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FRONT AXLE

DESCRIPTION

The PV 544 and 444-445 are fitted with independent front wheel suspension. The front axle is built up of a sturdy box-sectioned cross member, which is bolted to the front side sills of the unit body on the PV 544 and 444 and to the frame side members on the PV 445. The front wheel suspension is attached to the front axle member ends, and the engine front suspension rests on its centre part. See fig. 1.

The upper and lower control arms (2 and 8) are pivoted on the box-section member (6) at their inner ends by means of bolts and spindles. The outer ends of the control arms are attached

to the steering knuckle support (1) by means of bolts and threaded bushings. The upper bushing is eccentric to enable camber adjustment to be carried out.

The steering knuckle (6 fig. 2) is carried on the king pin (18), to which the steering knuckle is pivoted. The axial thrust of the steering knuckle support is taken up by a ball bearing (39, fig. 2).

The PV 544, 444 and the PV 445 are fitted with stabilizer bars attached to the unit body on the PV 544, 444 and the frame on the PV 445 and the lower control arms.

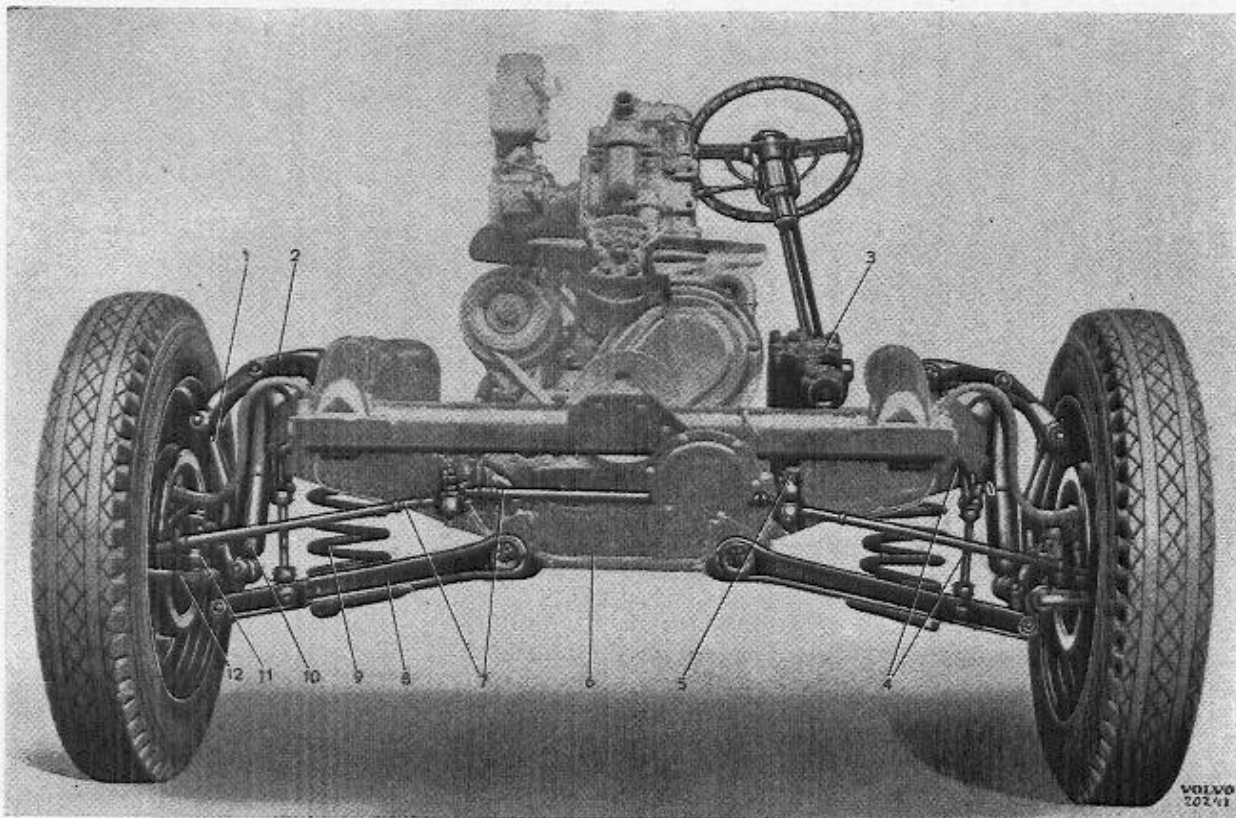


Fig. 1. Front axle and steering gear.

- | | |
|----------------------------------|-----------------------------|
| 1. Steering knuckle support | 7. Steering rod and tie rod |
| 2. Upper control arm | 8. Lower control arm |
| 3. Steering gear housing | 9. Spring |
| 4. Stabilizer | 10. Shock absorber |
| 5. Pitman arm | 11. Steering knuckle |
| 6. Front suspension cross member | 12. Steering knuckle arm |

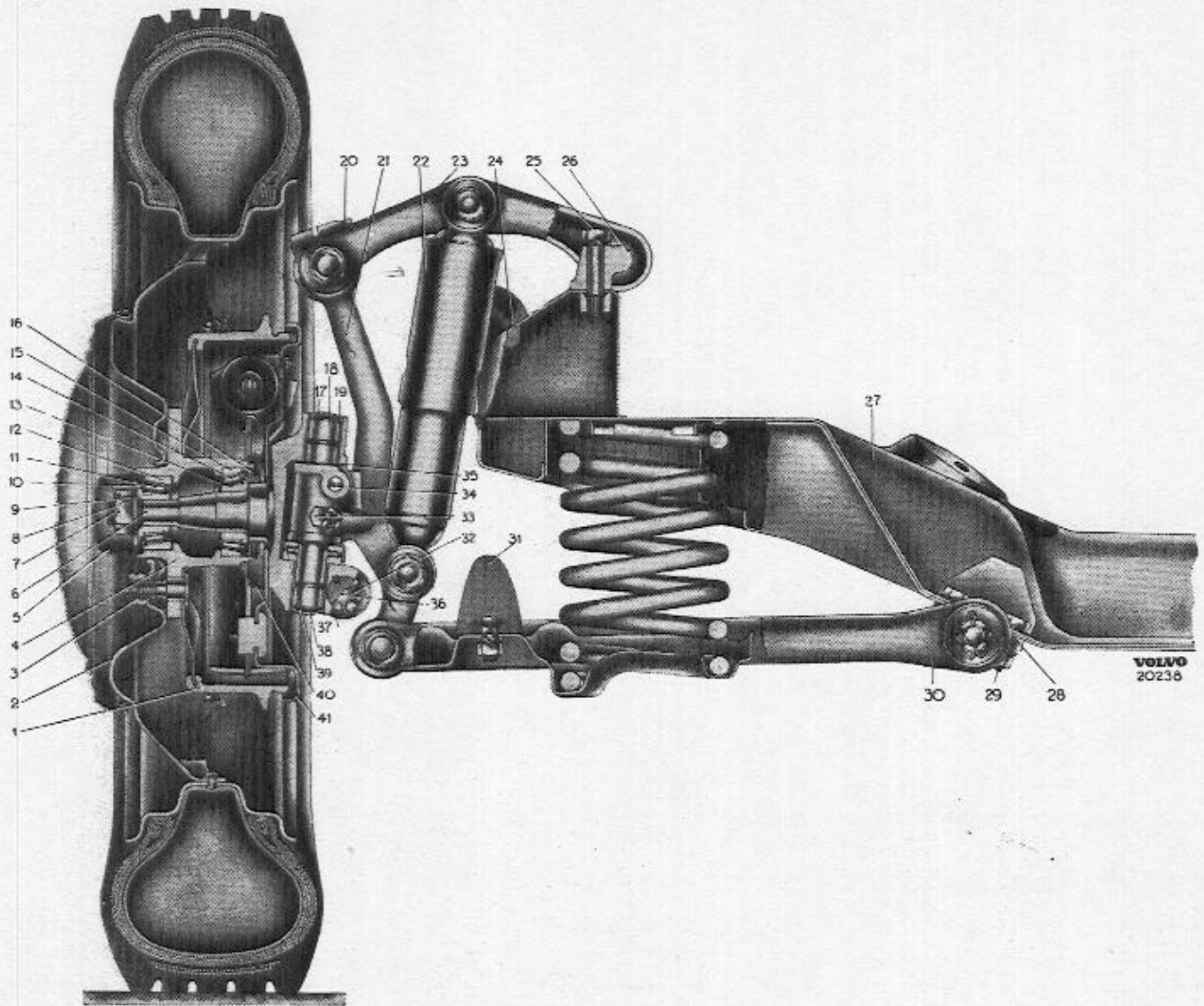
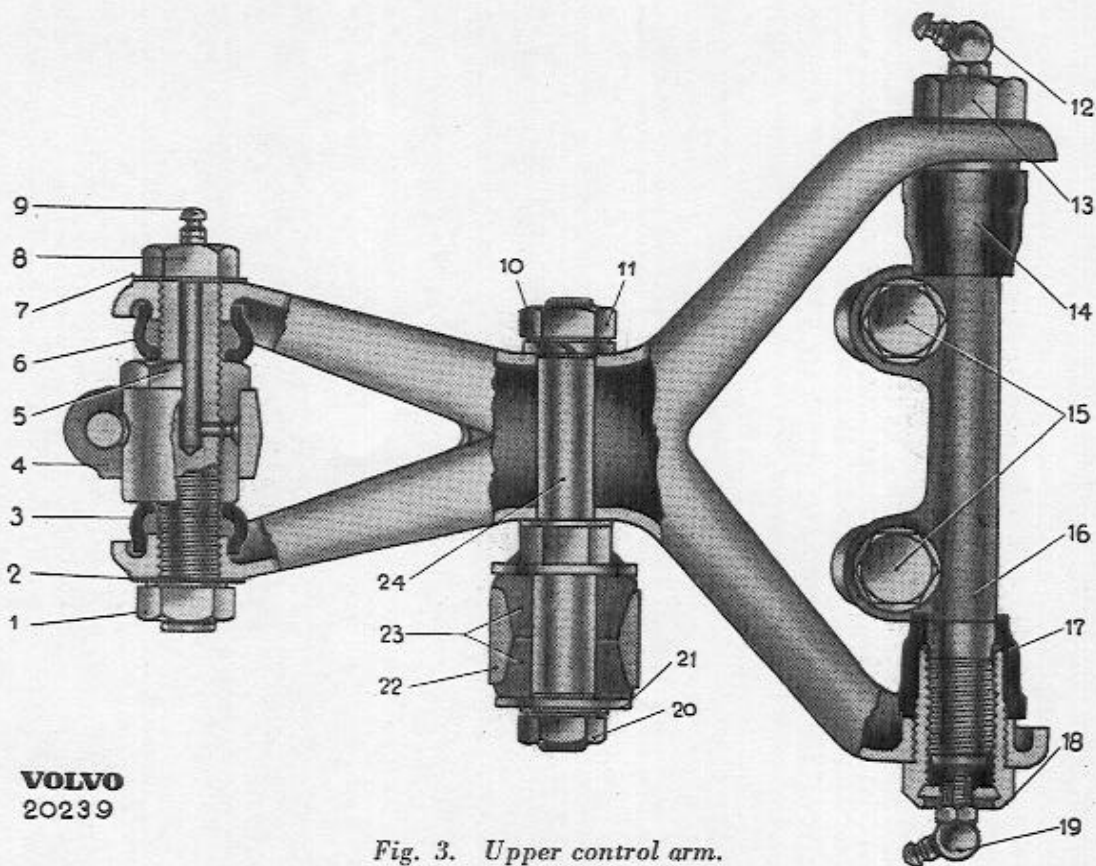


Fig. 2. Front axle.

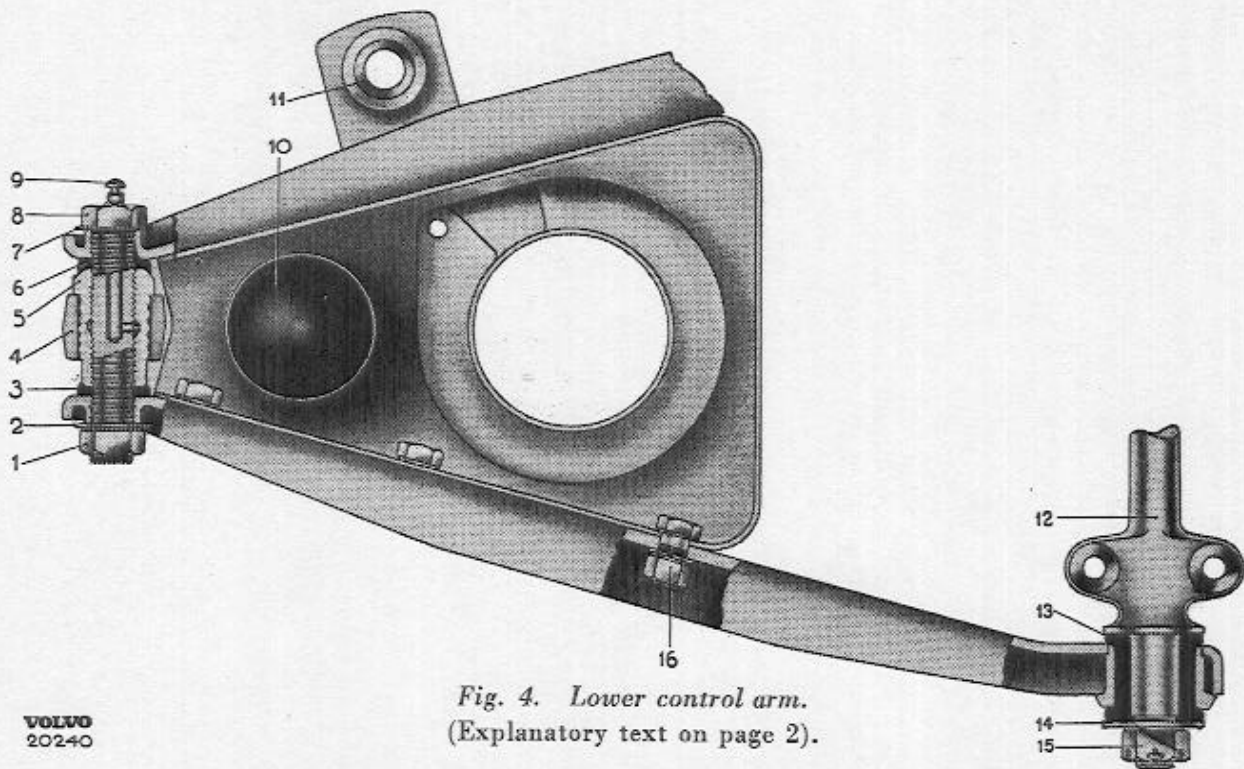
- | | | |
|------------------------------|-----------------------------------|--------------------------|
| 1. Brake drum | 15. Inner bearing outer ring | 29. Bolt |
| 2. Wheel | 16. Oil seal | 30. Lower control arm |
| 3. Wheel nut | 17. King pin seal washer | 31. Upper rubber bumper |
| 4. Hub | 18. King pin | 32. Nut |
| 5. Grease cap | 19. King pin bushing | 33. Stop screw |
| 6. Steering knuckle | 20. Clamp screw | 34. King pin stop key |
| 7. Cotter pin | 21. Steering knuckle support | 35. Adjuster shim |
| 8. Castellated nut | 22. Shock absorber | 36. Steering knuckle arm |
| 9. Outer bearing inner ring | 23. Upper control arm | 37. King pin bushing |
| 10. Washer | 24. Upper rubber bumper | 38. Seal washer |
| 11. Roller bearing | 25. Bolt | 39. Roller bearing |
| 12. Outer bearing outer ring | 26. Upper control arm pivot shaft | 40. Splash apron |
| 13. Inner bearing inner ring | 27. Front suspension cross member | 41. Brake backing plate |
| 14. Roller bearing | 28. Lower control arm pivot shaft | |
-
- | | | |
|-----------------------------|-------------------|---------------------------------|
| 1. Nut | 6. Rubber seal | 11. Stabilizer bracket |
| 2. Lock washer | 7. Lock washer | 12. Pivot shaft |
| 3. Rubber seal | 8. Bolt | 13. Rubber bushing |
| 4. Steering knuckle support | 9. Grease nipple | 14. Washer |
| 5. Bushing | 10. Rubber bumper | 15. Nut (later prod. Nyloc nut) |
| | | 16. Bolt with washer and nut |



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Fig. 3. Upper control arm.

- | | | | |
|-----------------------------|-------------------|-----------------|--------------------|
| 1. Nut | 7. Lock washer | 13. Bushing | 19. Grease nipple |
| 2. Lock washer | 8. Bolt | 14. Rubber seal | 20. Nut |
| 3. Rubber seal | 9. Grease nipple | 15. Bolt | 21. Washer |
| 4. Steering knuckle support | 10. Spring washer | 16. Pivot shaft | 22. Shock absorber |
| 5. Eccentric bushing | 11. Nut | 17. Rubber seal | 23. Rubber bushing |
| 6. Rubber seal | 12. Lubricator | 18. Bushing | 24. Bolt |



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Fig. 4. Lower control arm.
(Explanatory text on page 2).

REPAIR INSTRUCTIONS

Disassembly of complete front wheel suspension unit

1. Remove hub caps and loosen wheel nuts.
2. Jack up car front end and place trestles under the body (the frame on the PV 445) behind the front axle cross member.
3. Remove wheel nuts and lift off wheels.
4. Disconnect stabilizer from the lower control arms.
5. Pull off the pitman arm. Use tool SVO 2195 (see fig. 23).
6. Put a wooden block under the brake pedal. Disconnect the front wheel brake lines at the master cylinder. Plug the connections to prevent dirt penetrating into the brake lines.
7. Screw off nuts at the front engine suspension. Remove the front engine guard plate. Place a wooden block (1, fig. 5) ($62 \times 6 \times 6$ cm = $24.4 \times 2.4 \times 2.4$ ") above the sills but below the fan hub (3). Insert the wooden block from below. Two extra blocks (2) (size $4 \times 6 \times 6$ cm = $1.6 \times 2.4 \times 2.4$ ") should be placed between the wooden block mentioned above and the side members on the PV 445. A small overhead hoist can of course also be used to support the engine.
8. Remove the eight bolts attaching the front axle cross members to the body (the frame on the PV 445).

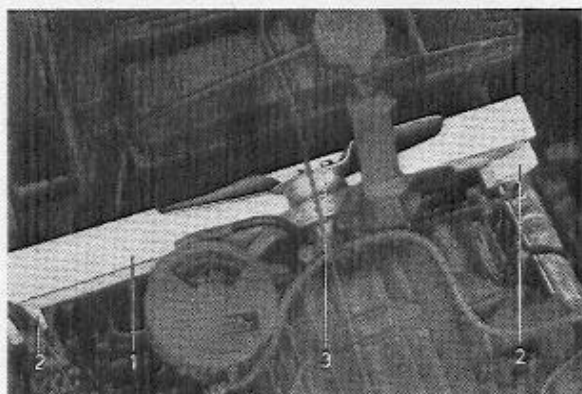


Fig. 5. Engine support.

1. Wooden block
2. Wooden block
3. Fan hub

Lower jack carefully. (Sometimes it is necessary to slacken one of the upper control arm inner attachments to the front suspension cross member in order that the front suspension unit can be lowered). When the brake backing plates have reached the floor the jack and front suspension unit are pulled out.

Assembly of complete front wheel suspension unit

1. Lift up the front wheel suspension unit on a hydraulic jack and move it under the car.
2. Insert two guide pins into the car body (the frame on the PV 445). Raise the front axle cross member into position and fit and tighten bolts.
3. Remove the wooden block and attach the engine to the front engine suspension. Connect brake lines.
4. Fit pitman arm (see instructions under "Steering gear").
5. Install stabilizer.
6. Bleed front wheel brake system. See part 7.
7. Mount wheels and lower car. Tighten wheel nuts and fit hub caps.
8. See "Wheel alignment" page 19 for checking and adjustment.

Replacing and adjustment of front wheel bearings

When adjusting front wheel bearings first remove the wheel hub for inspection of roller bearing races and rollers. Replace if damaged or worn. Below is described the procedure for complete replacement of bearings. For ordinary inspection and adjustment, disregard the points not applying.

The instructions given below are primarily concerned with PV 544 and late production PV 444 and PV 445. For early production PV 444 and 445 certain special tools are required. These are given in brackets.

1. Remove the hub caps and loosen the wheel nuts slightly.

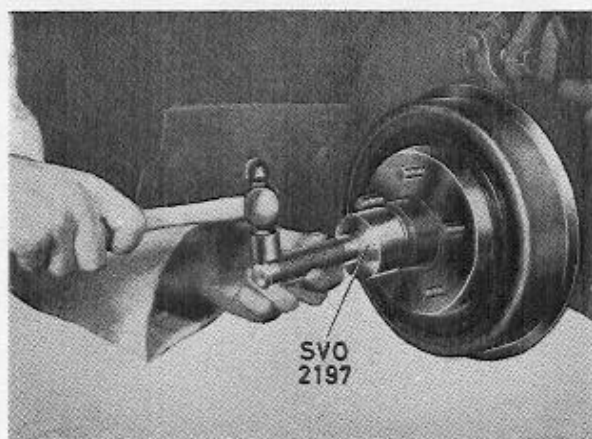


Fig. 6. Removing grease cap.

2. Jack up the front part of the vehicle and place trestles under the lower control arms. Remove the wheel nuts and lift off the wheels.
3. Remove the grease cap with tool SVO 2197 (Fig. 6). Remove the cotter pin and the castellated nut. Pull off the hub with puller SVO 1791 (SVO 1446 A) as shown in fig. 7.

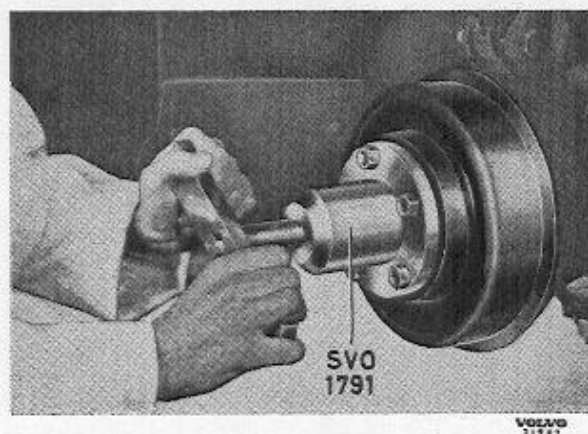


Fig. 7. Removing hub.

4. Drive out the bearings. Use driver SVO 1799 (SVO 4003) for the inner bearing and driver SVO 1800 (SVO 4002) for the outer bearing. Use standard handle SVO 1801 with these drivers.
5. Remove the inner ring with puller SVO 1794 (SVO 4016) if required (fig. 8).
6. Clean the hub, brake drum and grease cap.
7. Press in the new bearings. Use the standard handle SVO 1801 together with driver SVO 1798 (SVO 4001) for the inner and SVO 1797 (SVO 4000) for the outer bearings.

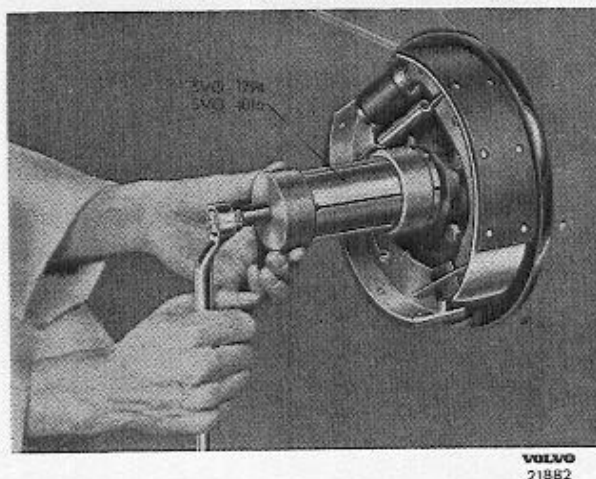


Fig. 8. Removing inner bearing.

8. Pack the inner bearing inner ring with heat-resistant bearing grease and fit it into position into the hub after the outer ring has been greased. Pack grease between the bearing and the seal ring. Press in the seal ring with driver SVO 1798 (SVO 4001) and the standard handle SVO 1801 (fig. 9).



Fig. 9. Fitting the seal ring.

9. Fit the hub on the steering knuckle. Pack the outer bearing inner ring with heat-resistant bearing grease and fit after the outer ring has been greased. Fit the washer and the castellated nut.
10. *The front wheel bearings are adjusted by first tightening the nut with a torque wrench to 6.9 kgm (50 lb.ft.). Then loosen the nut $\frac{1}{3}$ of a turn. If the nut recess does not index with the cotter pin hole in the steering knuckle, the nut is loosened further until the cotter pin can be fitted. Check that the wheel rotates easily without excessive play.*
11. Half-fill the grease cap with grease and fit it by using tool SVO 2197 (fig.10).
12. Fit the wheels. Lower the vehicle. Tighten the wheel nuts with a torque wrench to 10—14 kgm (70—100 lb.ft.). Fit the hub caps.

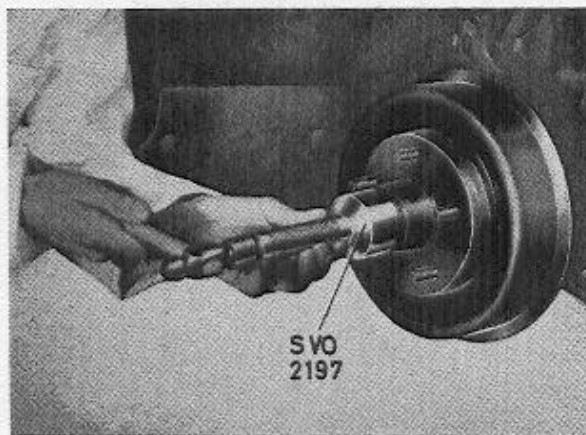


Fig. 10. Fitting the grease cap.

Replacing king pins, outer control arm bolts and bushings

Clearance in the threaded bushings should not exceed 0.3—0.6 mm (0.012"—0.024"). The maximum permissible clearance is 0.8 mm (0.032").

King pin radial clearance should not exceed 0.3 mm (0.012").

The following instructions are primarily concerned with PV 544 and late production PV 444 and 445. Early production vehicles require certain special tools. These are given in brackets.

Removal

1. Remove hub caps and loosen wheel nuts slightly.
2. Raise front end of car until the wheels are lifted up from the floor and place trestles under lower control arms. Remove wheel.
3. Remove grease cap with tool 2197 (fig. 6), loosen castellated nut and draw off front hub. Use puller SVO 1791 fig. 7 (SVO 1446 A). Remove inner ring if required (fig. 8).
4. Unscrew the four bolts attaching brake backing plate (41, fig. 2) and splash apron (40) to steering knuckle (6). Lift up brake backing plate and tie it up with a string to prevent damage to the brake hose.
5. Remove the cotter pin and nut for the steering rod ball joint. Screw back the tensioning bolt on tool SVO 2294 and place the tool on the ball joint as shown in fig. 11. Press in the tool well and ensure that the thread in the ball joint enters the recess in the tool.
Screw in the tensioning bolt until the ball joint loosens.
6. Remove the nut and screw out the upper control arm bolt. Remove the clamp screw and the eccentric bushing.
7. (Only when replacing control arm bolts and bushings).
Loosen the nut and screw out the lower control arm bolt. Detach the shock absorber at the bottom. Lift out the king pin support. Screw out the lower bushing.

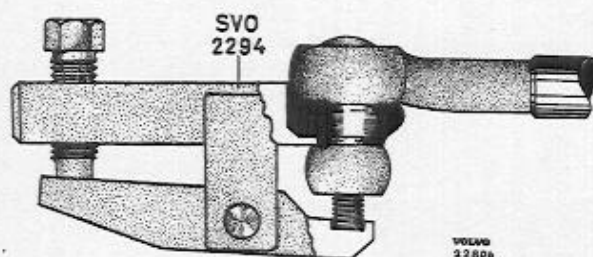


Fig. 11. Removing steering rod.

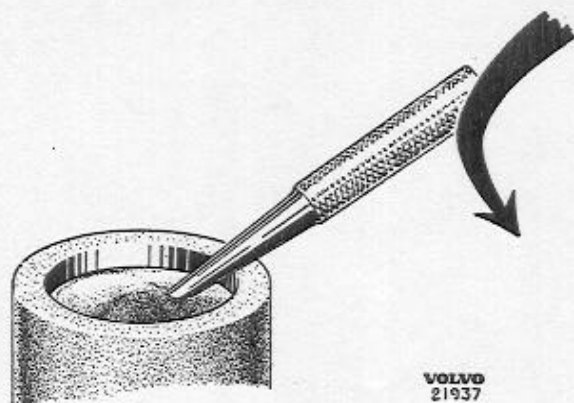


Fig. 12. Removing seal washer.

8. Remove the key with a drift. Remove the seal washer with a sharp drift, fig. 12. Drive out the king pin downwards with tool SVO 2224, see fig. 13. Use extension sections as required.
9. Remove the grease nipples. Drive out the bushings with tool SVO 1442.

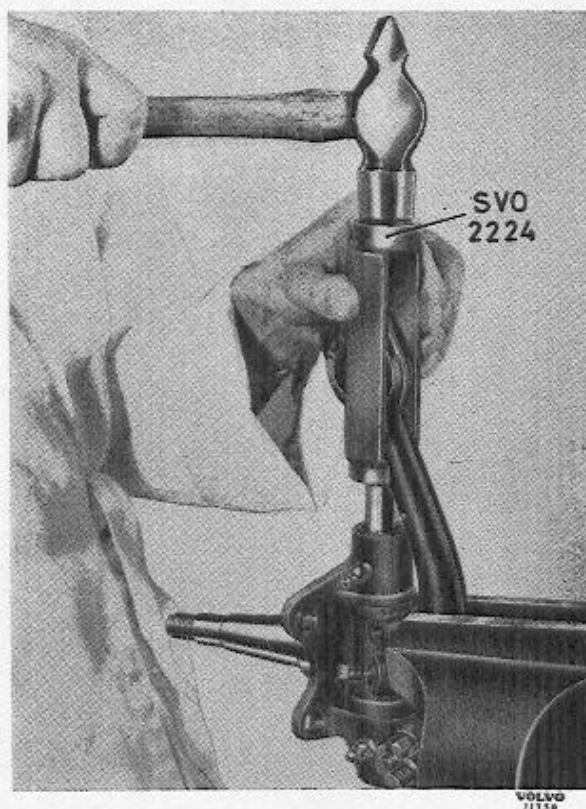


Fig. 13. Removing king pin.

Installation

1. Clean the steering knuckle. Remove burr from bushing contact surfaces. Press in the new bushings with tool SVO 1442. Make sure that the lubricating holes come into the correct position and that the lubricating grooves face the sealing washers.
2. Ream the bushings with reamer SVO1171A (fig.14) which shows an earlier type reamer, and check that the king pin has a light thumb fit. Fit the grease nipples and apply a little chassis lubricant to the bushings.

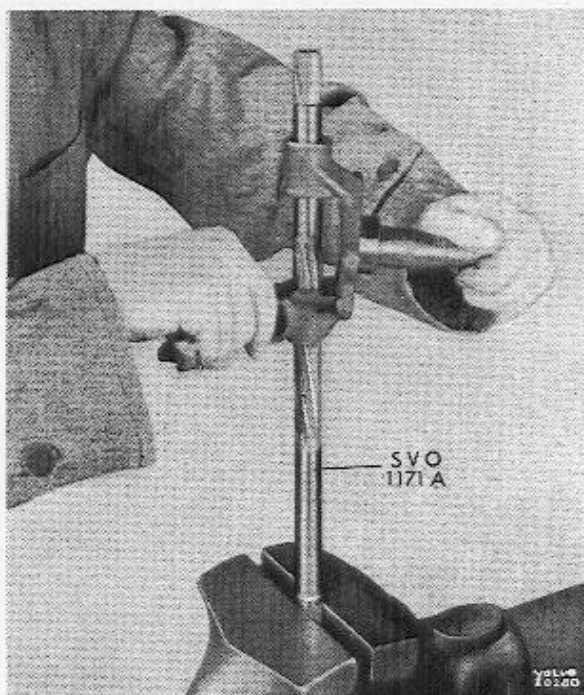


Fig. 14. Reaming of king pin bushings.

3. Place steering knuckle and thrust washer in position and place centering tool SVO 4005 in the upper bushing. Adjust to the least possible clearance with the shims which accompany the king pin set. Fitting should not be so hard that frictional torque in turning the spindle exceeds 45 kgcm (39.14 lb.in), that is to say that if a spring balance is connected to the cotter pin hole it should not give a greater reading than 3 kg (6.6 lb.) when pulled at right-angles to the spindle. Then drive in the king pin ensuring that it comes in the correct position. Fit the key. Check that the

steering knuckle can turn easily. Fit the sealing washers. These are fitted by placing them in position with the cupped side turned outwards. They are then knocked flat with a hammer and drift.

4. Fit the steering knuckle support and bushings together with dust guard and bolts. Fit steering rod to steering knuckle arm.
5. Fit brake backing plate and splash apron on steering knuckle.
6. Fit hub and wheel as shown in points 8—12 under "Replacing and adjustment of front wheel bearings", page 4.
7. Check front wheel alignment.

Overhaul of control arm mechanism

Straightening of damaged control arms and steering knuckle supports may only be carried out to a minor extent. If an old part differs considerably when compared with a new one, it should be replaced.

Removal of upper control arm

1. Loosen wheel nuts.
2. Raise front end of car until the wheels are lifted up from the floor and place a trestle under the lower control arm.
3. Remove wheel nuts and lift off wheel.
4. Disconnect the shock absorber anchorage at the upper control arm bolt (24, fig. 3).
5. Screw off nut (1) and remove bolt (8).
6. Remove bolts (15) attaching pivot shaft (16) to front suspension cross member and lift out control arm.
7. Remove pivot shaft (16) from control arm by screwing out grease nipples (12 and 19) and threaded bushings (13 and 18) at pivot shaft ends.

Installation of pivot shaft in upper control arm

1. Place tool SVO 2300 in a vice ensuring that the top surface of the plate is free.
2. Fit the rubber sleeves on the pivot shaft and insert this in the control arm. Screw the bushings on the shaft about 2 turns. The shaft should then be movable axially and if not, the bushings should be unscrewed slightly.

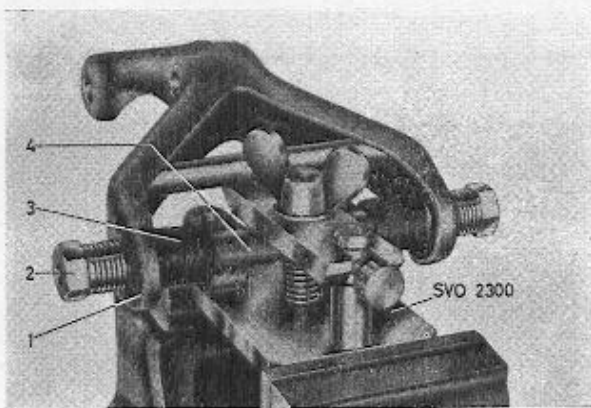


Fig. 15. Fitting upper control arm shaft.

1. Control arm
2. Bushing
3. Rubber sleeve
4. Shaft

3. Place the control arm in the tool so that the pin on the cap fits into the U profile on the control arm and the holes in the shaft shoulders fit on both the guide pins. Move the cap towards the control arm, slightly tighten the wing nut, screw in the stop screw and tighten up the wing nut. See fig. 15.
4. Lubricate the bushings externally and screw them in until the hexagon comes against the control arm. Place the rubber sleeves in position at the bushings and fit grease nipples.
5. Release the wing nut and stop screw and lift off the control arm.

Installation of upper control arm

1. Place control arm into position and fit bolts (15, fig. 3) attaching pivot shaft (16) to front suspension cross member.
2. If the eccentric bushing (5) has been replaced, the new bushing and screw (20, fig. 2) are fitted in the king pin support. Install bushing with its hexagon facing forwards.
3. Fit new rubber seals (3 and 6, fig. 3), bolt (8) (hexagon facing forwards) and nut (1). Do not forget lock washers 2 and 7. Check the clearance, which should be within 0.3—0.7 mm (.012"—.032").
4. Lubricate king pin and bushings, ensuring that grease enters all lubricating points properly.

5. Mount shock absorbers and wheels. Lower car. Tighten wheel nuts to a tightening torque of 10—14 kgm (72—101 lb.ft.).
6. Check wheel alignment. See "Wheel alignment" for particulars.

Removal and installation of lower control arm

Remove the lower control arm after having blocked up the front end of car in the usual way, by removing the wheel, disconnecting the stabilizer at its anchorage (11, fig. 4) in the control arm, and placing a jack under its inner anchorage in accordance with fig. 16. Loosen bolts (29, fig. 2) attaching the pivot shaft (28) to the cross member, lower the jack and remove the spring. Disconnect the control arm outer attachment from the steering knuckle support.

Replacement of pivot shaft (16, fig. 3) or rubber bushings (13, fig. 4) can be carried out after having removed the control arm by removing the two inner bolts (16, fig. 4) attaching the control arms to each other, and loosening the outer one a little. It is then possible to turn the parts from each other and the pivot shaft will come loose.

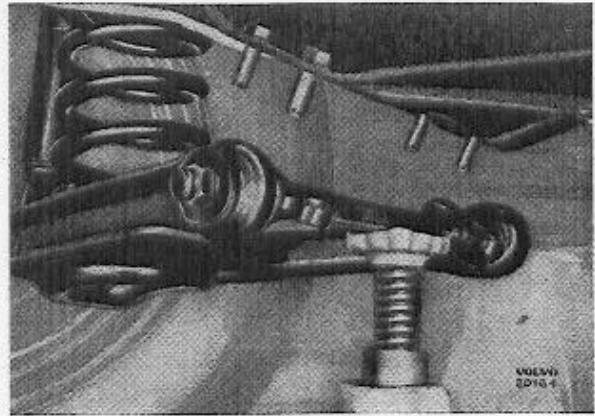


Fig. 16. Removing lower control arm.

When exchanging the lower bushing (5, fig. 4) of the steering knuckle support and bolt (8, fig. 4) remove only the wheel, after which a jack should be placed directly below the spring. Remove nut (1) bolt (8) and screw out bushing.

Be careful, when assembling, not to forget rubber seals (3 and 6) and washers (2 and 7) at the outer anchorage. Make sure that the spring comes into position, i.e. the end with the straight winding should face downwards.

The lower control arm should be attached to the front suspension cross member by means of bolts, castellated nuts and cotter pins.

STEERING GEAR

DESCRIPTION

Early production vehicles PV 444—445 have a cam and lever steering gear, part no. 250024. PV 544 and late production vehicles have an "hourglass worm and sector" type, part no. 250051. The steering gear housing is attached to the body (the frame of the PV 445) by means of bolts.

The movement is transferred from the pitman arm (4, fig. 17) to the wheels via tie rod (7), steering rods (3 and 9) and steering idler arm (11).

This steering gear gives the car a turning circle of about 10.5 m (34½ ft.). The number of steering wheel turns lock to lock is 3¾. See fig. 17—20 for particulars in design.

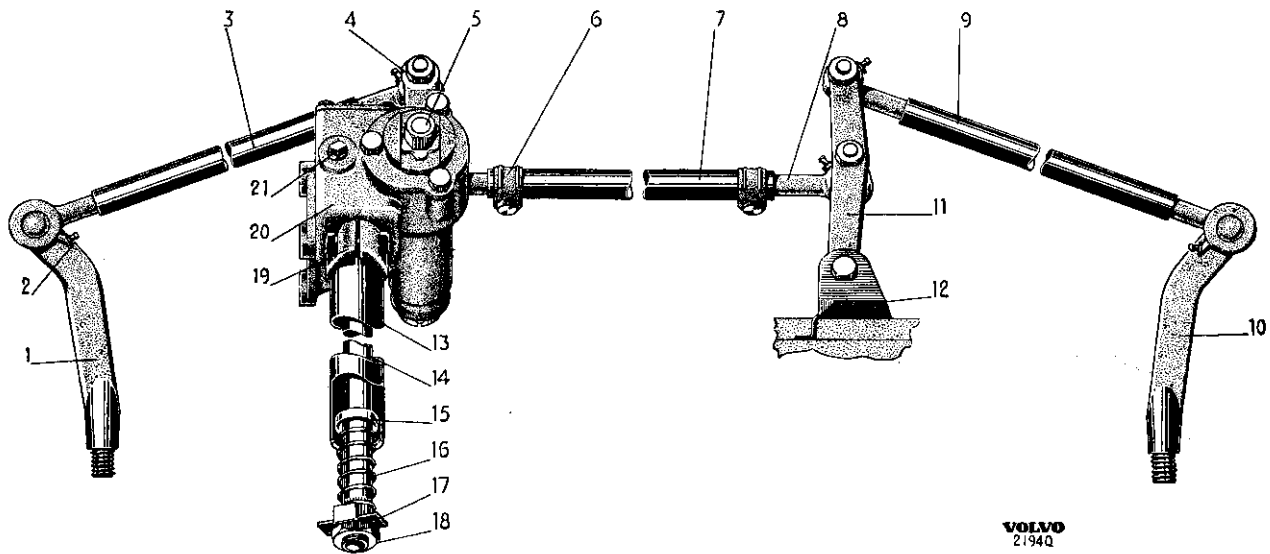


Fig. 17. Steering mechanism.

- | | | |
|---------------------------------------|--|---------------------------|
| 1. Left steering knuckle arm | 8. Ball joint | 15. Ball bearing |
| 2. Grease nipple. | 9. Right steering rod with ball joints | 16. Spring |
| 3. Left steering rod with ball joints | 10. Right steering knuckle arm | 17. Lock washer |
| 4. Pitman arm | 11. Steering idler arm | 18. Nut |
| 5. Nut over adjuster screw | 12. Clamp for idler arm | 19. Clamp for jacket tube |
| 6. Clamp | 13. Steering column jacket tube | 20. Steering gear housing |
| 7. Tie rod | 14. Steering shaft | 21. Filler plug |

- | | | |
|-------------------------|-------------------------|----------------------------------|
| 1. Dust shield (rubber) | 7. Bolt | 13. Ball joint |
| 2. Ball stud | 8. Bracket | 14. Clamp |
| 3. Steering idler arm | 9. Dust shield (rubber) | 15. Tie rod |
| 4. Cotter pin | 10. Nut | 16. Steering rod with ball joint |
| 5. Castellated nut | 11. Washer | 17. Bearing unit |
| 6. Spacer | 12. Bushing | 18. Spring |

1. Tube for horn cable
2. Seal washer
3. Lock ring
4. Bearing outer ring
5. Ball bearing
6. Cover
7. Adjuster screw
8. Adjuster screw
9. Lock nut
10. Twin lever shaft
11. Gasket
12. Upper cover
13. Spring washer
14. Screw for upper cover
15. Clamp
16. Lock ring
17. Shims
18. Bearing outer ring
19. Ball bearing
20. Bushings
21. Oil seal ring
22. Pitman arm
23. Spring washer
24. Nut
25. Steering gear housing
26. Steering shaft with cam

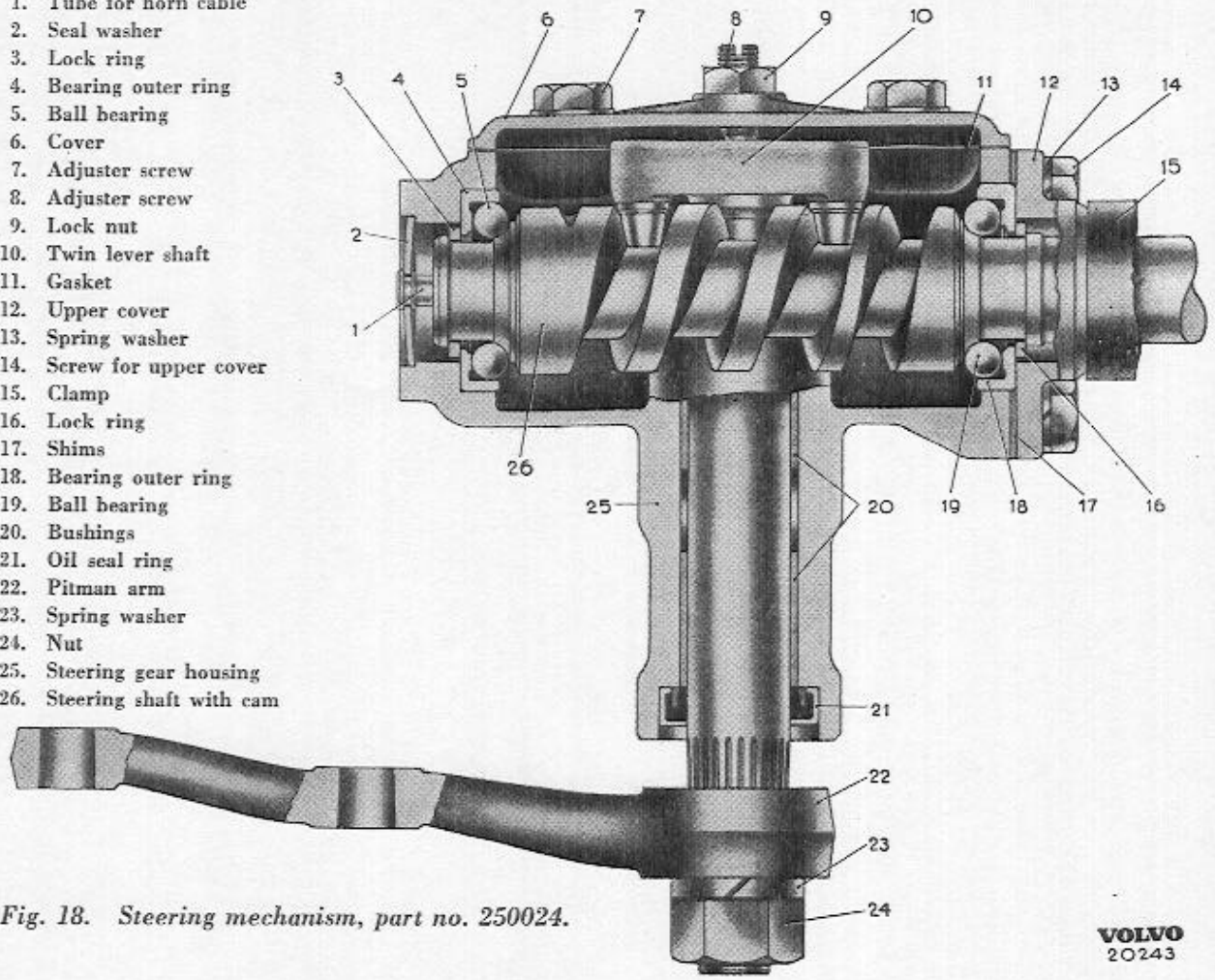


Fig. 18. Steering mechanism, part no. 250024.

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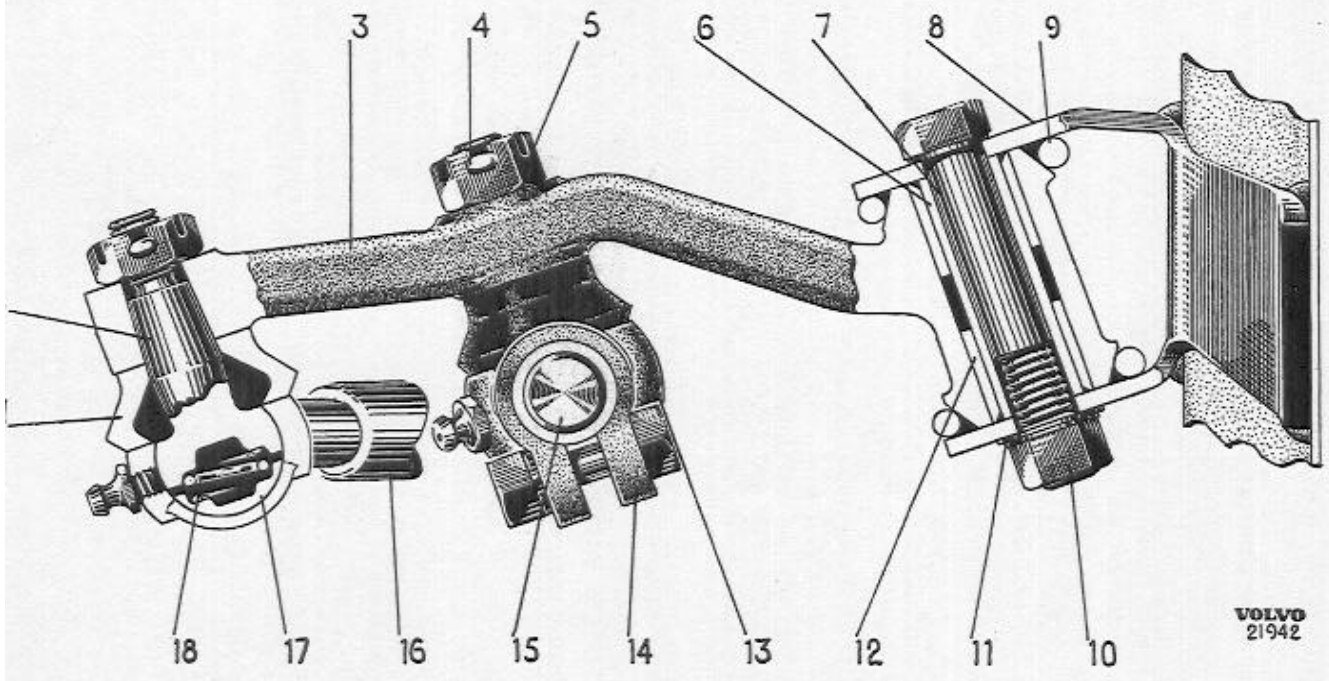
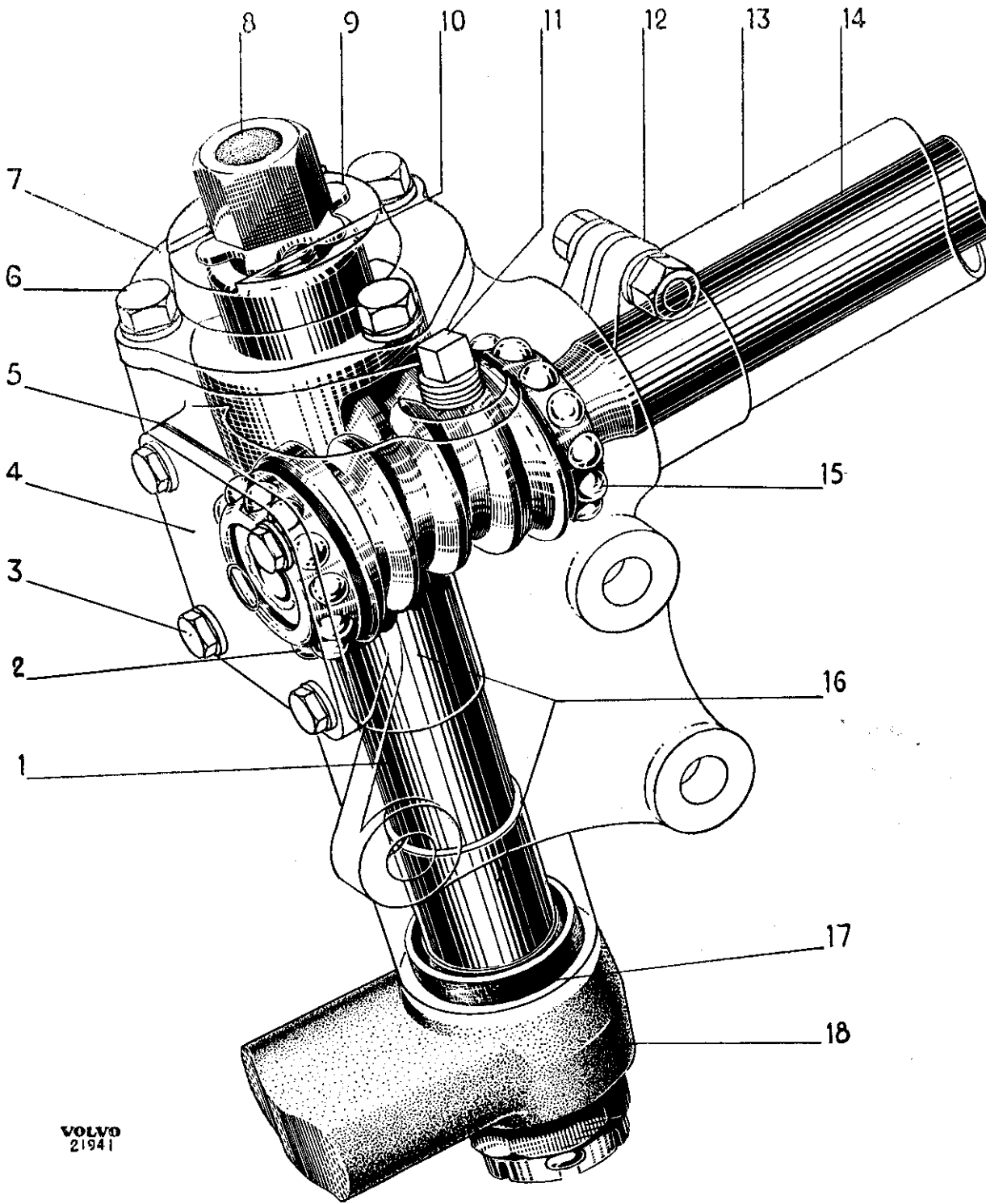


Fig. 19. (Steering idler arm).
Explanatory text on previous page.

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Fig. 20. Steering mechanism, part no. 250051.

- | | | |
|---------------------------|---|-----------------------------|
| 1. Sector shaft | 7. Top cover (early prod., cast iron) | 12. Clamp for jacket tube |
| 2. Ball bearing | 8. Nut (early prod., only) | 13. Jacket tube |
| 3. Bolt on bottom cover | 9. Lock washer for adjuster screw
(later prod. has lock nut) | 14. Steering shaft with cam |
| 4. Bottom cover with tube | 10. Adjuster screw | 15. Ball bearing |
| 5. Shims | 11. Filler plug | 16. Bushings |
| 6. Bolt for top cover | | 17. Seal ring |
| | | 18. Pitman arm |

REPAIR INSTRUCTIONS

Replacement of steering wheel

Removal and installation (jacket tube not fitted with direction indicator switch housing)

1. Remove fuse for horn.
2. Remove horn ring. Push it down and turn it a quarter of a complete turn anti-clockwise.
3. Loosen steering wheel nut.
4. Draw off steering wheel. Use puller SVO 1185 B and spacer SVO 1453 and clamp SVO 1454. See fig. 21.

Install in the reverse order and make sure that the steering wheel spokes are horizontal when the front wheels are parallel with the car centre line. Tighten nut with a tightening torque of 3.5 kgm (25 lb.ft.).

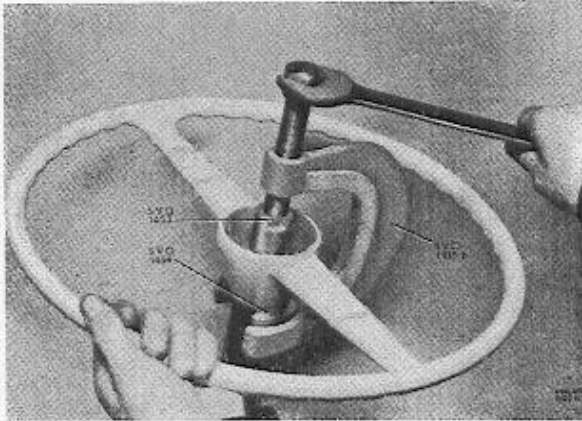


Fig. 21. Removing steering wheel.
(Early production).

Removal (jacket tube fitted with direction indicator switch housing)

1. Remove fuse for horn.
2. Remove horn ring. Loosen screw on the left side of steering wheel hub, turn and lift up horn ring.
3. Loosen steering wheel nut (also lock washer, late production).
4. Pull off steering wheel. Note: Indicator switch lever is to lie in neutral position to prevent damage to internal parts. Use standard puller, steering wheel clamp SVO 2102. See fig. 22.

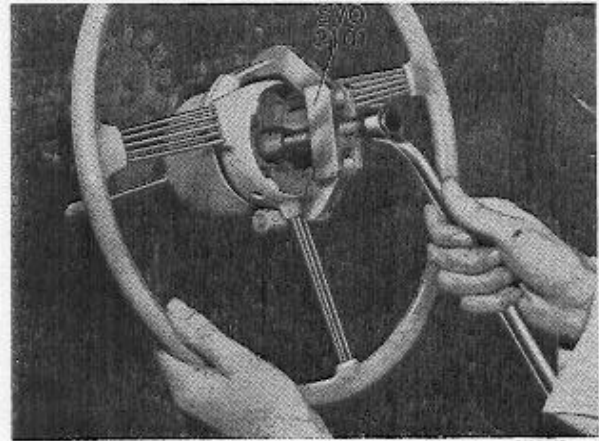


Fig. 22. Removing steering wheel.
(Late production).

Installation (jacket tube fitted with direction indicator switch housing)

1. Check that the indicator switch lever lies in neutral position.
2. Install steering wheel with the frontwheels parallel with the car's centre line. Make sure that the steering wheel spokes are horizontal. Tighten nut to 3.5 kgm (25 lb.ft.). Fit lock washer (late prod.).
3. Check that the indicator switch housing (1) does not lie too close to the steering wheel after installation. The distance between the housing upper edge and the steering wheel hub should be 1—1.5 mm (0.04"—0.06"). Adjust the distance by loosening the attachment screw at the indicator switch housing by means of a wrench and moving the housing into position.
4. Fit horn ring.
5. Install fuse.

Steering gear maintenance

Removal

1. Switch off current by removing fuse for horn.
2. Disconnect horn cable at steering gear housing.
3. Remove horn ring on early production without direction indicator housing, push

it down and turn it a quarter of a complete turn anti-clockwise. Release pressure on ring and lift it up. On steering column fitted with indicator switch housing the screw at the steering wheel hub should be loosened, after which the horn ring can be turned and lifted up.

4. Pull out the horn cable together with the bushing, spring and casing. Loosen the steering wheel nut (after loosening the lock washer on late production). Pull off the steering wheel with puller SVO 1185 B, spacer SVO 1453 and clamp SVO 1454 (fig. 21) for the model without direction indicator housing. Use puller SVO 2101 (fig. 22) for the model with a direction indicator housing. Loosen the screws and remove the direction indicator housing where this is fitted.
5. Loosen jacket tube bracket under instrument panel. Lift away the driving seat. Loosen nuts for pitman arm and pull same off from lever shaft by means of tool SVO 2195 (fig. 23).
7. Loosen steering gear housing from body (frame on the PV 445) and lift the steering gear with steering jacket tube forwards and upwards.

Disassembly, (part no. 250024)

1. Wash outside of steering gear housing.
2. Loosen bolt (15, fig. 18) for jacket tube. Pull off jacket tube.
3. Remove cover (6) and drain oil.
4. Lift up twin lever shaft (10).
5. Screw out the three bolts (14) attaching the upper cover (12) and remove same. Keep adjuster shims (17), if there are any fitted.
6. Pull out steering column complete with cam (26). Ball bearings (5 and 19) and outer rings (4 and 18) will be removed at the same time.
7. Remove ball bearings by removing lock rings (3 and 16).
8. If necessary, pull out the bearing (15, fig. 17) in the jacket tube with puller SVO 4078.

Disassembly, (part no. 250051)

1. Wash outside of steering gear housing.
2. Remove the nut (8, fig. 20) and lock washer (9) on the adjuster screw of early production. Loosen the three bolts (6) on the top cover. Pull up the cover (7) slightly and drain off the oil. Pull out the cover and sector shaft (1).
3. Unscrew the adjuster screw (10) from the cover. If required, remove the lock ring and take the adjuster screw from out of the sector shaft.
4. Loosen the clamp (12) and remove the jacket tube (13). If required, remove the ball bearing (15, fig. 17) in the jacket tube by using puller SVO 4078.
5. Loosen the bolts (3, fig. 20) and remove the bottom cover (4). Do not lose the shims (5). Take out the steering shaft (14) and the ball bearings (2 and 15).

Inspection

Before inspection, all parts should be thoroughly cleaned in paraffin (kerosene).

Inspection. (part no. 250024)

Check levers and replace the lever shaft, if the surfaces should be found scratched or badly worn.

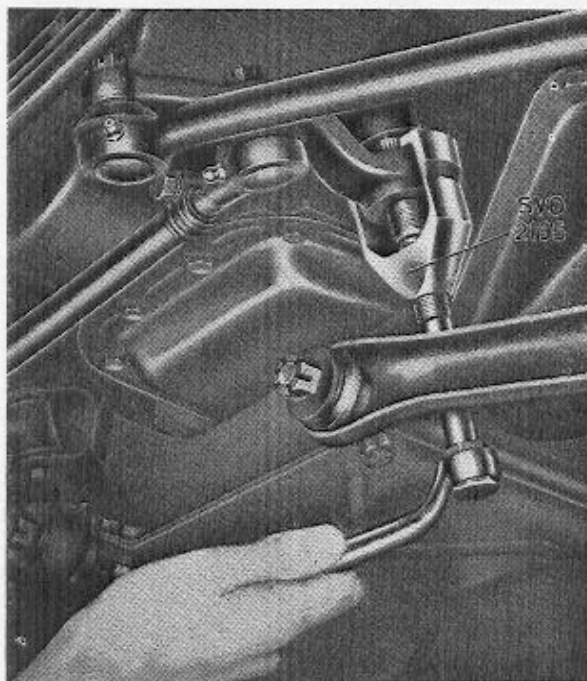


Fig. 23. Removing pitman arm.

Investigate also the contact surfaces of the cam and replace the steering column complete with cam, if it should be badly worn.

Install lever shaft in steering gear housing. Replace bushings, if excessive clearance should be found. Use drift SVO 4075 (fig. 24) for removal.

Investigate bearing outer rings and balls. Scratched or damaged bearing parts should be replaced.

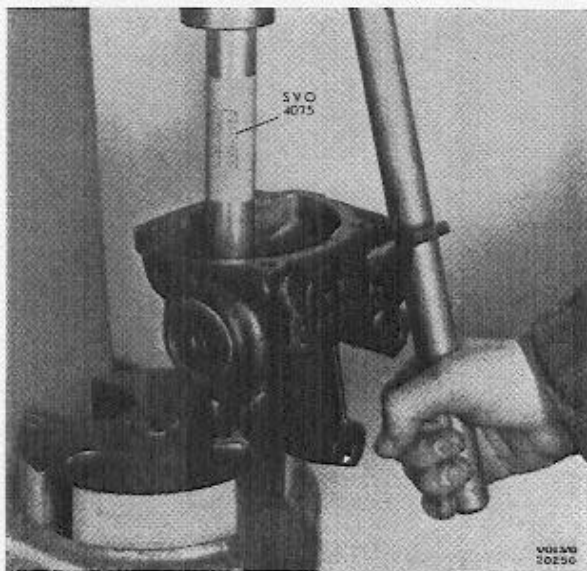


Fig. 24. Removing bushings.

Inspection, (part no. 250051)

Check the sector shaft. There should be no scratches, damage or evidence of excessive wear on the contact surfaces. There should be no looseness in the sector shaft. If there is looseness, the sector shaft should be replaced.

Check the axial play of the adjuster screw in the sector shaft. This should not exceed 0.1 mm (0.004") and can be reduced by inserting a thicker shim. The screw must, however, turn easily in the sector shaft.

Check the contact surfaces of the hourglass worm against the sector. Check the inner races on the ball bearings. If they are scratched or badly worn, the complete steering mechanism and steering shaft should be replaced.

Check the outer races and balls. Scratched or damaged bearing parts should be replaced.

Examine for play of the sector shaft in the bushings. If there is looseness, the bearings in the housing and cover should be replaced.

Press out both housing bushings at the same time towards the cover by using drift SVO 2228 and the standard handle SVO 1801. The bushing in the cover is divided and is removed with a chisel, or similar. Bushings in light-alloy covers are cast in, so that the whole cover must be replaced.

Assembly, (part no. 250024)

1. Press lever shaft bushings into position with drift SVO 4075 and ream with SVO 4076 (fig. 25). Remove burr from steering mechanism.
2. Fit new oil seal by means of drift SVO 4079.
3. Install ball bearings (11 balls in each bearing) in steering column and fit new lock rings.
4. Install steering column in steering gear housing. Fit top cover (fig. 26). Adjust with shims so that the steering shaft can be easily turned without excessive clearance when the screws are tightened.

Note: Be careful not to damage ball bearings if too many shims should have been removed.

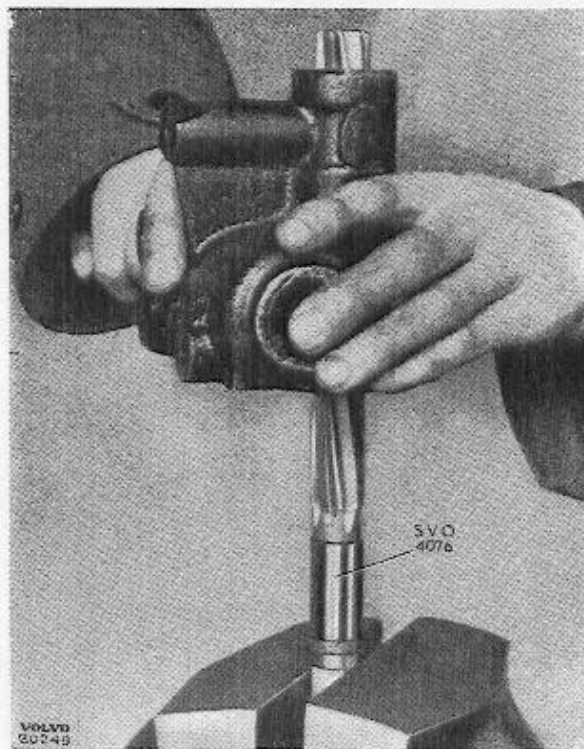


Fig. 25. Reaming the bushings.

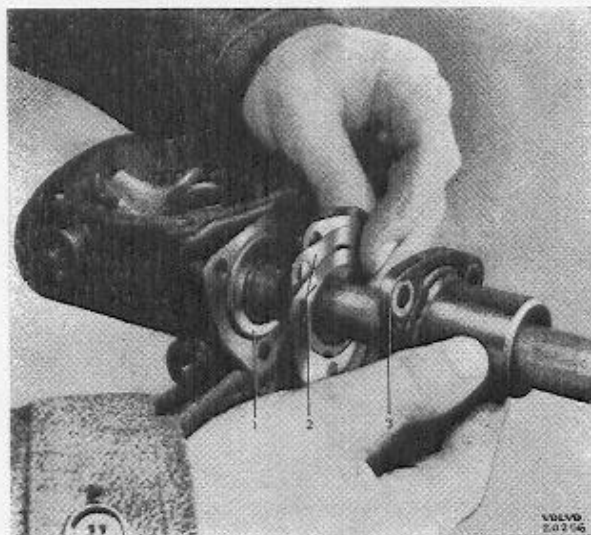


Fig. 26. Adjusting bearing clearance.

1. Outer ring
2. Shims
3. Cover

5. Install lever shaft in steering gear housing. Make sure that the levers run smoothly in the cam when this is turned.
6. Loosen adjuster screw in cover and fit same. Fit new gaskets.
7. Turn the steering shaft until the sector levers come about centrally on the cam. Tighten the adjusting screw whilst turning the steering shaft backwards and forwards till a slight stiffness is felt. Then screw back the adjusting screw until this stiffness just disappears. Lock the adjusting screw in this position.
8. Fit the bearing and jacket tube clamp and place the felt ring on the steering shaft. Fit the steering shaft with the slot turned upwards but tighten the clamp only on the type with traffic indicator switch housing.
9. Fill with oil. See "Specifications".

Assembly, (part no. 250051)

1. Press the sector shaft bushings into the housing from each side with tools SVO 2228 and 1801. In the upper cover of cast iron the bushing is pressed in with drift SVO 2227.
2. Ream the bushings in the housing with reamer SVO 2225 A. Introduce the reamer into the housing first after which the guide

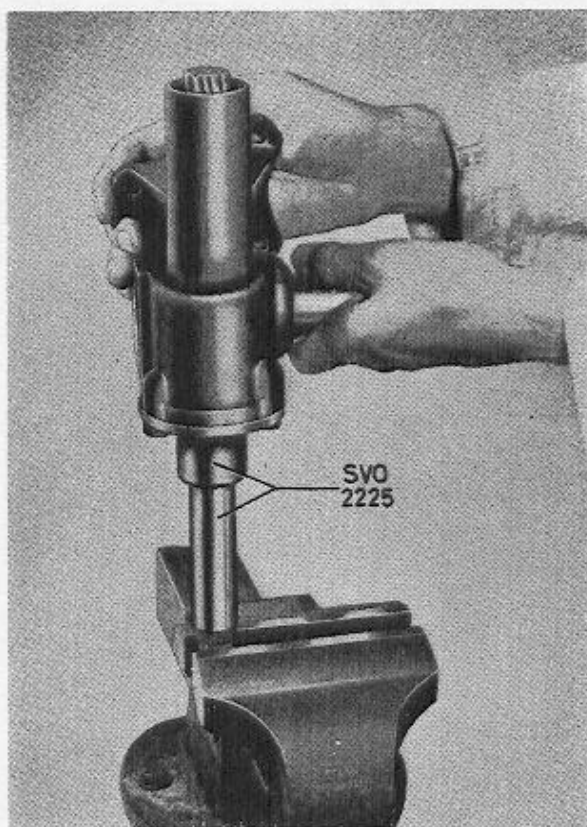


Fig. 27. Reaming the bushings.

SVO 2254 is screwed on and reaming can begin. (Fig. 27). In cast iron covers the bushing is reamed with reamer SVO 2226. This is first introduced through the housing bushings as shown in fig. 28. The cover is then placed in position and reaming carried out. After reaming, all burr should be removed from the steering gear. In light-alloy covers the bushing is ready machined.

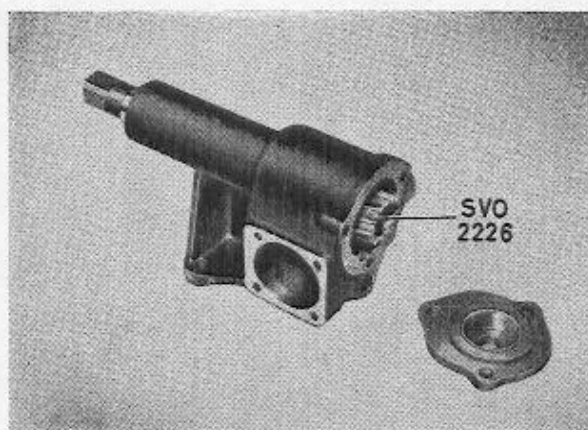


Fig. 28. Reaming the cover bushing.

3. Fit the steering shaft and bearing in the housing. Fit the bottom cover with shims of the same thickness as originally fitted. Tighten the bolts and check that the steering shaft turns easily without looseness. When the bearings are correctly adjusted, a torque not exceeding 1 kgcm (1 lb. in.) should be needed to turn the steering shaft.
4. Fit the jacket tube with ball bearing and felt ring. Turn the jacket tube until the slit is uppermost and tighten the clamp.
5. Press in the sector shaft seal ring. Use tool SVO 2199 as shown in fig. 29 and fit the sector shaft in the housing. Add a few drops of oil to the sector shaft adjuster screw.

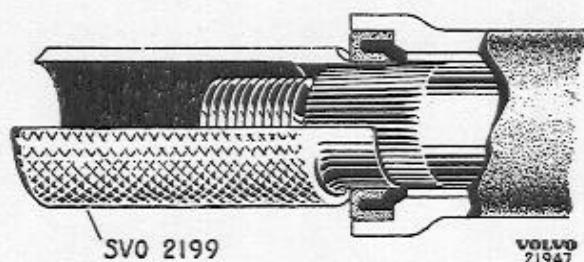


Fig. 29. Fitting the sector shaft.

6. Fit the cover and gasket over the sector shaft. Screw up the adjuster screw so far that the sector shaft is not clamped when the attaching bolts are tightened.
7. Fit the steering wheel and attach a spring balance as shown in fig. 30. Screw down the adjuster screw until a force of 0.4—0.7 kg (14 oz.—1½ lb.) is required to turn the steering wheel past the central position.

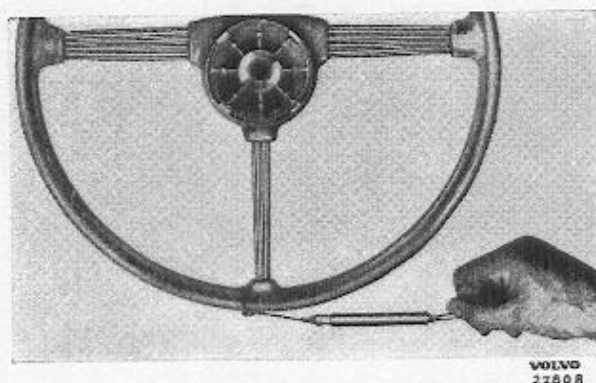


Fig. 30. Measuring steering wheel turning torque.

When the correct setting has been obtained, the lock washer and the nut are fitted to cast iron covers. There are two different types of lock washer depending on the position of the inner lock pin for fine adjustment of the adjuster screw. On light-alloy cover the adjusting screws is locked with a nut.

8. Fill with oil. See "Specifications".

Installation

1. Insert jacket tube through cowl hole (do not forget to fit rubber seal) and attach steering gear housing to body (frame of the PV 445).
2. Fit jacket tube bracket but do not tighten the bolts.
3. Turn the steering shaft to the central position and count the number of turns. Make sure that the front wheels are parallel with the centre line of car. Push the pitman arm on the lever (sector) shaft in this position and fit spring washer and nut.
4. Fit the direction indicator switch housing, if any.
5. Fit the washer and spring (also spacer on part No. 250024) onto the steering shaft. Fit the steering wheel so that the spokes are horizontal. Fit the lock washer (late production) and nut which should be tightened to 3.5 kgm (25 lb.ft.).
6. On models without a direction indicator switch housing, the jacket tube is pushed up under the steering wheel hub and the clamp is tightened.
7. Tighten the bolts on the bracket under the instrument panel.
8. Move up the direction indicator switch housing until there is a clearance of 1—1.5 mm (0.040—0.060") between the upper edge of the housing and the steering wheel hub.
9. Fit the horn cable, horn ring and lock screw. Connect cables on steering mechanism. Fit fuse.

Pitman arm adjustment

Check the pitman arm setting relative to the steering gear housing in the following way.

Jack up the vehicle until the wheels are clear of the ground. Turn the steering wheel to its central position (count the number of turns). Lower the vehicle. If the vehicle is correctly loaded, the wheels should be parallel with the centreline. If this is not the case, remove the pitman arm from the sector shaft. Use puller SVO 2195 (fig. 23). Then move the left-hand wheel until it is parallel with the centre line of the vehicle and then re-fit the pitman arm. The steering shaft should be in its central position. If the steering wheel spokes are not horizontal, they should be adjusted. See "Replacement of steering wheel".

Overhaul of tie rod and steering rods

Bent or damaged tie rods or steering rods must not be straightened but should be replaced.

Replacing ball joints

The ball joints cannot be dismantled or adjusted and if they become worn or damaged they must be replaced.

The steering rod ball joints are made integral with the steering rod so that the complete rod must be replaced. If the steering rod is to be removed with the wheels in position the ball joint at the pitman arm or steering idler arm is first loosened as shown in fig. 11.

The steering rod is then turned forwards and upwards and the tool placed on the ball joint as shown in fig. 31.

The ball joints on the tie rod can be replaced independently. When replacing, the ball joint is first loosened from the pitman arm or steering idler arm (see operation 5, page 6). The clamping screw on the tie rod is then loosened and the ball joint screwed out. The new ball joint should be screwed in the same number of threads which facilitates setting adjustment.

After having fitted new parts the setting should be checked. See under heading "Wheel alignment".

Replacement of steering idler arm bushings

Remove steering idler arm after having disconnected the ball joints of the right steering rod and tie rod. Pull over the steering idler arm

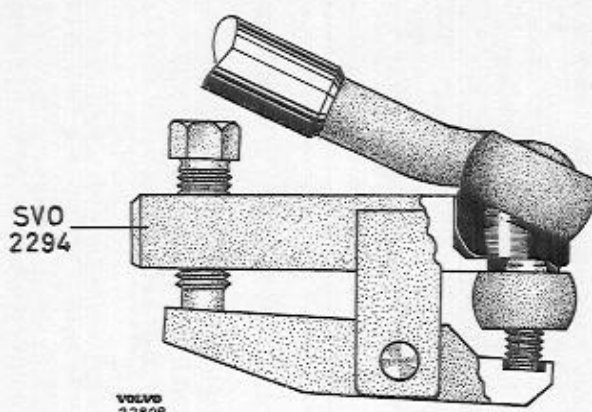


Fig. 31. Removing ball joint.

rubber dust shield (9, fig. 19) inwards and remove the bolt (7) for the steering idler arm attachment to the front axle member bracket (8).

Replace bushings (12) as well as spacer (6). Press out bushings by means of tool SVO 4025 and SVO 4089 after having removed the grease nipple. See fig. 32.

Install the new bushings by means of the same tool. Press in the bushings until flush with the outside of the steering idler arm.

Ream bushings to hand push fit. Assemble in reverse order to dismantling. Make sure that the steering idler arm can be easily turned after being fitted to the bracket.

Lubricate bushings with chassis lubricant.

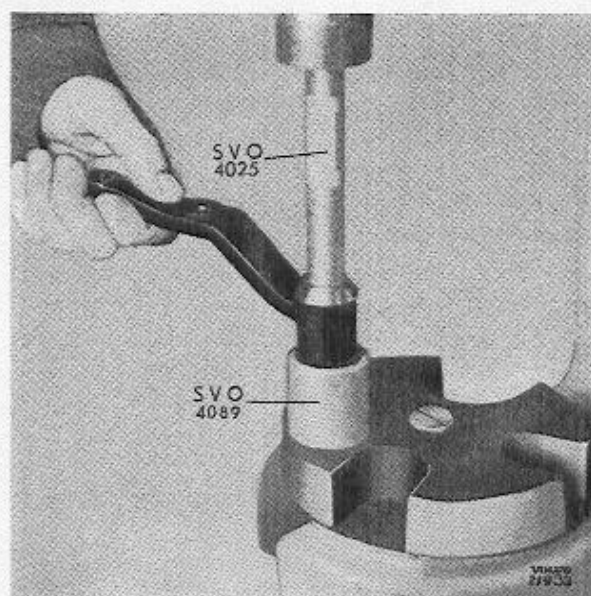


Fig. 32. Removing bushings from steering idler arm.

WHEEL ALIGNMENT

If the car is to have good steering properties and minimal tyre wear, certain settings must be carefully adjusted on the front wheels. This is known as wheel alignment and consists of caster, camber, king pin inclination, toe-out and toe-in.

Caster

This refers to the inclination of the king pin either backwards or forwards as shown in fig. 33 at A. This means easy steering since the wheels have an inclination to maintain the straight-forward position.

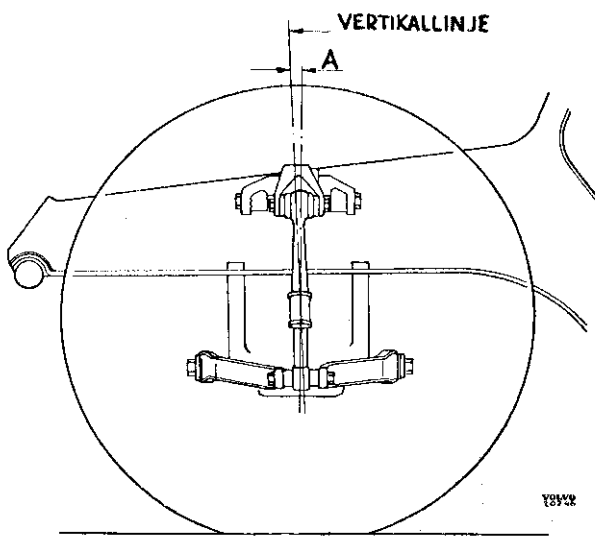


Fig. 33. Caster.

Vertikallinje=Vertical line

Camber

This refers to the inwards or outward inclination of the wheel. Camber is reckoned to be positive if the wheel is inclined outwards and negative if the wheel is inclined inwards. Positive camber is shown at C in fig. 34. Faulty camber means uneven tyre wear.

King pin inclination

This refers to the inwards inclination of the king pin. (B, fig. 34). King pin inclination means that the centre lines of the king pin and the wheel approach each other towards ground level. The

wheel is thus easier to turn. The king pin inclination also influences the tendency for the wheels to maintain a straight-forward position since the vehicle is lifted slightly when the steering wheel is turned.

Toe-out

When driving round a curve, the wheels will have varying radii of rotation. In order that they have the same turning centre and subsequent minimal tyre wear, the front wheels must be turned to a varying extent. This state of affairs, the toe-out, is fixed by virtue of the construction of the steering rods and steering knuckle arms. See fig. 35.

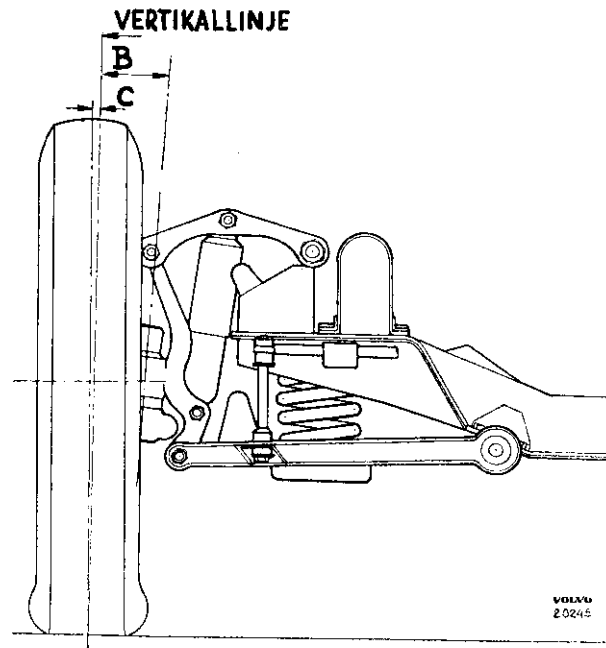


Fig. 34. Camber and king pin inclination.

Vertikallinje=Vertical line

Toe-in

The difference in the distances (E and G in fig. 35) between the back and front of the tyres at hub height is called toe-in. This decreases tyre wear.

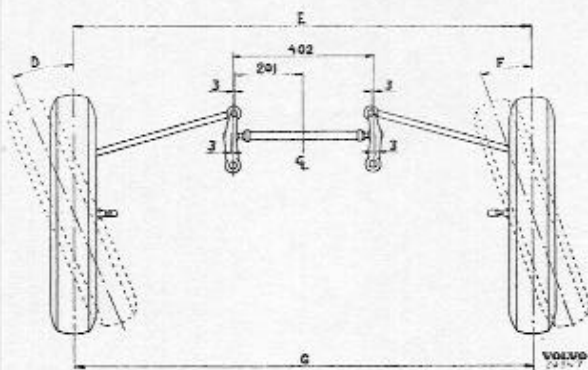


Fig. 35. Toe-out.

Measuring and adjustment of wheel alignment

Wheel alignment is measured by means of special instruments, of which many different types are available. For this reason, no general instructions concerning the procedures adopted are given with the exception of toe-out and toe-in. The principle of measurement is that camber is measured directly when the wheels are in the straight-forward position. Caster and king pin inclination cannot be measured directly. Instead measurements are carried out of the angular differences on the instrument when the wheels are turned from 20° outwards to 20° inwards.

When carrying out wheel alignment measurements, always follow the instructions given with the various instruments.

Precautions to be taken before adjusting wheel alignment

Before any adjustments are made, the following points must be checked:

1. Check tyre pressure on all wheels.
2. Check that the front wheel tyres are equally worn. If this is not the case, change around with a rear wheel tyre or the spare tyre.
3. Check that wheel warp and out-of-roundness does not exceed 2.5 mm ($\frac{3}{32}$ ").
4. Check front wheel bearings, king pin and bushings as well as shock absorbers.
5. Check that the control arms are not damaged and that they are firmly attached to the body unit. Check that the control arm bushings are not abnormally loose.

6. Check that the springs are in good order and are not suffering from fatigue.
7. Check for looseness in the steering mechanism and its settings. When the steering mechanism is in its central position, the wheels should be parallel with the centre line of the vehicle.
8. Check steering rods, steering knuckle arms, steering idler arm and intermediary rod.
9. Ensure that the vehicle is normally loaded (oil, water, fuel and tools).

Checking caster

Caster should be $-3/4^\circ$ — $+1/4^\circ$. It is adjusted by loosening the clamp bolt (1, fig. 36) and then turning the eccentric bushing (2). Use wrench SVO 1411 B if the bushing is early production with a width across flats of 28.5 mm ($1\frac{1}{8}$ "") and wrench SVO 2201 if the bushing is late production with a width across flats of 34.3 mm ($1\frac{11}{32}$ ""). One complete turn alters the angle by $1/2^\circ$. N.B. If the wheel has the correct camber, one complete turn must be given since otherwise the camber will be altered. Tighten the clamp bolt before checking the caster.

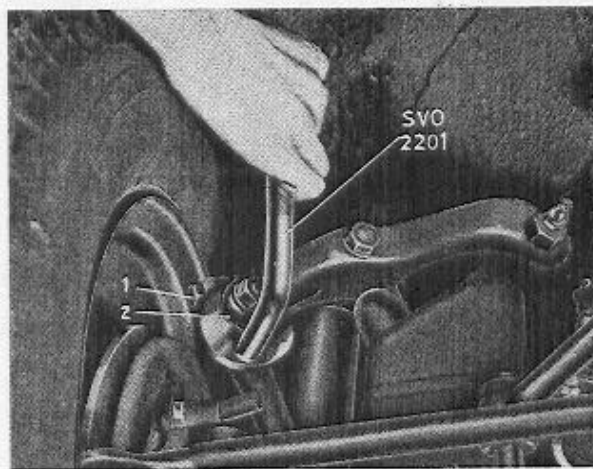


Fig. 36.

1. Clamp bolt
2. Eccentric bushing

Checking camber

After caster has been checked, adjust camber. This should be $-1/4^\circ$ — $+1/2^\circ$. It is adjusted by loosening the clamp bolt and turning the eccentric bushing with wrench SVO 1411 B and SVO 2201 (fig. 36). Alteration of camber also means a slight alteration of caster but this is negligible.

Checking king pin inclination

As a precautionary procedure, king pin inclination should also be measured. This should be 5° when the camber is 0° .

Checking toe-out

1. Have the vehicle standing with the front wheels on turntables and make sure that they are in the straight-ahead position. Zero the turntables first and lock them.
2. Turn one wheel 20° inwards and read off the angle of turn on the other wheel. This should be $22^{\circ} \pm 1^{\circ}$.

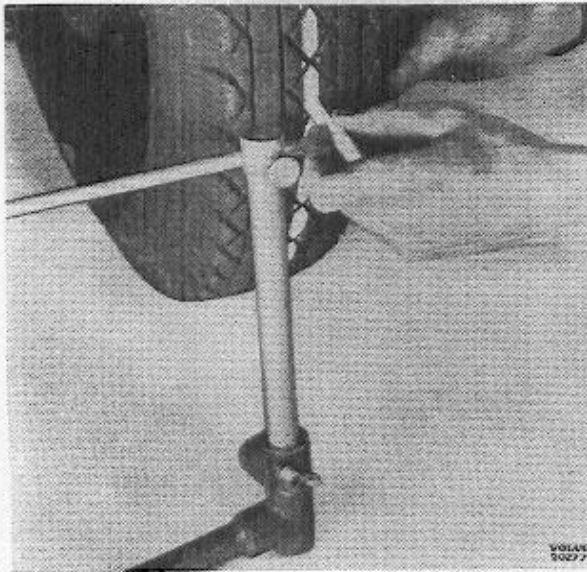


Fig. 37. Chalking the tyre.

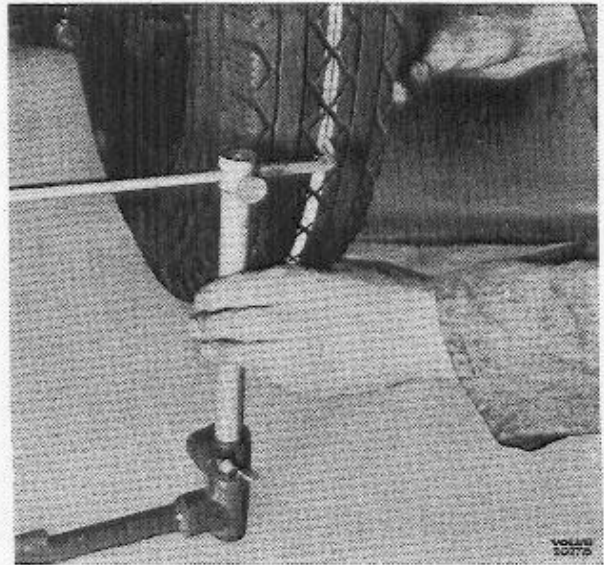


Fig. 38. Marking the tyre.

3. Turn the wheel in the other direction and read off the angle of turn on the other wheel in the same way.
4. There are no possibilities of adjusting toe-out. If it should be faulty, check the steering knuckles and steering rods and replace any damaged ones.

Checking toe-in

The operations below concern certain types of measuring instruments. As far as other types are concerned, follow the instruction given by the manufacturer.

1. Jack up the front end of the vehicle until the wheels are free from the ground.

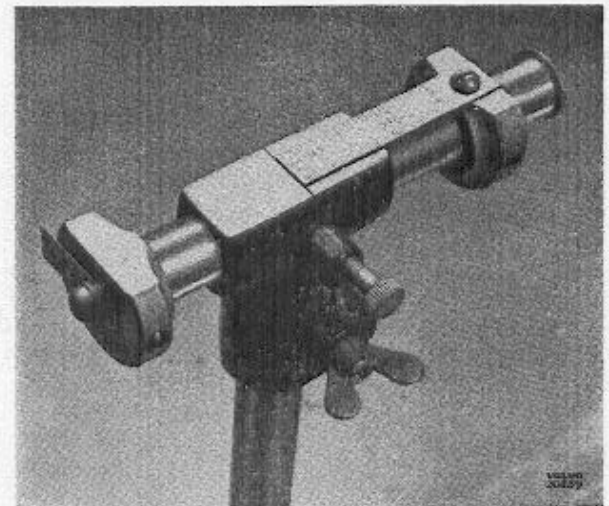


Fig. 39. Zeroing the measuring tool gauge.

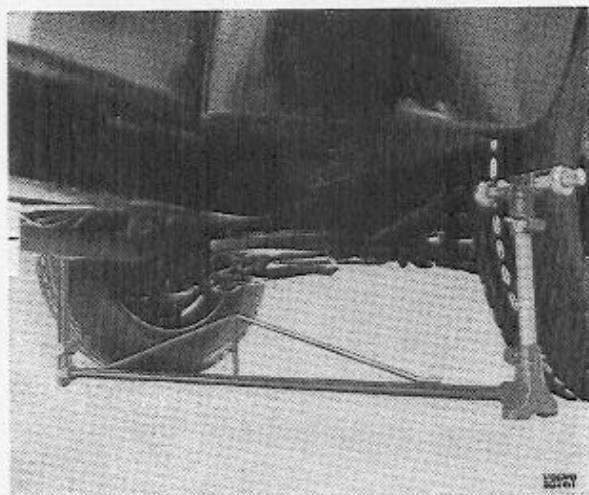


Fig. 40. Locating the measuring tool.

measuring point of the instrument against the mark on the right-hand wheel and adjust the movable measuring point against the mark on the left-hand wheel. (Fig. 40).

5. Move the tool carefully to the front of the wheel and set the movable point against the mark on the right-hand wheel. Adjust the measuring point against the mark on the left-hand wheel and read off the toe-in (fig. 41). This should be 0—3 mm (0— $\frac{1}{8}$ ").
6. If the toe-in is faulty it can be adjusted by

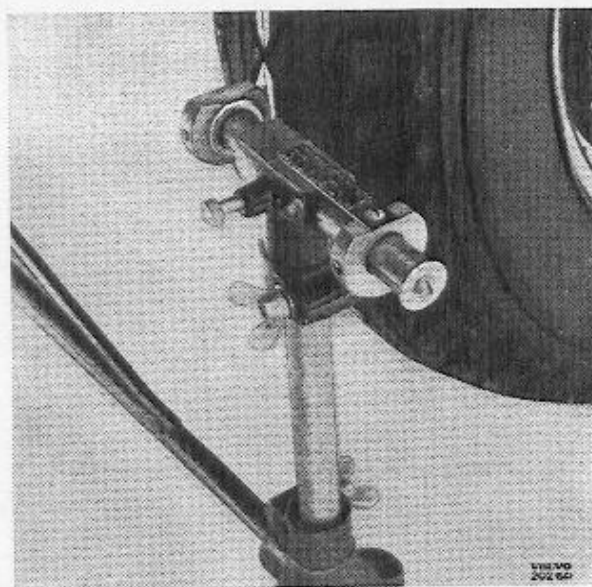


Fig. 41. Reading off the toe-in.

loosening the clamp bolt and turning the tie rod in the required direction. One turn in the normal direction of rotation of the wheel reduces the distance between the tyres at the front, i.e. increases toe-in. One quarter of a turn of the tie rod corresponds to about 3 mm ($\frac{1}{8}$ " toe-in. Tighten the clamp bolt.

7. After alteration has been carried out, the vehicle is rolled one complete wheel revolution forwards and the toe-in is measured again.

TRACING FAULTS

CAUSE	REMEDY
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Vehicle wanders

Incorrect caster.	Check and adjust caster if necessary.
Excessive or insufficient play in the steering gear.	Adjust steering gear.
Steering and tie rod ball joints worn or too tight.	Check ball joints and exchange worn ones.
	Lubricate ball joints via grease nipples.
Insufficient toe-in.	Check and adjust if necessary. See "Wheel alignment".
Control arm system stiff.	Lubricate thoroughly. Replace damaged parts.

Car pulls to one side

Low or uneven tyre pressure.	Check tyre pressure (see Part 8).
Front springs have grown slack or are of different height.	Remove and check springs (see Part. 9).
Abnormal friction in one wheel bearing.	Remove wheel. Check bearings. Exchange damaged bearings and adjust in accordance with instructions on pages 4—6.
Front and rear wheels not tracking.	Measure car body (frame of the PV 445) and straighten it if necessary (see Part 11 and 9).
Brake dragging.	Adjust brake (see Part 7).
Bent steering rod or tie rod.	Exchange damaged parts.
Incorrect camber.	Check and adjust if necessary.

Hard steering

Abnormal friction in steering knuckles or damaged roller bearing.	Remove wheels. Investigate and lubricate or exchange bushings, king pin and ball bearings if necessary.
Unsuitable or insufficient lubricating oil in steering gear housing.	Check oil level. See "Specifications" for oil viscosity.
Abnormal friction in steering gear.	Adjust steering gear. See "Steering gear".
Steering rod or tie rod ball joints or steering idler arm bushings binding.	Lubricate ball joints and bushings via grease nipples.
Excessive caster.	Check and adjust if necessary. See "Wheel alignment".

Front wheel shimmy

Excessively low tyre pressure.	Check pressure (see Part 8).
Wheels out-of-balance.	Balance wheels (see Part 8).
Brake drums worn out-of-round.	See Part 7.
Damaged steering rod and tie rod.	Exchange damaged parts.
Loose or worn front wheel bearings.	Remove wheel and hub. Investigate bearing races. Exchange the whole bearing if any part should be damaged.

Steering shock or kickback

Excessive play in steering gear.
Unsuitable or insufficient lubricating oil in steering gear housing.
Loose front wheel bearings.
Excessive play in steering rod and tie rod ball joints.
Pitman arm wrongly fitted.
Wheels out-of-balance.

Adjust play. See "Steering gear".
Check, flush steering gear housing and fill oil in accordance with specifications.
See under "Front wheel bearings".
Exchange ball joints if necessary.

See "Pitman arm adjustment".
Remove and balance wheels. See Part 8.

TOOLS

(see fig. 42)

The following tools are essential when carrying out repairs on the front axle and steering gear.

Front axle

SVO 1171B	Reamer for king pin bushing (late production, replaces SVO 1171A).	SVO 1801	Standard handle.
SVO 1411B	Wrench for eccentric bushing (early production PV 444 and PV 445).	SVO 2195	Puller for pitman arm.
SVO 1442	Drift for removal and assembly of king pin bushings.	SVO 2197	Drift for removing and assembling grease cap.
SVO 1446A	Puller for front wheel hubs (early production PV 444 and PV 445).	SVO 2201	Wrench for eccentric bushing (PV 544, late production PV 444 and PV 445).
SVO 1791	Puller for front wheel hubs (PV 544, late production PV 444 and PV 445).	SVO 2224	Tool for removing king pin.
SVO 1794	Puller for inner bearings on steering knuckles (PV 544, late production PV 444 and PV 445).	SVO 2300	Fixture for upper control arm.
SVO 1797	Tool for assembling outer bearing ring in front wheel hubs (PV 544, late production PV 444 and PV 445).	SVO 4000	Tool for assembling outer bearing ring in front wheel hubs (early production PV 444 and PV 445).
SVO 1798	Tool for assembling inner bearing ring and seal ring in front wheel hubs (PV 544, late production PV 444 and PV 445).	SVO 4001	Tool for assembling inner bearing ring and seal ring in front wheel hubs (early production PV 444 and PV 445).
SVO 1799	Tool for removing inner bearing ring in front wheel hubs (PV 544, late production PV 444 and PV 445).	SVO 4002	Tool for removing outer bearing ring in front wheel hubs (early production PV 444 and PV 445).
SVO 1800	Tool for removing outer bearing ring in front wheel hubs (PV 544, late production PV 444 and PV 445).	SVO 4003	Tool for removing inner bearing ring in front wheel hubs (early production PV 444 and PV 445).
		SVO 4005	Centring tool for king pin.
		SVO 4016	Puller for inner bearing on steering knuckles (early production PV 444 and PV 445).
		SVO 4025	Drift for removal and assembly of idler arm bushing.
		SVO 4089	Ring for removal of idler arm bushing.

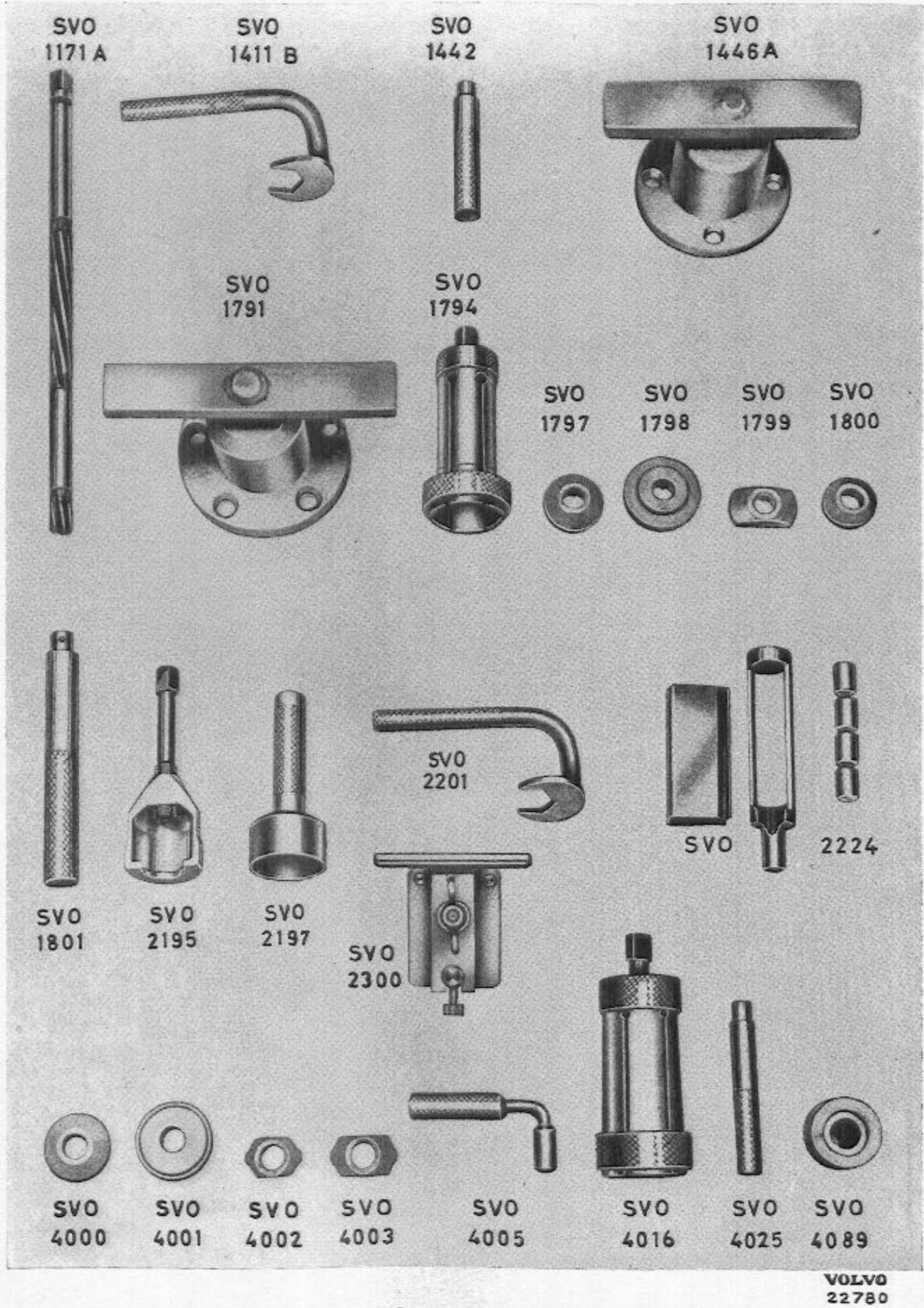


Fig. 42. Special tools for front axle.

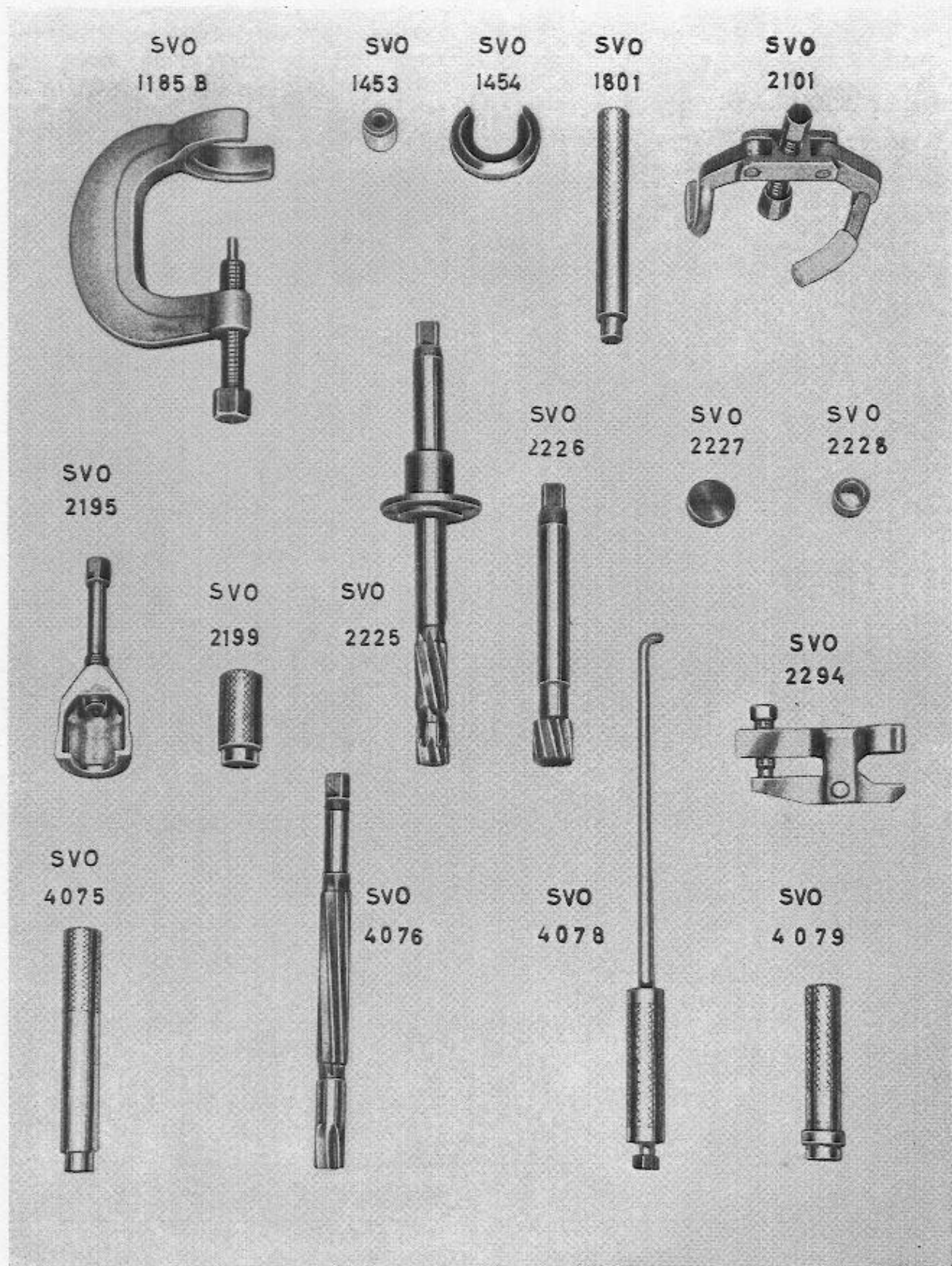


Fig. 43. Special tools for steering gear.

Steering gear

(see fig. 43)

SVO 1185B	Puller for steering wheel (early production PV 444 and PV 445).	SVO 2226	Reamer for cover bushing (steering mechanism Part No. 250051 with cast iron cover).
SVO 1453	Spacer (for steering wheel puller SVO 1185 B).	SVO 2227	Tool for bushing in cast iron cover and for seal ring (steering mechanism Part No. 250051).
SVO 1454	Clamp (for puller SVO 1185 B).	SVO 2228	Tool for removal and assembly of sector shaft bushing (steering mechanism Part No. 250051).
SVO 1801	Standard handle.	SVO 2294	Removing tool for ball joints.
SVO 2101	Puller for steering wheel (PV 544, late production PV 444 and PV 445).	SVO 4075	Drift for removal and assembly of bushings for sector shaft (steering mechanism Part No. 250024).
SVO 2195	Puller for pitman arm.	SVO 4076	Reamer for sector shaft bushings (steering mechanism Part No. 250024).
SVO 2199	Sleeve for seal ring when fitting sector shaft (steering mechanism Part No. 250051).	SVO 4078	Puller for bearing in jacket tube.
SVO 2225	Reamer for sector shaft bushings (Steering mechanism Part No. 250051).	SVO 4079	Drift for assembly of seal ring (steering mechanism Part No. 250024).
	SVO 2225A Reamer.		
	SVO 2254 Guide.		

SPECIFICATIONS

Front axle

King pin length:

PV 444 and PV 445, early production	124.5 mm (4 ²⁹ / ₃₂ "
PV 544, PV 444 and PV 445, late production	133.5 mm (5 ¹ / ₄ "
King pin diameter	19 mm (³ / ₄ "
King pin radial clearance, max.	0.3 mm (0.012")
Clearance of threaded control arm bushings, normal	0.3—0.6 mm (0.012—0.023")
" " " " " " " max.	0.8 mm (0.032")

Steering mechanism, part no. 250024

Steering wheel diameter, early production	417 mm (16 ²⁷ / ₆₄ "
" " " late production	425 mm (16 ⁴⁷ / ₆₄ "
Number of turns, lock to lock	3 ¹ / ₄
Type	Ross, cam and lever
Ratios:	
Central position	12: 1
Outer positions	14: 1
Shims for bearings	0.002"
	0.003"
	0.010"
Lubricant	Caltex Special Oil 250, Castrol SB Special Gear Oil, Esso Gear Oil 250 Special, Kendall 400, Mobilube Special Steering Gear Oil, Nynäs Steering Gear Oil, OK Special Steering Gear Oil or Shell Dentax Oil 250 At low temperatures (below —20° C [—4° F] SAE 80 if steering is stiff)
Steering gear oil capacity	0.3 litres (¹ / ₂ Imp. pint, ⁵ / ₈ US. pint)

Steering mechanism, part no. 250051

Steering wheel diameter	425 mm (16 ⁴⁷ / ₆₄ "
Number of turns, lock to lock	3 ¹ / ₄
Type	Gemmer, hourglass worm and sector
Ratio	13.9: 1
Shims for steering gear bearing	0.1 mm (0.004")
	0.2 mm (0.008")
	0.25 mm (0.001")
Washer between adjuster screw and sector shaft.....	2.1 mm (0.083")
	2.2 mm (0.087")
	2.3 mm (0.091")
Lubricant	See under lubricant for steering mechanism, Part No. 250024 above
Steering gear oil capacity	0.13 litres (¹ / ₄ Imp. pint, ³ / ₈ US. pint)

Wheel alignment (unloaded vehicle)

Caster	— ³ / ₄ ° to + ¹ / ₄ °
Camber	— ¹ / ₄ ° to + ¹ / ₂ °
King pin inclination with 0° camber	5°
Toe-in	0—3 mm (0— ¹ / ₈ "
Toe-out:	
When the outer wheel is turned 20°, the inner wheel should turn	22° ± 1°