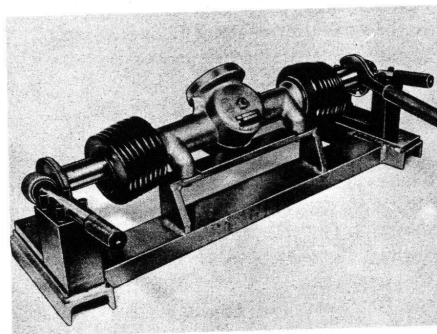


Fig. 13

Checking condition of parts

1. Examine the joint bushes for visible signs of wear and replace if necessary.
2. Check the flexible bellows for cracks and poor sealing and replace if necessary.
3. Replace defective retaining clips.

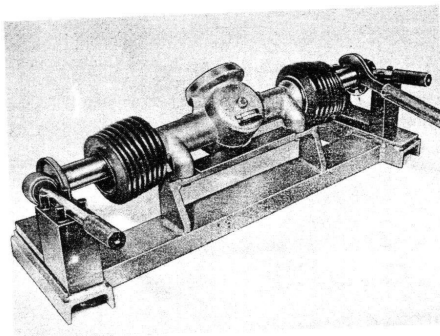


Fig. 14

Re-installing

When re-installing note the following procedures:

1. Install both flexible bellows on the steering lock's housing.
2. Screw the bellows holders to the joint bushes, coat the threads of the joint bushes and the front face of the rack with "Teroson Atmosit" sealer, and install the joint bushes.
3. Mount the steering box on special tool P 285a without the 3 mm (0.12") spacing washers. Attach the joint bushes as determined by special tool P 285a and tighten the bellows holders. Tighten to approx. 7,0 mkp (50 lb/ft).
Warning:
The joint bushes must be installed and tightened evenly on both sides.

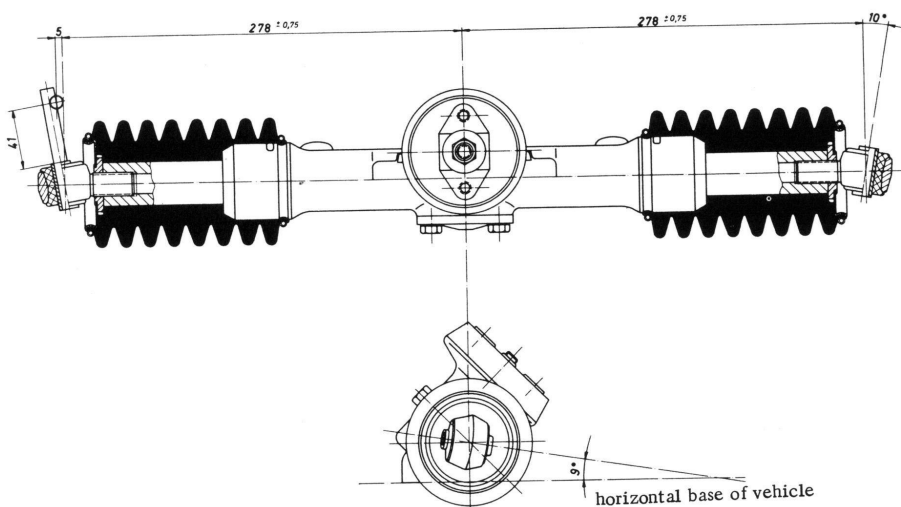
REMOVING AND INSTALLING JOINT BUSHING ON RACK AND PINION STEERING (FROM MODEL 70 ON)

Special tools:

P 285b Adjusting for steering gears

Note!

The measurements in the illustration below indicate the basic adjustments, which should be adhered to to ensure proper steering operations.

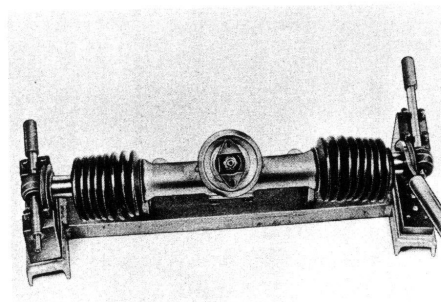


Removing

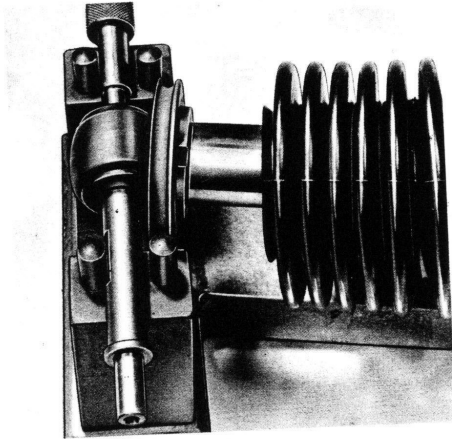
1. Clamp steering gear into special tool P 285b without 3 mm (0.12 in.) washers.
2. Remove spring clamp on outside of bellows. Pull bellows from holder. Loosen holder with 42 mm (1.65 in.) spanner wrench and unscrew joint bushing together with bellows holder.

Checking Individual Parts

1. Check joint bushing for wear and replace if necessary.
2. Check bellows for cracks and leaks and replace if necessary.
3. Replace faulty spring clamps.



Installing



1. Mount both bellows on housing.
2. Screw bellows holder to joint bushings, coat threads of joint bushings as well as rack face end with sealing compound and mount together with joint bushings.
3. Attach steering gear to special tool P 285b without 3 mm washers. Locating bolts should easily slip into joint bushings with the flattened end of the locating bolts resting against the outer set pins with only slight clearance.
4. Tighten bellows holder (tightening torque approx. 7.0 mkg/50 ft. lbs.) and attach bellows to holder by means of holding spring.

MODIFIED ZF RACK AND PINION STEERING

General

A modified version of the ZF rack and pinion steering is being used in the Type 911 T and S as of the following dates and chassis serial numbers:

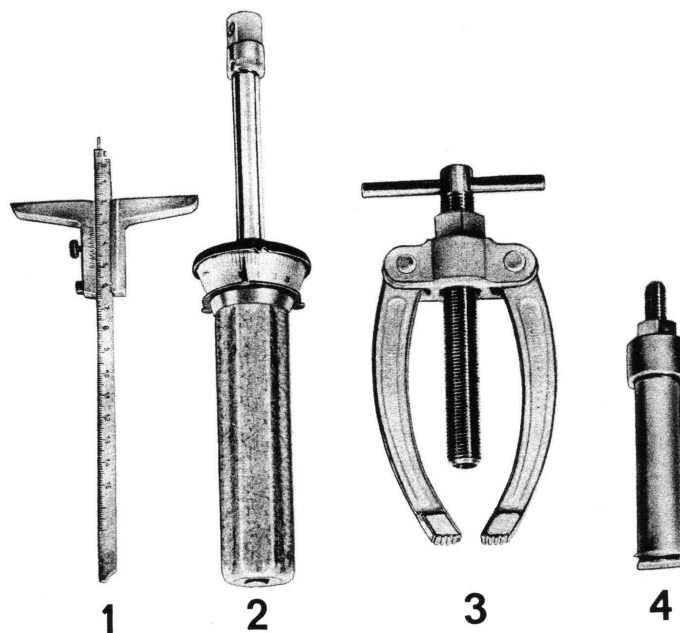
Type 911 T (May 25, 1970)

Coupe 911 010 1699 and 911 012 3497
Targa 911 011 2140

Type 911 S (August 26, 1970)

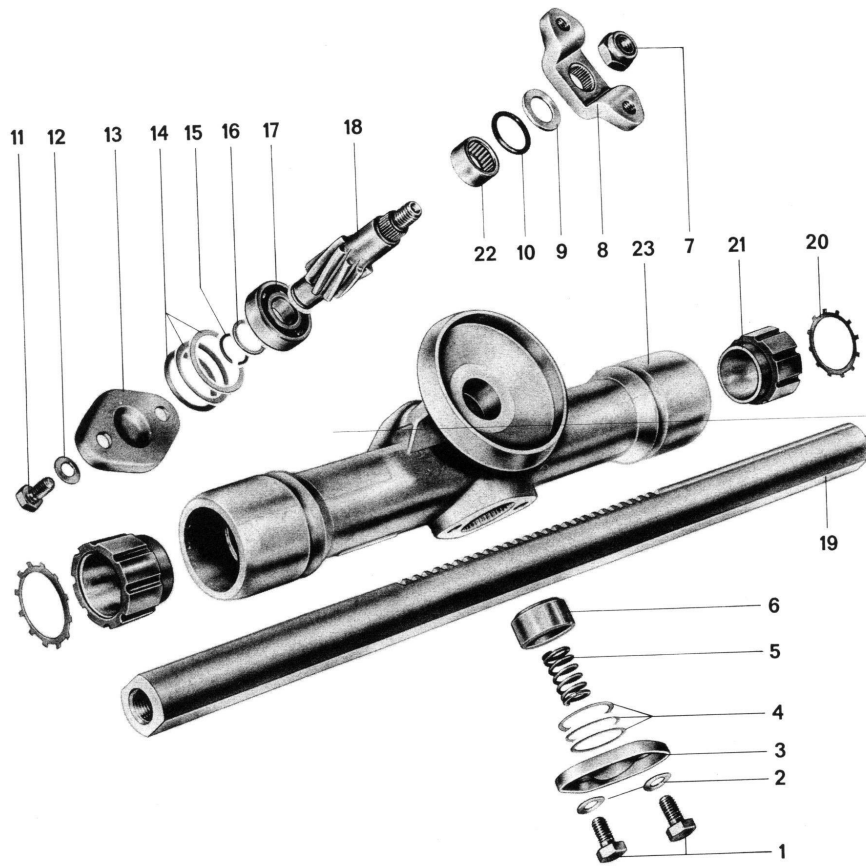
Coupe 911 130 0043
Targa 911 131 0043

Special Tools



N°	Description	Special Tool N°	Remarks
1	Depth gauge		
2	Torque wrench, 0-25 cmkp		
3	Puller, 22-1		
4	Puller N° 21/4		

Modified ZF Rack and Pinion Steering



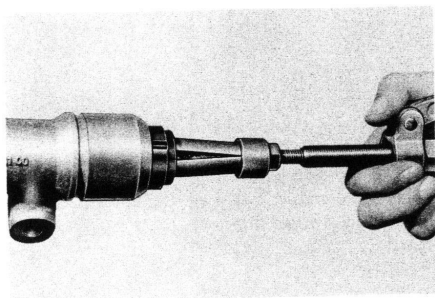
Nº	Description	Qty	Removing	Note when Installing	Special instructions see
1	Bolt, M8	2		Torque to 1.5 mkp	
2	Spring washer	1		Replace if necessary	
3	Cover	1		Use gasket compound during installation	
4	Shim	x	Can fall out	Determine number shims required	SS 50
5	Spring	1		Replace spring if specified drag cannot be attained	SS 50
6	Pressure block	1		Adjust free play	SS 50
7	Self-locking nut, M10	1		Replace with new nut, torque to 4.7 mkp (33.9 ft.lbs.)	
8	Coupling flange	1			
9	Washer	1			
10	O-ring	1		Lubricate lightly	
11	Hex bolt, M 8 x 18	2		Torque to 1.5 mkp (10.8 ft.lbs.)	
12	Spring washer	2		Replace if necessary	
13	Cover	1		Use gasket compound during installation	
14	Shim	x	Can fall out	Determine number shims required	SS 50
15	Snap ring	1		Must seat in pinion shaft groove	
16	Thrust washer	1			
17	Ball bearing	1	Press off	Replace if necessary	SS 49
18	Pinion	1	Remove together with bearing	Replace if necessary	

N°	Designation	Qty	Note when		Special instructions see
			Removing	Installing	
19	Rack	1	Mark location for reassembly	Lubricate with multipurpose grease LM-Kfz 3 or LM-47 L	
20	Lock ring	2		Must seat properly	
21	Rack bushing	2	Pull out	Replace if necessary	SS 49
22	Needle bearing	1	Drive out with P 362	Note installed depth	SS 49
23	Steering housing	1		Fill with multi-purpose grease LM-Kfz 3 or LM-47 L	

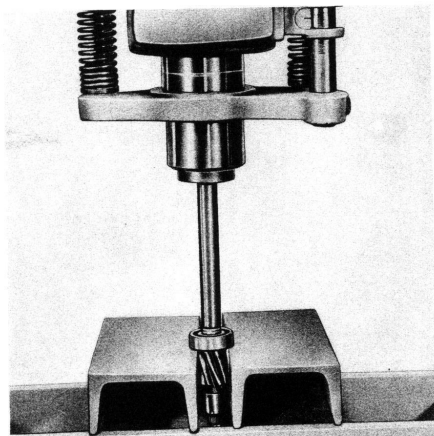
DISASSEMBLING AND ASSEMBLING MODIFIED ZF RACK AND PINION STEERING

Disassembling

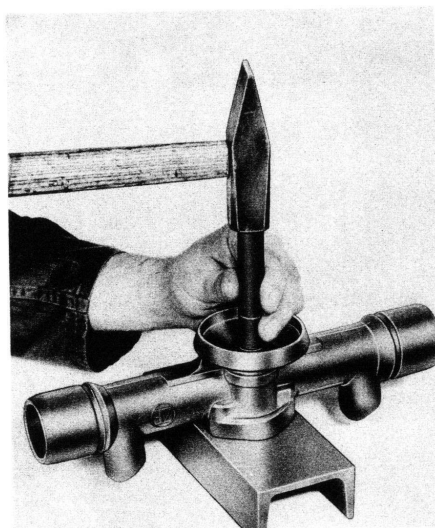
1. Pull rack bushing out of steering housing.



2. Remove snap ring and thrust washer from pinion and press off ball bearing.



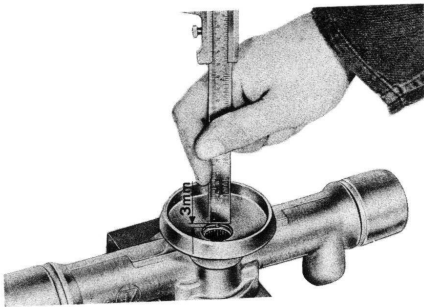
3. Drive needle bearing out of the steering housing using special tool P 362.



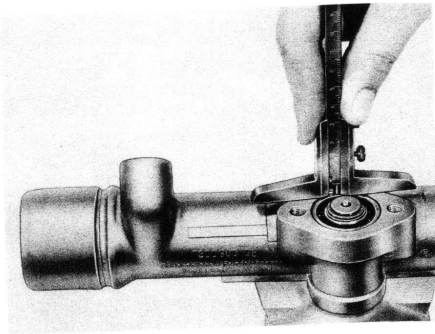
Assembling

Note the following when assembling:

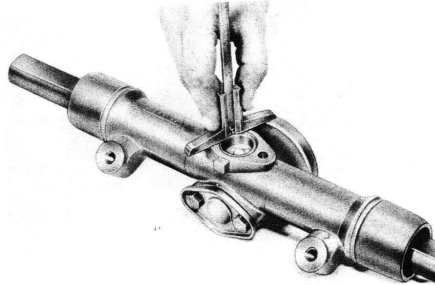
- fill steering housing with multipurpose grease
- drive in needle bearing with special tool P 362 until the depth from top edge of steering housing to the top of the needle bearing is 3.0 mm (0.12 in.).



3. Install steering pinion. Measure distance from ball bearing to contact surface of housing. The clearance must be taken up with shims. Maximum free play between housing cover and ball bearing is 0.05 mm (0.002 in.).

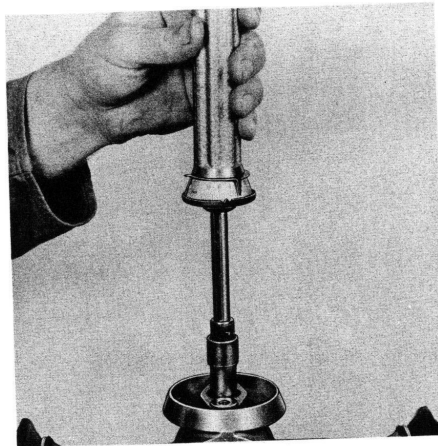


4. Measure distance between pressure block and contact surface of housing. Total thickness of all shims to be installed must be 0.2 mm (0.008 in.) less than this measurement.



5. Install the determined shims and check the free play. The correct free play with cover installed is 0.2 mm (0.008 in.).

6. Check steering gear drag over the entire working length of the steering rack. A drag of 8-14 cmkp (7-12 in. lbs.) must be attained.



SHOCKABSORBER STRUT REPLACEMENT KIT

General

Beginning with chassis number 301 800, shockabsorber replacement kits can be installed in the suspension struts of Type 911 and 912 vehicles. As a result, the complete strut assembly does not have to be replaced.

Special Tools

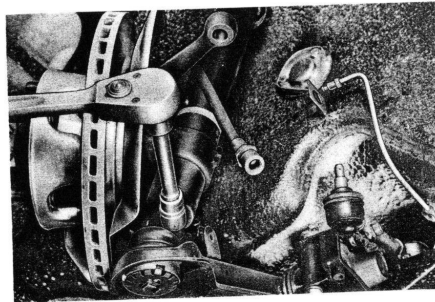
VW 266 h Puller for tie rod ball joint

Locally manufactured tool for KONI shockabsorber strut

Locally manufactured tool for BOGE shockabsorber strut

Removing

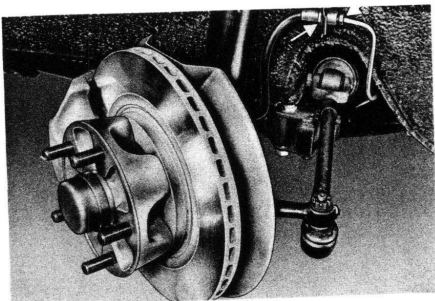
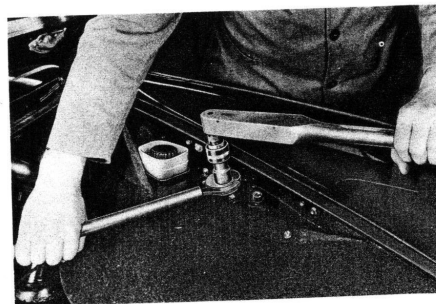
Remove the shockabsorber strut when replacing the inserts.



1. Raise car and remove both wheels.

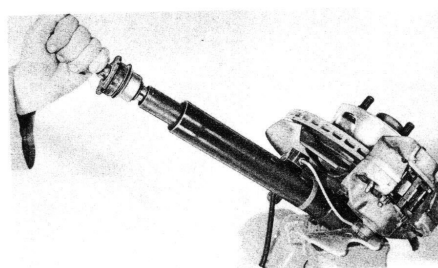
4. Unsnap part of luggage compartment padding around the top of the suspension strut seat. Remove nut from the top of the shockabsorber strut and take shockabsorber strut out.

2. Disconnect brake line at the supporting bracket (use pedal prop to hold brake pedal slightly down to keep hydraulic fluid from draining out of the brake fluid reservoir). Remove cotter pins and castle nuts from tie rods and ball joints. Remove ball joint with special tool VW 266h.

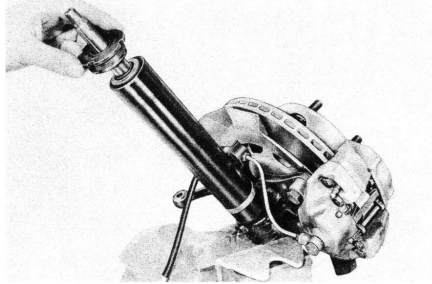


5. Mount the shockabsorber strut in a vise equipped with jaw caps. Remove cover tube and take rubber buffer out. Remove insert retaining nut and take out the old insert components.

3. Remove ball joint retaining bolt (M 10 x 30) from strut and pull ball joint out of the strut by pushing the suspension control arm downward.

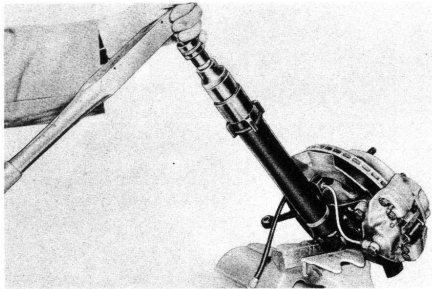


6. Drain the hydraulic fluid from the strut casing and install the new insert.



7. Tighten insert retaining nuts:

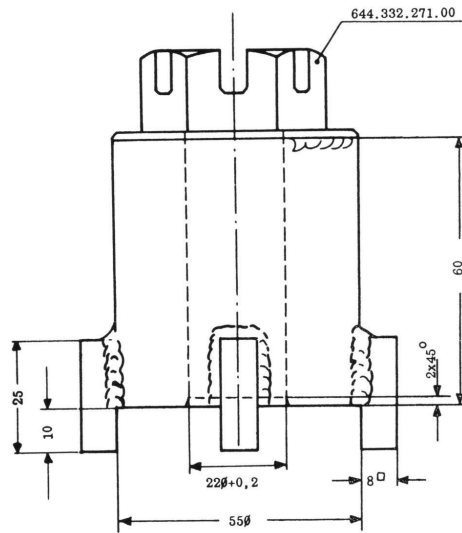
BOGE = 12-14 mkp (87 - 101 ft. lbs.)
for
KONI = 20 mkp (144 ft. lbs.)



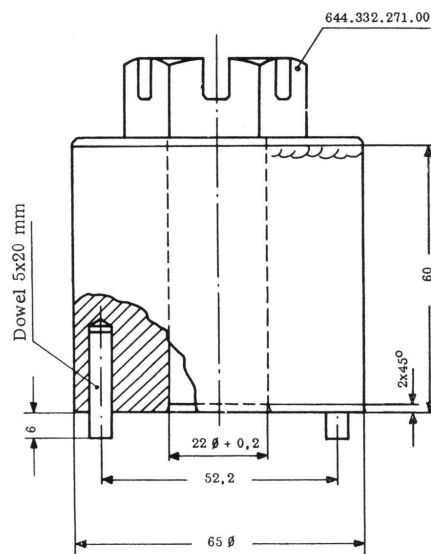
8. Install shockabsorber strut in vehicle and torque nuts and bolts to correct values.

9. Bleed brake system and check for leaks.

Sketches for Local Manufacture of Tools



For BOGE shockabsorber strut



For KONI shockabsorber strut