



# **SERVICE MANUAL**

**VOLVO 164 1971**

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# STEERING GEAR

## DESCRIPTION

### MECHANICAL STEERING GEAR

The design of the steering gear is shown in Fig. 6-29. Steering wheel movement is transmitted to the wheels via the steering column (5), steering box (3), pitman arm (10), tie rod (11), steering rods (8 and 13) and steering knuckles (7 and 10).

The relay arm (Fig. 6-42) is supported on a pin in the bracket by means of a bush. The bush consists of three parts, a rubber bush, an outer sleeve of sheet-metal and inside a spacer sleeve. The outer sleeve has a press fit in the hole of the relay arm. When the relay arm is turned, movement takes place between the outer sleeve and the rubber bush, the intervening space of which has been lubricated for life. The bearing thus requires no lubrication.

The upper and lower sections of the steering column (5, Fig. 6-29) are connected by means of a universal joint. The lower section is mounted to the steering

box by means of a flange (4) with rubber disc. Should a frontal collision involving the indentation of the front end occur, it is possible for the lower section of the steering column to break away and thus prevent the steering wheel from being forced backwards-upwards. A splined joint with staved sleeve on the upper section of the steering column permits axial compression during powerful impact and so assists in the above steering column breakage.

The upper section of the steering column is carried in ball bearings in the jacket tube. The ends of the tie rods and steering rods are plastic-lined and therefore require no lubrication.

The car has a turning circle of about 10 m (35 ft.) and the number of steering wheel turns from lock to lock is 4.8.

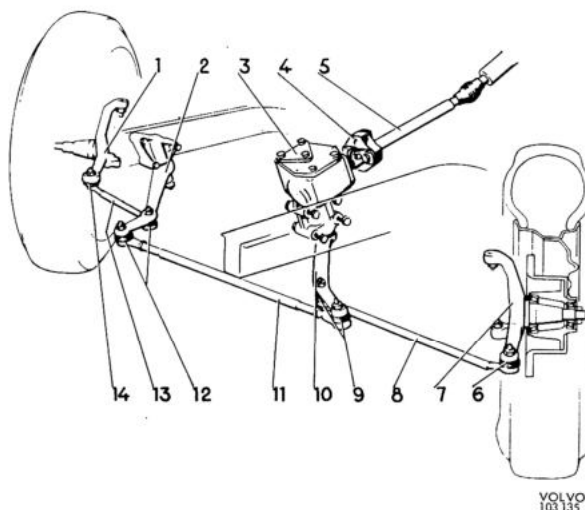
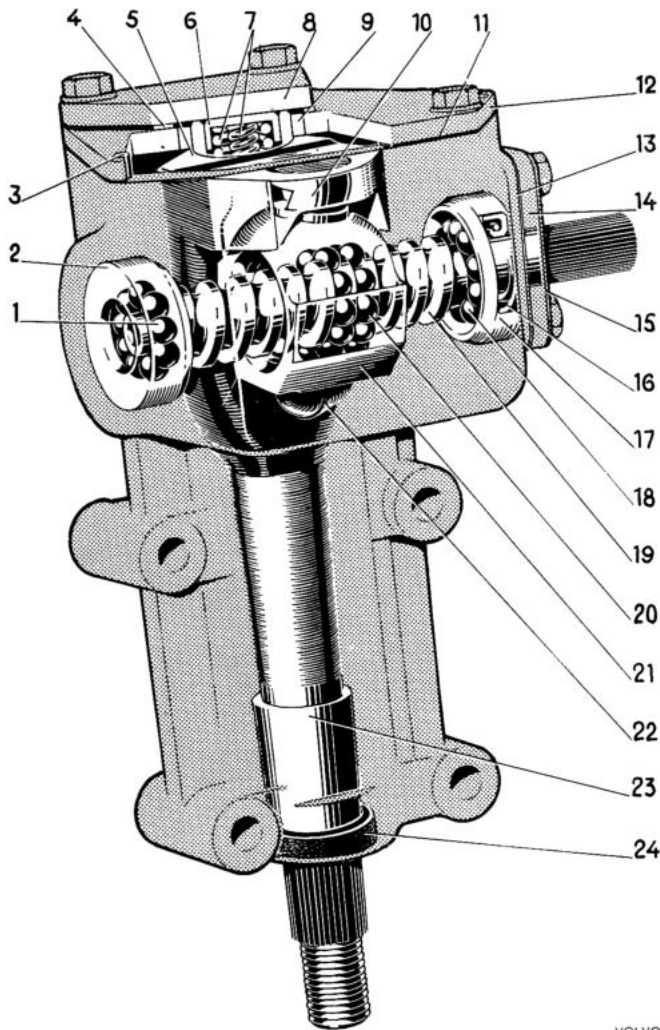


Fig. 6-29. Steering gear components

1. Steering knuckle, right
2. Relay arm
3. Steering box
4. Lower steering column flange
5. Lower steering column section with universal joint
6. Ball joint
7. Steering knuckle, left
8. Steering rod, left
9. Ball joint
10. Pitman arm
11. Tie rod
12. Ball joint
13. Steering rod, right
14. Ball joint



**Fig. 6-30. Steering box, mechanical**

1. Lower ball bearing, steering cam
2. Bearing race
3. Guide pin
4. Shims and gaskets
5. Lever shaft
6. Spring guide
7. Springs
8. Stop plate
9. Bush
10. Nut guide
11. Gasket
12. Steering box cover
13. Shims and gaskets
14. Steering cam cover
15. Retainer
16. Oil seal
17. Bearing race
18. Upper steering cam bearing
19. Steering cam
20. Balls
21. Ball nut
22. Recirculating ball tube
23. Bush
24. Oil seal

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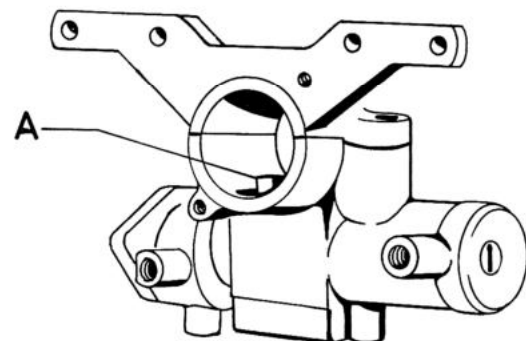
### Steering wheel lock

The engine of the vehicle has been made tamper-proof by the installation of a steering wheel lock, which is integrally built with the ignition switch. The ignition switch has four positions, 0-I-II-III. Removing the ignition key, which can only take place when it is in position "0", releases a catch and lock pin (A) is pressed forwards by a spring. When the steering wheel is turned, so that a slot coincides with the lock pin, the lock pin enters the slot and locks the steering column so that the front wheels cannot be turned.

When the ignition key is inserted and switched to position "I", the lock pin is pulled back and this releases the steering column which is secured in a withdrawn position. At position "I" the vehicle can be moved with the ignition switched off.

At position "II" the ignition is connected up and in position "III" the starter motor can be engaged. The ignition switch and steering wheel lock can only be replaced as a single unit.

The steering wheel lock is mounted to the column by means of two shear-off bolts, and to the dashboard with two screw.



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**Fig. 6-31. Steering wheel lock**

## SERVO STEERING

As alternative, this vehicle can be fitted with the ZF recirculating cam and ball nut type servo steering. The main components of the servo system are the steering box, servo pump and oil container with filter. These are connected to the various oil lines, see Fig. 6-32. From the pitman arm the servo steering system is similar to the mechanical steering arrangement, see Fig. 6-29.

The number of steering wheel turns from lock to lock is 3.7.

### Steering gear

#### CONSTRUCTION

The steering gear is of the cam and roller type. In addition to the mechanical section, the servo cylinder and control valves are built into the steering box. The lower part of the steering box (1 Fig. 6-33) is in the shape of a cylinder in which the piston (2) is fitted.

On the one side the piston is in the form of a rack gear which meshes with the tooth segment of the lever shaft (20).

The axial movement of the piston which determines the direction the wheel turn, is obtained via steering cam (5) and ball nut. The recirculating balls (4) are located in annular grooves and form the thread for the nut. Movement of the steering cam comes from the steering column at the control spindle (16) and the torsion rod (17) secured in the spindle. The steering cam is journalled in the upper section of the steering box partly by means of an axial thrust needle bearing and partly by means of a taper ball bearing. The inner race of the taper ball bearing also is an outer race for the double needle bearings of the control spindle.

Located in the upper part of the steering cam are the control valves (9 and 10): they are drawn out in the figures. These valves are influenced by two pins in the lower end of the control spindle (16).

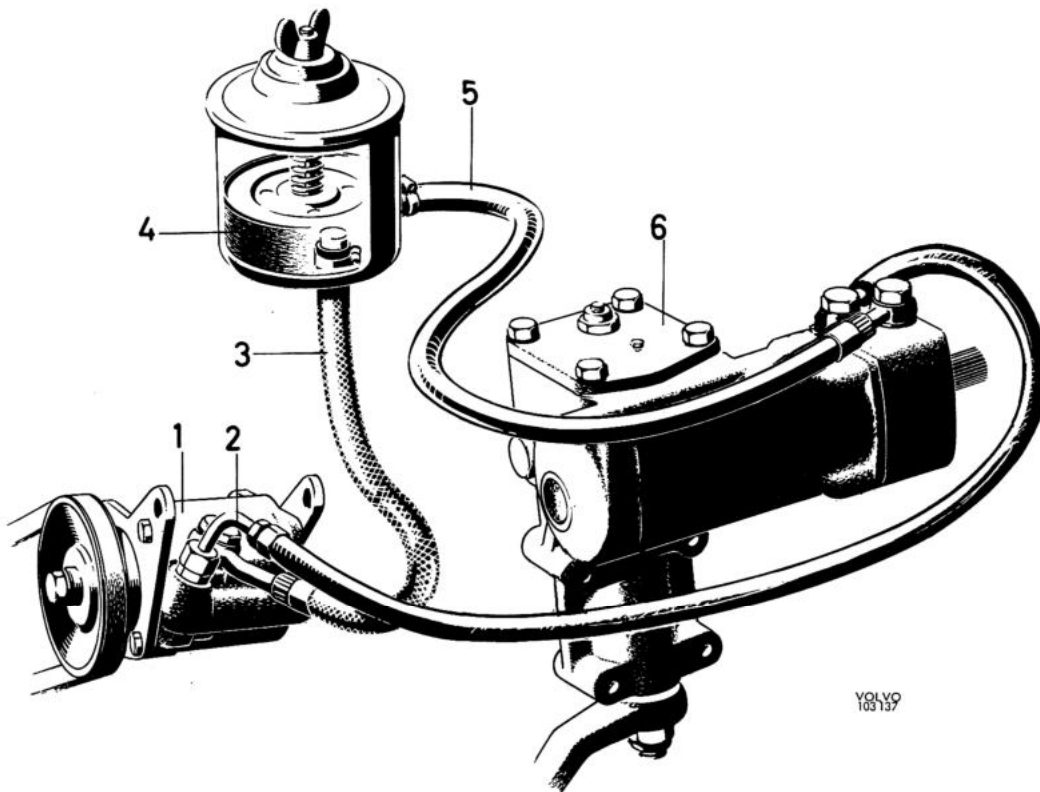


Fig. 6-32. Servo steering

- |                      |                              |
|----------------------|------------------------------|
| 1. Servo pump        | 4. Oil container with filter |
| 2. Delivery oil line | 5. Return oil line           |
| 3. Pump suction line | 6. Steering box              |



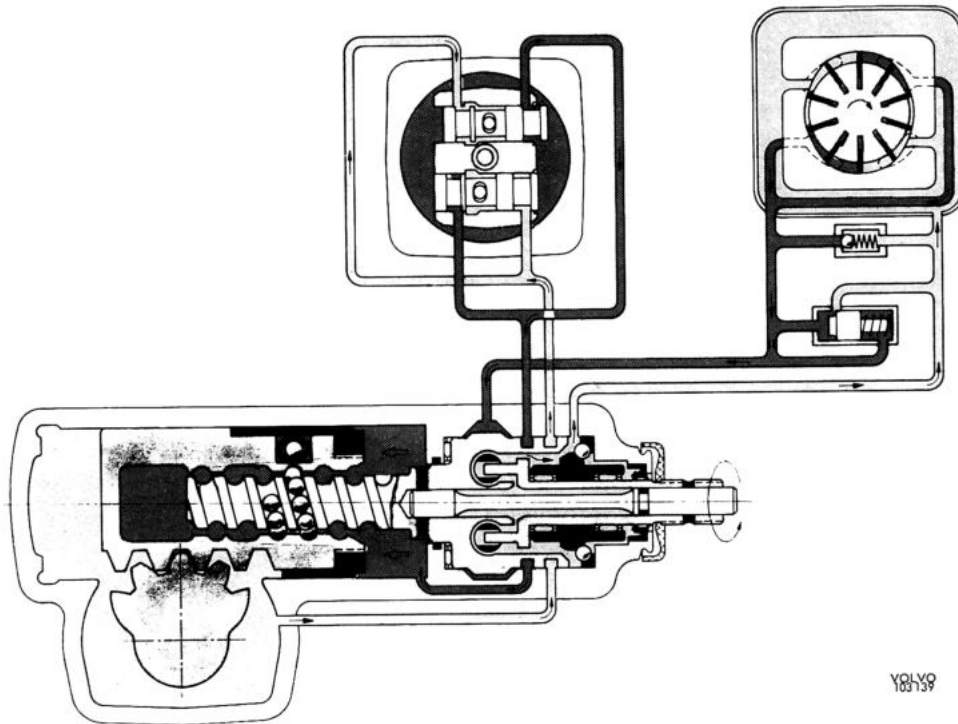


Fig. 6-34. Principle of function, left-hand turn

through the return groove (6) of the control valve (10) back to the oil container (13).

Oil is conveyed under pressure from the pump into an annular chamber round the valve housing (the large circle in the cross-section). In the neutral position (Fig. 6-33) the valves (9 and 10) are so adjusted that oil can pass the intake ports (8 and 11) and flow on to the annular grooves (18 and 19) in the valve housing. From here the oil is led partly to both sides of the piston (2) through the channels (18 and 19), and partly — as long as the valves are in the neutral position — to both the return grooves (6 and 7) at the control valves. From the return grooves oil flows through the return channel back to the container.

When the steering wheel is turned to the left (see Fig. 6-34) movement is transmitted via the control spindle (16) and the torsion rod (17) to the steering cam (15), so that the piston (2) is screwed to the left in the figure (downwards in the vehicle). Since the torsion rod is resilient, the steering spindle will be turned in relation to the steering cam and thus influence the valves placed in the cam. The greater the turning movement, the greater will be the valve displacement. One of the control valves (9) is then displaced to the

right and opens the intake port (8) wider, while at the same time the other control valve (10) is displaced to the left and closes the intake port (11). The delivery line of the control valve (9) is linked with the annular groove (19) in the valve housing. This also applies to the return groove (6) of the control valve (10). The delivery line of the control valve (10) is connected to the annular groove (18) and to the return groove (7) for the control valve (9).

Under such conditions, oil under pressure flows in through the intake port (8) to the annular groove (19) and then on to the cylinder on the right-hand side of the piston (2). Oil also flows to the return groove (6). Since the outlet port is blocked, pressure will rise and assist in pressing the piston (2) to the left.

Oil in the left-hand section of the cylinder is forced away via the annular groove (18) in the valve housing to the intake port (11) which is closed. At the same time, oil flows to the return groove (7) and then through the return line to the oil container.

As soon as the front wheels are turned to the desired angle and the forces operating on the steering wheel become less, the control valve returns to neutral position as a result of the influence of the torsion rod.

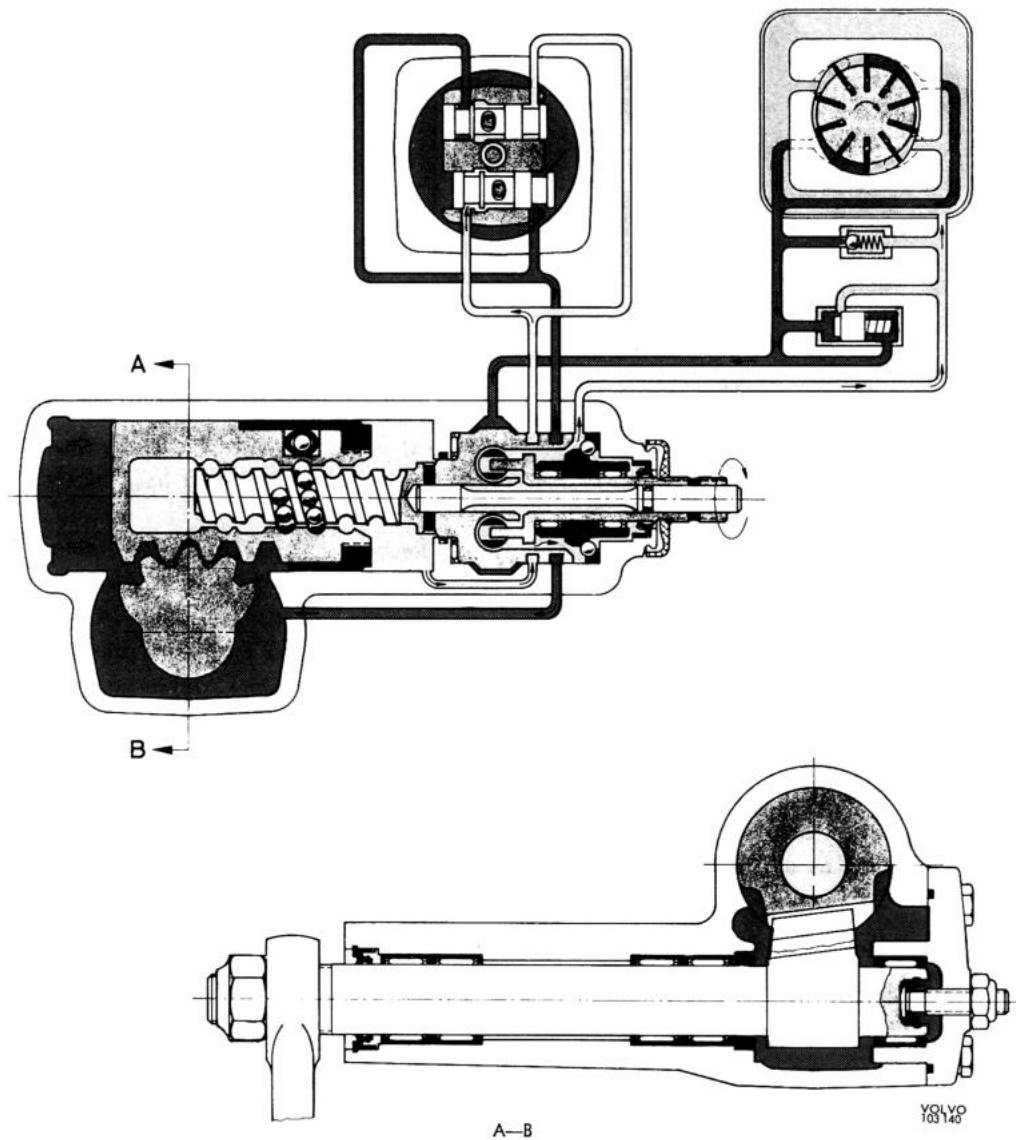


Fig. 6-35. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-35) will screw the piston (2) to the right on the figure. The control valve (10) is displaced to the right and permits oil under pressure to pass to the annular groove (18) of the valve housing and from there on to the left-hand side of the cylinder. Oil under pressure also flows to the return groove (7) which, however, is closed so that oil pressure on the left-hand side of the operating piston (2) rises and facilitates the turning of the lever shaft. Oil at the right-hand section of the cylinder is pressed by the piston via the annular groove (19) through the return groove (6) of the control valve (10) back to the oil container (13).

### Servo pump

The servo pump (Fig. 6-36) is of the vane type. It is mounted on a bracket on the left-hand side of the engine and is pulley-driven by the engine at engine speed.

The pump rotor is provided with 10 loose vanes and rotates in a circular-shaped intermediate piece. The vanes are pressed against the wall of the intermediate piece partly by centrifugal force and partly by oil pressure.

The space in the intermediate piece is oval, see Fig. 6-35. This permits the area between the rotor, the wall of the intermediate piece and two of the vanes to

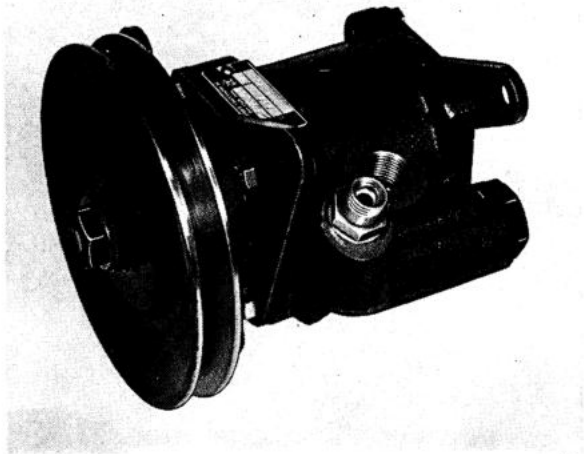


Fig. 6-36. Servo pump

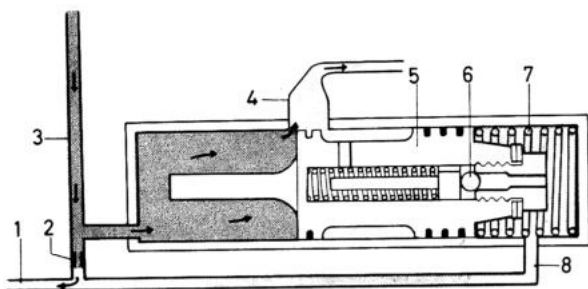
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alter when the rotor rotates. When a couple of vanes are moved from the suction side to the pressure side, the area between them and the sucked-in oil increases to start with. When the connection with the suction side has been passed, a link-up with the pressure side is then attained instead. Since the space between the vanes contracts at the same time, the pressure will rise and oil will be forced out into the delivery line. Due to the fact that there are two inlet and two outlet channels, the pump has double capacity.

### CONTROL VALVE

The pump housing contains a control valve which regulates partly the oil flow and partly the maximum pressure.

When the pump starts functioning, the valve (5, Fig. 6-37) maintains the valve pressed to the left of the spring (7). The oil supplied by the pump passes through the delivery channel (3) via the check valve



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Fig. 6-37. Control valve, normal position

- |                     |                  |
|---------------------|------------------|
| 1. Delivery line    | 5. Control valve |
| 2. Check valve      | 6. Safety valve  |
| 3. Delivery channel | 7. Spring        |
| 4. Return channel   | 8. Link channel  |

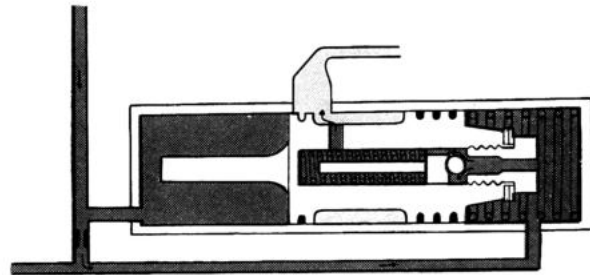


Fig. 6-38. Control valve, maximum pressure

(2) out into the delivery line (1) and from there to the steering box. The space to the right of the control valve is linked-up with the delivery line (1) by means of the link channel (8) and has, therefore, the same pressure.

The check valve's (2) function is to ensure that the pressure on the left-hand side of the control valve piston is higher than that in the line and also to the right of the piston. When the spring pressure is overcome, the piston is, therefore, displaced to the right. And when the speed is sufficiently high in relation to the counterpressure, the piston has been displaced so much that the surplus oil can flow back to the inlet side of the pump, see Fig. 6-37. Since the pump should deliver a quantity smaller than the maximum capacity, this valve adjustment can be called normal.

Should the pump flow through the outlet be stopped, for example, because the front wheel turning is blocked, the pressure in the delivery line (1), will rise and the pressure difference between both ends of the control valve will be equalized. This will cause the spring to be moved to the left, the connection with the return channel to be closed and the pressure to rise even more. At about 75 kp/cm<sup>2</sup> (1066 p.s.i.) the spring pressure on the safety valve (6) is overcome, that is, the inner part of the control valve, and oil can then pass out to the return channel (4). See Fig. 6-38. The pressure on the right-hand side of the piston will then drop and the entire control valve will be moved to the right so that the connection with the return channel opens. When the pressure drops to its normal value, the safety valve closes and the control valve returns to its normal position.

### Oil container

The oil container is placed in the engine compartment where it is easily accessible. It is provided with a filter, from the centre of which oil is sucked to the pump. By means of the by-pass valves, oil can flow past the filter should it become blocked. The oil level can be seen against the level line after removing the cap.

# REPAIR INSTRUCTIONS

## REPLACING THE STEERING WHEEL

### REMOVING

1. Remove the screws (1, Fig. 6-39) for the upper part of the directional indicator switch housing and the three attaching screws for the lower part. Lift off the housing.
2. Remove the attaching screws (2 and 3) for the horn ring. Turn and lift up the ring and pull out the cable contact.
3. Remove the steering wheel nut.
4. Point the front wheels straight forwards. Fit on the steering wheel puller SVO 2711, see Fig. 6-40, and pull off the steering wheel.

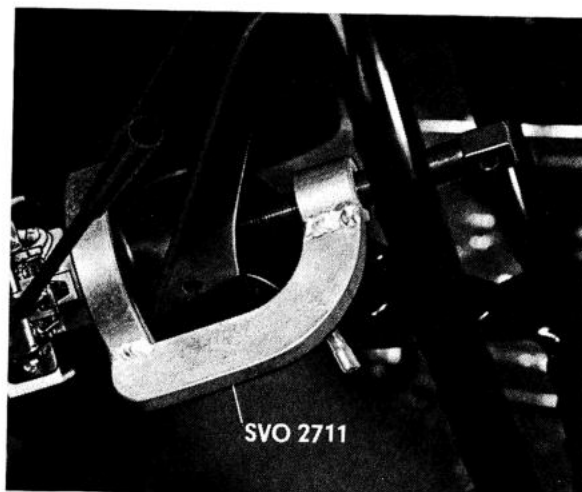


Fig. 6-40. Removing the steering wheel

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### FITTING

1. Make sure that the front wheels are pointing straight forwards.



Fig. 6-39 Attaching screws

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1. For directional indicator switch housing
2. and 3. For horn ring

2. Fit the slip contact and the steering wheel. Tighten the steering wheel nut to a torque of 3—4 kpm (20—30 lb.ft.).
3. Connect the cable contact and fit the horn ring so that the holes come opposite the attaching screws. Fit the screws (2 and 3, Fig. 6-39). Check the function of the horn ring.
4. Fit both parts of the directional indicator switch housing and their attaching screws.

## REPLACING STEERING COLUMN JACKET BEARING

Take off the steering wheel to replace the upper bearing. If the lower bearing is damaged, replace the steering shaft complete.

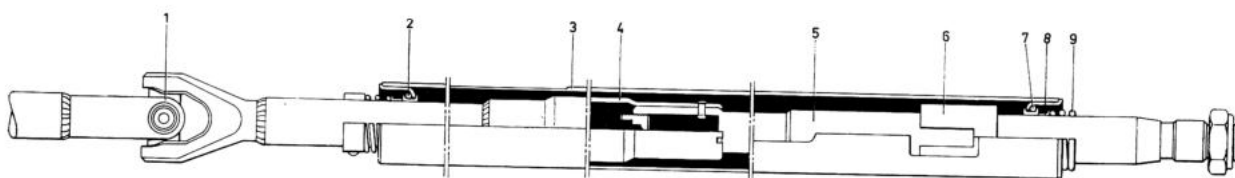


Fig. 6-41. Steering column components

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- |                           |                            |                  |
|---------------------------|----------------------------|------------------|
| 1. Universal joint        | 4. Sleeve                  | 7. Upper bearing |
| 2. Lower bearing          | 5. Steering column section | 8. Seat          |
| 3. Steering column jacket | 6. Lock lug                | 9. Spring        |

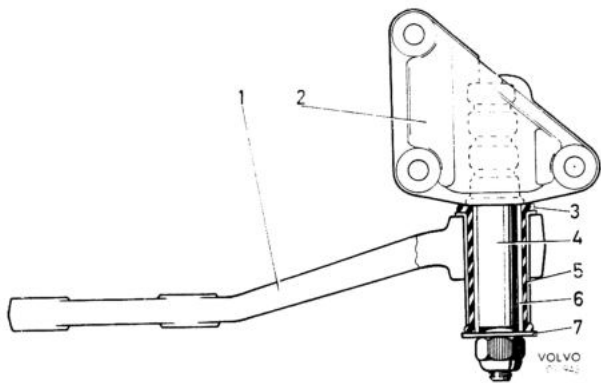


Fig. 6-42. Relay arm bearing

- |                |           |
|----------------|-----------|
| 1. Relay arm   | 5. Sleeve |
| 2. Bracket     | 6. Sleeve |
| 3. Rubber bush | 7. Washer |
| 4. Bearing pin |           |

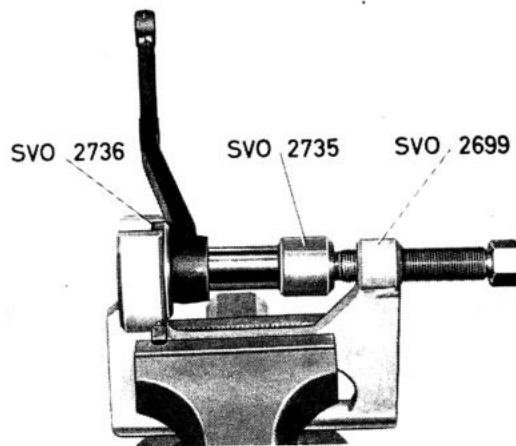


Fig. 6-44. Fitting the rubber bush, relay arm

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## REPLACING THE RELAY ARM BUSH

1. Jack up the vehicle at the front end.
2. Disconnect the ball joints for the steering rod and tie rod from the relay arm with puller SVO 2294, see Fig. 6-19.
3. Remove the nut and washer (7, Fig. 6-42) and take down the relay arm (1).
4. Secure press tool SVO 2699 in a vice and press the bush out with a counterhold SVO 2736 and drift SVO 2734 (see Fig. 6-43).
5. Turn the relay arm and press in the new bush with tools SVO 2699 + SVO 2736 and drift SVO 2735 (see Fig. 6-44).
6. Place the relay arm in position, fit the washer (7) and the nut. Tighten the nut to a torque of 7.0—8.5 kpm (50—60 lb.ft.).

7. Fit the steering rod (in the inner hole on the relay arm) and the tie rod. Tighten the Nyloc nuts to a torque of 3.5—4.1 kpm (25—30 lb.ft.).

## MECHANICAL STEERING GEAR

### Steering box

#### REMOVING

1. Jack up the front end.
2. Remove the locknut for the pitman arm. Pull the pitman arm off with tool SVO 2849. When fitting the puller, turn the wheels fully to the right, see Fig. 6-45.
3. Slacken the clamping bolt (1), Fig. 6-45. Remove the attaching bolts (4). Pull the steering box forwards (2).

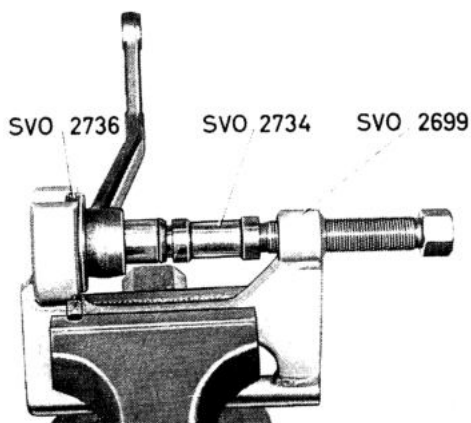


Fig. 6-43. Removing the rubber bush, relay arm

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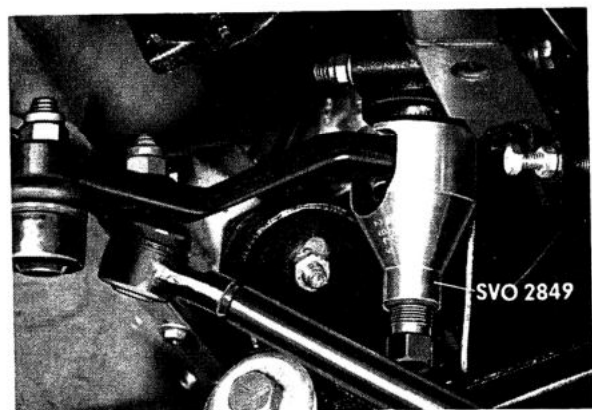
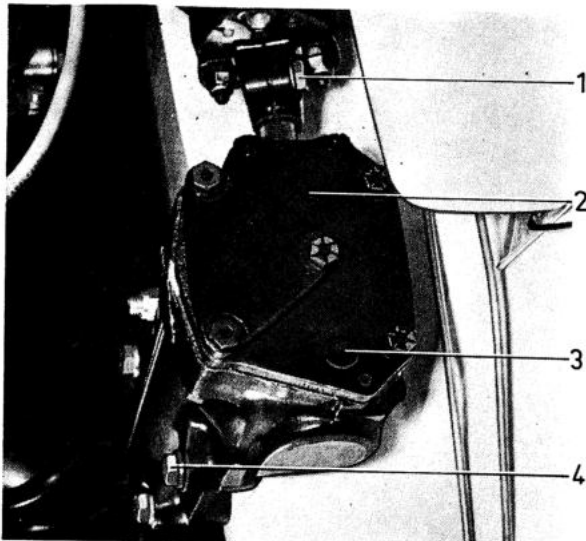


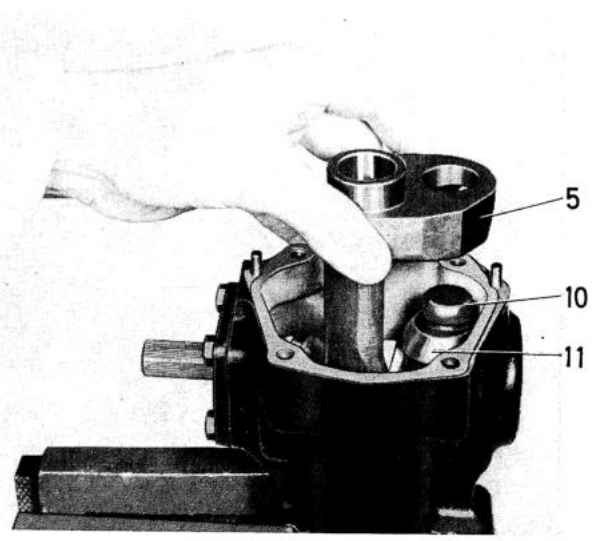
Fig. 6-45. Removing the pitman arm

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**Fig. 6-46. Steering box, mechanical steering**

- |                  |                   |
|------------------|-------------------|
| 1. Clamping bolt | 3. Filler plug    |
| 2. Steering box  | 4. Attaching bolt |



**Fig. 6-48. Removing the pitman arm shaft**

- |                     |               |              |
|---------------------|---------------|--------------|
| 5. Pitman arm shaft | 10. Nut guide | 11. Ball nut |
|---------------------|---------------|--------------|

### DISMANTLING

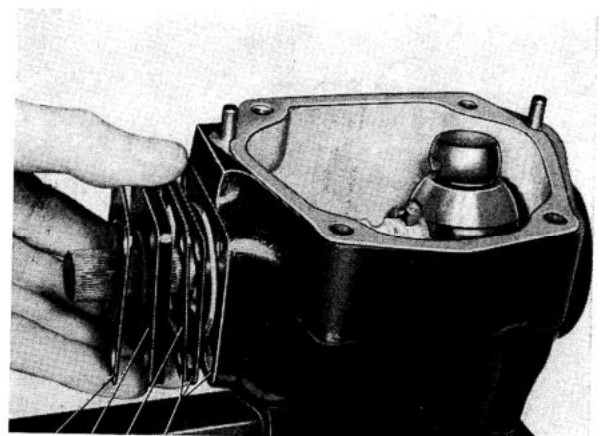
1. Remove the stop plate (8, Fig. 6-47), spacer (4), spring guide (6) and springs.
2. Carefully remove the steering box cover (12, Fig. 6-30) from the guide pins.
3. Turn the ball nut (21) to the end position. Remove the pitman arm shaft (Fig. 6-48) and the nut guide (10).
4. Remove the steering cam cover with retainer and shims, see Fig. 6-49.

5. Pull out the steering cam with bearing and screw off the ball nut at the same time, see Fig. 6-50.
6. Collect the 10 balls for the lower ball bearing.
7. Remove the upper bearing from the steering cam. Collect the 13 balls.
8. Remove the balls from the ball nut, a total of 27.  
The transfer tube does not need to be removed.  
N.B. Do not mix up the balls from both the bearings (7.14 mm) and the ball nut (7.93 mm).



**Fig. 6-47. Removing the stop plate**

- |          |                 |               |
|----------|-----------------|---------------|
| 4. Shims | 6. Guide spring | 8. Stop plate |
|----------|-----------------|---------------|



**Fig. 6-49. Removing the steering cam cover**

- |                       |              |
|-----------------------|--------------|
| 13. Gaskets and shims | 15. Retainer |
| 14. Cover             | 16. Oil seal |

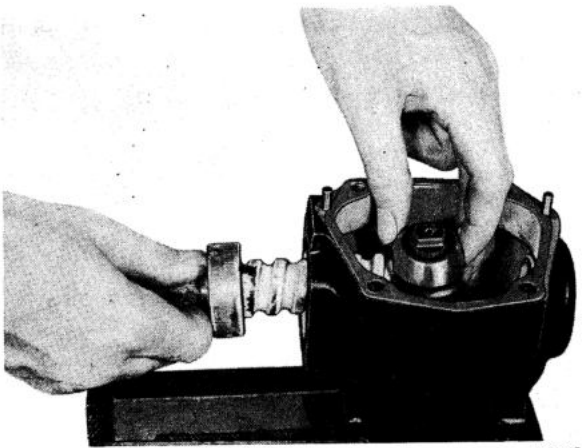


Fig. 6-50. Removing the steering cam

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### INSPECTING

Clean all the parts in white spirit.

Check thoroughly all the bearing races and balls. Replace any parts that are damaged. In connection with this, replace all the balls and the race if the steering cam bearings are involved. If the ball nut or the steering cam is damaged, replace these parts complete.

The race for the lower steering cam bearing is pulled out with an angle screwdriver.

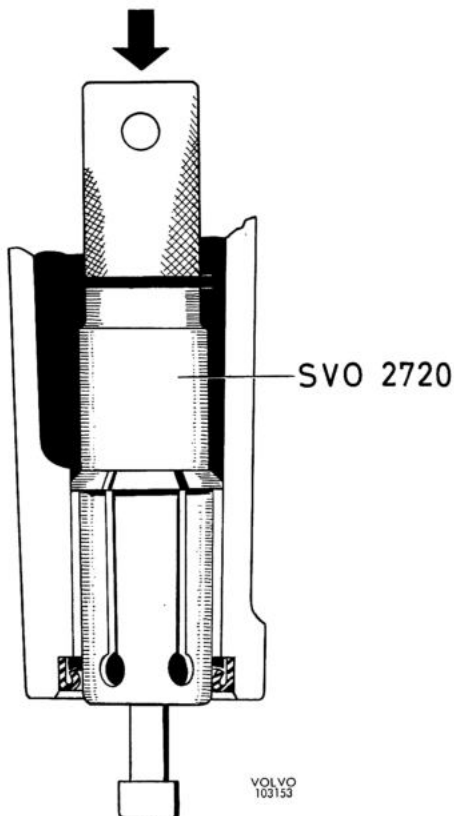


Fig. 6-51 Removing the bush

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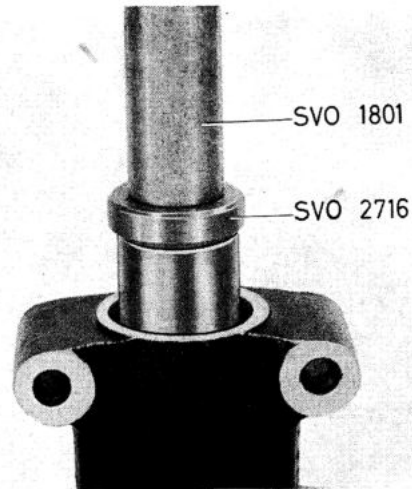


Fig. 6-52. Fitting the bush

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Measure the diameters for the bush in the housing and cover as well as the pitman arm shaft. For new parts the clearance is 0.025—0.063 mm (0.0010—0.0024"). If the clearance exceeds 0.18 mm (0.007"), replace the bush according to the following:

Use tool SVO 2720, see Fig. 6-51, for pressing the bush out of the housing. To press in the new bush use tool SVO 2716 and standard handle SVO 1801, see Fig. 6-52. After pressing in the bush, ream it with the help of reamer SVO 2721 and pilot SVO 2850 fitted in the cover, see Fig. 6-53. After the bush has been reamed and the housing carefully cleaned, fit the oil seal tool SVO 2719 (see Fig. 6-54) and with the sealing lip facing inwards.

The bush in the cover is replaced together with the cover and is ready-machined together with it.

### ASSEMBLING

To make the assembling possible, the loose balls must be smeared with a light layer of grease. Use a durable type of grease for this purpose, that is, the same type as used for the wheel bearings.

1. Press the lower ball bearing race (2, Fig. 6-30) in position in the housing. Fit the 10 balls (7.14 mm). Use grease to hold the balls in position.
2. Pack the 27 balls (7.93 mm) into the ball nut (21) with the help of grease (Fig. 6-55). Screw the steering cam (19) into the ball nut. Check to make sure that it has a good fit.
3. Fit the ball nut together with the steering cam into the housing (Fig. 6-56). Carefully fit the steering cam in position in the lower bearing.
4. Pack 13 balls (7.14 mm) into the upper bearing and carefully fit the bearing over the steering cam.

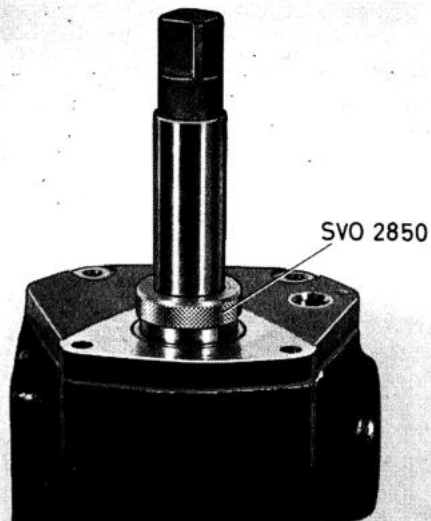


Fig. 6-53. Reaming

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Fig. 6-55. Ball nut

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5. Fit the oil seal (16) in the steering cam cover (14) with the seal lip facing inwards. Fit the gasket, shim, gasket, cover and retainer, see Fig. 6-49. The gaskets have a thickness of 0.127 mm (0.005") and the shims are available in thicknesses of 0.05, 0.127 and 0.254 mm (0.002, 0.005 and 0.010"). Tighten the four bolts to a torque of 1.7—2.1 kpm (12—15 lb.ft.).
6. Check the tension with the steering cam horizontal. With correct tension, a torque of 2.3—4.6 kgcm (2.0—4.0 lb.in.) is required to turn the steering cam. The torque can be measured with the help of a spring balance and cord round the steering cam shaft (Fig. 6-57). The balance should give a reading of 2.6—5.2 kg (5.7—11.5 lb.). If necessary, adjust by removing or adding shims or gaskets.
7. Turn the steering cam so that the ball nut is moved to the lower end position. Fit the nut guide onto the ball nut. Lubricate the oil seal (24) and fit the pitman arm shaft into position. When doing this, protect the oil seal with tool SVO 2719, see Fig. 6-58. Then turn the ball nut to the centre position. Fit the gasket (11) and steering box cover (12). Tighten the two bolts to a torque of 1.7—2.1 kpm (12—15 lb.ft.).
8. Place the spring guide (6) in position but without the springs (7). Fit the paper and steel shims as well as the stop plate (8). The gaskets have a thickness of 0.127 mm (0.005") and the shims are available in thicknesses of 0.05, 0.127 and 0.254 mm (0.002, 0.005 and 0.010"). Tighten the three bolts to a torque of 1.7—2.1 kpm (12—15 lb.ft.). N.B. Check to make sure that there is axial play on the pit-

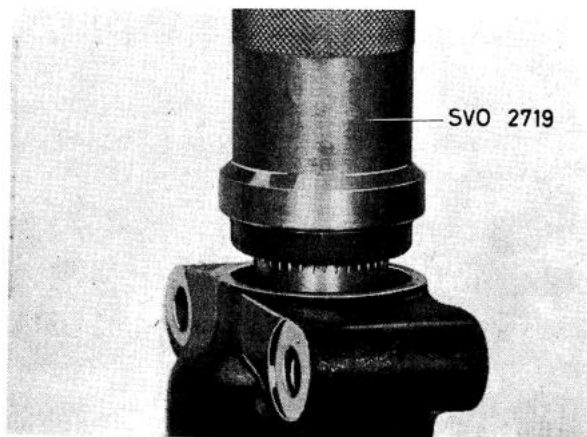


Fig. 6-54. Fitting the oil seal

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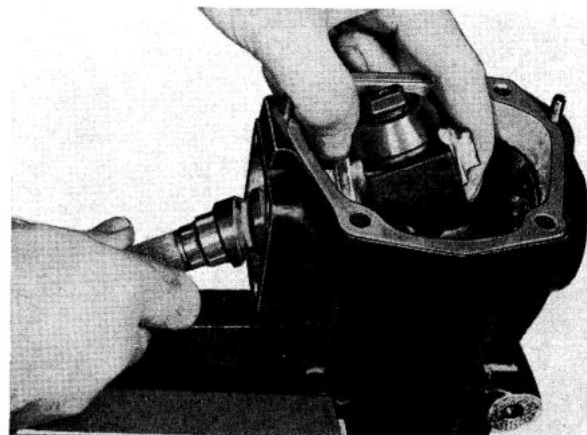


Fig. 6-56. Fitting the steering cam

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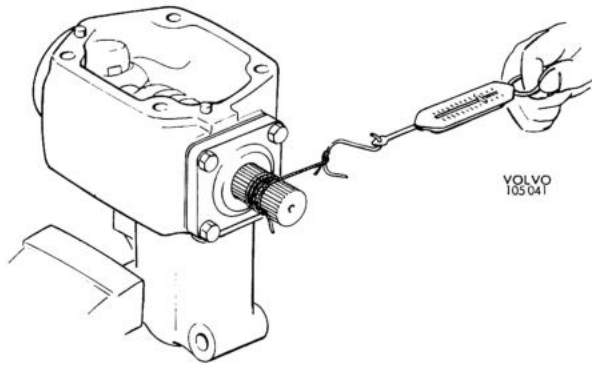


Fig. 6-57. Checking the torque

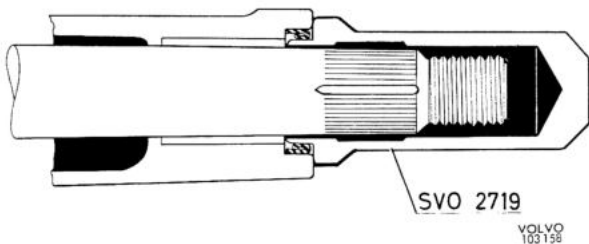


Fig. 6-58. Fitting the pitman arm shaft

man arm shaft. If there is not, the balls may be damaged when tightening.

9. Measure the axial play (Fig. 6-59) after the bolts have been tightened. Then reduce the total thickness of the shims so that there is a calculated pre-tensioning of 0.025—0.075 mm (0.0010—0.0030"). If, for example, the first measured play is 0.05 mm (0.0020") and the thinnest shim 0.127 mm (0.0050"), replace this shim with one of thickness 0.05 mm (0.0020"). The play will then reduce 0.077 mm (0.0031") and become a pre-tensioning of (0.077—0.05 = 0.027 mm (0.0031—0.0020 = 0.0011").

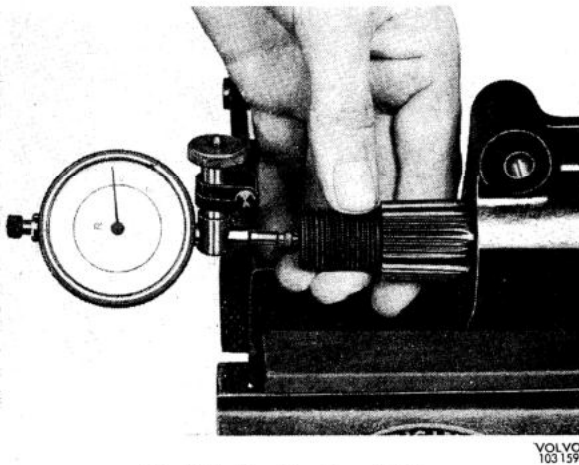


Fig. 6-59. Checking the axial play

10. Remove the stop plate and the spring guide after correct clearance has been obtained and then fit the springs (7). Refit the guide, shims and plate.
11. When filling with oil, place the steering box as when installed in the vehicle, that is, at an angle of 10°. The box is then filled with hypoid oil up to the filling hole level.

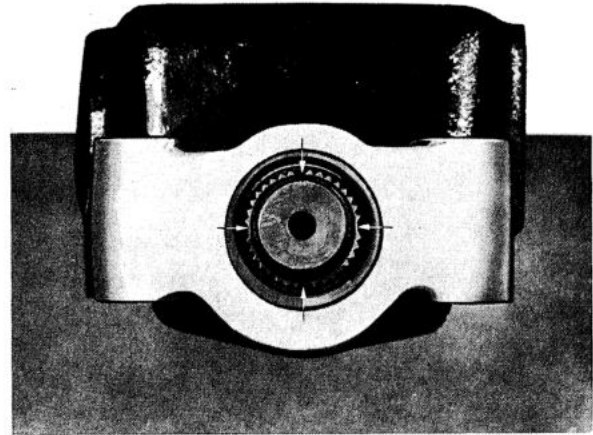


Fig. 6-60. Pitman arm shaft setting

## FITTING

1. Turn the steering cam to the right to the end position and then back 2½ turns. The steering gear will then be in the middle position, which can be checked on the pitman arm shaft land covers, see Fig. 6-60.
2. Check that the steering wheel has the position for driving straight forwards. Place the steering box in position and fit it on to the flange. Fit and tighten the attaching bolts (4, Fig. 6-46). Tighten the clamping bolt (1).  
the clamping bolt (1). Check that the distance between the steering box housing and the lower flange is  $10 \pm 5$  mm ( $0.4 \pm 0.2$ ").
3. Point the front wheels straight forwards and fit the pitman arm. Tighten the nut to a torque of 17.5—20 kpm (125—145 lb.ft.).
4. Check to make sure that the steering gear can be turned from stop bolt to stop bolt without hindrance. Lower the front end of the vehicle.

## SERVO STEERING

### Work which can be carried out with the servo steering installed in the vehicle

NOTE: The utmost cleanliness should be observed for all work on the power steering equipment. Always clean the connections before disconnecting

them, also the outside of the oil container before removing its cover.

Only oil ATF, Type A or Dexron may be used for the servo system.

### CHECKING THE OIL LEVEL

The oil level should be checked every 10 000 km (6 000 miles). The level should first be checked with the engine stationary in order to see whether there has been any loss of oil. The oil level should then come about 5—10 mm ( $\frac{1}{4}$ " ) above the level mark. If the level is lower than this, fill with oil with the engine stationary: this will eliminate risk of air being sucked in. Start the engine and then check the oil level again, which should now fall to the maximum mark, see Fig. 6-61. When the engine has stopped, the oil level may rise to 5—10 mm ( $\frac{1}{4}$ " ) above the level mark.

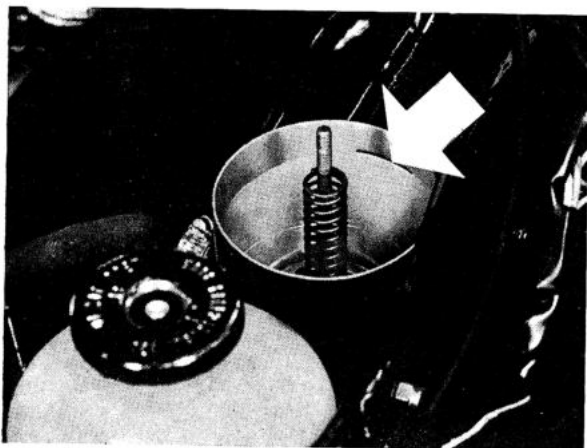
### DRAINING THE OIL

With the servo steering pump complete, oil is drained off as follows:

Jack up the front end. Screw out the drain plug (10, Fig. 6-62). Turn the steering wheel to the left to the stop position. Remove the cover on the container. Start the engine and allow it to run max. 10 seconds until the oil is emptied out of the container and pump. Stop the engine and turn the steering wheel from the stop lock to stop lock until all the oil has run out.

### FILLING WITH OIL AND BLEEDING

NOTE: The oil capacity is about 1.2 litres (2.1 Imp. pints=2.5 US pints). Drained-off oil may not be put back into the system.



YOLVO  
103161

Fig. 6-61. Oil level

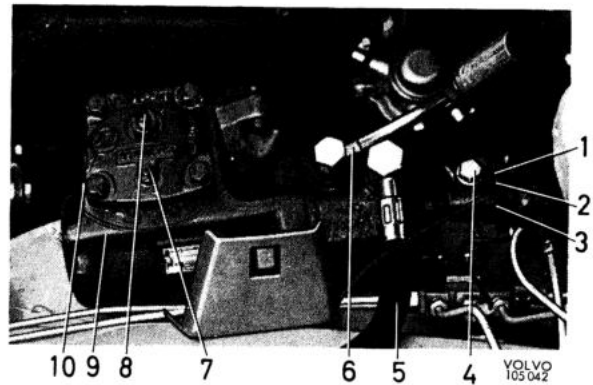


Fig. 6-62. Steering box fitted

- |                  |                                |
|------------------|--------------------------------|
| 1. Nut           | 6. Delivery line (early prod.) |
| 2. Bolt          | 7. Bleeder screw               |
| 3. Flange        | 8. Adjusting screw             |
| 4. Clamping bolt | 9. Steering box                |
| 5. Return line   | 10. Drain plug                 |

1. Fill with oil up to the edge of the oil container.
2. With oil within easy reach, start the engine. Gradually fill the container with oil as the level drops. When the level has stabilized itself, proceed to the next operation.
3. Turn the steering wheel repeatedly and evenly in both directions. The steering wheel should be turned slowly so that the pump operates at low pressure. If necessary, fill with more oil.
4. Open the bleeder screw (7, Fig. 6-62)  $\frac{1}{2}$ —1 turn. Close it when oil starts flowing out.
5. Continue turning the steering wheel until the oil in the container is practically free from air bubbles.
6. Stop the engine. The oil level should then rise 5—10 mm ( $\frac{1}{4}$ " ) above the level mark. If it rises further than this, there must be air still in the system, in which case continue venting.
7. Lower the front end.

After the bleeding, a small number of air bubbles may remain in the system. When the pump causes pressure to be applied to the oil during driving, these air bubbles will eventually disappear in the container.

### INSPECTING THE SERVO STEERING

The inspection procedure described below can be applied with a view to fault tracing or preventing possible faults.

#### I. Checking the outer ceiling

1. Check to make sure that all screw unions are not damaged. Re-tighten if necessary.
2. Check the hoses for damage. Replace those that are damaged.

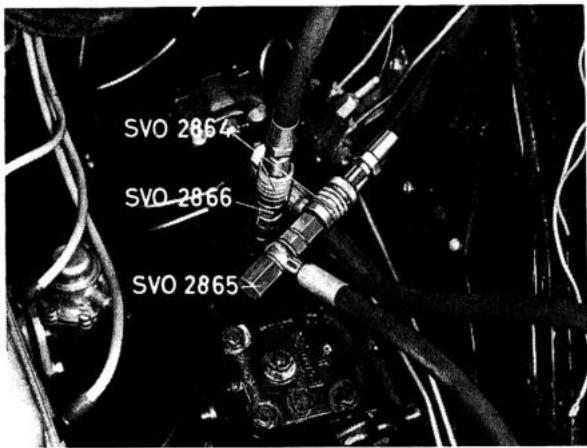


Fig. 6-63. Pressure gauge connected

## II. Checking oil level and bleeding

1. Connect the test instrument SVO 2864 to the delivery line at the steering box, see Fig. 6-63. The inlet hose of the instrument is connected to the banjo nipple with tool SVO 2865 (Fig. 6-63) and the outlet hose to the steering box with tool SVO 2866. Check to make sure that the operating lever of the instrument is in the open position (to the left).
2. Jack up the front end of the vehicle. Check that the oil level is 5—10 mm (1/4") above the level mark with the engine stationary.
3. Start the engine. Check the level and fill with oil if the level has fallen below the level mark with the engine running. Turn the steering wheel from full lock to full lock as long as air bubbles are visible in the container. With the engine idling, the oil level should be at the level mark.
4. When the engine is stopped, the oil level should rise 5—10 mm (1/4").

## III. Checking the hydraulic function for steering box and pump

1. Run the engine warm.
2. **Pump testing:** With the engine idling, move the operating lever of the instrument briefly (max. 10 seconds) to the closed position. Read off the max. pressure on the pressure-gauge. This should be maximum 10 % below the indicated maximum pressure of the pump, that is, at least 67 kp/cm<sup>2</sup> (953 p.s.i.). If pressure less than this is obtained, examine the pump and drive as follows:
  - a) Check the tension and condition of the drive belt. Replace the belt if defective.
  - b) Remove the pump control valve, see Fig. 6-64. Observe the utmost cleanliness. Wash and

blow clean before screwing out the plug (4, 6-67), which should be done from underneath. Check the valve piston and drilling in the housing. The hole in the valve piston must not be blocked. The piston should run easily in the housing and not jam. If necessary, fit a new valve. If this does not help, replace or recondition the pump.

3. **Steering box test:** With the engine idling and the instrument operating lever open, turn the steering wheel to the right to the end position. Increase the force on the steering wheel to about 10 kg (22 lb.) and maintain this position for about 5 seconds and read off the gauge. Repeat this procedure after turning the steering wheel to the left. If it is established that the steering box oil pressure, with the steering wheel turned either to the right or to the left or in both directions, is below the previously determined oil pressure for the pump, then the function of the servo steering is not satisfactory. If no external leakage can be discovered, the reason for the pressure drop must be an internal leakage, in which case the steering box must be replaced.

## IV. Checking the mechanical function

1. Check the mechanical components of the front end and steering such as ball joints, rods, bearings, steering box and flanges concerning play. Re-tighten attaching bolts and replace damaged or worn components.
2. Adjust the pressure point between the piston of the steering box and pitman arm shaft as follows:
  - a) Remove the locknut for the pitman arm. Pull the pitman arm off with tool SVO 2849. When fitting the puller, turn the wheels fully to the right, see Fig. 6-45.
  - b) Place the steering box in the middle position (count the number of steering wheel turns).

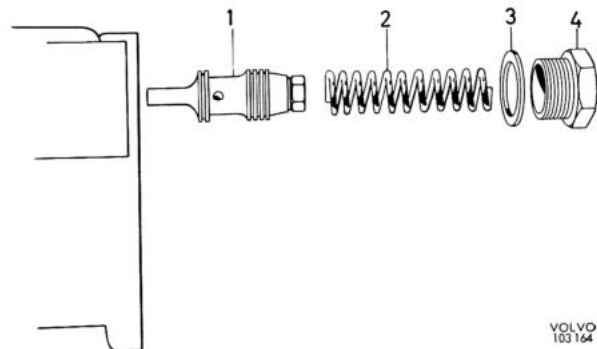


Fig. 6-64. Removing the control valve

1. Piston 2. Spring 3. Gasket 4. Plug

- c) Slacken the nut for the adjusting screw (8, Fig. 6-62).
- d) Turn the adjusting screw clockwise until a light resistance is felt in the flange device when it is turned to the left or to the right on both sides of the centre position.
- e) Tighten the locknut while holding the adjusting screw firmly.
- f) Check the adjustment by turning the steering wheel several times more past the centre position. In the centre position a slight increase in resistance should be felt.
- g) Set the front wheels straight forwards and fit the pitman arm with the steering box in the centre position. Tighten the nut to a torque of (17.5—20 kpm (125—145 lb.ft.)).

## V. Test driving

If the servo steering is only normally worn and is not damaged or overloaded, the steering should function satisfactorily during the test driving, that is, the hydraulic servo assistance should not be staccatic and result in erratic steering.

## REPLACING THE CONTROL SPINDLE SEALING RING

1. Dismantle the flange device by removing the two nuts (1, Fig. 6-62) and the screws (2). Move the rubber disc and lower steering column section to the one side.
2. Mark up the location of the flange (3) on the control spindle. Slacken the clamping bolt (4) and pull off the flange.
3. Remove the rubber cover as well as the circlip for the sealing ring.

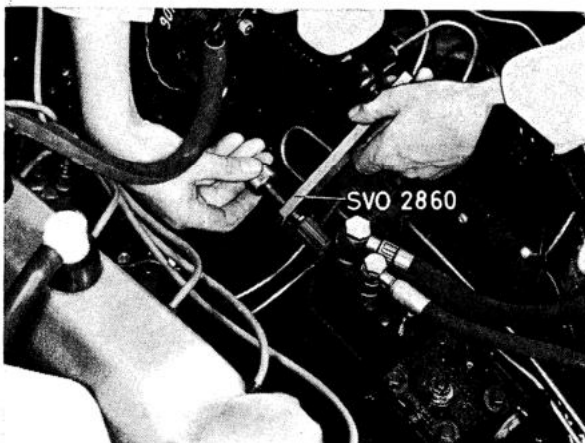


Fig. 6-65. Removing the sealing ring

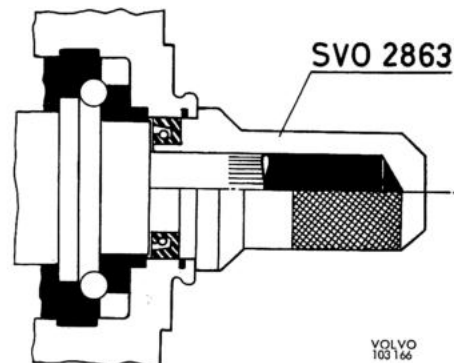


Fig. 6-66. Filling the sealing ring

4. Carefully apply tool SVO 2860 to the sealing ring. Tighten the screw (Fig. 6-65). This also tightens the sealing ring. If the ring sticks in the circlip groove, carefully turn the tool backwards and forwards.
5. Fill the space between the new sealing ring lips with multipurpose grease. Fit the sealing ring on to installation tool SVO 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the steering box, see Fig. 6-66.
6. Fit the circlip and cover.
7. Re-fit the flange according to the line-up marks. Check that the distance between the steering box housing and the lower flange is  $7 \pm 5$  mm ( $0.28 \pm 0.20$ ").  
Assemble the other parts.

## Replacing the steering box

### REMOVING

1. Jack up the front end.
2. Drain the oil, see under "Draining the oil".
3. Remove the locknut for the pitman arm. Pull the pitman arm off with tool SVO 2849. When fitting the puller, turn the wheels fully to the right, see Fig. 6-45.
4. Disconnect the oil lines (5 and 6, Fig. 6-62) from the steering box after the connections have been cleaned. Slacken the clamping bolt (4).
5. Remove the attaching bolts (11) and pull the steering box forwards.

### FITTING

1. Place the steering box in the centre position. A slight increase in resistance should then be felt and the position of the pitman arm shaft lands should be as in Fig. 6-60 and the line-up marks on the control spindle and housing should coincide.

2. Check to make sure that the steering wheel is pointing the front wheels straight forwards.
3. Fit the steering box spindle in the flange of the lower steering column section. Fit and tighten the attaching bolts (11, Fig. 6-62). Tighten the clamping bolt (4). Check that the distance between the steering box housing and the lower flange is  $7 \pm 5$  mm ( $0.28 \pm 0.20$ "). Connect the oil lines. The longer delivery line should run in a curve backwards, (see Fig. 6-32) and should be clamped.
4. Point the front wheels straight forwards and fit the pitman arm. Tighten the nut to a torque of 17.5—20 kpm (125—141 lb.ft.).
5. Fill with oil and bleed, see under the heading "Oil filling and bleeding".

## Replacing the servo pump

### REMOVING

1. Clean round the connections (5 and 6, Fig. 6-67).
2. Disconnect the suction line (5) and collect the oil running out.
3. Disconnect the delivery line (6), and unscrew the tensioning bolt (1) and the attaching bolts (3). Protect the nipples and connections from dirt.
4. Unscrew and remove the pump.

### FITTING

Concerning replacement of pump, supplement the new pump with brackets, pulley and other parts, see Fig. 6-67. When fitting the pulley, the tolerances may be such that the pulley cannot be pressed on by hand. In these cases, press on the pulley with care. It must not be hammered on, otherwise the bearings might easily get damaged, resulting in noise in the pump.

1. Place the pump in position and connect the oil lines with new seals.

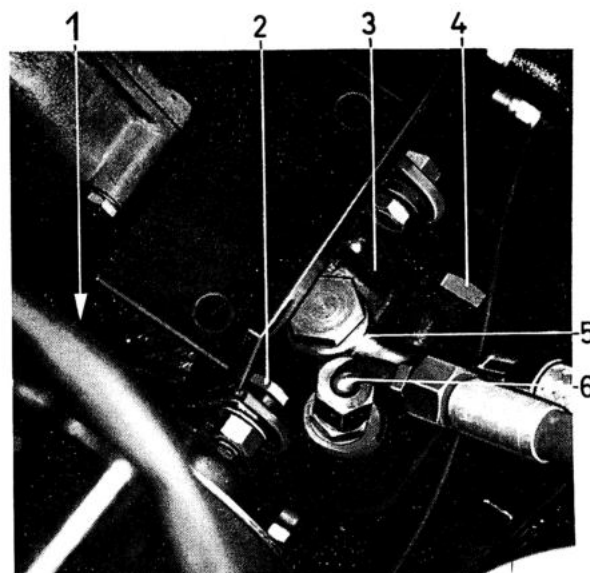


Fig. 6-67. Servo pump, fitted

- |                    |                           |
|--------------------|---------------------------|
| 1. Tensioning bolt | 4. Plug for control valve |
| 2. Servo pump      | 5. Suction line           |
| 3. Attaching bolt  | 6. Delivery line          |

2. Fit the attaching bolts and other components, see Fig. 6-67. Tension the drive belt so that it can be pressed in about 5 mm ( $3/16$ ") in the middle. Tighten the bolts and the connections.
3. Fill with oil and bleed, see under "Oil filling and bleeding".

## Replacing the oil filter

When changing the oil, which is normally done only in connection with replacement of the servo steering components, the filter should also be replaced. This is accessible after the spring and retainer in the oil container have been lifted off. Clean the container before fitting the new filter. Also replace the gasket in the outer cover.