



# SERVICE MANUAL

CARS AND VANS

P 120

Part 6

FRONT AXLE AND STEERING GEAR

*Service Department*

AKTIEBOLAGET

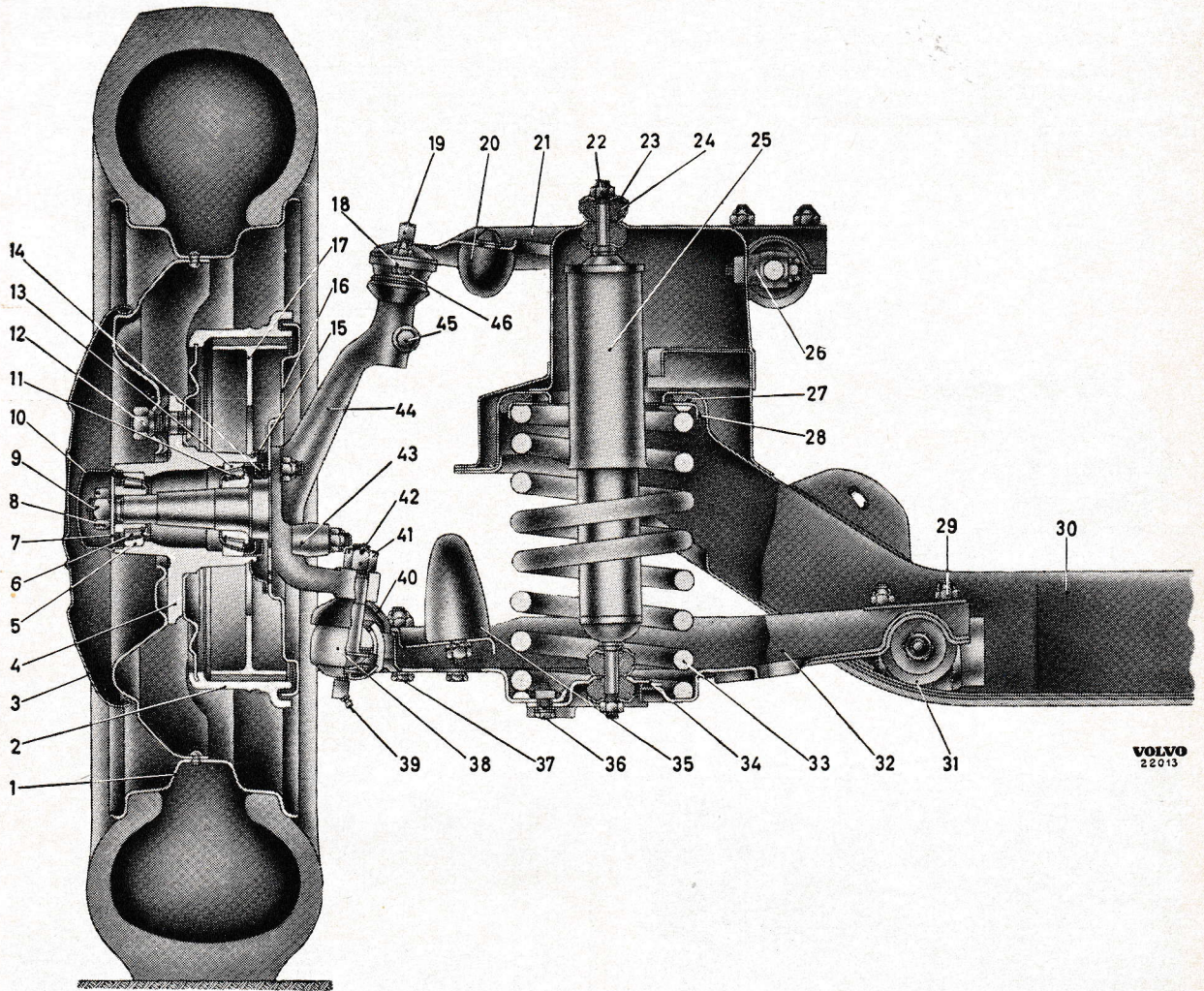
# VOLVO

GÖTEBORG SWEDEN

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# FRONT AXLE DESCRIPTION



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Fig. 1. Front axle.

- |                               |                       |                       |
|-------------------------------|-----------------------|-----------------------|
| 1. Wheel                      | 17. Brake shoe        | 33. Front spring      |
| 2. Brake drum                 | 18. Upper ball joint  | 34. Attaching washer  |
| 3. Hub cap                    | 19. Grease nipple     | 35. Rubber buffer     |
| 4. Hub                        | 20. Rubber buffer     | 36. Bolt              |
| 5. Outer ring, outer bearing  | 21. Upper control arm | 37. Bolt              |
| 6. Roller bearing, outer      | 22. Nut               | 38. Lower ball joint  |
| 7. Washer                     | 23. Washer            | 39. Grease nipple     |
| 8. Nut                        | 24. Rubber bushing    | 40. Rubber dust cover |
| 9. Split pin                  | 25. Shock absorber    | 41. Nut               |
| 10. Grease cap                | 26. Shim              | 42. Split pin         |
| 11. Roller bearing, inner     | 27. Rubber spacer     | 43. Steering rod      |
| 12. Wheel nut                 | 28. Washer            | 44. Steering knuckle  |
| 13. Outer ring, inner bearing | 29. Nut               | 45. Clamping screw    |
| 14. Sealing ring              | 30. Front axle member | 46. Bolt              |
| 15. Splash plate              | 31. Clamp             |                       |
| 16. Brake backing plate       | 32. Lower control arm |                       |

The P 120 has independent front wheel suspension. This means that there is no actual front axle, this being replaced by a robust box-section front axle member. This member is bolted to the self-supporting body and the front wheel suspension and springs are fitted at the ends of the member. The construction is illustrated in Fig. 1.

The steering knuckle (44, Fig. 1) is pivoted on the upper and lower control arms (21 and 32) by means of ball joints (18 and 38). At the inner attachments of the control arms the mo-

vement is transmitted through rubber bushings, see Fig. 2 and 3. Camber and caster are adjusted by means of shims on the upper control arm shaft and front axle member and side member respectively.

The front wheels are mounted in taper roller bearings (6 and 11, Fig. 1). The front springing consists of coil springs inside which telescopic shock absorbers are fitted. In order to increase anti-rolling properties, the car is equipped with a stabilizer which is attached to both the lower control arms and to the body.

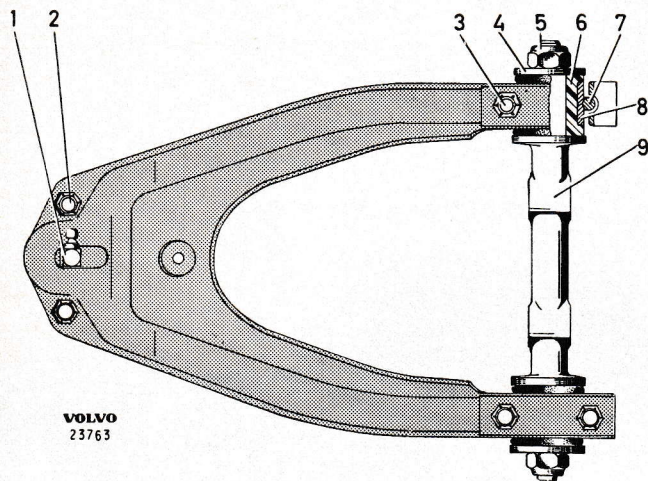
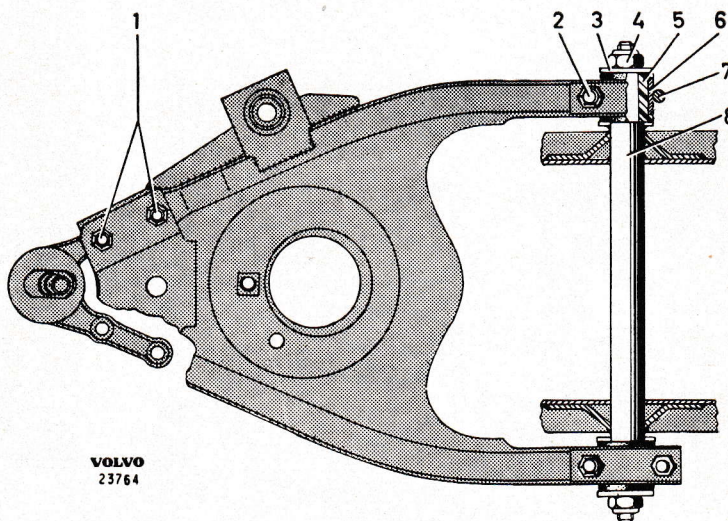


Fig. 2 Upper control arm.

1. Grease nipple
2. Attaching nut for ball joint
3. Nut for clamp
4. Flat washer
5. Nut
6. Rubber bushing
7. Clamp
8. Sleeve
9. Upper control arm shaft

Fig. 3. Lower control arm.

1. Attaching nut for ball joint
2. Nut for clamp
3. Flat washer
4. Nut
5. Rubber bushing
6. Sleeve
7. Clamp
8. Lower control arm shaft



## REPAIR INSTRUCTIONS

### Removing complete front end

1. Remove the hub caps and slacken the wheel nuts.
2. Lift up the front end so that the wheels are free. Place blocks under the body at the front jacking points.
3. Remove the wheel nuts and lift off the wheels.
4. Place a support under the front part of the engine.
5. Place a wooden block under the brake pedal. Disconnect the brake hoses from the body and plug the connections so that no dirt can enter.
6. Remove the pitman arm with the help of puller SVO 2282. See Fig. 4.
7. Disconnect the front engine mountings. Disconnect the idler arm and stabilizer from the body.
8. Place a jack under the front axle member. Screw out the front axle member attaching bolts (1, 3 and 4, Fig. 38). Take care of the adjusting shims (2, Fig. 39).
9. Lower the front axle member and pull it out forwards.

### Fitting complete front end

1. Place the front axle member on a jack and move it under the car.
2. Raise the jack so that the member comes in the right position. Place in the adjusting shims and tighten the bolts (1, 3 and 4, Fig. 41) well.

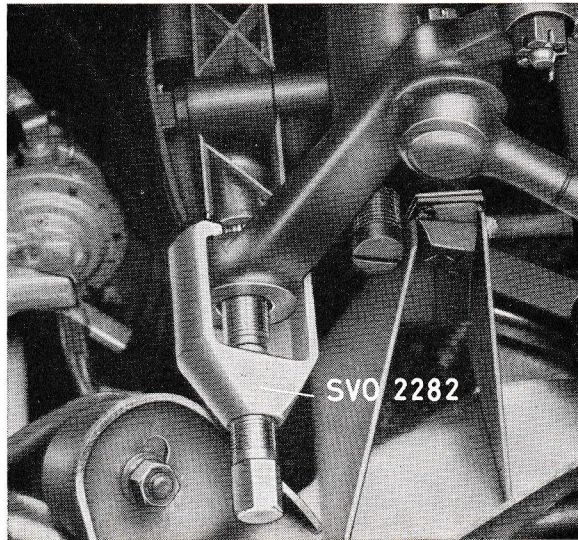


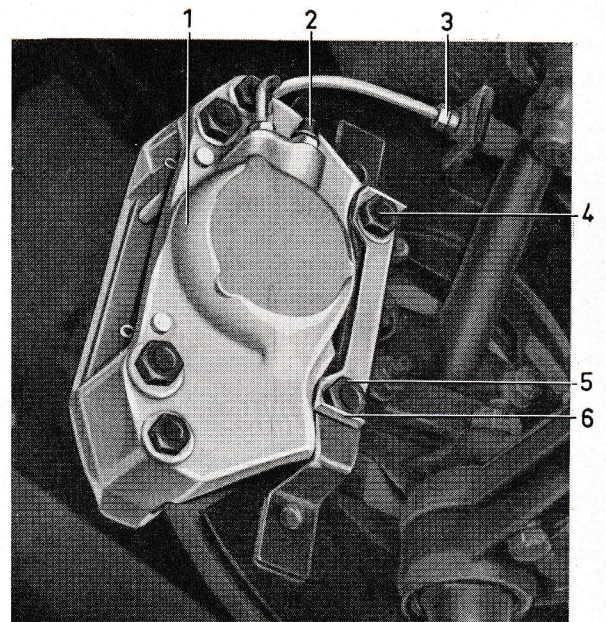
Fig. 4. Removing the pitman arm.

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3. Remove the support from under the engine and tighten down the engine onto the front engine mountings.
4. Fit the idler arm and stabilizer to the body.
5. Fit the pitman arm, where the marks on the pitman arm shaft and pitman arm should coincide. Fit the spring washer and nut.
6. Connect the brake lines and air-vent the brake system. (See Part 7, Brakes).
7. Fit the wheels and lower the car. Tighten the wheel nuts to a torque of 10—14 kgm (70—100 lb.ft.). Fit the hub caps.
8. Check the wheel alignment. See "Wheel Alignment" on page 17.

### Replacing and adjusting front wheel bearings

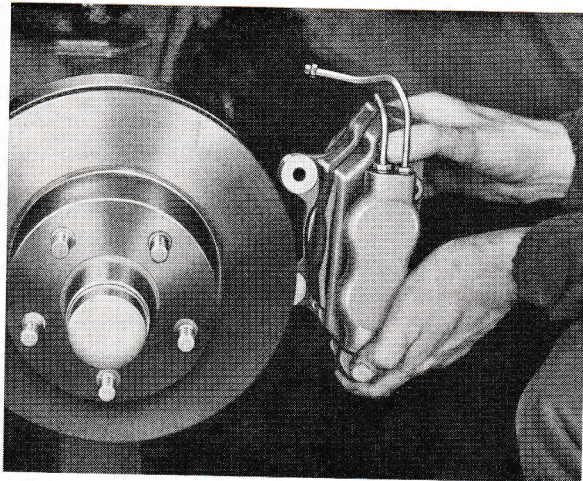
When adjusting the front wheel bearings, the hub should first be removed for inspecting the bearing races and rollers. Badly worn or scored bearings must be replaced. The complete replacement of the bearings is described below. When inspection and adjustment only are to be carried out, pass over the operations not involved.



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Fig. 5. Front wheel brake unit.

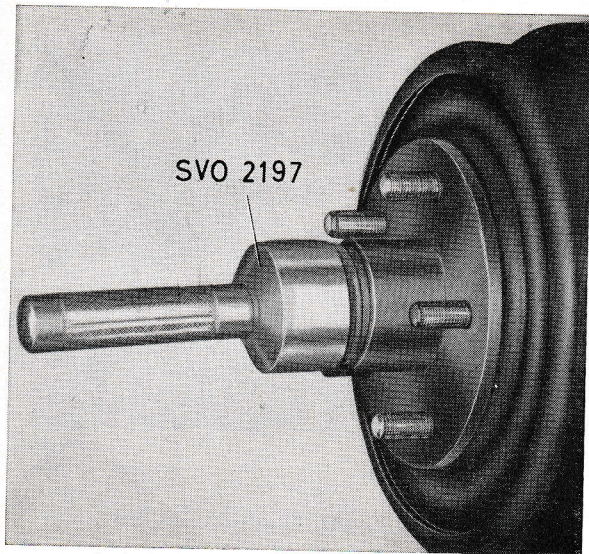
- |                       |                   |
|-----------------------|-------------------|
| 1. Caliper            | 4. Attaching bolt |
| 2. Air-venting nipple | 5. Attaching bolt |
| 3. Brake line         | 6. Locking washer |



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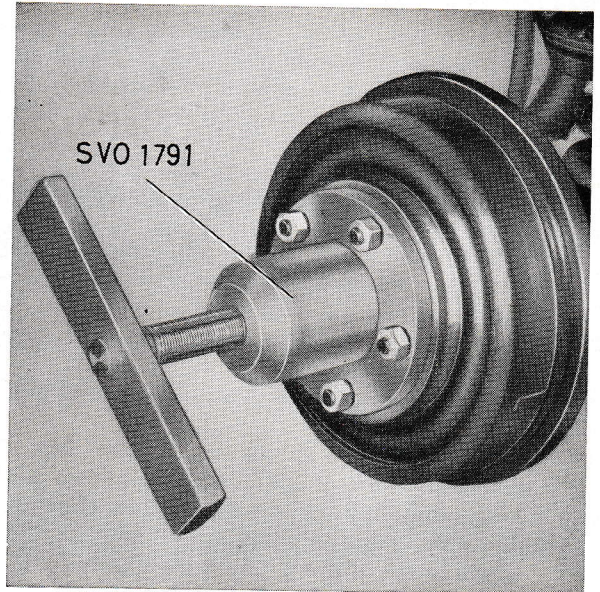
Fig. 6. Removing the front wheel brake unit.

1. Remove the hub and slacken the wheel nuts slightly.
2. Lift up the front end and place blocks under the lower control arms. Unscrew the wheel nuts and lift off the wheel.
3. (Applies only to cars with disc brakes). Disconnect the brake line (3, Fig. 5) and plug the connection. Bend up the locking washer (6) and unscrew the attaching bolts (4 and 5). Lift off the caliper (1) complete, see Fig. 6.
4. Remove the grease cap with tool SVO 2197 (Fig. 7). Remove the split pin and castle nut. Pull off the hub with puller SVO 1791 (Fig. 8). Pull off the inner bearing from the steering knuckle with puller SVO 1794 (Fig. 9) if the bearing remains in place.



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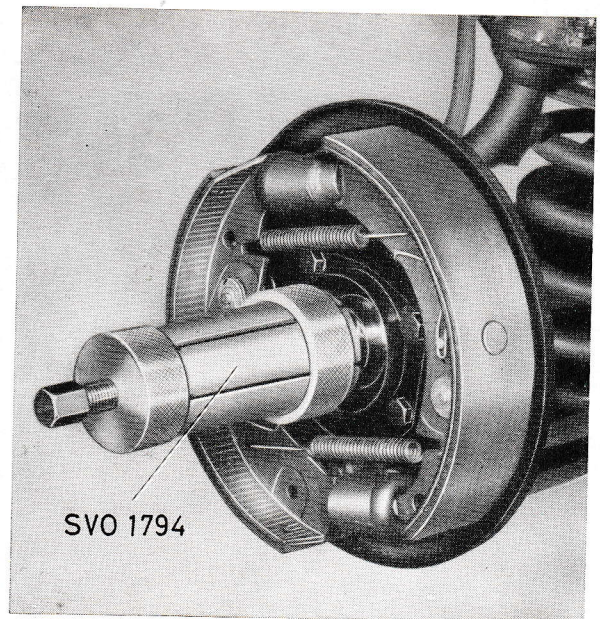
Fig. 7. Removing grease cap.



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Fig. 8. Removing hub.

5. Remove the bearing rings. For the inner bearing ring, use drift SVO 1799 (Fig. 10) and for the outer bearing ring, drift SVO 1800 (Fig. 11) together with standard handle SVO 1801.
6. Clean the hub, brake disc or brake drum and grease cap.
7. Press in the new bearing rings. In addition to the standard handle SVO 1801, drift SVO 1798 (Fig. 12) is used for the inner bearing ring and drift SVO 1797 (Fig. 13) for the outer bearing ring.



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Fig. 9. Removing the inner bearing.

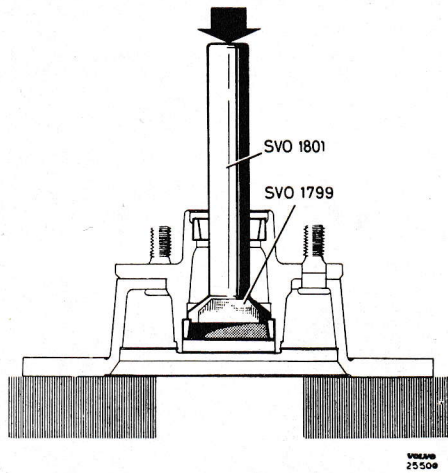


Fig. 10. Removing the inner bearing ring.

8. Press grease into the bearings with the help of a pressure lubricating apparatus. If one of these is not available, pack grease into the bearings by hand so that the space between the roller retainer and bearing inner ring is completely filled. Also coat the outer sides of the bearings and the outer rings pressed into the hub with grease. The recess in the hub should be filled up with grease all round up to the smallest diameter of the outer ring for the outer bearing, see Fig. 14. Place the inner bearing in position in the hub. Press in the sealing ring with drift SVO 1798 together with standard handle SVO 1801 (Fig. 15).
9. Place the hub on the spindle. Fit the outer bearing, washer and castle nut.
10. The front wheel bearings are adjusted by first tightening with a torque wrench to a value of 7 kgm (50 lb.ft). The nut is then slackened a  $\frac{1}{3}$  of a turn and if the recess in the nut does not coincide with split pin hole in the spindle, slacken it further until the

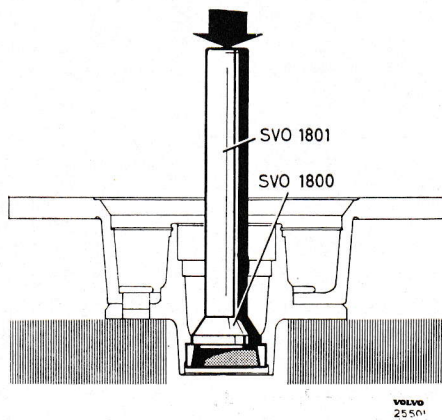
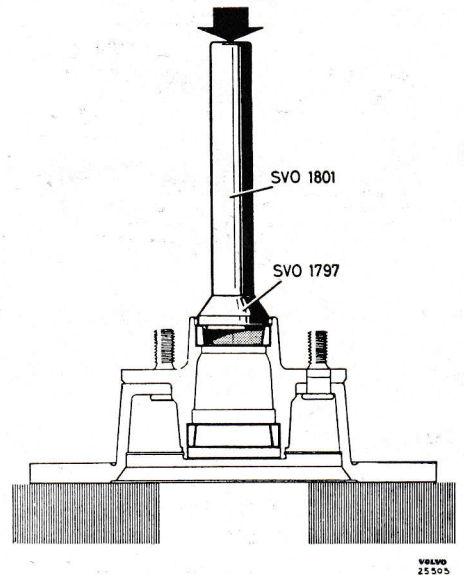


Fig. 11. Removing the outer bearing ring.



- split pin can be fitted. Check that the wheel can rotate easily but without any play.
11. Fill the grease cap half full of grease and fit it with tool SVO 2197.
12. (Applies only to cars with disc brakes). Fit the caliper and lock the attaching bolts. Connect the brake lines. Air-vent the wheel unit cylinders, see Part 7.
13. Lift on the wheel after having cleaned the contact surfaces between the wheel and hub free from all dirt and grit, and tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the car and tighten the wheel nuts. Tighten every other nut a little at a time until all are tightened to a torque of 10—14 kgm (72—100 lb.ft.). Fit the hub cap.

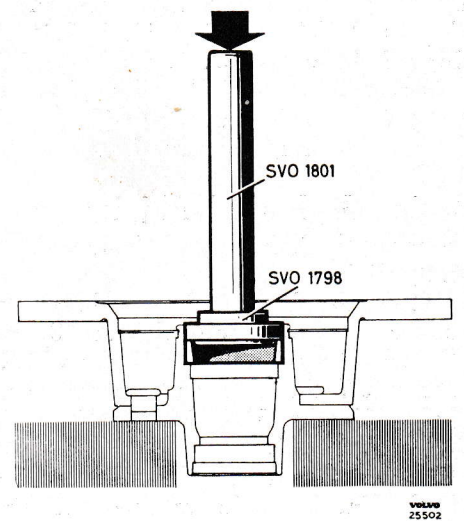


Fig. 13. Fitting the outer bearing ring.

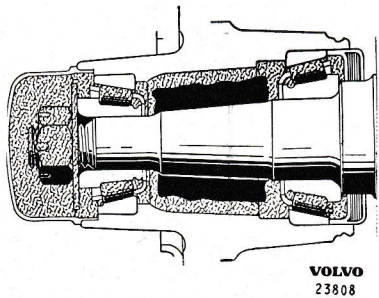


Fig. 14. Lubricating front wheel bearing.

## Reconditioning the control arm system

The ball joints cannot be dismantled or adjusted so that when worn they must be replaced.

The control arms may only be straightened to a minor extent and then only in a cold condition. If the old part deviates to any great extent when compared with a new one, it should be replaced.

### Replacing the upper ball joint

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a trestle under the lower control arm. Screw off the wheel nut and lift off the wheel.
3. Screw off the nuts and remove the bolts (46, Fig. 1). Lift the upper control arm (21).
4. Screw off the nut and remove the bolt (45). Remove the upper ball joint (18) with sealing washer and rubber dust cover from the spindle.
5. Fitting is done in the reverse order. Fill up with grease between the rubber dust cover and ball joint.

On cars with chassis numbers lower than 84300 a special ball joint for increasing the adjusting range of the front wheel alignment may be fitted. When fitting this ball joint, the attaching hole of which is displaced 2.5 mm (0.1") in relation to the ball stud, washers should be placed between the ball joint and control arm and longer attaching bolts used.

### Replacing the lower ball joint

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a trestle under the lower control arm. Screw off the wheel nuts and lift off the wheel.
3. Screw off the nuts and remove the four bolts (37, Fig. 1). Remove the split pin (42) and nut (41).
4. (On cars with disc brakes). Disconnect the brake line from the retainer. Apply tool SVO 2281 to the spindle as shown in Fig. 16. If may be necessary to bend the brake

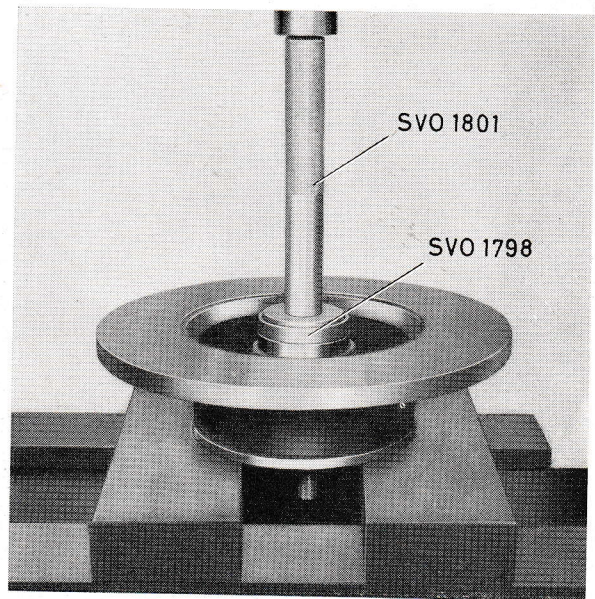


Fig. 15. Fitting sealing ring.

line retainer to one side slightly. Turn the nut on the tool until it begins to tension. Then turn the nut until the ball joint releases, but not more than 1½ turns. If the ball joint is so tight that it does not release with this, strike a few light blows with a hammer and dolly on the ball joint attachment of the spindle.

5. Fitting is done in the reverse order. The castle nut is tightened to a torque of 4.8—5.5 kgm (35—40 lb.ft.). Fill up with grease between the rubber dust cover and ball joint. Air-vent wheel unit cylinders in cases where the brake line has been disconnected.

### Replacing the upper control arm bushings

1. Remove the hub cap and slacken the wheel nuts slightly.
  2. Lift up the front end and place a trestle under the lower control arm. Screw off the wheel nuts and lift off the wheel.
  3. Screw off the nuts (3, Fig. 2) and remove the clamps (7).
  4. Bend up the locking washer, screw out the attaching bolts and remove the shaft (9). Take care of the adjusting shims.
  5. Remove the nuts (5), washers (4) and bushings (6), together with sleeves (8).
  6. Fit the new rubber bushings (6) and sleeves (8) on the control arm shaft (9). The use of a soap solution as lubricant will facilitate fitting.
- Fit the washers (4) and tighten the nuts (5). Then attach the control arm with its clamps loosely on both the bushings.

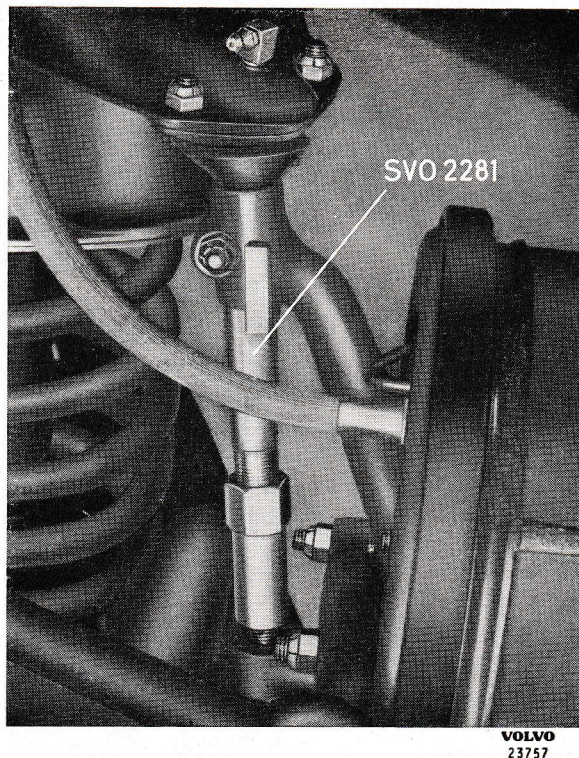


Fig. 16. Removing lower ball joint.

7. Fit the adjusting shims and attach the shaft (9) and control arm. Tighten the attaching bolts (1, Fig. 42) to a torque of 4.8—5.5 kgm (35—40 lb.ft.) and lock them with the locking plate (2).
8. Tighten the attaching nuts (3, Fig. 2) for the clamps to a torque of 2—2.5 kgm (14—18 lb.ft.). Fit the other parts in the reverse order to removing.
9. Check the wheel alignment, see under "Wheel Alignment".

### Replacing the upper control arm

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a trestle under the lower control arm. Screw off the wheel nuts and lift off the wheel.
3. Screw off the nuts (3, Fig. 2) and remove the clamps (7).
4. Remove the nuts (2) and attaching bolts for the upper ball joint and lift off the upper control arm.
5. Fitting is done in the reverse order to removing. Tighten the nuts (3, Fig. 2) for the clamps to a torque of 2—2.5 kgm (14—18 lb.ft.). Check the wheel alignment, see under "Wheel Alignment".

### Replacing the lower control arm bushings

1. Lift up the front end and block up under the front axle member.
2. Screw off the nuts (2, Fig. 3) and remove the clamps (7). Remove the nuts (4) and washers (3).
3. Place a jack under the lower control arm inside the spring and lift so that the bushings are released. Pull off the bushings (5) and sleeves (6).
4. Coat the rubber bushings (5) and sleeves (6) with soap solution and fit them on the control arm shaft (8). Fit the washers (3) and nuts (4). When tightening the nuts, the outer part of the control arm should be lifted so that the distance between the rubber buffer (35, Fig. 1) and front axle member is about 40 mm (1½").
5. Lower the control arm and fit the clamps (7) and nuts (2). Tighten the nuts to a torque of 2—2.5 kgm (14—18 lb.ft.).
6. Lower the car. Check the wheel alignment, see under "Wheel Alignment".

### Replacing the lower control arm

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and block up under the front axle member. Screw off the wheel nut and lift off the wheel.
3. Remove the nuts (22, Fig. 1), washers (23) and rubber bushings (24). Remove the bolt (36) for the attaching washer (34). Remove the washer and shock absorber (25) downwards.
4. Place a jack under the lower control arm immediately under the spring. Raise the jack until the upper control arm rubber buffer (20) lifts.
5. Disconnect the stabilizer from the lower control arm. Remove the four attaching bolts (37) and remove the lower ball joint from the control arm.
6. Lower the jack slowly and remove the spring (33) when the control arm has come sufficiently far down.
7. Remove the nuts (29) and clamps (31) at the inner attachment, after which the control arm can be lifted off.
8. Fitting is done in the reverse order. Tighten the nuts (2, Fig. 3) for the clamps to a torque of 2—2.5 kgm (14—18 lb.ft.). Check the wheel alignment, see under "Wheel Alignment".

# STEERING GEAR

## DESCRIPTION

The construction of the steering gear on the P 120 is illustrated in Figs. 17—21.

The movement of the steering wheel is transmitted to the wheel via the steering column (2, Fig. 17), steering box (8), pitman arm (11) tie-rod (12), idler arm (15) and the steering rods (7, and 17) and steering arms (5 and 18).

The steering box (Fig. 18) is of cam and roller type. The early type idler arms (Figs. 19 and 20) are carried in needle bearings and the late

type (Fig. 21) in bushings. The steering column is divided into two parts (2 and 6, Fig. 17) joined with a coupling (3).

The upper part of the steering column is carried in bearings in the jacket tube. The ball joints in the steering system are lined with plastic making lubrication unnecessary.

The car has a turning circle of about 9.5 m (32 ft.). The number of steering wheel turns from lock to lock is  $3\frac{1}{4}$ .

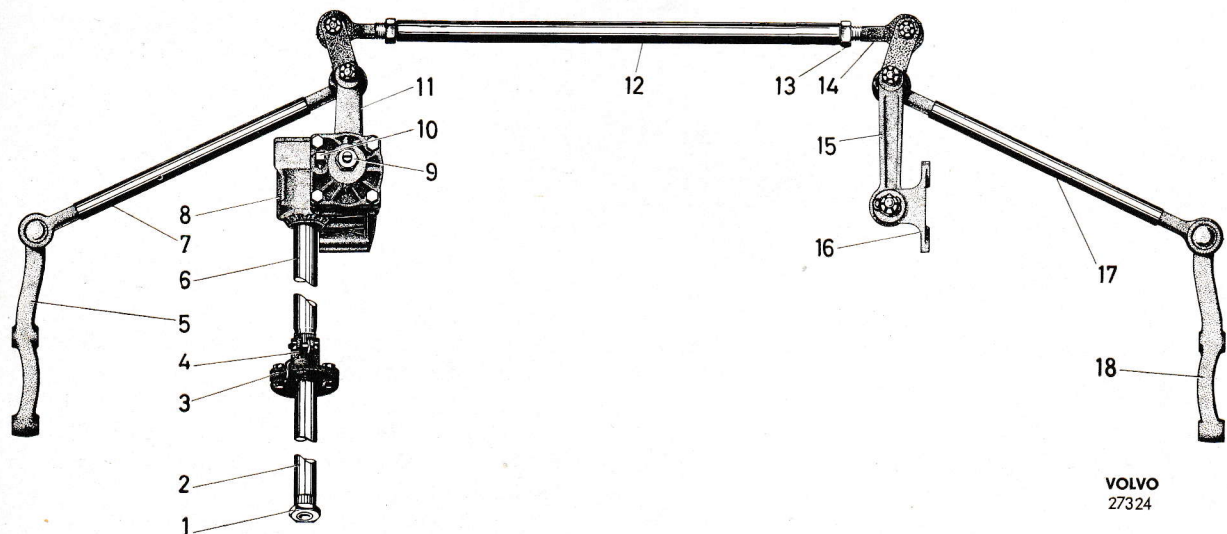
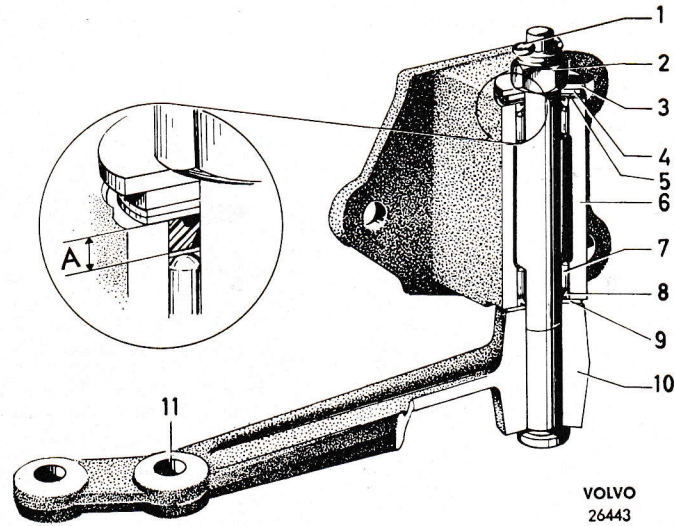


Fig. 17. Steering gear.

- |                                |                           |
|--------------------------------|---------------------------|
| 1. Steering wheel nut          | 10. Oil filling plug      |
| 2. Steering column, upper part | 11. Pitman arm            |
| 3. Coupling disc               | 12. Tie-rod               |
| 4. Flange                      | 13. Clamping nut          |
| 5. Left steering arm           | 14. Tie-rod end           |
| 6. Steering column, lower part | 15. Idler arm             |
| 7. Left steering rod           | 16. Bracket for idler arm |
| 8. Steering box                | 17. Right steering rod    |
| 9. Adjusting screw             | 18. Right steering arm    |

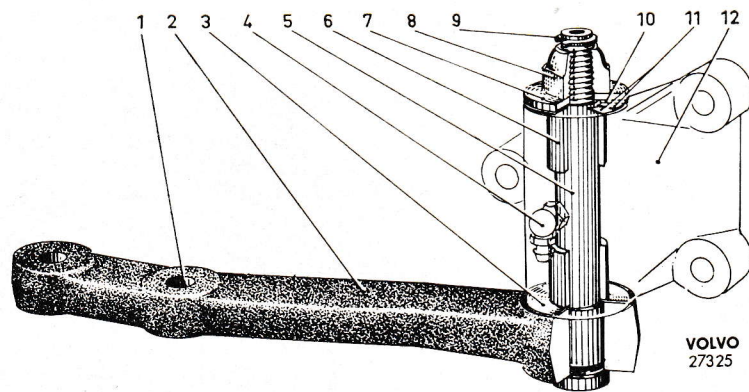




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Fig. 20. Mounting of idler arm, type II.

- |                     |                           |
|---------------------|---------------------------|
| 1. Split pin        | 7. Needle bearing         |
| 2. Nut              | 8. Sealing ring           |
| 3. Flat washer      | 9. Vulcollan washer       |
| 4. Vulcollan washer | 10. Idler arm             |
| 5. Shims            | 11. Hole for steering rod |
| 6. Bracket          |                           |



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Fig. 21. Mounting of idler arm, type III.

- |                          |                      |
|--------------------------|----------------------|
| 1. Hole for steering rod | 7. Washer            |
| 2. Idler arm             | 8. Nut               |
| 3. Vulcollan washer      | 9. Locking ring      |
| 4. Grease nipple         | 10. Vulcollan washer |
| 5. Shaft                 | 11. Shims            |
| 6. Bushing               | 12. Bracket          |

## REPAIR INSTRUCTIONS

## Replacing the steering wheel

1. Unscrew both the attaching bolts on the underside of the steering wheel spokes and remove the horn ring upwards.
2. Bend up the locking washer and remove the steering wheel nut. Mark the position of the steering wheel.
3. Set the direction indicator switch in the neutral position. Pull off the steering wheel with puller SVO 2263 (Fig. 18).
4. Fit the new steering wheel, paying attention to the marking. The steering wheel spokes should be horizontal when the wheels are pointed straight forwards. Tighten the steering wheel nut to a torque of 3.5—5.0 kgm (25—35 lb.ft.) and then lock with the locking washer.
5. Fit the horn ring and check its function.



Fig. 22. Removing the steering wheel.

## Steering gear

## Removing

1. Disconnect the horn lead from the junction piece.
2. Unscrew the two nuts (2 and 4, Fig. 23) and remove the bolts.
3. Remove the pitman arm with puller SVO 2282 (Fig. 4).
4. Unscrew and remove the three attaching bolts (6, Fig. 23).
5. Lift up and turn the steering box as shown in Fig. 24. Pull out the horn lead (3) from the lower section of the steering column and steering box. Lift out the steering box but be careful when the carrier (2) is moved past the brake line (1).

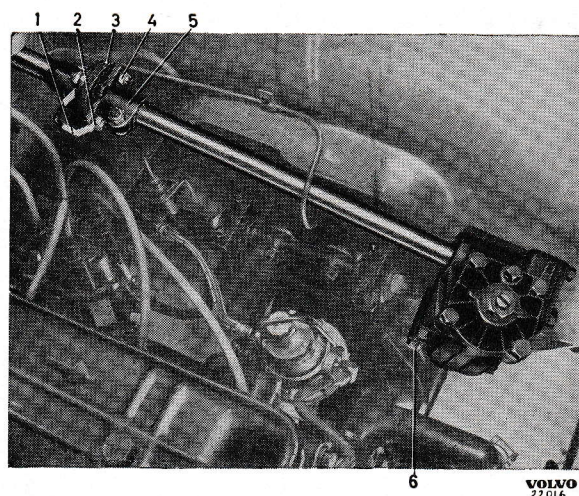


Fig. 23. Steering box.

- |                  |            |
|------------------|------------|
| 1. Earth lead    | 4. Nut     |
| 2. Nut           | 5. Carrier |
| 3. Coupling disc | 6. Bolt    |

## Dismantling

1. Wash the steering box clean externally and remove the carrier (5, Fig. 23) from the steering column.
2. Remove the four bolts (1, Fig. 17) for the upper cover (5), pull up the cover and pitman arm shaft slightly and drain off the oil. Pull out the cover and pitman arm shaft.

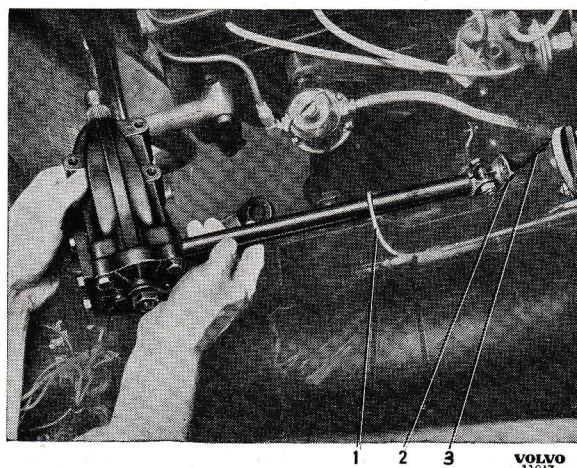
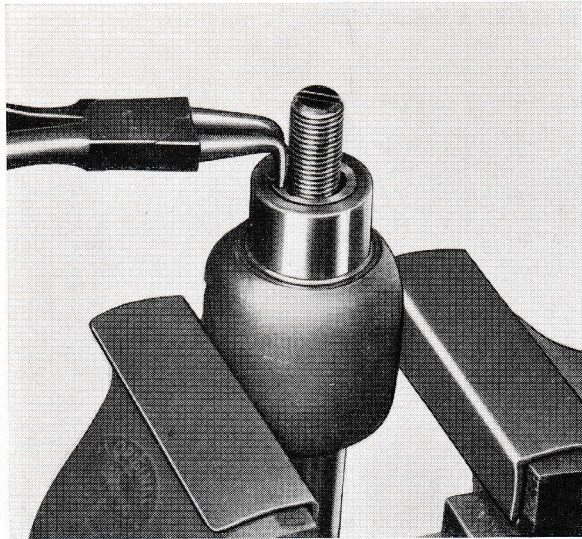


Fig. 24. Removing the steering box.

- |               |
|---------------|
| 1. Brake line |
| 2. Carrier    |
| 3. Horn lead  |



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Fig. 25. Removing the adjusting screw.

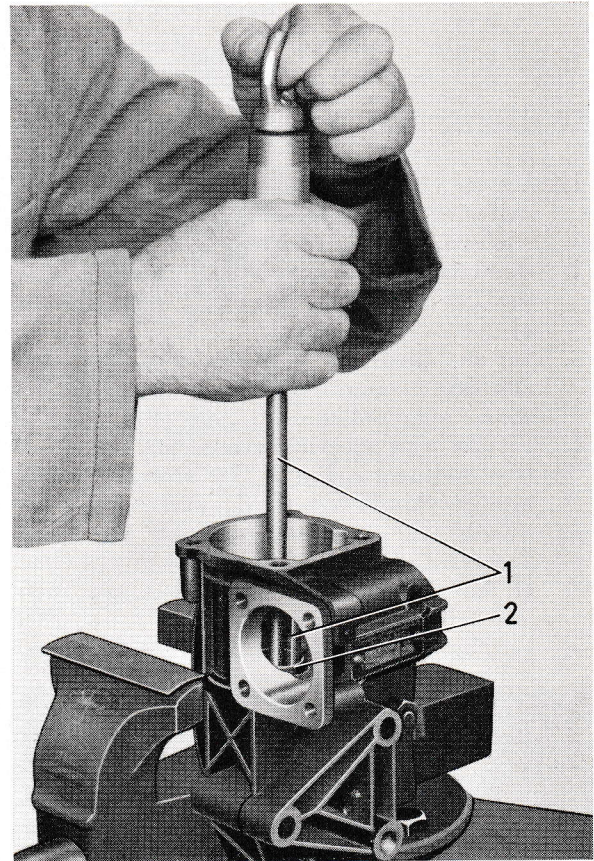
### Inspecting

3. Remove the bolts and lower cover (17). Take care of the adjusting shims (20).
4. Knock the steering column (10) carefully so that the lower bearing outer race comes out of the housing. Remove the steering column (10) with bolt and bearing.
5. Slacken the locknut (3) and screw the adjusting screw (2) out of the cover. The adjusting screw can be removed from the pitman arm shaft after the locking ring has been taken off, see Fig. 25.

Clean all parts in white spirit or similar. Examine the sealing rings. If these show the slightest signs of damage or wear, they must be replaced. Removing is done with the help of puller SVO 4030 or with a screwdriver. Check the pitman arm shaft. The roller must not be scratched scored or noticeably worn on the contact surfaces or be loose in the pitman arm shaft. If so, or if the pitman arm shaft is damaged in any other way, it must be replaced.

Examine the steering worm contact surfaces with the roller and the inner races of the ball bearings. If there are scratches, scoring or noticeable wear, the steering worm with steering column must be replaced. Examine the outer rings and ball of the bearings. Any scratched or damaged bearing parts must be replaced. The upper bearing outer ring is removed with puller SVO 1819 or, if the sealing ring is removed, with drift SVO 1708.

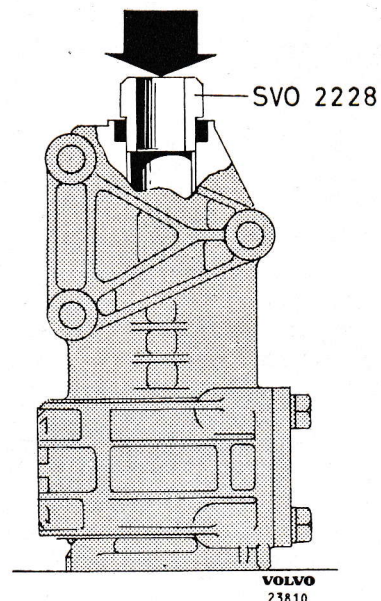
Check to see whether the pitman arm shaft is loose in the bushings. If so, the bushings in the housing must be replaced, when they are removed in either direction with puller SVO 1819 (Fig. 26). The bushing in the pitman arm shaft cover cannot be removed so that the complete cover must be replaced.



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Fig. 26. Removing the pitman arm shaft bushing.

1. SVO 1819
2. Pitman arm shaft bushing



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Fig. 27. Fitting the pitman arm shaft bushing.

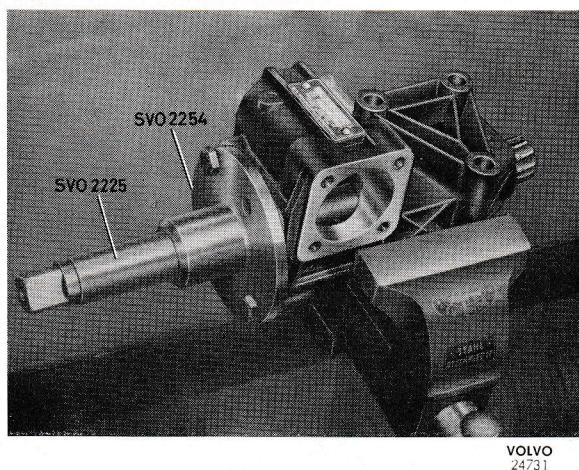


Fig. 28. Reaming the pitman arm shaft bushings.

### Assembling

1. Press in the pitman arm shaft bushings from either direction with drift SVO 2228 and standard handle SVO 1801, see Fig. 27. Ream the bushings with reamer SVO 2225. Use the guide SVO 2254, which is attached to the housing with two bolts, see Fig. 28. Thoroughly clean all metal chippings from the housing after reaming.
2. Fit the sealing rings for the pitman arm shaft and steering column with the help of drift SVO 2227.
3. If the outer race of the upper bearing has been removed, this should be pressed in with a suitable drift. Press it in so that it lies flush against the shoulder in the housing.
4. Fit the steering column with bearings in the housing carefully so as not to damage the sealing ring. Secure the steering box housing in a vice so that the steering column comes horizontally. Fit the lower cover and washer together with adjusting shims of the same thickness as were fitted

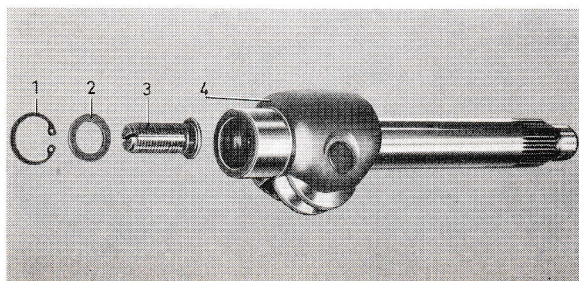


Fig. 29. Pitman arm shaft.

- |                 |                                 |
|-----------------|---------------------------------|
| 1. Locking ring | 3. Adjusting screw              |
| 2. Washer       | 4. Pitman arm shaft with roller |

earlier. Tighten the cover while checking that the steering wheel turns easily but without any play. When the bearings are correctly adjusted, it should require a torque of 1—2,5 kgcm (0.87—2.17 lb.in.) to turn the steering column.

5. Fit the adjusting screw, washer and locking ring on the pitman arm shaft, see Fig. 29. The axial clearance of the adjusting screw should be as small as possible and should not exceed 0.05 mm (0.002"). The clearance is reduced by replacing the washer (2) with a thicker one. The adjusting screw should, however, be easy to turn after fitting.
6. Apply the protecting sleeve SVO 2199 as shown in Fig. 30 and fit the pitman arm shaft in the steering box housing. Apply a few drops of oil to the adjusting screw in the pitman arm shaft.

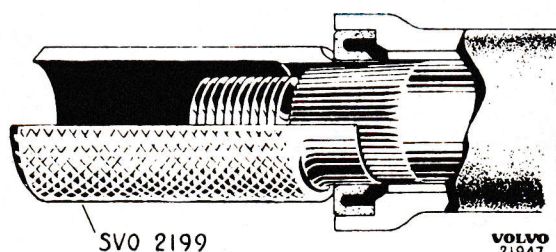


Fig. 30. Fitting the pitman arm shaft.

7. Fit the cover and gasket over the pitman arm shaft. Screw up the adjusting screw sufficiently far so that the pitman arm shaft is not pinched when the attaching bolts are tightened.
8. Set the steering column in the centre position. Screw in the adjusting screw until a noticeable resistance is felt when turning backwards and forwards over the centre position.

Attach a spring balance at a distance of 210 mm (8<sup>1</sup>/<sub>4</sub>" ) from the pivoting centre. The spring balance can be attached on a balance rod fitted on the steering column as shown in Fig. 31.

Screw back the adjusting screw until the spring balance gives a reading of 0.4—0.7 kg (0.88—1.54 lb.) when it turns the steering column over the centre position. Pulling should be done at right-angles to the steering column (see Fig. 28) and the steering box should be secured in such a way that the steering column is horizontal when measuring. When the correct adjustment has been obtained, the adjusting screw is locked with the stop nut. Repeat the test when the stop nut has been tightened.

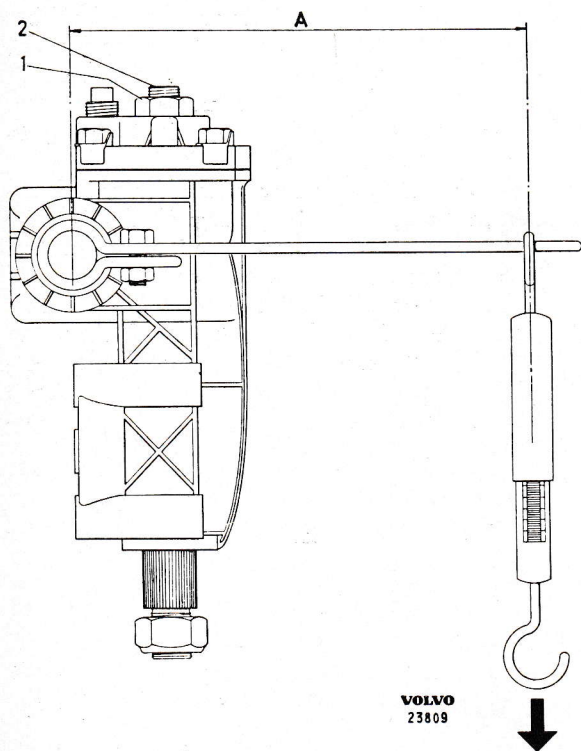


Fig. 31. Checking the tension between cam and roller.

- 1. Locknut
  - 2. Adjusting screw
- "A" = 210 mm (8 1/4")

- 9. Fit the carrier on the steering column in the same position it had before removing.
- 10. Fill up the steering box with 0.25 litre (3/8" Imp. pint = 1/2 US pint) of SAE 90 hypoid oil.

**Fitting**

- 1. Place the steering worm in position. Be careful when moving the carrier past the brake line. Fit the attaching bolts (6, Fig. 23).
- 2. Assemble the carrier (5) to the coupling disc (3). Do not forget the earth lead (1).
- 3. Adjust the position of the steering worm so that there is the least possible strain on the coupling disc, that is to say, the upper and lower parts of the steering column should form a straight line. Tighten the attaching nuts (6).
- 4. Fit the pitman arm so that the mark on the pitman arm shaft coincides with the mark on the pitman arm.
- 5. Check that the steering wheel spokes are horizontal when the wheels point straight forwards. If not, take off the steering wheel and alter its position. See under "Replacing the steering wheel".

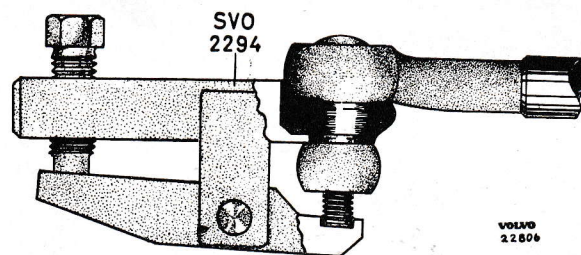


Fig. 32. Removing ball joint.

**Reconditioning the steering rod and tie-rod**

The steering rod and tie-rod must not be straightened, but any rod which is bent or damaged must be replaced.

The ball joints cannot be dismantled or adjusted so that when worn or damaged they must be replaced.

The steering rod ball joints are made integrally with the steering rod so that the rod must be replaced complete. When removing, the split pins and castle nuts are first removed. Tool SVO 2294 is then placed on the ball joint as shown in Fig. 32. Press in the tool properly and make sure that the thread on the ball joint enters the recess in the tool. Screw in the screw until the ball joint releases. If the steering rod is to be removed without taking off the wheels, the ball joint on the pitman arm and idler arm respectively must first be disconnected as above. When doing this the steering rod is turned forwards and upwards and the tool placed on the ball joint as shown in Fig. 33.

The tie-rod ball joints can be replaced independently. When replacing, the ball joint is first disconnected from the pitman arm or idler arm respectively as above (see Fig. 32). The locknut or clamping screw respectively is then slackened and the ball joint screwed out. The new ball joint to start with is screwed in the same number of turns so as to facilitate adjusting toe-in. Lock the ball joint to the rod.

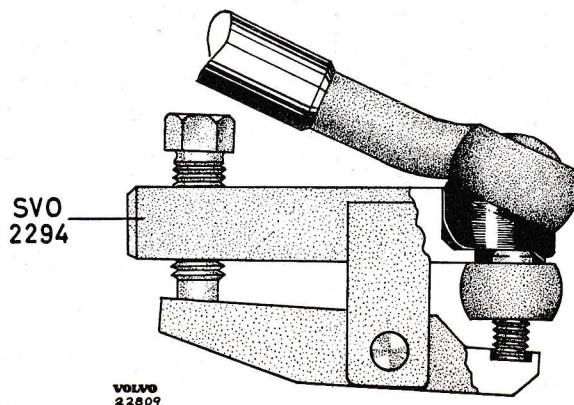


Fig. 33. Removing the steering rod.

When replacing the ball joint dust covers, these should be filled with grease.

When the ball joint is fitted to the pitman arm, the ball stud is turned so that the split pin hole is located across the longitudinal direction of the rod. Tighten the castle nut to a torque of 3.2—3.7 kgm (23—27 lb.ft.) and lock it with the split pin.

After completing reconditioning work on the rods and ball joints, the toe-in must always be checked.

### Replacing the jacket tube and jacket tube bearings

1. Remove the steering wheel, see under "Replacing the steering wheel".
2. Unscrew the screws for the attachment. Remove the directional indicator switch and lever, see Part 10. Then pull the jacket tube off the steering column.
3. If only the bushings or bearings in the jacket tube are to be replaced, the old ones are first knocked out with a suitable drift or pulled out with a puller. After this the new parts are pressed carefully into the jacket tube.
4. Check that the rubber bushings for the jacket tube attachments are undamaged. Then fit the jacket tube and other parts in the reverse order to removing and as shown in the figure in the case of late production. In early production, the bushings should be smeared with a thin coating of ball bearing grease. Tighten the steering wheel nut to a torque of 3.5—5.0 kgm (25—35 lb.ft.) and do not forget to lock it.

### Reconditioning the idler arm and bracket

#### Removing

1. Lift up the front end and place trestles under the lower control arms.
2. Screw back the screw on puller SVO 2294 and place the tool on the tie-rod ball joint at the idler arm as shown in Fig. 32. Press in the tool properly and make sure that the thread on the ball joint enters the recess in the tool. Screw in the screw until the ball joint releases from the idler arm.
3. Disconnect the steering rod from the idler arm in a corresponding manner.
4. Remove the three attaching bolts of the bracket and lift off the bracket with idler arm.

#### Dismantling

1. Remove the split pin or locking ring respectively and the nut. Pull out the idler arm with shaft. Take care of the washers and adjusting shims.

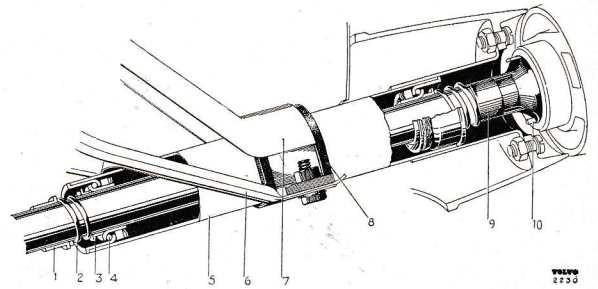


Fig. 34. Steering column bearing, late production.

- |                 |   |
|-----------------|---|
| 1. Sleeve       | 6. Steering column stay, lower (early production) |
| 2. Spring       | 7. Steering column stay, upper                    |
| 3. Seating      | 8. Rubber bushing                                 |
| 4. Ball bearing | 9. Actuator                                       |
| 5. Jacket tube  | 10. Slotted pin                                   |

2. Secure the bracket in a vice and pull out the needle bearings with a bearing puller, for example, SVO 4090, see Fig. 35. The bushings are removed with drift SVO 2498.



Fig. 35. Removing the needle bearing.

## Inspecting

Clean all parts and inspect them. Any damaged parts or those which shows signs of wear should be replaced.

## Assembling

1. Press in the new needle bearings or bushings respectively. In the case of type I idler arm mounting (Fig. 19), pressing in is done flush with the outer side. On type II (Fig. 20), the needle bearings are pressed in so that measurement A is 3.2—3.5 mm (0.126—0.138"). The sealing rings are

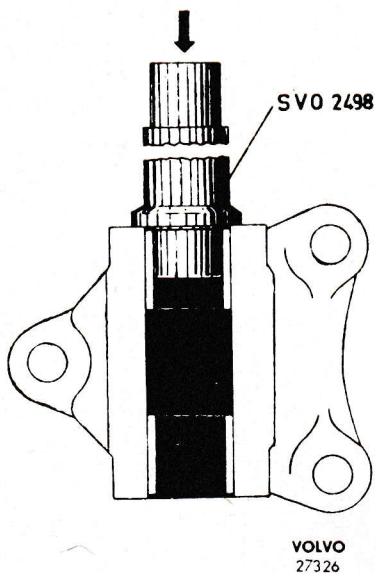


Fig. 36. Fitting the bushing.

fitted in these spaces with the lip turned outwards. On type III (Fig. 21) the bushings are pressed in 0.3—0.5 mm (0.012—0.020") inside the outer face with the help of drift SVO 2498 (Fig. 36). Check the fit of the shaft in the bearings. The shaft should turn easily but without any play. On type III the bushings are reamed with reamer SVO 4153.

2. Fill the bearings and the space between them with chassis grease. Also lubricate the vulcollan washers on both sides.
3. Fit the other parts as shown in Figs. 19—21. The nut is tightened to a torque of 7 kgm (50 lb.ft.).
4. After assembling there must be no play in the bearings. When adjusted correctly, a turning torque of  $15 \pm 5$  kgm ( $13 \pm 4.3$  lb.in.) is required. When, for example, pulling on the idler arm at the steering rod hole (the inner hole) at right-angles, a spring balance should give a reading of 0.7—1.3 kg (1.54—2.86 lb.). If this result is not obtained when checking, the bearings must be taken apart and adjusted with shims of suitable thickness. When the correct torque has been obtained, the split pin or locking ring respectively is fitted.

## Fitting

Fit the bracket in position and tighten the attaching bolts well. Fit the steering rod in the inner hole of the idler arm and the tie-rod in the outer hole. Tighten the castle nuts to a torque of 3.2—3.7 kgm (23—27 lb.ft.) and lock them with split pins.

# WHEEL ALIGNMENT

In order for the car to have good steering properties and a minimum of tyre wear, the front wheels must have certain pre-determined adjustments, generally known as wheel alignment. Wheel alignment consists of caster, camber, king pin inclination, toe-out and toe-in.

## Caster

Caster generally refers to the longitudinal inclination (forwards or backwards) of the king pin. On this car, which does not have a king pin, caster consists of the angle between a vertical line and a line through the centre of the ball joints (A, Fig. 37).

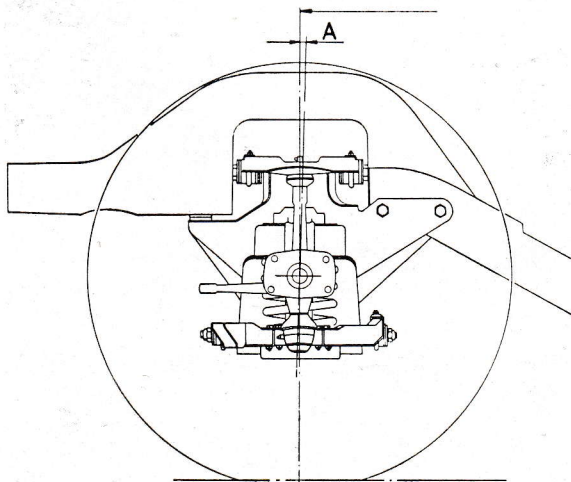
Caster has the effect of causing the wheels to run straight forward thus facilitating steering.

## Camber

Camber is the inclination of the wheel outwards or inwards. Camber is positive if the wheel is inclined outwards (C, Fig. 38) and negative if the wheel inclines outwards. Faulty camber causes uneven tyre wear.

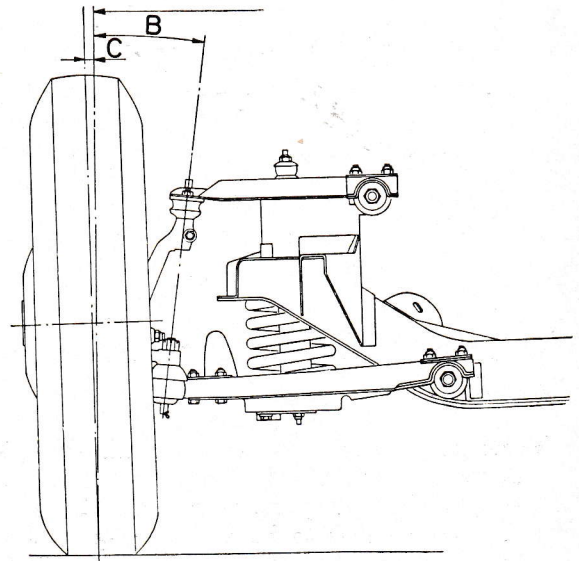
## King pin inclination

King pin inclination means the inclination of the king pin inwards. Since this car does not have a king pin, the inclination is represented by the angle made between a vertical line and a line through the centre of the ball joints (B, Fig. 38).



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Fig. 37. Caster.



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Fig. 38. Camber and king pin inclination.

B = King pin inclination  
C = Camber

King pin inclination causes the centre lines of the ball joints and the wheel to approach each other towards the road surface. In this way the wheel is easier to turn. The inclination also assists the tendency of the wheel to run straight forward since the car is lifted very slightly when the wheels are turned.

## Toe-out

When driving round a bend the wheels roll at different radii. In order for them to have the same pivoting centre and consequently minimum tyre wear, the front wheels must be turned to different extents. This relationship, known as toe-in, is determined by the shape of the steering rod and steering arms. See Fig. 39.

## Toe-in

The difference in the distances (A and B, Fig. 39) between the wheels measured at hub height at the front and rear of the tyres is known as toe-in. Toe-in has the purpose of reducing tyre wear.

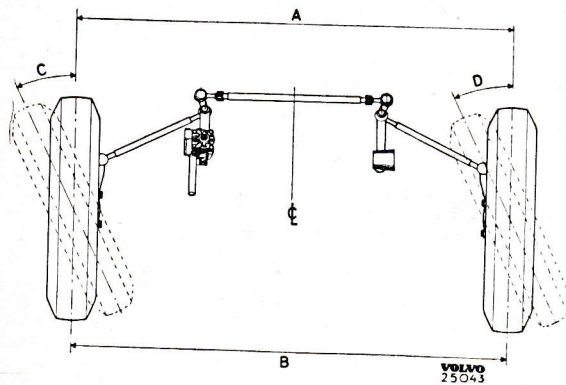


Fig. 39. Toe-out.

## Measuring and adjusting wheel alignment

Wheel alignment is measured with special measuring instruments of which there are a number of different types. No general description can be given as to how measuring should be carried out except in the case of toe-out. The measuring principle is that camber is measured directly with the wheels pointing straight forwards. Caster and king pin inclination cannot be measured direct. Instead the angular alteration which occurs when the wheel is turned from  $20^\circ$  outwards to  $20^\circ$  inwards is measured on the instruments.

Most types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack. This is not sufficient on cars with Duo-Servo brakes since the brake shoes in this system have a certain amount of reciprocating travel. On such cars, therefore, the brake drum should be locked mechanically to the brake backing plate when measuring. This can be done, for example, by applying welding pliers between the drum and brake backing plate on each front wheel (see Fig. 40), when it is not necessary to use a pedal jack.

*When measuring wheel alignment, follow the instructions applying for the measuring instruments concerned.*

## Checks to be carried out before adjusting

Before any adjusting is carried out, the following points should be checked and any defects remedied.

1. Check the air pressure in all tyres.
2. Check that the front wheel tyres are evenly worn. If not, replace them with the rear wheel tyres or the spare wheel.
3. Check that the wheels are not warped more than 2.5 mm (0.1") and that the radial throw does not exceed 2.5 mm (0.1")

4. Check the front wheel bearings and steering knuckle bushings together with shock absorbers.
5. Check that the control arms are undamaged and firmly attached to the front axle member. Check that the control arm bushings do not have excessive play.
6. Check that the springs are undamaged and are not fatigued.
7. Check the clearance and adjustment of the steering box. With the steering box in the centre position, the wheels should point straight forwards.
8. Check the steering rod, steering arms, idler arm and tie-rod.
9. Ensure that the car has normal equipment (oil, water, petrol and tools), but is otherwise unloaded.

NOTE. Front wheel alignment must always be adjusted in the following order:

1. Caster
2. Camber
3. Toe-out

## Adjusting caster

On cars with chassis numbers up to 2610 the caster should be  $0 \pm 1/2^\circ$  and with effect from chassis number 2611 onwards 0 to  $+1^\circ$ . If it is the same on both sides, but incorrect, this is adjusted by means of shims (2, Fig. 41) between the front axle member and side member. When adjusting, the front end is lifted and trestles placed under the body at the jacking points. After the front axle member attaching bolts (1, 3 and 4, Fig. 41) have been slackened, the requisite number of adjusting shims are added or removed in order to obtain the correct caster.

The attaching bolts are tightened before a new measurement is made.

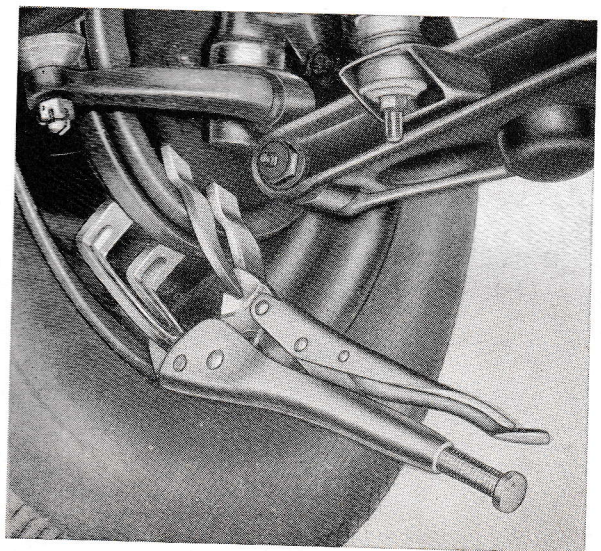


Fig. 40. Locking the brake drum.

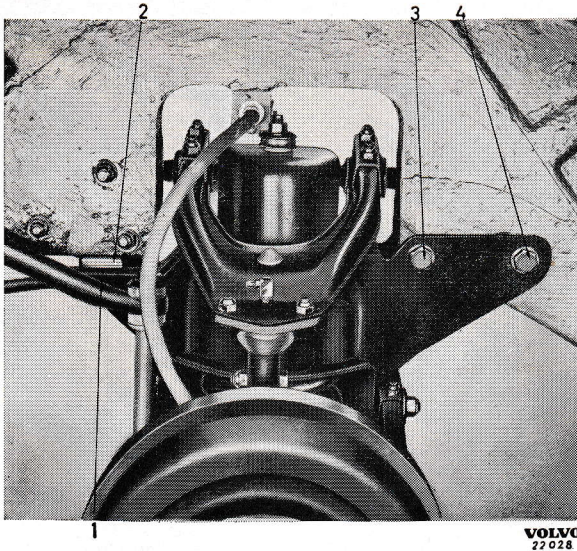


Fig. 41. Adjusting caster.

- |                    |         |
|--------------------|---------|
| 1. Bolt            | 3. Bolt |
| 2. Adjusting shims | 4. Bolt |

Shims for adjusting the caster at the front axle member — side member are available in thicknesses of 2 and 3 mm (0.079 and 0.118"). The extent to which caster is altered by these shims is shown in the diagram, Fig. 43.

NOTE. The alteration must be the same on both sides in order to avoid extra stress in the front axle member.

When the caster is different on the right and left sides, adjustment is done at the upper control arm shaft, see Fig. 42. Slacken the attaching bolts (1) so that the adjusting shims can be lifted up. These are stocked in thicknesses of 0.15; 0.5; 1; 3 and 6 mm (0.006; 0.012; 0.039; 0.118 and 0.236"). The extent to which these alter the caster is shown in the diagram, Fig. 43. The same alteration is obtained if a shim is removed from one of the attaching bolts or if it is added to the other. In both cases the camber is altered slightly and the procedure will therefore partly depend on how much it is required to alter this. When the camber is correct, caster is adjusted by removing shims. Always tighten the attaching bolts to a torque of 4.8—5.5 kgm (35—40 lb.ft.) before making a new measurement. When the correct caster has been obtained, the attaching bolts are locked with the locking plate (2).

### Adjusting camber

The camber should be 0 to  $+1/2^\circ$  and is adjusted by means of shims (3, Fig. 42) at the upper control arm shaft. When doing this, the attaching bolts (1) are slackened slightly. The number of shims is increased or reduced depending on the angular fault. After adjusting, the attaching bolts are tightened to a torque of

4.8—5.5 kgm (35—40 lb.ft.) and the camber checked. Adjusting shims are stocked in the following thicknesses: 0.15; 0.5; 1; 3 and 6 mm (0.006; 0.012; 0.039; 0.118 and 0.236"). The extent to which the shims alter the angle can be seen from the diagram, Fig. 43.

NOTE. Adjusting shims of the same thickness must be removed or added to both the attaching bolts as otherwise the caster will be altered.

When the correct camber has been obtained, the attaching bolts are locked with the locking plate (2).

### Checking king pin inclination

The king inclination, which on this car is represented by the inclination of the centre line of the ball joints, should be  $8^\circ$  at a camber of  $0^\circ$ .

### Checking toe-out

1. Place the front wheels of the car on turntables and ensure that the wheels point straight forwards. Before the car is placed on them, the turntables must be set to 0 and locked.
2. Turn the wheels to the left until the right wheel has turned  $20^\circ$  inwards. The scale on the left turntable should then read  $22.5 \pm 1^\circ$ .

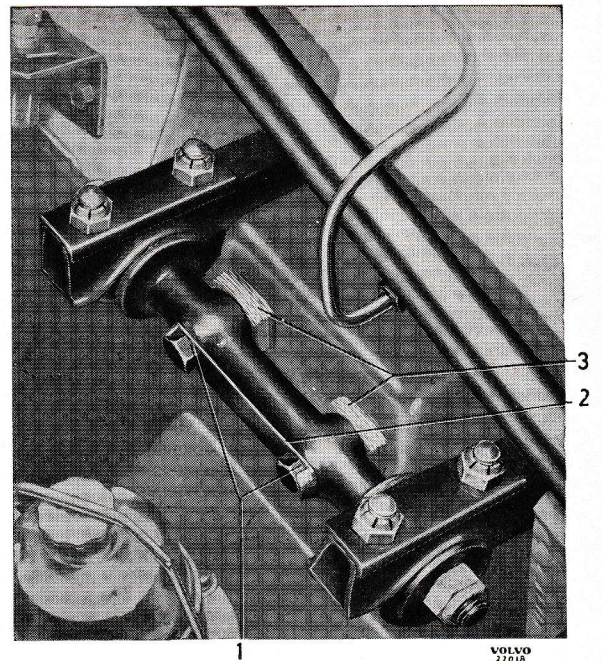


Fig. 42. Adjusting caster and camber.

- |                  |
|------------------|
| 1. Bolts         |
| 2. Locking plate |
| 3. Shims         |

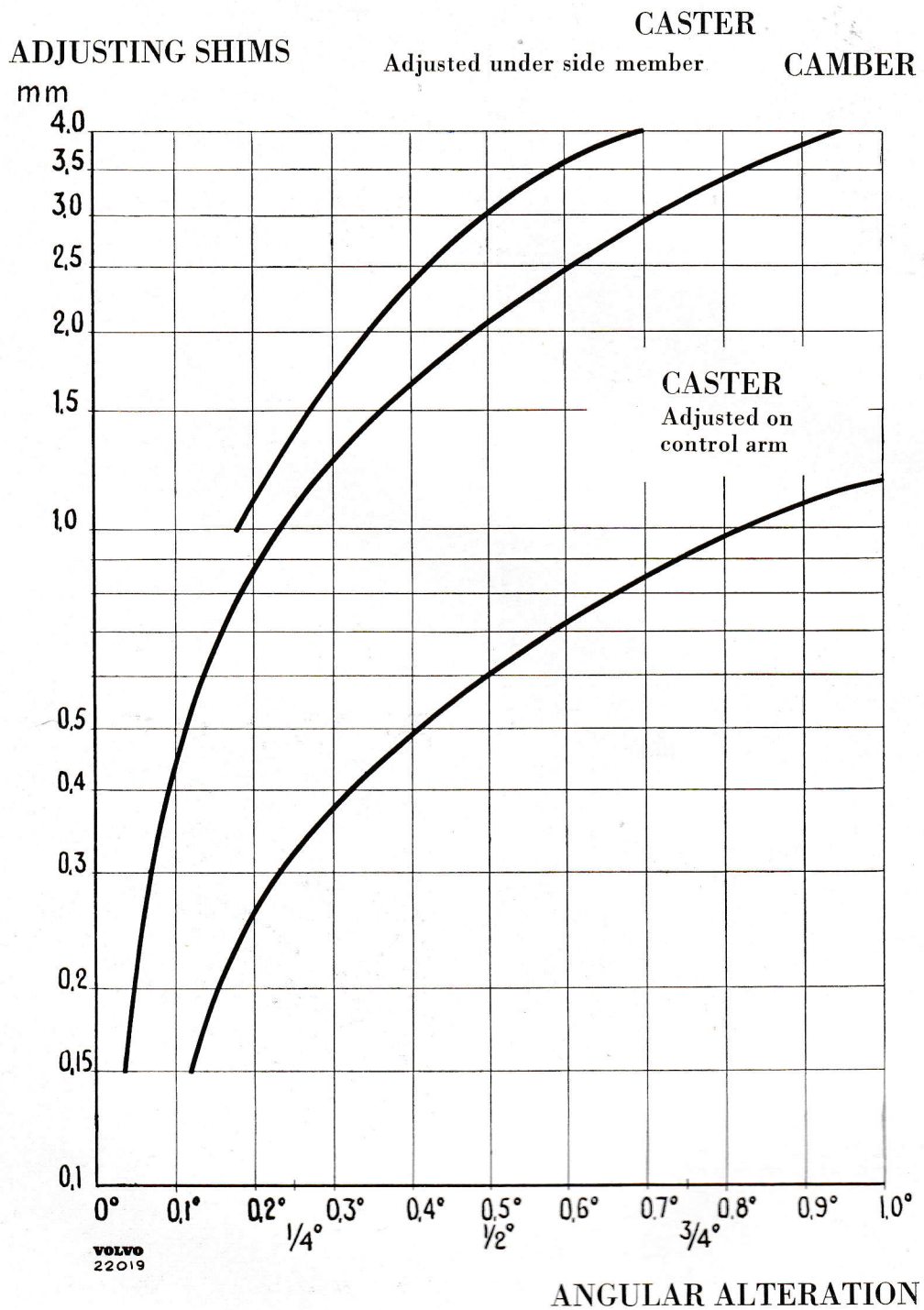
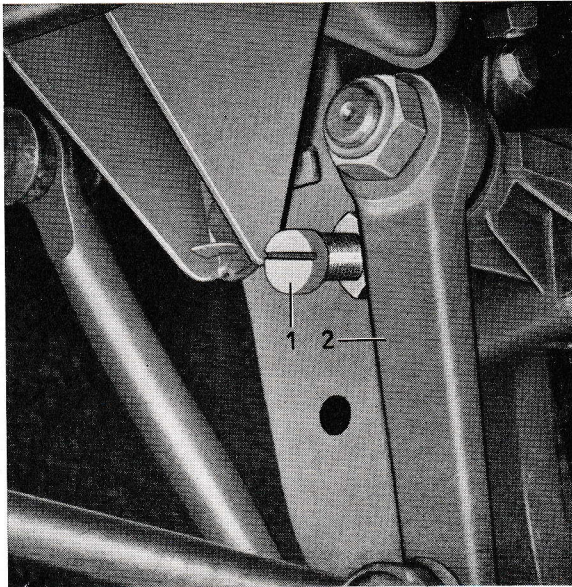


Fig. 43. Diagram for alteration of caster and camber.

3. Check the position of the right wheel in the same manner by turning the wheels to the right until the left wheel has turned 20° inwards, when the right turntable scale should give the same reading as previously indicated on the left. Both the measurements should thus lie within the above-mentioned tolerance, otherwise it means that the steering gear is deformed in some manner, or the front end distorted.
4. There are no adjusting possibilities but if the toe-out is incorrect, the steering arms and steering rod should be checked. Damaged parts should be replaced.



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Fig. 44. Adjusting steering limits.

1. Eccentric stop screw
2. Pitman arm

### Adjusting steering limits (early production)

It should be possible to turn the wheels a maximum of 40° in either direction. Turning is limited by a stop screw on the pitman arm and idler arm. See Fig. 44. Adjustment is carried out as follows.

1. Set the front wheels to point straight forwards and drive them up onto turntables. When doing this, the turntables should be set to 0 and locked.
2. Release the turntable locking devices and turn the left wheel for a left-hand turn as far as it goes. Read off the turning angle. If this deviates from 38—40°, slacken the locknut for the eccentric head stop

screw on the pitman arm. Turn the wheel to 40°. Adjust the stop screw so that it just contacts the pitman arm and tighten the locknut.

3. Repeat this procedure with the right wheel and stop screw on the idler arm.

### Adjusting steering limits (late production)

Turning is limited by the stop screw on the pitman arm and idler arm, (see Fig. 45).

Adjusting is done as follows:

1. Turn the left wheel for a left-hand turn as far as it goes. Check that the distance between the tyre and stabilizer (measurement A, Fig. 45) is 10—15 mm (<sup>25</sup>/<sub>64</sub>—<sup>19</sup>/<sub>32</sub>" ). If not, slacken the locknut for the idler arm stop screw, after which this is turned until the correct value is obtained. Then lock the stop screw.
2. Repeat this procedure with the right wheel and the stop screw on the pitman arm.

### Adjusting toe-in

Toe-in should be 0—4 mm (0—<sup>5</sup>/<sub>32</sub>" ). Faulty toe-in is adjusted by slackening the clamping screws or locknuts respectively on the tie-rod after which the rod is turned in the required direction. The distance between the tyres at the front is reduced, that is to say, toe-in is increased, by turning the tie-rod in the normal direction of rotation of the wheels.

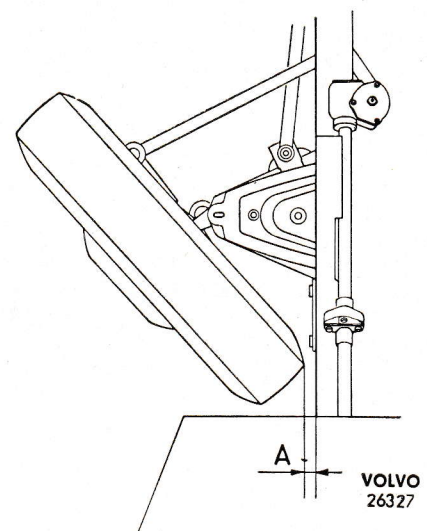


Fig. 45. Adjusting steering limits.

## FAULT TRACING

REASON	REMEDY
--------	--------

### The car wanders

Faulty caster.  
Excessive or too little play in the steering box.  
Steering rod ball joints worn or binding.

Check and adjust caster.  
Adjust steering box.  
Examine ball joints and replace any which are worn. Ball joints with grease nipples should be lubricated.

Faulty toe-in.  
Control arm system binding.

Check and adjust toe-in.  
Carry out thorough lubrication. Replace any damaged parts.

### The car pulls to either side

Insufficient or uneven tyre pressure.  
Front springs fatigued or have different heights.  
One of the roller bearings takes up too tightly.

Check the tyre pressure (see Part 8).  
Remove and check the springs (see Part 9).  
Check the bearings. Replace any damaged bearings and adjust in accordance with the instructions on page 3.

Faulty tracking.

Carry out check measurements on the body and adjust if necessary (see Parts 11 and 9 respectively).

Dragging brakes.  
Bent steering rod.  
Faulty camber.

Adjust the brakes (see Part 7).  
Replace damaged steering rod.  
Check and adjust camber.

### Hard or stiff steering

Binding or damaged ball joints.  
Unsuitable or insufficient lubricant in the steering box.  
Steering box adjusted too tightly.  
Steering rod ball joints or idler arm bearings binding.

Replace ball joints.  
Check the oil. Concerning oil quality, see Specifications.  
Adjust steering box.  
Lubricate the joints and remove the idler arm bracket and examine bearings. Replace any other parts.  
Check and adjust caster.

Excessive caster.

### Jazzing

Wheels out-of-balance or warped.  
  
Oval brake drum.  
Insufficient pressure in tyres.  
Damaged steering rod.  
Loose or worn front wheel bearings.

Balance the wheels and correct them if necessary (see Part 8).  
See Part 7.  
Check tyre pressure (see Part 8).  
Replace damaged rod.  
Remove wheels and hubs. Examine bearing races. If any part is damaged, replace complete bearing.

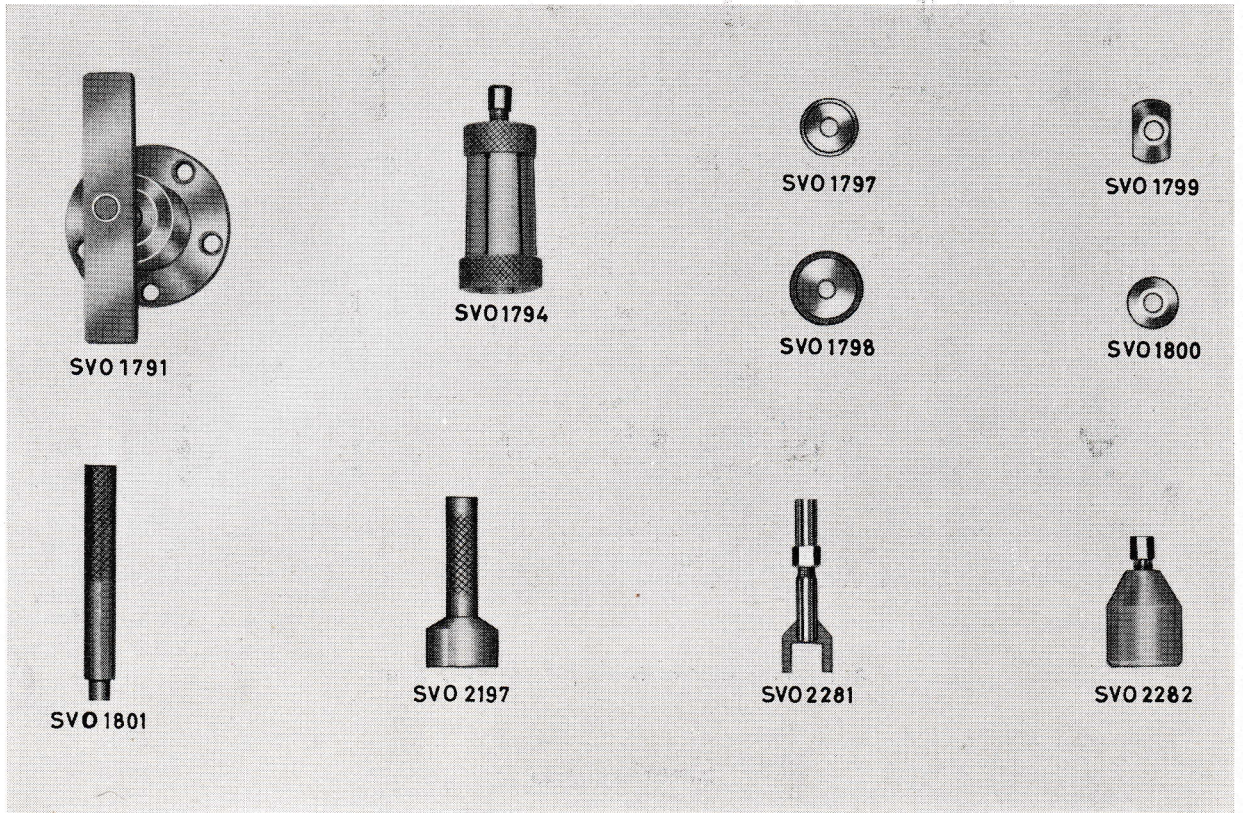
### Shocks and impacts in steering wheel

Excessive play in steering box.  
Unsuitable or insufficient lubricant in steering box.  
Play in front wheel bearings.  
Play in steering rod ball joints.  
Faultily fitted pitman arm.  
Wheels warped or out-of-balance.

Adjust steering box.  
Check the oil. Concerning oil quality, see Specifications.  
See under "Front wheel bearings".  
Replace loose ball joints.  
See page 14.  
Balance the wheels and correct if necessary.

# TOOLS

The following special tools are required for repairs to the front axle and steering gear.

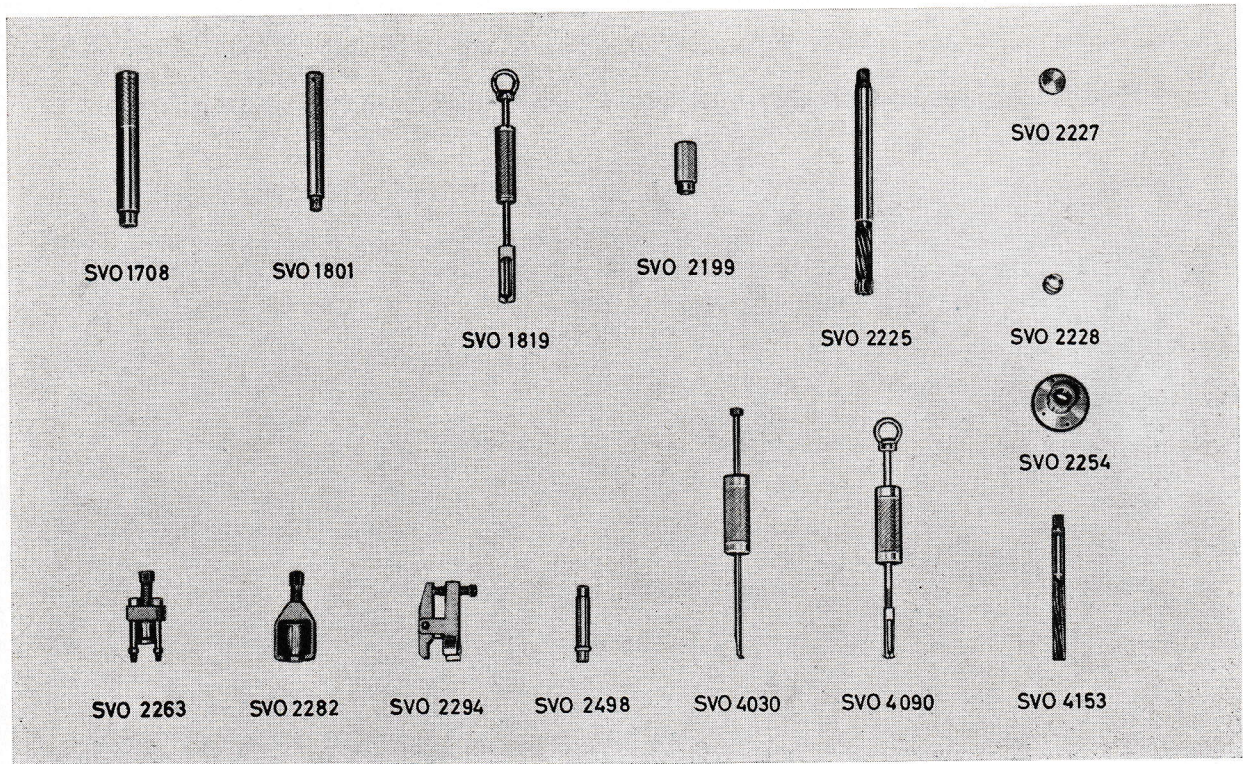


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Fig. 46. Special tools for front axle.

## Front axle

- |          |  |          |  |
|----------|--|----------|--|
| SVO 1791 | Puller for wheel hub.                                  | SVO 1800 | Drift for fitting outer race, outer wheel bearing. |
| SVO 1794 | Puller for inner ring, inner wheel bearing.            | SVO 1801 | Standard handle 18×200.                            |
| SVO 1797 | Drift for fitting outer wheel bearing.                 | SVO 2197 | Drift for fitting and removing grease cap.         |
| SVO 1798 | Drift for fitting inner wheel bearing and seal in hub. | SVO 2281 | Tool for removing lower ball joint, control arm.   |
| SVO 1799 | Drift for fitting inner wheel bearing.                 | SVO 2282 | Puller for pitman arm.                             |



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Fig. 47. Special tools for steering gear.

### Steering gear

- |          |   |          |   |
|----------|---|----------|---|
| SVO 1708 | Drift for removing upper, outer bearing race (steering column bearing). | SVO 2254 | Guide for reamer SVO 2225.                                  |
| SVO 1801 | Standard handle.  | SVO 2263 | Steering wheel puller.                                      |
| SVO 1819 | Puller for pitman arm shaft bushings.                                   | SVO 2282 | Puller for pitman arm.                                      |
| SVO 2199 | Protecting sleeve for seal when fitting pitman arm shaft.               | SVO 2294 | Puller for ball joint, tie-rod and steering rod.            |
| SVO 2225 | Reamer for pitman arm shaft bushings.                                   | SVO 4030 | Puller for packing boxes.                                   |
| SVO 2227 | Drift for fitting pitman arm shaft seal.                                | SVO 4090 | Puller for needle bearing in idler arm bracket.             |
| SVO 2228 | Drift for fitting pitman arm shaft bushings.                            | SVO 4153 | Reamer for bushings in idler arm bracket.                   |
|          |   | SVO 2498 | Drift for fitting and remove bushings in idler arm bracket. |

## SPECIFICATIONS

## Front axle

Adjusting shims for front axle member .....	Thickness = 2 mm (0.079") Thickness = 3 mm (0.118")
Adjusting shims for upper control arm .....	Thickness = 0.15 mm (0.006") Thickness = 0.5 mm (0.020") Thickness = 1 mm (0.039") Thickness = 3 mm (0.118") Thickness = 6 mm (0.236")

## Steering gear

Steering wheel diameter .....	430 mm (17")
Number of turns (from lock to lock) .....	3 <sup>1</sup> / <sub>4</sub>
Steering box, make and type .....	Gemmer, "cam and roller"
Reduction ratio .....	15.5:1
Adjusting shims for steering box bearing .....	Thickness = 0.10 mm (0.0039") Thickness = 0.12 mm (0.0047") Thickness = 0.15 mm (0.0059") Thickness = 0.30 mm (0.0118")
Washer between adjusting screw and pitman arm shaft (in steps of 0.05 mm = 0.002") .....	2.20—2.45 mm (0.0866—0.0965")
Lubricant for steering box .....	Hypoid oil SAE 80
Oil capacity .....	0.25 litre ( <sup>3</sup> / <sub>8</sub> Imp. pint = <sup>1</sup> / <sub>2</sub> US pint)
Idler arm:	
Necessary turning torque .....	10—20 kgcm (8.7—17.4 lb.in.)
Adjusting shims .....	Thickness = 0.1 mm (0.0039") Thickness = 0.15 mm (0.0059") Thickness = 0.35 mm (0.0138")

## Wheel alignment (car unloaded)

Caster (up to chassis no. 2610) .....	-1/2 to +1/2°
Caster (with effect from chassis no. 2611 onwards) ....	0 to +1°
Camber .....	0 to +1/2°
"King pin" inclination at 0° camber .....	8°
Toe-in .....	0 to 4 mm ( <sup>5</sup> / <sub>32</sub> ")
Toe-out:	
When the outer wheel is turned 20°, the inner wheel should be turned .....	21.5 to 23.5°
Max. turning angle to either side .....	40°

## Tightening torques

	Kgm	Footpound (ftlb.)
Nut for idler arm shaft .....	7	50
Steering wheel nut .....	3.5—5	25—35
Nut for pitman arm .....	13.5—16.5	100—120
Castle nut for steering rod and tie-rod .....	3.2—3.7	23—27
Nut for control arm clamp .....	2—2.5	14—18
Bolt for upper control arm shaft .....	4.8—5.5	35—40