

GENERAL TOOLS

Special tools are marked 999 or SVO (e.g. 9991801 or SVO 1801).

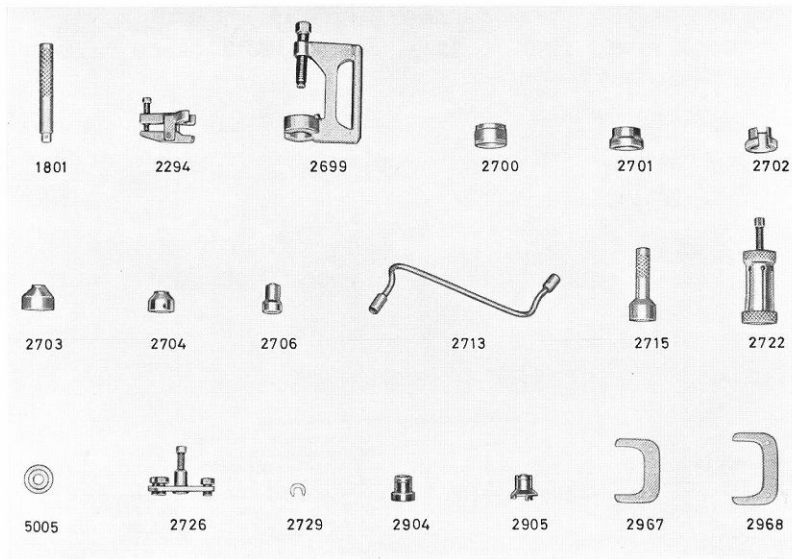


Fig. 6-1. Tools for wheel adjustment and work on front axle

- 999
(SVO)
1801 Standard handle 18x200
2294 Press tool, for removing ball joints, tie-rod end
2699 Press tool, for removing and fitting ball joints and rubber bushes, control arms
2700 Sleeve, removing lower ball joint
2701 Sleeve, removing and fitting upper ball joint and bushes in lower control arm, also fitting lower ball joint
2702 Sleeve, removing and fitting bushes, upper control arm
2703 Drift, fitting lower ball joint
2704 Drift, fitting upper ball joint
2706 Drift, removing and fitting bushes, upper control arm
2713 Spanner ($\frac{1}{2}$ "") for upper control arm shaft bolt
2715 Drift, fitting and removing grease cap on hub
2722 Puller, inner ring, inner front wheel bearing
2726 Puller, front wheel hub
2729 Spacer, removing shaft, upper control arm
2904 Drift, removing and fitting bushes for diagonal tyres, lower control arm
2905 Drift, for removing and fitting bushes for radial tyres
2967 Gauge for lower ball joint, type 1
2968 Gauge for lower ball joint, type 2
5005 Drift, for fitting outer ring, inner front wheel bearing and spacer hub

For removal and fitting of front end complete, engine lift tool 2727 is also used, see Fig. 6-16.

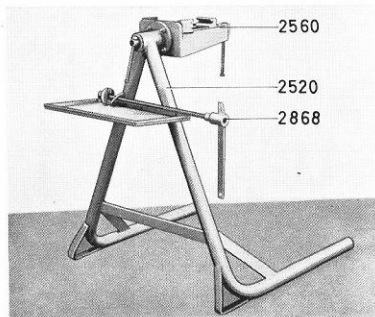


Fig. 6-2. Tools for work with removed front axle

- 999
(SVO)
2520 Stand for fixture
2560 Fixture
2868 Press tool for spring

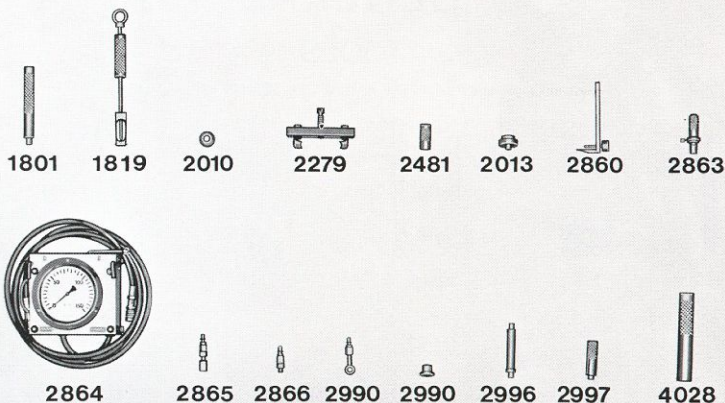
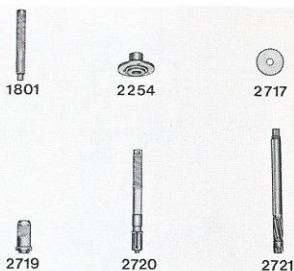


Fig. 6-3. Tools for work on power-assisted steering

YOLVO
107164

- 999
(SVO)
1801 Standard handle 18×200
1819 Extractor for needle bearings
2010 Drift for fitting upper sealing ring
2013 Drift for fitting bearing ring
2279 Puller for pulley
2481 Sleeve for fitting bearing sleeve
2860 Extractor for sealing ring

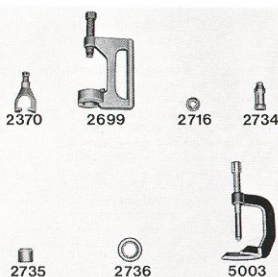
- 2863 Drift for fitting sealing ring
2864 Test instrument
2865 Connection nipple for 2864
2866 Connection nipple for 2864
2990 Connection nipple for 2864 (R-H steered vehicle)
2996 Drift for fitting needle bearing and sealing ring
2997 Drift for removing and fitting needle bearing, pump
4028 Drift for fitting lower sealing ring



YOLVO
107165

Fig. 6-4. Tools for work on removed mechanical steering

- 999
(SVO)
1801 Standard handle 18×200
2254 Guide for reamer SVO 2721
2717 Drift, for fitting upper bearing race, steering worm
2719 Sleeve, for fitting sealing ring, pitman arm shaft
2720 Tool for removing bush, pitman arm shaft
2721 Reamer for bush, pitman arm shaft



YOLVO
107166

Fig. 6-5. Tools for work on other steering components

- 999
(SVO)
2370 Puller, pitman arm
2699 Press tool, for removing and fitting bushes on relay arm
2716 Drift, for fitting bush, pitman arm shaft
2734 Drift, for removing bush, relay arm
2735 Drift, for fitting bush, relay arm
2736 Counterhold, for removing and fitting bush, relay arm
5003 Puller for steering wheel

WHEEL GEOMETRY

WHEEL ANGLES

For the vehicle to have good steering properties and a minimum of tyre wear, the front wheels must have certain pre-determined settings, generally known as the wheel angles. The wheel angles refer to the caster, camber, king pin inclination, toe-out and toe-in.

CASTER

Caster generally refers to the longitudinal inclination (forwards or backwards) of the king pin. As this vehicle does not have a king pin, the caster consists of the angle between a vertical line and a line through the centre of the ball joints (Fig. 6-6).

Caster has the effect of causing the wheels to run straight forwards thereby facilitating the steering.

CAMBER

Camber is the inclination of the wheel itself outwards or inwards. It is positive if the wheel is inclined outwards (see C, Fig. 6-7) and negative if the wheel inclines inwards. Faulty camber causes uneven tyre wear.

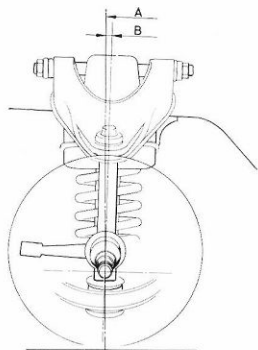


Fig. 6-6. Caster
A=Vertical line
B=Caster

VOLVO
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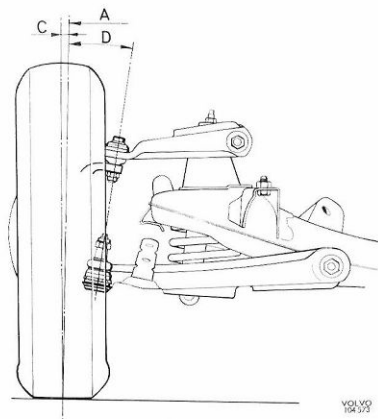


Fig. 6-7. Camber and king pin inclination

A=Vertical line C=Camber D=King pin inclination

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KING PIN INCLINATION

King pin inclination means the inclination of the king pin inwards. Since this car does not have a king pin, the inclination is represented by an angle made between a vertical line and a line through the centre of the ball joints (D, Fig. 6-7).

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

TOE-OUT

When driving round a bend, the wheels roll at different radii. For them to have the same pivoting centre, and consequently minimum tyre wear, the front wheels must be turned to different extents. This relationship is determined by the shape of the steering rod and steering arms, see Fig. 6-8.

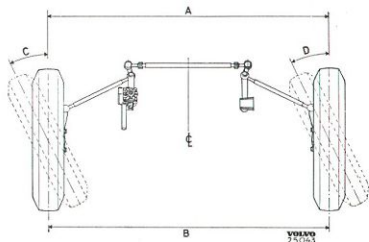


Fig. 6-8. Toe-out and toe-in

MEASURING WHEEL ANGLES

The wheel angles are measured with special measuring instruments of which there are many different type. No general description can, therefore, be given as to how measuring should be carried out except in the case of the steering geometry. The measuring principle is that camber is measured directly with the wheels pointing straight forwards. Caster and kin pin inclination cannot be measured directly. Instead, the angular alteration which occurs when the wheel is turned from 20° outwards to 20° inwards is measured on the instrument.

Most types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack. When measuring the toe-in, the so-called "wheel spreader" should be applied at the front between the wheels at a spring force of 100–150 N (22–33 lb). When measuring the wheel angles, follow the instructions for the measuring instruments concerned.

CHECKING KING PIN INCLINATION

The king pin inclination, which on this vehicle is represented by the inclination of the centreline of the ball joints, should be 7.5° at a camber of 0° . This cannot be adjusted and is difficult to measure exactly due to the tension and resilience in the parts, so that the angle read off on the instruments will not be the exact king pin inclination but can serve as a guide.

CHECKING TOE-OUT

1. Before running the vehicle front wheels onto turntables, set the turntables to zero and lock them. Make sure the wheels point straight ahead.
2. Turn the wheels to the left until the right wheel has turned 20° inwards. The scale on the left turntable should then read $22.5 \pm 1^\circ$.
3. Check the position of the right wheel in the same manner by turning the wheels to the right until the left wheel has turned 20° inwards, when the right turntable scale should give the same reading previously indicated on the left. Both measurements should thus lie within the above-mentioned tolerances, otherwise it means that the steering gear or front end is distorted.
4. There are no adjusting possibilities, but if the toe-out is incorrect, the steering arms and steering rods should be checked. Replace any parts that are damaged.

CHECKING WITH WHEEL ALIGNMENT INDICATOR

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

If the green lamp on the indicator board remains lighted, then the front end is properly adjusted and the wheels are properly aligned.

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

PROCEDURE BEFORE WHEEL ADJUSTING

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

1. Check tyre pressure and wear.
 2. Play in front wheel bearings.
 3. Play in ball joints or control arm attachments.
 4. Broken springs.
 5. Abnormal (temporary) equipment or loading.
- Other factors which can influence the steering during driving without being revealed when measuring the wheel angles are:
1. Wheel out-of-true more than 2.5 mm ($0.1''$).
 2. Poor shock absorbers.
 3. Faulty steering gear adjustment.
 4. Play in intermediate arm jounalling or steering rod parts.

ADJUSTING WHEEL ANGLES

NOTE. The front wheel angles are always adjusted in the following order:

1. Caster
2. Camber
3. Toe-in

To save time and labour, caster and camber should be adjusted at the same time, see under "Adjusting the camber".

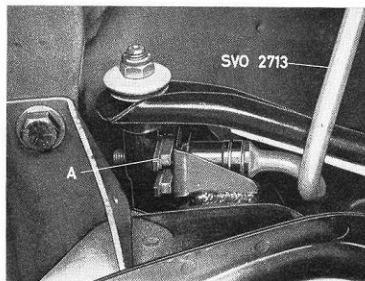


Fig. 6-9. Adjusting the caster and camber

A=Shims

CASTER

The caster for each wheel should be within a tolerance range of 1° to $+2^\circ$, that is, min 1° and max. 2° positive. The difference between both sides should not, however, exceed $\frac{1}{2}^\circ$.

To adjust, slacken the special bolts at the upper control arm shaft with tool 2713 (Fig. 6-9). Use one end of the tool for the front bolt and the other for the rear bolt. After the bolts have been slackened several turns, the requisite number of shims can be either removed or added, whichever is the case. Positive caster is obtained by either **adding** shims to the **rear** bolt or **removing** shims at the **front** bolt.

The diagram in Fig. 6-8 shows the shim thicknesses required for a certain alteration in angle. Shims are stocked in thicknesses of 0.15—0.5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.12 and 0.24"). The caster is altered to the same extent by either

1. removing a shim at one of the bolts,
2. adding a shim to the other bolt,
3. moving over half of the required shim thickness from one bolt to the other.

For proper camber, adjustment should be according to alternative 3.

After adjustment has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

CAMBER

The camber for each wheel should be within a tolerance range of 0° to $+\frac{1}{2}^\circ$, that is, it should be min. 0° and max. $\frac{1}{2}^\circ$ positive.

To adjust, slacken the special bolts at the upper control arm shaft several turns with tool 2713 (Fig. 6-9). Use one end of the tool for the front bolt and the other for the rear bolt. Then either increase or

reduce the number of shims equally for both bolts. More **positive** camber is obtained by **removing** shims, and **negative** camber by **increasing** the number of shims.

The shim thickness required for a certain alteration in angle is shown in the diagram in Fig. 6-10. Shims are stocked in thicknesses of 0.15—0.5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.12 and 0.24"). The camber is altered by removing or adding an equal number of shims at both the bolts.

After adjustment has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

To save time and labour adjust the caster and camber at the same time by removing or adding shims for the camber and altering the number of shims for the caster. If, for example, the camber is increased 0.6° and the caster $\frac{1}{4}^\circ$, first remove 2.5 mm (0.1") in shims at both the bolts and move 0.3 mm (0.012") in shims from the front to the rear bolt.

TOE-IN

Toe-in should be 2—5 mm ($\frac{1}{8}$ "") with the wheel spreader. Incorrect toe-in is adjusted by slackening the locknuts on the tie rod, after which the rod is turned in the required direction. The distance between the tyres at the front is reduced, that is to say, toe-in is increased by turning the tie-rod in the normal direction of rotation of the wheels. Tighten the locknut after adjustment to a torque of 75—90 Nm (55—65 lbft).

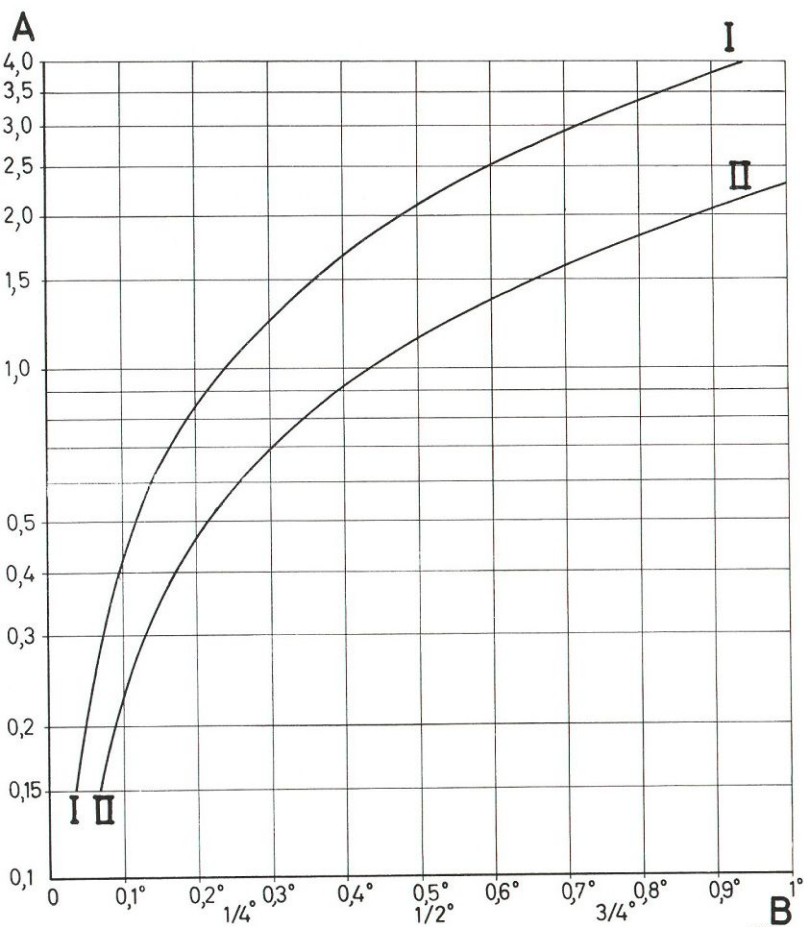


Fig. 6-10. Diagram for alteration of caster and camber

I = Camber
 II = Caster
 A = Shims (mm)
 B = Alteration of angle

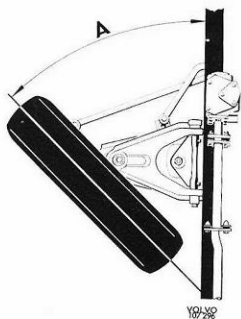


Fig. 6-11. Adjusting max. wheel lock

A=40—41° without power steering
38—39° with power steering

ADJUSTING STEERING LIMITS

Turning of the wheels is limited by stop screws at the pitman arm (Fig. 6-12) and at the relay arm. Adjusting is done as follows:

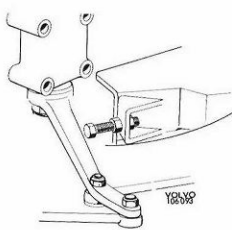


Fig. 6-12. Adjusting screw, max. wheel lock

1. Turn the left wheel for a left-hand turn as far as it goes. Check the wheel lock according to Fig. 6-11. If the lock is not as in this figure, then adjust to this angle with the adjusting screw (Fig. 6-12).
2. Repeat this procedure with the right wheel and the stop screw on the other arm.

NOTE. Check that brake hoses are clear at full wheel lock.

FRONT AXLE

DESCRIPTION

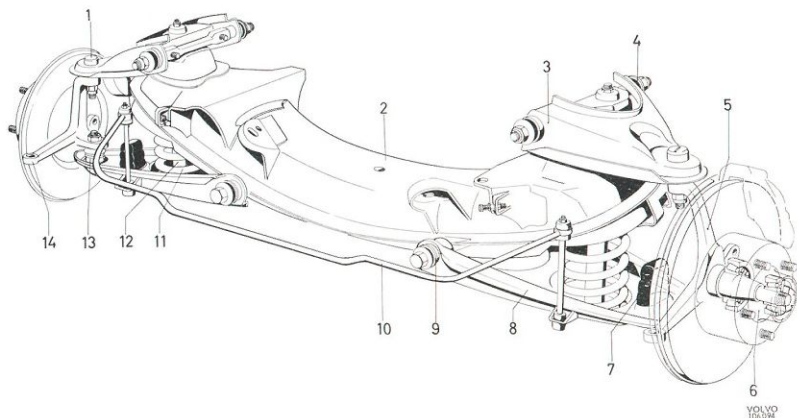


Fig. 6-13. Front axle

- | | |
|---------------------------|---------------------------|
| 1. Upper ball joint | 8. Lower control arm |
| 2. Front axle member | 9. Lower control arm bush |
| 3. Upper control arm | 10. Stabilizer |
| 4. Upper control arm bush | 11. Coil spring |
| 5. Steering knuckle | 12. Shock absorber |
| 6. Hub | 13. Lower ball joint |
| 7. Rubber buffer | 14. Steering arm |

The vehicle has independent front wheel suspension. This means that there is no actual front axle, this being replaced by a robust box-section front axle member, which is bolted to the self-supporting body. The front wheel suspension and springs are fitted at the ends of the member. The construction is illustrated in Fig. 6-13.

The steering knuckle is pivoted on the upper and lower control arms by means of ball joints (1 and 13) which are pressed into the control arms. The control arms shafts are carried in rubber bushes

(4 and 9), which are journaled in the control arms. Camber and caster are adjusted by means of shims between the upper control arm shaft and its attachment in the front axle member (see Fig. 6-9).

The front wheels are carried in taper roller bearings Fig. 6-13. The front spring assembly consists of coil springs (11) inside which telescopic shock absorbers (12) are fitted. In order to increase its anti-roll properties, the car is equipped with a stabilizer (10) which is attached partly to the lower control arm and partly to the body.

The tightening torque is given in the "Specifications". Otherwise the standard torque applies for the respective bolting.

FRONT END COMPLETE

REMOVING

1. Install the lifting tool 2727 according to Fig. 6-16. Fix the plate with the upper screw (no flat washer) for the timing gear casing. Raise the engine until the weight is taken off the front engine mountings. Temporarily block the vent-hole in the brake fluid container cover to reduce leakage. Remove the hub caps and loosen a couple of turns the nuts for the front wheels.
2. Jack up the vehicle under the front jack attachment. Remove the front wheels.
3. Disconnect the steering rods from the steering arms with tool 2294 according to Fig. 6-21.
4. Remove the brake hose clamps from the stabilizer screws and remove the screws.
5. Loosen the brake hoses from the bracket at the support member.
6. Remove the lower nuts for the front engine mountings.
7. Remove the front axle member attaching screws, lower and remove the front end.

DISASSEMBLING AND ASSEMBLING

Fixture 2560 and stand 2520 can suitably be used for work on a removed front end.

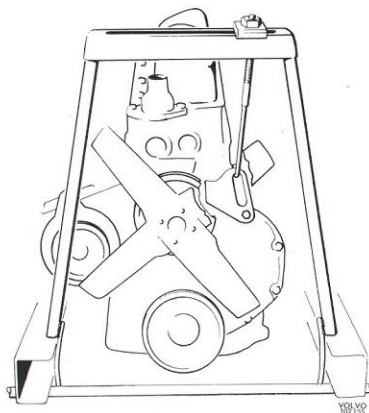


Fig. 6-16. Lifting tool for engine

After the shock absorber has been removed, place tool 2868 as shown in Fig. 6-17. Compress the spring by screwing the spindle until there is clearance at the rubber buffer of the upper control arm.

Concerning other instructions, see under "Removing" and "Installing" for the various components.

If the rubber buffer which limits the engine mounting stop is to be replaced, place the new buffer on the rear side of the front axle member as shown in Fig. 6-18.

INSTALLING

1. Fix the guide pins in the front holes for the front axle member.
2. Place a jack under the front end and raise the front end so that it comes into position. Fit rear bolts provided with plastic plugs. Remove the guide pins and fit the front bolts (also those with plastic plug).
3. Tighten the engine mountings.
4. Fit the brake hoses according to Fig. 5-15 (Part 5). Fit the bolts for the stabilizer. Firmly secure the brake hoses. NOTE. Check the location of the brake hoses according to Fig. 5-15 (Part 5).
5. Fit the steering rods.
6. Bleed the brakes according to the instructions given in Part 5. Remove the temporary seal from the brake fluid container cap.
7. Fit the front wheels. Lower the vehicle and remove the lifting device. Then fit the timing gear casing screw with the flat washer.

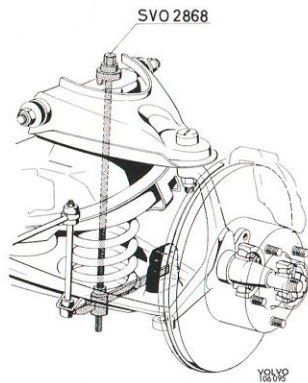


Fig. 6-17. Compressing spring

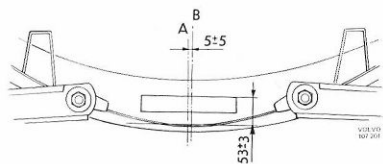


Fig. 6-18. Locating rubber buffer

A. Member centreline

B. Buffer centreline

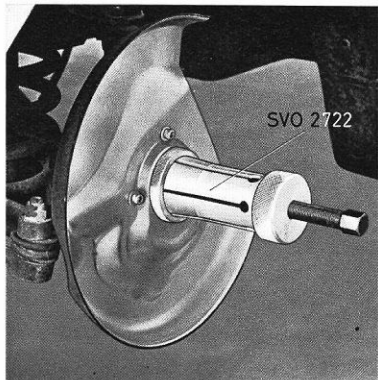


Fig. 6-20. Removing inner bearing

STEERING KNUCKLE

REMOVING

1. Remove the front wheel brake unit according to Part 5, "Removing the front wheel brake unit", points 1—4.
2. Remove the grease cap with tool 2715. Remove the split pin and castle nut. Pull off the hub with puller 2726, see Fig. 6-19. Pull off the inner bearing for the steering knuckle with tool 2722, see Fig. 6-20.
3. Remove the steering rod from the steering arm with tool 2294, see Fig. 6-21.
4. Slacken but do not remove the nuts for the ball joints and knock on the axle with a hammer until the ball joint pins loosen. Raise the lower control arm a little with the jack. Remove the nuts for the ball joints and then the steering knuckle.

EXAMINING BEARING COMPONENTS

Clean the hub and grease cap thoroughly. Make sure that all the old grease, even inside the hub is removed. Compressed air can suitably be used for a comprehensive cleaning of the bearings. Then wash the bearing components in white spirit and allow them to dry. Drying by means of compressed air should be avoided since the air often contains water and dust particles. Accessible bearing components are dried with cotton or cloth rags (but not waste). The bearing surfaces must be dry of cleaning fluid in order not to reduce the adhesion of the grease which is applied later. A new bearing taken directly from its packing container should not be cleaned.

After the cleaning, inspect the parts. If the bearing races or rollers are damaged, rusted or are blued,

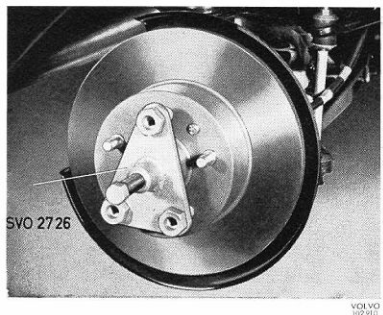


Fig. 6-19. Removing front wheel hub

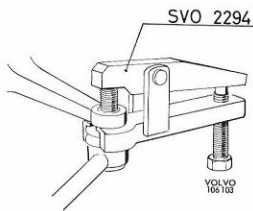


Fig. 6-21. Removing steering rod

replace the bearing. If the outer or inner ring is loose in its seating, try a new ring. The sealing rings should be replaced if they are worn or damaged.

For lubrication of the wheel bearings, use only a high-class, durable grease for wheel bearings. Pack the bearings by hand with as much grease as possible between the roller retainers and the inner race. Grease also on the outside of the rollers and container. The intermediate spaces in the hub between the outer and inner bearing should be filled with grease, see Groups 46 and 77. Before being fitted, the wheel hub felt rings should be oiled generously with, for example, light engine oil. Cleanliness of the bearings is of major importance for their lifetime. For this reason, do not let bearings not greased remain unprotected. Observe the greatest cleanliness when fitting them.

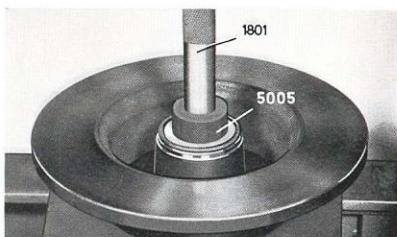


Fig. 6-22. Fitting sealing ring

INSTALLING

1. Place the inner bearing in position in the hub and press in the sealing washer (1, Fig. 6-20) until it goes against the bearing outer ring. Use drift 5005 and standard handle 1801.
2. Place the steering knuckle in position and tighten the ball joint nuts. If the ball joint twists, hold it firmly in position with a screw vice (see Fig. 6-22). Fit the steering rod onto the steering arm.
3. Press the sealing ring (2, Fig. 6-20) onto the steering knuckle without the tool until it bottoms. It is important that the ring is not fitted at an angle.
4. Place the hub on the steering knuckle, fit the outer bearing, washer and castle nut.
5. Adjust the front wheel bearings by tightening the nut with a torque wrench to a torque of 70 Nm (50 lbft). Then slacken the nut one third of a turn. If the slot in the nut does not coincide with the split pin hole in the steering knuckle, slacken the nut further until the split pin can be fitted. Check that the wheel rotates easily but without any play.
6. Fill the grease cap half full of grease and fit it with tool 2715.
7. Fit the front wheel brake unit and wheel according to Part 5 "Fitting front wheel brake unit".

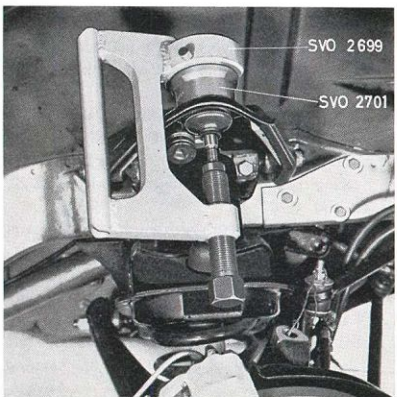


Fig. 6-23. Removing upper ball joint

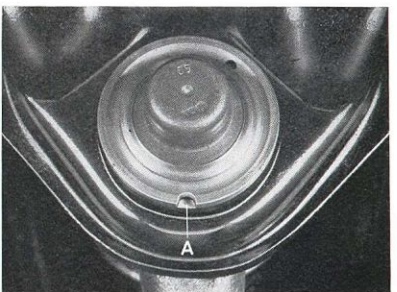


Fig. 6-24. Location of upper ball joint
A=Slot

UPPER BALL JOINT

CHECKING WEAR

In principle this check can be made with the front end either jacked up or lowered. However, the upper control arm should not be against the rubber stop.

Check to see whether the ball joint has any radial clearance by bending up the wheel. If there is radial clearance, the upper ball joint should be replaced.

Note: Do not mix up possible play in the wheel bearings with clearance in the ball joint. Axial clearance should not be measured for the upper ball joint.

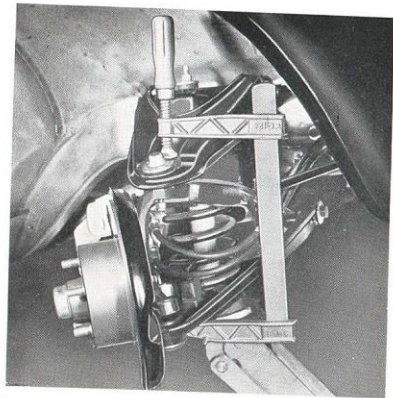


Fig. 6-26. Upper ball joint securely held by vice

REMOVING

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the front end of the vehicle under the front jack attachments. Remove the wheel.
3. Slacken but do not remove the nut for the upper ball joint. Knock with a hammer on the steering knuckle round the ball joint pin until it loosens from the axle. Remove the nut and suspend the upper end of the axle with a wire to avoid straining the brake hoses. See Fig. 6-23.
4. Loosen the nuts for the control arm shaft a $\frac{1}{2}$ turn. Lift up the control arm slightly and press out the ball joint with press tool 2699 and sleeve 2701, see Fig. 6-23.

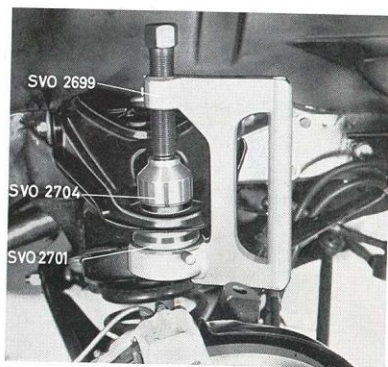


Fig. 6-25. Fitting the upper ball joint

INSTALLING

1. Before fitting the ball joint, check that the rubber cover is filled with grease. Bend the pin end over the slot, see Fig. 6-24. Check that the grease forces its way out. If necessary top up with multipurpose grease.
2. Press the ball joint into the control arm with press tool 2699, sleeve 2701 and drift 2704, see Fig. 6-25. Make sure that the ball joint recess comes in line with the longitudinal shaft of the control arm (within $\pm 8^\circ$) either externally or internally, see Fig. 6-24, as the pin has maximum movement along this line. Should the ball joint be incorrectly fitted when being pressed in, turn the tool 2699 half a turn and then press the ball joint into the correct position.
3. Turn down the control arm and tighten the nuts for the control arm shaft. Tighten the ball joint against the steering knuckle. If the pin rotates, hold it firmly with a screw vice, see Fig. 6-26.
4. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (70—100 lbf). Fit the hub cap.

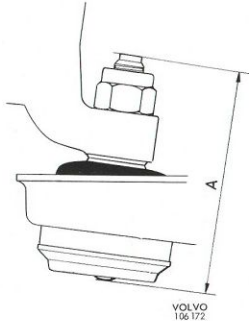


Fig. 6-27. Lower ball joint, type 1 (without spring)
A=Max. 99.3 mm (3.91")

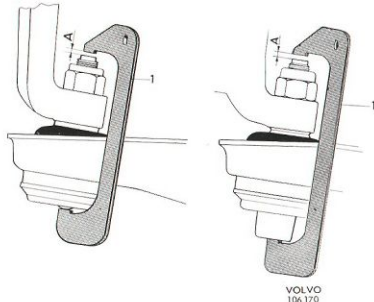


Fig. 6-29. Approved ball joints
1. 2967 for ball joint type 1
2968 for ball joint type 2
A=Clearance

LOWER BALL JOINT CHECKING WEAR

There are two types of lower ball joints. Type 2 (Fig. 6-28) has a built-in spring, while type 1 (Fig. 6-27) does not have such a spring.

This tool is available for marking a quick check on the lower ball joint in its operating position. The check should be made with normal load on the wheels, that is, with the vehicle standing on the ground, or a platform or similar. The wheels should point straight forwards. The tool cannot be used when jacking with a jack or hoist, which off-loads the ball joint. The check is carried out as follows: Place the gauge over the ball joint. If the gauge (see Fig. 6-29) can be fitted over the ball joint, then the joint can be approved. If the length of the ball joints is greater than the tool span (see Fig. 6-30), the ball joint should be replaced.

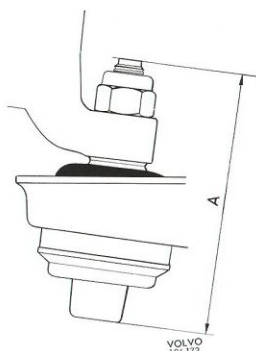


Fig. 6-28. Lower ball joint, type 2 (with spring)
A=Max. 113 mm (4.5")

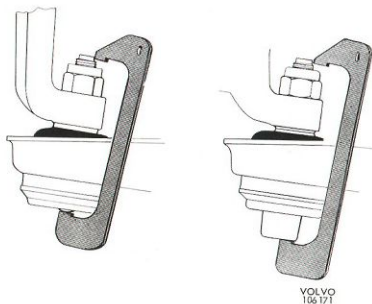


Fig. 6-30. Worn ball joints

REMOVING

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the vehicle under the front jack attachment. Remove the wheel.
3. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-21, and disconnect the brake lines from the stabilizer bolt.
4. Loosen the nuts for the upper and lower ball joints, but do not remove them. Knock with a hammer until the ball joints loosen from the axle. Raise the lower control arm with the jack. Remove the nuts.
5. Remove the steering knuckle with hub and the front wheel brake unit, and place them on a stand or similar.

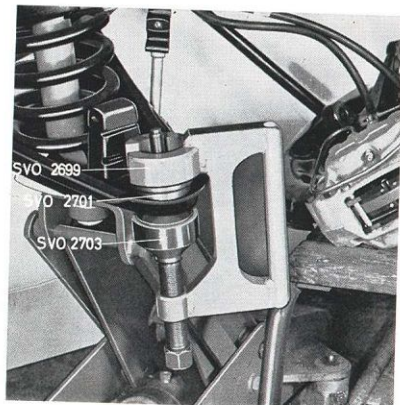


Fig. 6-32. Fitting lower ball joint

VOLVO
101 902

INSTALLING

1. Press the ball joint out of the lower control arm with press tool 2699 and sleeve 2700, see Fig. 6-31.
2. Check that the rubber cover is filled with grease by breaking the pin to the side so that grease is forced out. If this does not happen, then fill the rubber cover with grease.
3. Press the ball joints into the control arm with tools 2699+2701+2703, see Fig. 6-32. Should the ball joint not fit correctly, turn the tool 180° and tighten finally with the tool in this position. The ball joint must not be loose in the control arm.
4. Fit the steering knuckle and tighten the nuts of the upper and lower ball joints. If the pins rotate, fix them securely with a screw vice, see Fig. 6-26. Fit the steering rod and lower the jack in order to take the load off the control arms. Point the wheels straight forwards and fasten the brake hoses to the stabilizer screw.
5. Fit the wheel. Lower the vehicle and tighten the wheel nuts. Fit the hub cap.

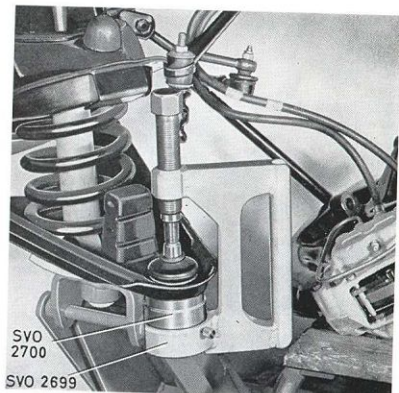


Fig. 6-31. Removing lower ball joint

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UPPER CONTROL ARM

REMOVING

1. Carry out operations 1—3 described in "Replacing upper ball joint".
 2. Remove the screws for the control arm shaft with tool 2713, see Fig. 6-9.
- NOTE. Keep the shims in a safe place. Lift off the control arm.

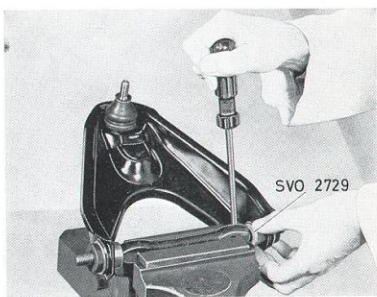


Fig. 6-33. Removing control arm shaft. 1. Removal tool 2729

REPLACING BUSHES

1. Remove the nuts (4, Fig. 6-14) and the washers (3) for the control arm shaft.
2. Fix the control arm shaft securely in a vice. Carefully bend out the control arm ends so that tool 2729 can be fitted, see Fig. 6-33. Drive out one of the bushes with a fiber club and tool 2702, see Fig. 6-34. Turn the control arm, move tool 2729 over to the other side and drive out the other bush in the same way as for the first one.

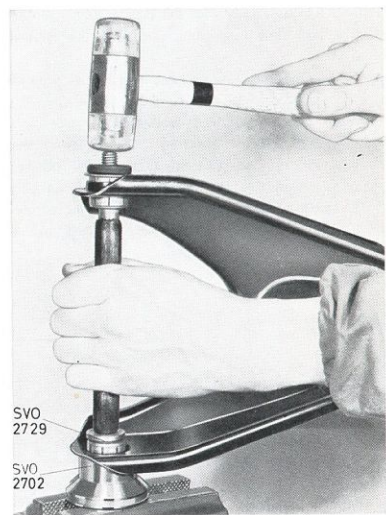


Fig. 6-34. Removing control arm shaft. 2. Driving out shaft

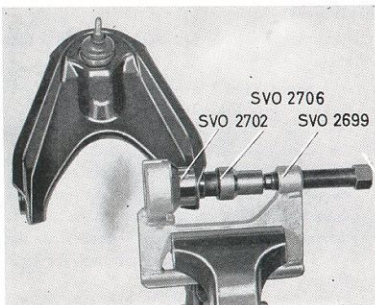


Fig. 6-35. Fitting first rubber bush, upper control arm

3. Hold press tool 2699 firmly in a vice. Press in one of the bushes with tool 2702 and tool 2706, see Fig. 6-35.
4. Fit the control arm shaft and press in the other bush with the sleeve 2702 + drift 2706, see Fig. 6-36. Make sure that the shaft fits the recess of the tool 2702.
5. Fit the washers (3) and the nuts (4). Tighten the nuts when the control arm is fitted.

FITTING

NOTE. The control arms is fixed with a special screw containing a nylon plug.

1. Place the control arm in position and fit the screw by hand. Fit the shims in the position they occupied previously. Tighten the screws with tool 2713. Tighten the nuts for the control arm shaft to a torque of 55—62 Nm (40—45 lbf).

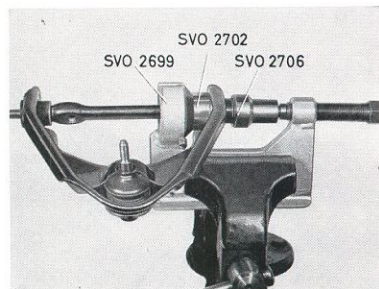


Fig. 6-36. Fitting second rubber bush, upper control arm

2. Fit the upper ball joint in the steering knuckle and tighten the nut.
3. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (70—100 lbft). Fit the hub cap.

LOWER CONTROL ARM

REMOVING

1. Remove the hub cap and loosen the wheel nuts a couple of turns.
2. Jack up the vehicle at the front jack attachment. Remove the wheel.
3. Remove the shock absorber, see Part 7, "Removing shock absorber".
4. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-21. Loosen the clamp for the brake hoses. Remove the screw for the stabilizer.
5. Place the jack under the lower control arm. Loosen the nuts for the ball joints, and knock with a hammer until the ball joints loosen from the steering knuckle. Remove the nuts and lower the jack. Remove the steering knuckle with the front brake wheel unit and place them on a stand or suchlike.
6. Then lower the jack and remove the spring.
7. Remove the nut from the control arm shaft and take off the latter. Turn the relay arm with the tie rod so that the control arm shaft is free and thus can be removed. Take off the control arm.

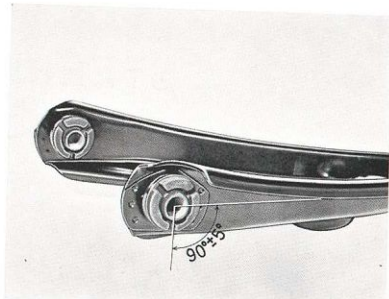


Fig. 6-38. Bushes for radial tyres

REPLACING BUSHES

Note that there are special bushes intended for radial tyres. When about to replace the bushes, bear in mind if the vehicle is fitted with radial or diagonal tyres.

1. Tension the press tool 2699 in the vice. Remove the washer (1, Fig. 6-15), the rubber ring (2) and the spacer ring (3). Press the bushes out with counterhold 2701. Use drift 2904 for bushes where diagonal tyres are fitted and 2905 for radial tyres. The tools are placed as shown in Fig. 6-37. The bushes are, of course, pressed out in the direction towards their flanges.
2. Press in the bushes with control arm and drift (A, Fig. 6-37) facing in the opposite direction.

Note. Both the bushes should be faced with the flange towards the rear in the vehicle, see Fig. 6-15. If it concerns a bush for radial tyres, its recess must also be turned downwards at right angles to the longitudinal direction of the control arm, see Fig. 6-38.

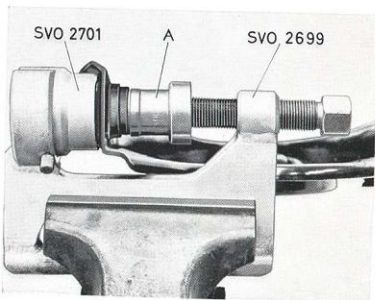


Fig. 6-37. Removing bush, lower control arm

A=2904 for bushes intended for diagonal tyres and 2905 for radial tyres

INSTALLING

1. Supplement the control arm with rings and washers as shown in Fig. 6-15. Fit the control arm in position.
Fit the control arm shaft. Keep the control arm fairly horizontal and tighten the nut for the control arm shaft.
2. Fit the spring. Raise the jack and fit the steering knuckle according to point 8 in "Replacing ball joint, lower control arm".
3. Fit the shock absorber according to Part 7, "Installing shock absorber".
4. Fit the wheel. Lower the vehicle. Tighten the wheel nuts. Fit the hub cap.

STEERING GEAR

DESCRIPTION

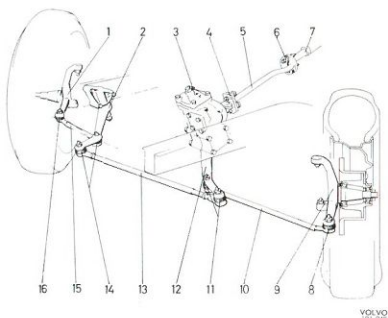


Fig. 6-39. Steering gear

- | | |
|----------------------------------|---------------------------|
| 1. Steering knuckle, right | 9. Steering knuckle, left |
| 2. Relay arm | 10. Steering rod, left |
| 3. Steering box | 11. Ball joint |
| 4. Lower steering column flange | 12. Pitman arm |
| 5. Lower steering column section | 13. Tie rod |
| 6. Upper steering column flange | 14. Ball joint |
| 7. Upper steering column section | 15. Steering rod, right |
| 8. Ball joint | 16. Ball joint |

GENERAL

The layout of the steering is shown in Fig. 6-37. Movement of the steering wheel is transmitted to

the wheels via the divided column (7 and 5), the steering box (3), the pitman arm (12), the tie rod (13), the steering rods (10 and 15) as well as the steering knuckles (1 and 9).

The vehicle may have a mechanical steering gear or power steering. In the latter case, the steering gear also includes a power pump and oil reservoir.

STEERING COLUMN JOURNALLING

The steering column is divided. Its upper section is journalled by means of two ball bearings in a jacket, which is attached to the body by means of a rubber bush (4, Fig. 6-40) and slide (6). The lower and upper sections of the steering column are linked by means of a safety device (1). In the event of frontal collision causing compression of the front end, the lower steering column flange breaks loose from that of the upper section and the lower section pushes upwards. The upper section remains in position and this eliminates possibility of the steering wheel being forced backwards and upwards inside the car.

On the other hand, the entire steering column journalling can be pushed forwards-downwards if, e.g., the driver is thrown against the steering wheel.

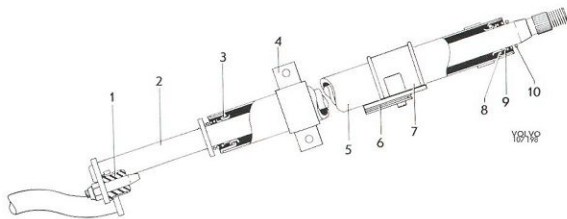


Fig. 6-40. Steering column journalling

- | | |
|----------------------------------|------------------------|
| 1. Safety mechanism | 6. Upper attachment |
| 2. Upper steering column section | 7. Steering wheel lock |
| 3. Lower bearing | 8. Upper bearing |
| 4. Lower attachment | 9. Seat |
| 5. Steering column jacket | 10. Spring |

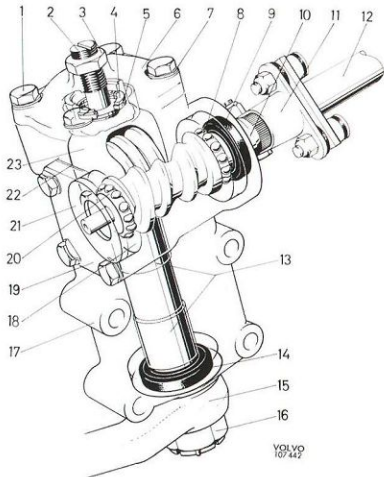


Fig. 6-41. Steering gear

1. Bolt
2. Adjusting screw, sector shaft
3. Locknut
4. Circlip
5. Adjusting washer
6. Cover
7. Tab washer
8. Upper ball bearing worm
9. Oil seal, worm
10. Worm
11. Flange
12. Lower steering column section
13. Bushes, sector shaft
14. Oil seal, sector shaft
15. Pitman arm
16. Nut
17. Steering housing
18. Lower bearing race, worm
19. Worm cover
20. Lower ball bearing, worm
21. Washer
22. Spacer
23. Sector shaft

MECHANICAL STEERING GEAR

The steering gear is of the "worm and roller" type and its construction is shown in Fig. 6-41. It has a ratio of 17.5:1. The worm (10) is journaled in two ball bearings (8 and 20) and it is tensioned by means of shims (22). The pitman arm shaft (sector shaft) is journaled in two bushes (13) and its roller in two needle bearings. Since the roller mesh in the steering worm is determined by the axial position of the pitman arm shaft, the adjusting screw (2) regulates the steering gear clearance. The steering gear is lubricated with hypoid oil.

STEERING RODS AND RELAY ARM

The ball joints of the steering rod are plastic-lined, which makes maintenance lubrication unnecessary. The tie rod (13, Fig. 6-39) has replaceable ball joints (p-ends) while the ball joints of the steering rods (10 and 15) are made in one piece with the rod.

The relay arm (Fig. 6-67) is journaled by means of a bush on a pin in the bracket. The bush consists of three parts, a rubber bush with an outer sleeve of plate and an inner one comprising a spacer sleeve. The outer sleeve has a press-fit in the relay arm hole. When the relay arm is turned, there is movement between the outer sleeve and rubber bush, the space between which has been lubricated for life. The journaling is, in other words, "lubricated for life".

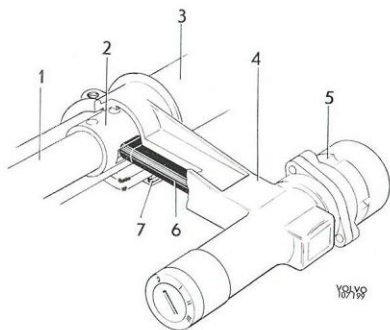


Fig. 6-42. Steering wheel lock

- | | |
|------------------------|---------------|
| 1. Steering shaft | 5. Contact |
| 2. Lock sleeve | 6. Lock pin |
| 3. Steering column | 7. Attachment |
| 4. Steering wheel lock | |

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 screws.

POWER STEERING

This vehicle can be fitted with the ZF recirculating ball and nut type power steering. The main components of the power steering gear are the steering gear, power pump and oil reservoir with filter. These are connected to the various oil lines, see Fig. 6-43. The number of steering wheel turns from lock to lock is 3.7.

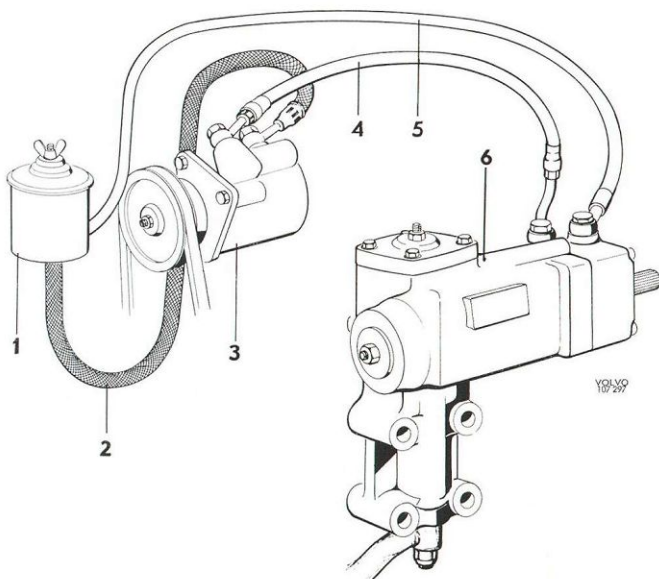


Fig. 6-43. Power steering

- | | |
|------------------------------|----------------------|
| 1. Oil reservoir with filter | 4. Delivery oil line |
| 2. Pump suction line | 5. Return oil line |
| 3. Power pump | 6. Steering gear |

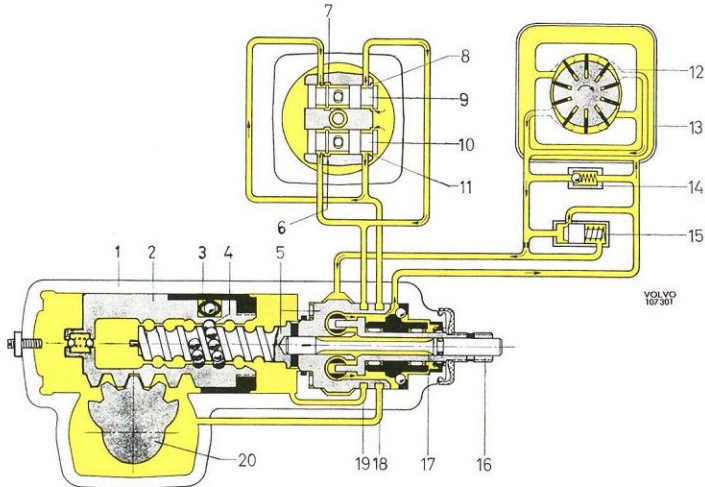


Fig. 6-44. Function, neutral position

- | | | |
|--------------------------------|-------------------|------------------------|
| 1. Steering housing | 7. Return groove | 14. Safety valve |
| 2. Piston | 8. Intake port | 15. Flow control valve |
| 3. Recirculation pipe ball nut | 9. Control valve | 16. Steering spindle |
| 4. Balls | 10. Control valve | 17. Torsion bar |
| 5. Worm | 11. Intake port | 18. Annular groove |
| 6. Return groove | 12. Power pump | 19. Annular groove |
| | 13. Oil reservoir | 20. Pitman arm shaft |

Power steering gear CONSTRUCTION

The power steering gear is of the ball nut type. In addition to the mechanical section, the power cylinder and control valves are built into the steering housing. The lower part of the steering housing (1, Fig. 6-44) is in the form 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 sector shaft (20).

The axial movement of the piston, which determines the direction the wheel turns, is obtained via the worm (5) and ball nut. The recirculating balls (4) are located in annular grooves and form the thread for the nut. Movement of the worm comes from the steering column at the steering spindle (16) and the torsion bar (17) secured in the spindle. The worm is journalled in the upper section of the steering housing 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 steering spindle.

The worm head has two 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 steering spindle (16).

The pitman arm shaft (20) is journalled in the steering housing and side cover by means of needle bearings, see Fig. 6-46. Sealing between the valve housing and the upper section of the housing as well as between the intermediate piece and steering cam is catered for by O-rings and plastic rings. The steering gear reduction ratio is 15.7:1.

The construction of the steering gear differs with regard to a left-hand steered and a right-hand steered vehicle in the matter of the location of the sector shaft and the steering cam thread. Fig. 6-43 shows the steering gear for left-hand steering while Figs. 6-44—6-46 show that for right-hand steering. The following description of the function applies to both.

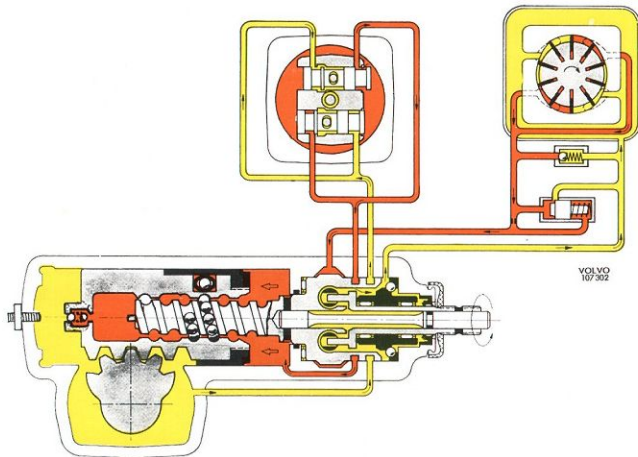


Fig. 6-45. Principle of function, left-hand turn
 Concerning references to numbers, see Fig. 6-44

FUNCTION

The location of the steering valves as well as that of the oil flow are shown schematically in Figs. 6-44, 6-45 and 6-46. In order to illustrate more clearly how the valves are connected to the part of the housing where the power piston operates, a cross-section has been made through the steering valves in addition to the longitudinal section. Moreover, extra channels have been drawn to link up both sections.

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. 6-44) 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 reservoir.

When the steering wheel is turned to the left (see Fig. 6-45) movement is transmitted via the control spindle (16) and the torsion bar (17) to the worm (15), so that the piston (2) is screwed to the left in the figure (downwards in the vehicle). Since the torsion bar is resilient, the steering spindle will be turned in relation to the worm and thus influence

the valves placed in the worm. 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 bar.

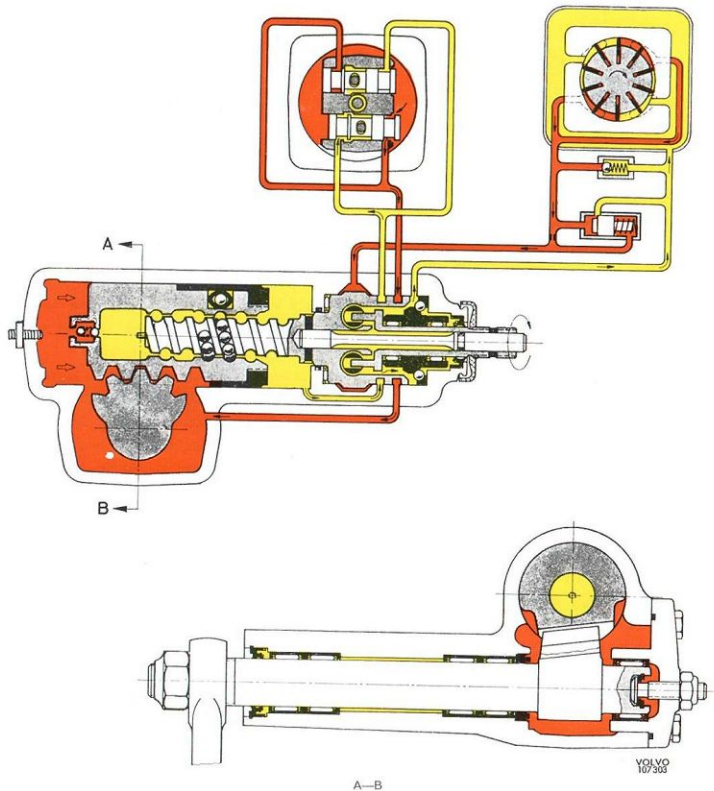


Fig. 6-46. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-46) 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 reservoir (13).

Power pump

The power pump (Fig. 6-47) 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. 6-46. This permits the area between the rotor, the wall of the intermediate piece and two of the vanes to alter when the rotor rotates. When a couple of vanes are moved from the suction side to the pres-

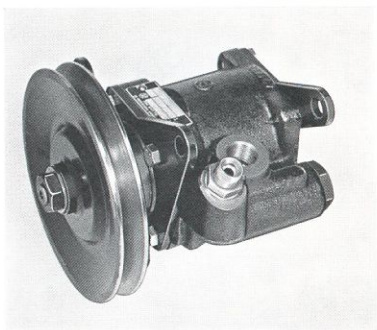


Fig. 6-47. Power pump

sure 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. 6-48) 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 (2) out into the delivery line (1) and from there to the steering housing. The space to the right of the

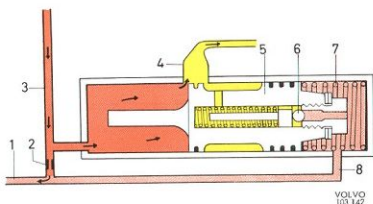


Fig. 6-48. Control valve, normal position

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

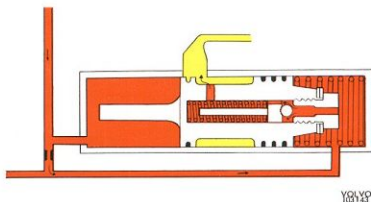


Fig. 6-49. Control valve, maximum pressure

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. 6-48. 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/cm² (1066 psi) 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. 6-49. 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 reservoir

The oil reservoir is placed in the engine compartment where it is easily accessible. It is provided with a filter, from the center 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

GENERAL

The ball joints for the tie rod and steering rods are plastic-lined. For this reason, they do not require any maintenance. Since sealing is most important with regard to the lifetime of these ball joints, the ball joints should be checked every 10 000 km (6 000 miles) to make sure that their rubber seals are intact. If they are cracked or damaged in any other way, they should be replaced. When fitting, fill the rubber seals with universal grease. With regard to **tightening torque**, see "Specifications". Otherwise the standard torque for the respective bolts apply.

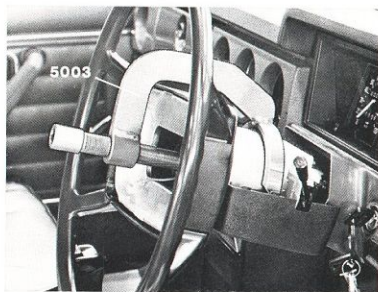


Fig. 6-51. Removing steering wheel

REPLACING STEERING WHEEL

Removing

1. Lever loose the impact guard (5, Fig. 6-50).
2. Unscrew the attaching screws for the upper part of the directional indicator switch housing and lift it off.
3. Remove the steering wheel nut.
4. Set the wheels straight forwards. Fit steering wheel puller 5003 according to Fig. 6-51 and pull off the steering wheel.

Installing

1. Make sure that the wheels are pointing straight forwards.
2. Place the steering wheel in position with the slip contact to the left.
3. Fit the steering wheel nut. Tightening torque is 30—40 Nm (20—30 lbft).
4. Fit the impact guard and test the horn.
5. Fit the upper part of the directional indicator switch housing.

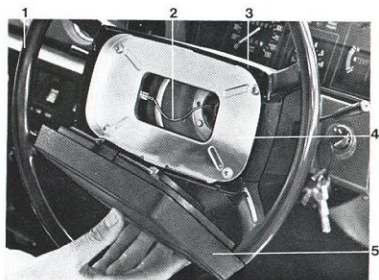


Fig. 6-50. Steering wheel components

- | | |
|-----------------------|-----------------|
| 1. Steering wheel | 4. Horn ring |
| 2. Collapse mechanism | 5. Impact guard |
| 3. Housing | |

STEERING COLUMN JOURNALLING

The upper bearing can be replaced separately. If the lower bearing is damaged, the steering column shaft must be replaced complete.

Replacing upper bearings

1. Remove the steering wheel, see under "Replacing steering wheel". Remove the upper part of the directional indicator switch housing.
2. Remove the directional indicator switch from its attachment on the steering wheel column.
3. Remove the attachment from the steering column.

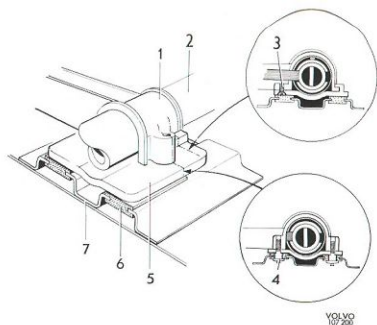


Fig. 6-52. Upper attachment

- | | |
|------------------------|-----------------------|
| 1. Steering wheel lock | 5. Attaching plate |
| 2. Steering column | 6. Slide |
| 3. Slotted screw | 7. Side member (dash) |

4. Pull out the spring and seat.
5. Remove the bearing.
6. Fit the new bearing after having greased it with universal grease.
7. Re-fit the other parts.

Replacing complete journalling

1. Remove the steering wheel and steering wheel lock, see the instructions for this.
2. Remove the directional indicator switch and the other components from the steering column.
3. Remove the nuts at the coupling between the upper and lower steering shafts. Remove the nut and clamp for the lower attachment.
4. Pull forward both the upper and lower steering shafts complete.
5. Fit the new components in reverse order to removal. Check all functions before shearing off the shear bolts for the upper steering column attachment and steering wheel lock.

STEERING WHEEL LOCK

With damage to the steering column or the steering shaft lock lug, replace the steering shaft complete. The following instructions apply to replacement of the steering wheel lock.

Removing

1. Remove the combined instrument, see Part 3.
2. Remove the contact piece (5, Fig. 6-42) of the steering wheel lock.

3. Drill off the collars on the shear bolts (4, Fig. 6-52). Start with a small drill and finish with, for example, a 13 mm (1/2") one. The bolt guide has a diameter of 12 mm (15/32").
4. Remove the attaching bolts and take off the left impact guard and side member (7) with slide piece (6).
5. Screw out the bolt (3) and unhook the attaching plate (5).
6. With a spanner turn back the lock pin and lift up the steering wheel lock.

Installing

1. Fit the new steering wheel lock and the electrical part in position. Hook on the attaching plate (5, Fig. 6-52) and screw in the bolt (3). Check the locking function.
2. Fit the side member (7) with the slide piece (6) which must be in good condition. Fit the impact guard.
3. Fit the shear bolts (4) but do not shear off the heads.
Fit the contact piece.
4. Check all the functions of the steering wheel lock. Thereafter tighten up the bolts until the heads shear off.
5. Fit the combined instrument and the other parts, see Part 3.

MECHANICAL STEERING HOUSING

Removing

1. Jack up the front end of the vehicle.
2. Release the bolt (A, Fig. 6-53) at the lower flange. Remove the nuts (B) and push the lower part of the flange as far down as possible on the guide bolt.

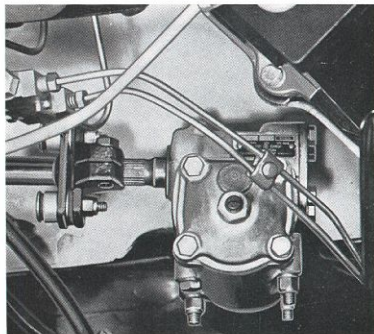


Fig. 6-53. Steering housing fitted



Fig. 6-54. Removing pitman arm

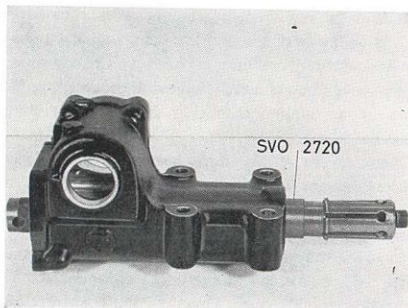


Fig. 6-56. Fitting tool 2720

3. Remove the locknut for the pitman arm. Pull off the pitman arm with 2370. When the puller has been placed there, turn the wheel completely to the left (Fig. 6-54).
4. Remove the nuts and bolts and lift off the steering housing.

Disassembling

1. Mark up and remove the flange if it is still on the shaft of the steering worm.
2. Place the steering gear in the middle position (Fig. 6-62). Remove the four bolts (1, Fig. 6-41) for the upper cover (6). Pull up the cover and pitman arm shaft a bit and drain the oil. Pull out the cover and pitman arm shaft.
3. Remove the bolts and lower cover (19). Take care of the spacers (22).
4. Carefully knock on the steering worm shaft (10) so that the lower bearing outer races come loose from the housing. Take out the steering worm with bearings.
5. Remove the locknut (3) and screw the adjusting screw (2) out of the cover. The adjusting screw

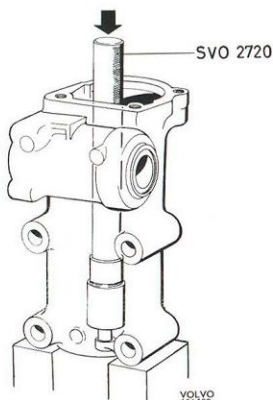


Fig. 6-57. Removing bushes, pitman arm shaft

can be removed from the pitman arm shaft after the circlip has been removed, see Fig. 6-55.

6. Remove the sealing rings (9 and 14, Fig. 6-41) from the steering worm and pitman arm shaft with a screw driver. Take care not to damage the steering housing.

Inspecting

Wash all the parts in white spirit except the gasket and sealing rings, which should be replaced when reconditioning. Check the pitman arm shaft. The roller may not be scratched, scored or heavily worn on contact surfaces or be loose in the pitman arm shaft. If this is the case or if the pitman arm shaft has any other kind of damage, replace the shaft. Examine the contact surfaces of the steering worm against the roller and the inner races of the ball bearings. Scoring or heavy wear, etc., are

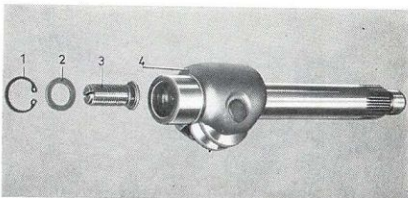


Fig. 6-55. Pitman arm shaft

1. Circlip
2. Adjusting washer
3. Adjusting screw
4. Pitman arm shaft

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reasons for replacing the steering worm. The outer rings of the bearings and the balls should be examined. Scored or bearings damaged in any other way should be replaced. Remove the outer ring for the upper bearing with drift 2718 and standard handle 1801.

Check to see if the pitman arm shaft is loose in the bushes or if the bushes are damaged. If this is the case, replace the bushes in the steering housing, in which case they are removed by tool 2720. Insert the tool with the expander sleeve, loose, see Fig. 6-56. Pull in the tool until the expander comes in position in the bush. Press out the bush according to Fig. 6-57. For the other bush, fit the tool in from the opposite direction. The bush in the pitman arm shaft cover cannot be removed so that the cover must be replaced complete.

Assembling

1. Press the bushes of the pitman arm shaft from opposite directions with drift 2716 and standard handle 1801, see Fig. 6-58. Ream the bushes with reamer 2254. Use the guide 2254, which is attached to the housing by means of two bolts, see Fig. 6-59. Clean the housing carefully from metal chippings after the reaming.
2. If the outer race of the upper bearing has been removed, it is pressed back into position by means of tool 2717. Press in the bearing so that it is against the shoulder in the housing. Fit the sealing ring for the guide bolt.
3. Fit the guide bolt with bearing in the housing carefully so that the sealing ring is not damaged. Fix the housing in a vice so that the guide bolt is horizontal. Fit the lower cover and washer together with shims of the same thickness as previously. The two bolts with the through-going holes are coated with a non-

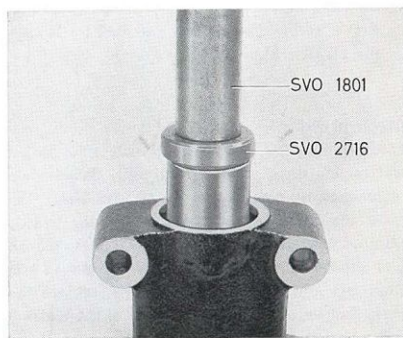


Fig. 6-58. Fitting pitman arm shaft bush

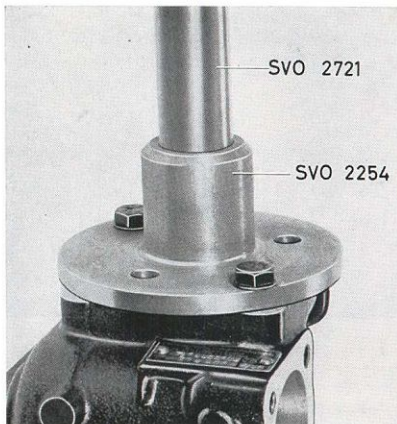


Fig. 6-59. Reaming

- hardening sealing agent. Tighten the cover while checking that the guide bolt rotates easily without any play. If properly located the bearings should require a torque of 0.1—0.25 Nm (1—2 lbin) in order to rotate the guide bolt. The torque is measured with a cord and spring balance as shown in Fig. 6-60. The balance should give a reading of 10—25 N (2.2—5.5 lb). If this is not the case, adjust by inserting or removing shims.
4. Fit the adjusting screw, washer and lock ring on the pitman arm shaft, see Fig. 6-55. The adjusting screw play axially should be as little as possible and should not exceed 0.05 mm (0.002"). The play is reduced by exchanging the washer (2) for a thicker one. However, the adjusting screw should rotate easily after fitting.
 5. Oil and fit the pitman arm shaft. Put on the cover together with gasket. Unscrew the adjusting screw so far that the roller on the pitman arm shaft goes free from the guide bolt when the bolts for the cover are tightened. Fit and tighten the bolts.

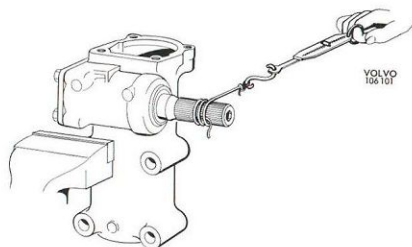


Fig. 6-60. Checking bearing location

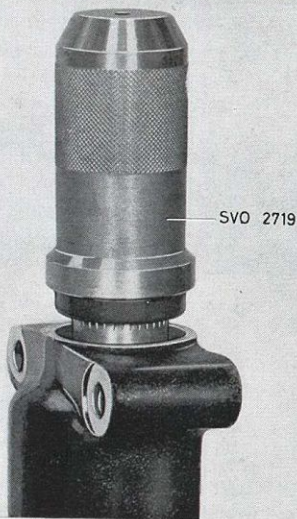


Fig. 6-61. Fitting sealing ring, pitman arm shaft

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6. Coat the sealing ring with oil and fit it with tool 2719 as shown in Fig. 6-61.
7. Locate the steering gear centrally (see Fig. 6-62). Screw in the adjusting screw so far that a noticeable resistance is felt when rotating it forwards and backwards over the centre position. The adjustment of the "pressure point" can be measured in different ways. The measurement, for example, can be done with a cord and balance, see Fig. 6-60, in which case the balance should give a reading of 80—140 N (18—31 lb) when it pulls the guide bolt over the center position. With the swing iron and spring balance position as shown in Fig. 6-63, the balance should give a reading of 4—7 N (9—15 lb). When the gear is properly located, lock the adjusting screw by means of the stop nut. Repeat the test after the stop nut has been tightened securely.

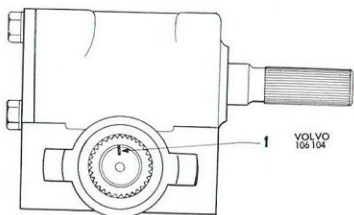


Fig. 6-62. Center position

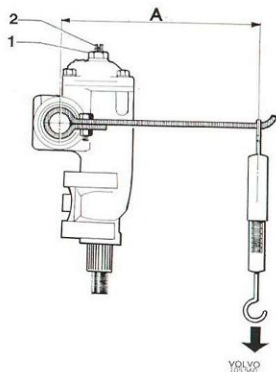


Fig. 6-63. Checking tensioning, cam — roller

A=210 mm (8 1/4")

1. Locknut

2. Adjusting screw

8. Fit the flange on the steering column in the same position it had before being removed.
9. Fill with 0.25 dm³ (1/2 pint) hypoid oil SAE 80 in the steering housing.

Installing

1. Fit the steering in position and secure it.
2. Fit the pitman arm so that the line-up mark on the pitman arm shaft coincides with that on the pitman arm and tighten the nut.
3. With the steering wheel set the wheels so that they point straight forwards, and secure both halves of the lower flange. Check that the distance between the steering housing and lower flange is 27 ± 5 mm ($1 \pm 3/16$ ").
4. Lower the vehicle.

STEERING RODS AND TIE ROD

If bent the steering rods and tie rod may not be straightened out but should be replaced. This also applies if they are damaged in any other way.

The ball joints cannot be disassembled or adjusted so when worn or damaged they must be replaced. The ball joints of the tie rod can be replaced individually. When removing, first take off the split pins and crown nuts. Then place tool 2294 on the ball joints as shown in Fig. 6-64. Press in the tool well and make sure that the thread on the ball joint enters the recess in the tool. Screw in the bolt until the ball joint loosens.

Then remove the locknut on the rod and unscrew the ball joint. From the beginning the new ball joint is screwed in the same number of turns and this

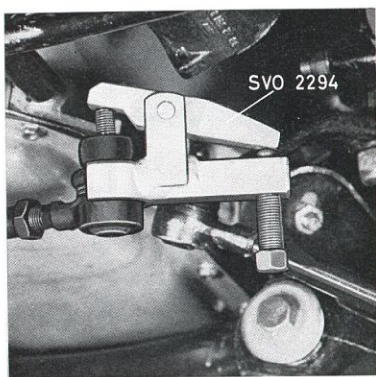


Fig. 6-64. Removing ball joint

facilitates adjusting toe-in. Lock the ball joint with the rod.

The steering rod ball joints are made in one piece with the steering rods and for this reason the steering rod and ball point are replaced complete. To make sure that the steering rods are not mixed up when installed, the left one is marked "L" and the right steering rod "R" at their outer ends. The marked end should be fitted to the steering knuckle.

After having reconditioned the rods and ball joints, the toe-in should always be checked.

RELAY ARM

Replacing as complete unit

1. Jack up the front end of the vehicle.
2. Disconnect the steering rod and tie rod ball joints from the relay arm with puller 2294 as shown in Fig. 6-64.
3. Remove the three attaching bolts for the bracket (2, Fig. 6-67) and lift out the unit.
4. Fit the new complete unit.
5. Connect up and lock the ball joints for the rod. Lower the vehicle.

Replacing bush

1. Jack up the front end of the vehicle.

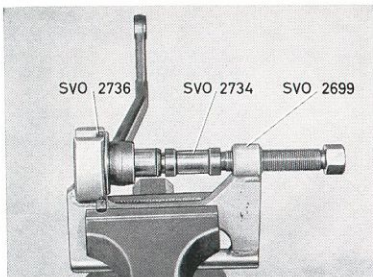


Fig. 6-65. Removing rubber bush, relay arm

2. Disconnect the ball joint for the steering rods and tie rod from the relay arm with puller 2294 as shown in Fig. 6-64.
3. Remove the nut and washer (7, Fig. 6-67) and take down the relay arm (1).
4. Secure the press tool 2699 in a vice and press out the bush with counterhold 2736 and drift 2734 (Fig. 6-65).
5. Turn the relay arm and press in the new bush with 2699 + 2736 and drift 2735 (Fig. 6-66).
6. Place the relay arm in position, fit the washer (7) and nut.
7. Connect and lock the ball joints for the rods. Lower the vehicle.

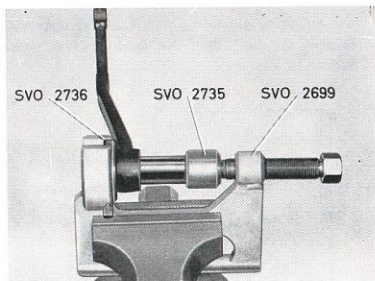


Fig. 6-66. Fitting rubber bush, relay arm

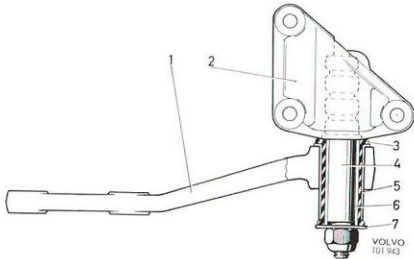


Fig. 6-67. Relay arm journaling

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

POWER STEERING

Work on power steering in 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 Automatic Transmission Fluid, Type A or Dexron may be used for the power system.

CHECKING 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. 6-68. When the engine has stopped, the oil level may rise to 5—10 mm ($\frac{1}{4}$ ") above the level mark.

DRAINING OIL

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

Jack up the front end. Screw out the draining plug (6, Fig. 6-74). 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 reservoir and pump. Stop the engine and turn the steering wheel from full lock to full lock until all the oil has run out.

FILLING WITH OIL AND BLEEDING

NOTE: The oil capacity is about 1.2 dm³ (2.1 Imp. pints=2.5 US pints). Drained-off oil may not be put back into the system.

1. Fill with oil up to the edge of the oil reservoir.
2. With oil within easy reach, start the engine. Gradually fill the reservoir 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 (4, Fig. 6-74) $\frac{1}{2}$ —1 turn. Close it when oil starts flowing out.
5. Continue turning the steering wheel until the oil in the reservoir 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 bleeding.
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 reservoir.

INSPECTING POWER STEERING

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

I. Checking outer sealing

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.

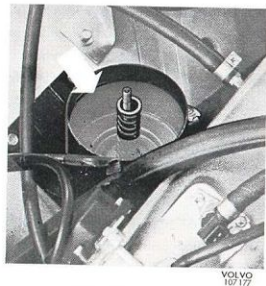


Fig. 6-68. Oil level

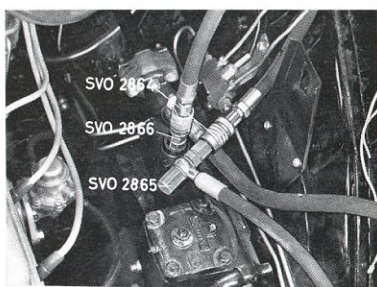


Fig. 6-69. Pressure gauge connected

II. Checking oil level and bleeding

1. Connect the test instrument 2864 to the delivery line at the steering housing, see Fig. 6-69. The inlet hose of the instrument is connected to the banjo nipple with tool 2865 (Fig. 6-69) and the outlet hose to the steering housing with tool 2866 (r-h steered vehicle, tool 2990). 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 ($\frac{1}{4}$ ") 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 ($\frac{1}{4}$ ").

III. Checking hydraulic function for steering housing 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^2 (953 psi). 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. 6-70. Observe the utmost cleanliness. Wash and blow clean before screwing out the plug (4, Fig. 6-67), which should be done from underneath. Check the valve piston and drill-

- ing 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 gear test.** Place a 6 mm (0.24") thick shim on each stop bolt limiting the full steering wheel lock. With the engine at idle and the instrument open, turn the steering wheel to the left until there is resistance from the shim on the stop bolt. Increase the force on the steering wheel by about 100 N (22 lb) and maintain this for about 5 seconds while reading off the gauge.

If the oil pressure in the steering gear agrees with the previously determined oil pressure for the pump, continue the test. If the pressure is lower, first check to make sure there is no external leakage. Thereafter adjust the unloading valve according to below. If this does not remedy the fault, the pressure drop may be due to another internal leakage and this means that the steering gear must be replaced or reconditioned.

Turn the steering wheel until it is stopped by the shim on the right-hand side and repeat the test. Even here the pressure should coincide with that of the pump, the only difference being that the opening point for the unloading valve cannot be adjusted.

Replace the shims with 1 mm (0.04") thick ones and repeat the test. In this case, the unloading valve should open, that is, the power effect should not be obtained at the end positions.

Adjusting unloading valve. The unloading valve should be open in both directions about 3° before stop.

The function of the valve can therefore be checked with shims as above.

The valve's opening point in the left end position can be adjusted. To do this release the locknut for the adjusting screw at the front end of the housing. Screwing out the nut delays the opening point,

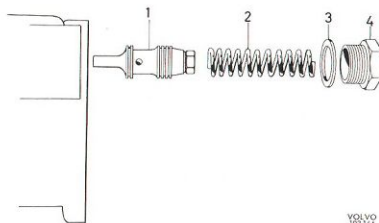


Fig. 6-70. Removing control valve

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

screwing it in advances it. Lock the screw after adjustment.

IV. Checking mechanical function

1. Check the mechanical components of the front end and steering such as ball joints, rods, bearings, steering housing 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 housing and pitman arm shaft as follows: **NOTE.** This adjustment should only be made if there is reason to suspect a fault. Accurate adjustment is made in connection with re-conditioning.
 - a) Remove the locknut for the pitman arm. Pull the pitman arm off with tool 2370. When fitting the puller, turn the wheels fully to the right, see Fig. 6-54.
 - b) Place the steering housing in the middle position (count the number of steering wheel turns).
 - c) Slacken the nut for the adjusting screw (8, Fig. 6-74).
 - 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 center 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 center position. In the center 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 175—200 Nm (125—145 lbf).

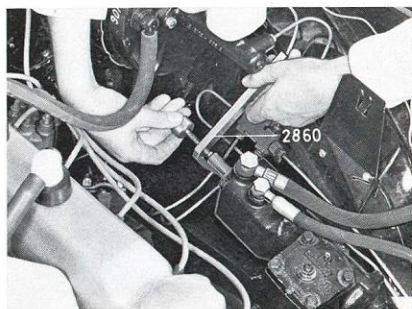


Fig. 6-71. Removing sealing ring

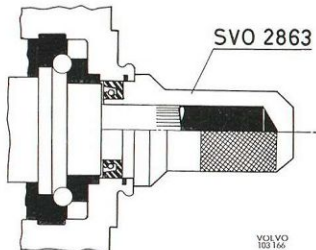


Fig. 6-72. Installing sealing ring

REPLACING STEERING SPINDLE SEALING RING

1. Dismantle the flange device by removing the two nuts and the screw. Move the rubber disc and lower steering column section to the one side.
2. Mark up the location of the flange on the steering spindle. Slacken the clamping bolt and pull off the flange.
3. Remove the rubber cover as well as the circlip for the sealing ring.
4. Carefully apply tool 2860 to the sealing ring. Tighten the screw (Fig. 6-71). 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 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the steering housing, see Fig. 6-72.
6. Fit the circlip and cover.
7. Re-fit the flange according to the line-up marks. Check that the distance between the steering housing and the lower flange is 7 ± 5 mm (0.28 ± 0.20 ").
Assemble the other parts.

Replacing steering housing 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 2370. When fitting the puller, turn the wheels fully to the right, see Fig. 6-54.
4. Disconnect the oil lines (1 and 2, Fig. 6-74) from the steering housing after the connections have been cleaned. Slacken the clamping bolt.
5. Remove the attaching bolts (8) and pull the steering housing forwards.

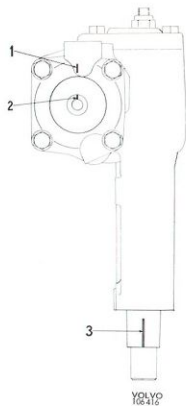


Fig. 6-73. Steering housing in middle position

1—3 Line-up marks

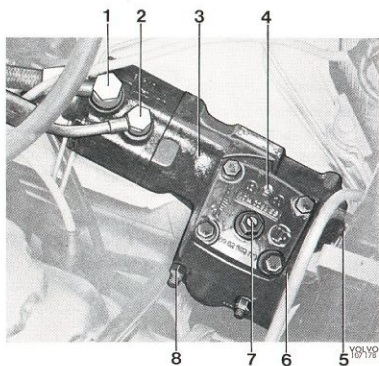


Fig. 6-74. Steering housing installed

- | | |
|---------------------|--------------------|
| 1. Return line | 5. Adjusting screw |
| 2. Delivery line | 6. Drain plug |
| 3. Steering housing | 7. Adjusting screw |
| 4. Bleeder screw | 8. Nut |

INSTALLING

- Place the steering housing in the middle position. A slight increase in resistance should then be felt and the position of the pitman arm shaft lands should be as in Fig. 6-73 and the line-up marks on the steering spindle and housing should coincide.
- Check to make sure that the steering wheel is pointing the front wheels straight forwards.
- Fit the steering housing spindle in the flange of the lower steering column section. Fit and tighten the attaching bolts (8, Fig. 6-74). Tighten the clamping bolt. Check that the distance between the steering housing and the lower flange is 12 ± 3 mm. Connect the oil lines. The longer delivery line should run in a curve backwards, (see Fig. 6-43) and should be clamped.
- Point the front wheels straight forwards and fit the pitman arm. Tighten the nut to a torque of 175—200 Nm (125—141 lbft).
- Fill with oil and bleed, see under the heading "Oil filling and bleeding".

Reconditioning steering gear

In the instructions below the figures in brackets refer to those on Illustration A. With regard to work which can be carried out with the power steering in the vehicle and also removal and fitting, see the previous pages.

DIASSEMBLING

- Secure the steering gear in a vice as shown in Fig. 6-59.
- Remove the locknut (17) and the attaching bolts (19) for the cover. Screw in the adjusting screw (11) through the cover and remove the cover (16). Take out the loose needles in the cover bearing (14).
- Remove the circlip (13) and adjusting screw (11), see Fig. 6-76. Adjust the pitman arm shaft (10) to the center position and lift it up, see Fig. 6-73. With a magnet remove the loose rollers in the bearings (3 and 7).

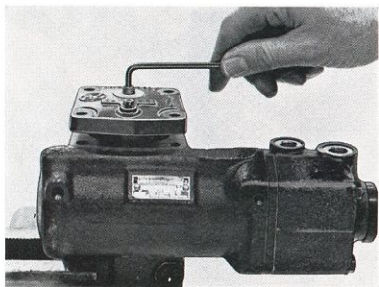


Fig. 6-75. Removing cover

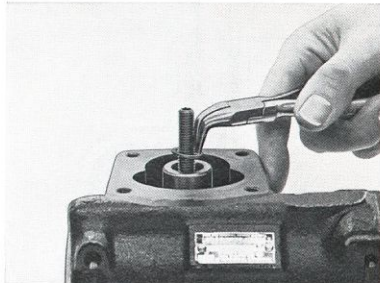


Fig. 6-76. Removing circlip

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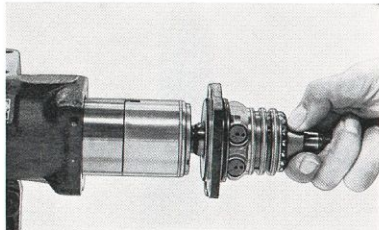


Fig. 6-78. Removing worm

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4. Remove the rubber cover (51) and the attaching bolts (50 and 52). Pull off the valve housing (56), see Fig. 6-77. Remove the lock ring (53) and press out the sealing ring (54).
5. Pull out the worm (68), cover (30) and piston (22), see Fig. 6-78.
6. Lift the piston and screw out the worm, see Fig. 6-79. Take care when the 23 balls drop out that they do not get damaged. Remove the cover (30), needle bearings (36) and bearing washer (35). Remove the packing (34) and O-ring (33), shims (32) and O-rings from the cover.

7. With a screwdriver remove the upper sealing ring (9) in the housing. The ring should be demolished but carefully in order not to damage the bearing in the housing. Turn the housing and remove the circlip (1), see Fig. 6-80. Remove the sealing ring (2) with a chisel. The retainer (3) for the needle bearings should only be removed if the bearing is to be replaced, see under "Inspecting".



Fig. 6-79. Removing piston

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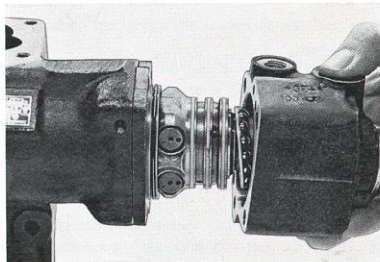


Fig. 6-77. Removing valve housing

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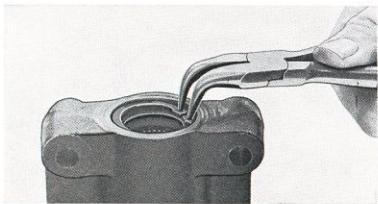


Fig. 6-80. Removing circlip

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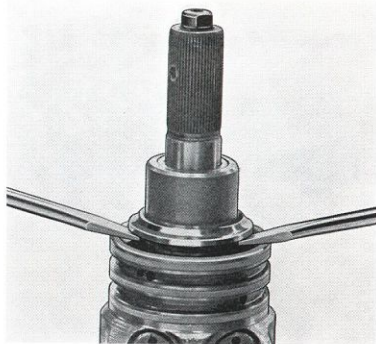


Fig. 6-81. Removing bearing sleeve

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8. Clamp the worm between, for example, copper jaws in a vice. Remove the inner bearing sleeve (60) and the bearing (61), see Fig. 6-81. Remove all rings (62—67) from the worm.

9. Secure the piston between soft vice jaws and unscrew the ring nut (27) with a hook spanner, see Fig. 6-82. Remove the sleeve (24) and its ring (25), the packing (41) and the pipe halves (42).

Remove the plug (21) and the valve components (44, 45, 46).

Disassemble the worm valve head. The parts are fitted and fixed in special apparatuses and their mutual position must not be altered.

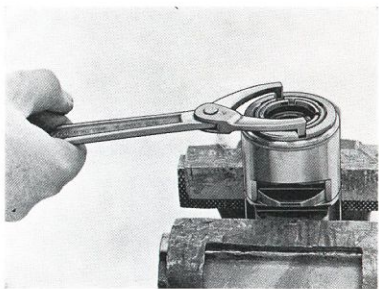


Fig. 6-82. Removing ring

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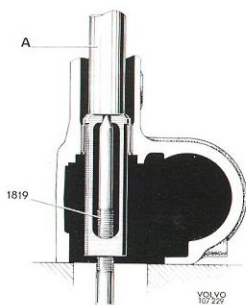


Fig. 6-83. Removing needle bearing

A=Drift

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INSPECTING

NOTE. Clean all parts thoroughly in a cleaning agent. Sealing rings and other rubber parts may not be washed in trichlorethylene, but preferably in a cleaning agent which is completely soluble in water. Since new sealing parts are to be used when assembling, washing off the old parts is generally unnecessary.

Housing and cover

1. Check the cylinder bore in the housing for wear and scoring. The piston must run easily in the cylinder.
2. Check the sealing surfaces and threads in the connections for the delivery and return line for damage.
3. Check the needle bearings in the housing and the cover for damage. Replace if necessary. For removal, use tool 1819 (Fig. 6-83) and for pressing in, drift 2995 and handle 1801 (Fig. 6-84).
4. Check the threads in the cover and housing for damage.
5. Check the bearing ring in the valve housing. If it is to be replaced, knock it out with a chisel and fit the new one with tool 2013.

Piston and worm

1. Check the threading on the worm and piston.
2. Check the piston and sleeve slide surfaces for scoring.
3. Check the piston teeth for damage.

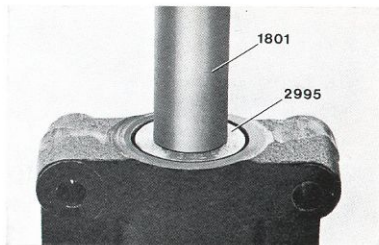


Fig. 6-84. Fitting needle bearing

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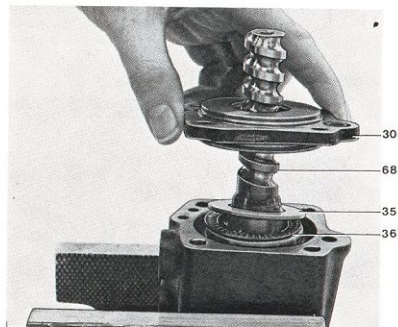


Fig. 6-86. Fitting cover

30. Cover 36. Needle bearing
35. Bearing washer 68. Worm

VOLVO
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Steering shaft

1. Check the steering shaft for cracks.
2. Check the gears for wear and scoring.
3. Check the bearing surfaces for wear and scoring.
4. Check the sealing rings for wear and corrosion.
5. Check the serration for damage.
6. Check the adjusting screw threads and the two flat surfaces for damage. Check sealing surfaces for damage and paint residues. Remove the paint.

ASSEMBLING

Before assembling the parts, wash them well and lightly oil them. All seals should be replaced by new ones.

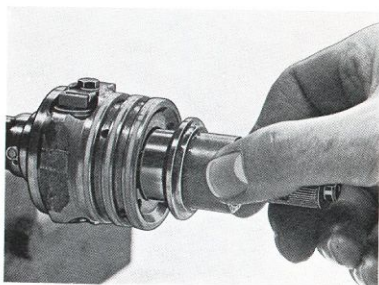


Fig. 6-85. Checking bearing

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1. Fit the needle bearings (61) in the bearing sleeve (60) and test it on the worm spindle (Fig. 6-85). The sleeve should turn easily without any noticeable play. If there is any noticeable play, test with thicker needles in the needle bearing. These are available in four sizes with a difference between each of $2 \mu\text{m}$ ($0.002 \text{ mm} = 0.0008''$), see "Specifications". Bearing sleeves are available with external diameter 28.0 mm ($1.102''$) and 28.015 mm ($1.103''$). Use tool 2481 for installing the sleeve.
2. Tighten up the valve housing (56) with the large bore facing upwards (see Fig. 6-86). Fit the preassembled worm in the housing. Fit the needle bearing (36), the bearing washer (35) and the cover (30), see Fig. 6-86. Secure the cover with the help of the bolts (50 and 52) and four nuts M8. Tightening torque is 34 Nm (25 lbft). Check to make sure there is no looseness in the journalling. A torque of $0.15 - 0.25 \text{ Nm}$ ($1.3 - 2.2 \text{ lbin}$) is required to turn the worm. If this is measured according to Fig. 6-87, the scale should give a reading of $17 - 29 \text{ N}$ ($3.7 - 6.4 \text{ lb}$).

NOTE. The test should be done without a sealing ring.

The preload can be regulated by replacing the bearing washer (35).

There are bearing washers in 6 different thicknesses between 1.9 and 2.4 mm (0.075 and $0.094''$).

When the correct pre-load has been obtained, remove the valve housing.

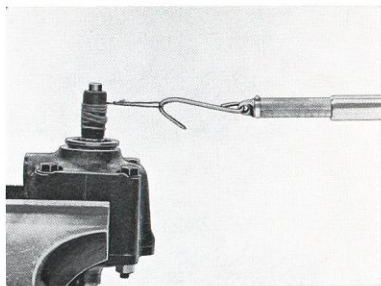


Fig. 6-87. Checking torque

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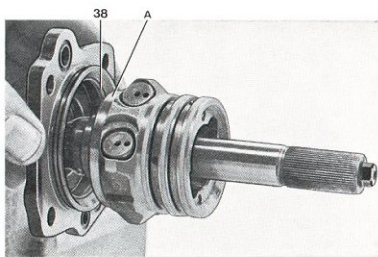


Fig. 6-89. Checking packing

38. Packing A. Contact surface

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- Place the O-rings (63, 65 and 67) in the grooves on the worm. Carefully fit the packings (62, 64 and 66) in position on top of the O-rings, starting with the inner one (see Fig. 6-88).

- Place the O-ring (37) in position in the cover (30). A 1.7 mm (0.067") packing (38) is placed on the O-ring.

Apply marking colour to the contact surface (A) and fit the worm (Fig. 6-89). Rotate the worm. Lift it out and check its contact against the packing. If the worm has not made a perfectly satisfactory sealing against the packing, replace the packing with a 1.8 mm (0.071") one.

Remove and clean the worm. Fit all the O-rings on the cover's valve housing side. Fit the same number of shims (32) previously there. Fit the O-ring (33) and then the packing (34). Oil the packings in the cover. Place the bearing washer (35) and bearing (36) in the cover.

- Fit the sealing ring (54) on the fitting tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the valve housing, see Figs. 6-90 and 6-72. The sealing ring should face inwards. Fit the circlip (53).

- Fit the pre-assembled cover and valve housing onto the worm with the help of the fitting sleeve 2863. Screw the cover and valve housing together with the four bolts and nuts. Tightening torque 34 Nm (25 lbft).

Check the worm torque (see Fig. 6-87). This should now be 0.4—0.6 Nm (3.5—5.2 lbin), that is, the balance should give a reading of 45—70 N (10—15 lb). If any other value is obtained, adjust with the shims. Remove the worm and bearing from the valve housing.

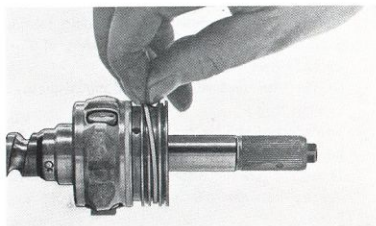


Fig. 6-88. Fitting packing

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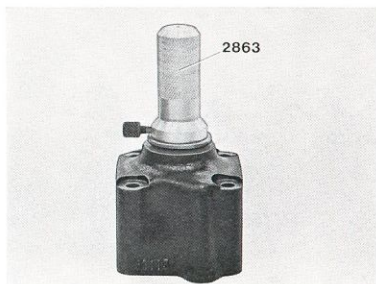


Fig. 6-90. Fitting sealing ring

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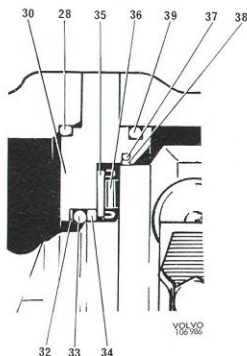


Fig. 6-91. Sealing components

28. O-ring	35. Bearing washer
30. Cover	36. Needle bearing
32. Shims	37. O-ring
33. O-ring	38. Packing
34. Packing	39. O-ring

- Clamp the piston between soft jaws in a vice. Slide the sleeve (24) onto the worm. Insert the worm far enough into the front piston bore that its top comes opposite the first recess for the pipe half. Fill the bore (Fig. 6-92) with the balls. Screw the worm further down by hand so that the balls are carried up to the rear piston for the recirculating pipe. When 16 balls have been inserted, the first ball should appear at the other recess. Thereafter insert the remaining 7 balls. The balls should be greased in order to facilitate installation. Place the halves together and install them, see Fig. 6-93.

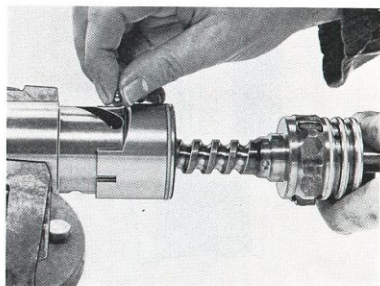


Fig. 6-92. Inserting balls

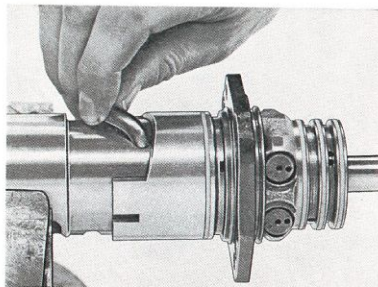


Fig. 6-93. Fitting pipe halves

Check the torque required to turn the worm in the piston. The correct value is 0.2—0.4 Nm (1.7—3.5 lbin). If the torque is measured with a cord (see Fig. 6-94), the balance should give a reading of 23—46 N (5—10 lb). If any other value is obtained, all 23 balls should be replaced. Sets are available with balls in 5 different sizes.

After the correct value has been obtained, remove the 23 balls and keep them in a safe place.

- Place the O-ring (26) and the piston ring (25) in the recess on the sleeve (24). Fit the pre-assembled cover (30) with bearing washer (35), bearing (36), ring (27) and sleeve (24) on the worm, see Fig. 6-75.

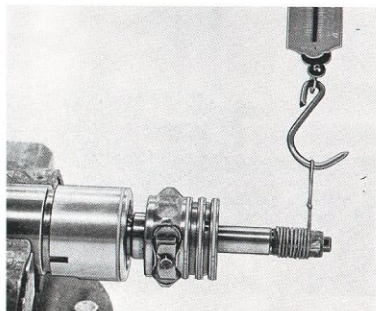
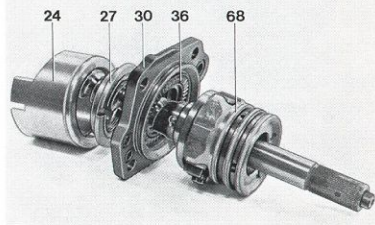


Fig. 6-94. Checking torque

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Fig. 6-95. Worm components

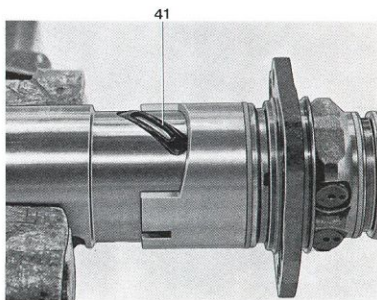
24. Sleeve	36. Needle bearing
27. Ring nut	68. Worm
30. Cover	

Move the worm into the piston while fitting the 23 balls, see point 7. Fit the packing (41), see Fig. 6-96. Assemble the piston and sleeve and fit the pin (23) if it has been removed. The sleeve recess should be on the gear side.

Warning! The worm must not be pulled so far out of the piston that the balls run out (into the piston). Tighten the circlip (27) and lock it, see Fig. 6-97. When doing this, protect the worm to make sure that no metal filings get into the piston.

Fit the valve components (44, 45 and 46) and the plug (21) in the piston.

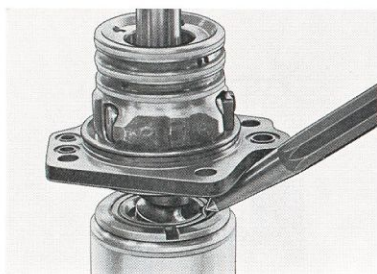
9. Tighten up the housing (4) with the neck facing downwards. Fit the washer (8) in the housing. Fit the sealing ring (9) with the sealing lip facing upwards. Use tools 2010 and 1801, see Fig. 6-98.
10. Oil the O-ring (28) and fit it on together with the other O-rings in position in the cover with



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Fig. 6-96. Packing fitted

41. Packing



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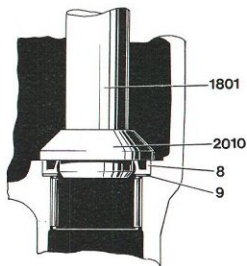
Fig. 6-97. Locking circlip

the help of grease. Move the piston complete in with cover and worm into the housing, see Fig. 6-78.

11. Tension out the sealing ring (54) with tool 2863. Place the bearing (59) in position. Fit the valve housing (56), see Fig. 6-99. The tightening torque for the bolts (50 and 52) is 34 Nm (25 lbf_t).
12. Place the piston teeth in the center position, that is, the opening between the second and third teeth about opposite the steering shaft hole (Fig. 6-100). Fine-adjust by setting the worm scribe mark to coincide with that on the housing (Fig. 6-58).

If the bearings (3 and 7) have not been replaced, place the needle in position with the help of grease.

Place appropriate tape on the steering shaft serration to protect the sealing ring in the housing. Fit the steering shaft (Fig. 6-101) using great care in order to avoid damage to the sealing ring in the housing. Push the steering shaft into the bottom position. Turn the steering spindle forwards and backwards while pressing in the steering shaft at the same



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Fig. 6-98. Fitting sealing ring

8. Washer 9. Sealing ring

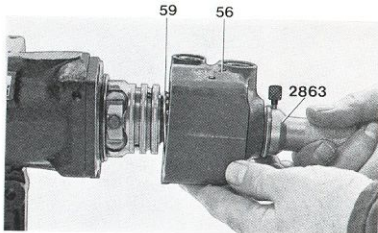


Fig. 6-99. Fitting valve housing
46. Valve housing 59. Ball bearing

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time so that the steering shaft and piston take up the correct position in relation to each other.

Fit the adjuster screw (11), and adjuster washer (12) and lock ring (13) on the steering shaft (10). Check the adjuster screw play on the shaft. This may go up to a maximum 0.05 mm (0.002"). The play is adjusted by replacing the adjuster washer (12). This washer is available in 7 thicknesses between 2.15—2.45 mm (0.085—0.096"). Start with the thicker washers and choose the first dimension which gives a clearance after the lock ring has been fitted.

13. Fit the needles in the bearing (14). Place the O-ring (15) on the cover. Fit the cover by screwing up the adjuster screw (11) until the cover fits. Fit the nut (17) temporarily. Fit washers (20) and bolts (19). The tightening torque is 31 Nm (22 lbf^t). Fit the protective casing (51).
14. Fit the sealing ring (2) with the help of tool 4028. Fit the lock ring (1) in position. Remove the tape.

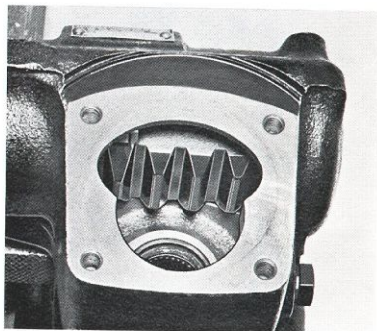


Fig. 6-100. Center position

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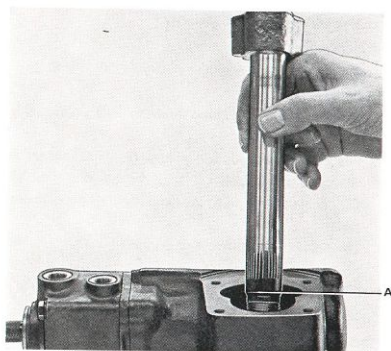


Fig. 6-101. Fitting steering shaft

A. Tape

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15. Turn the steering spindle to the end position. Check for sufficient torque about 1/2 turn from the end position (Fig. 6-102). Adjust the steering spindle to the center position. Screw in the adjuster screw (11) so that a noticeable pressure point is obtained. Measure the torque and adjust so that the balance gives a reading of 45—60 N (10—13 lb) greater than at the end position, but max. 185 N (40 lb). Tighten the nut (17) to a torque of 25 Nm (18 lbf^t) while holding the adjuster screw in position.

FUNCTION TEST

After assembling test the function of the power steering and to make sure that it does not leak. When doing this, follow the instructions given on page 6-32.

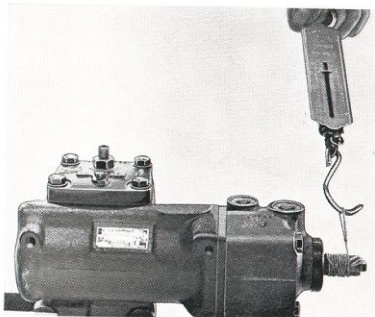


Fig. 6-102. Checking torque

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Replacing power pump

REMOVING

1. Clean round the connections (at 2 and 3, Fig. 6-103).
2. Disconnect the suction line (2) and collect the oil running out.
3. Disconnect the delivery line (3), and unscrew the tensioning bolt (4) and the attaching bolts (5). Protect the nipples and connections from dirt.
4. Unscrew and remove the pump.

INSTALLING

Concerning replacement of pump, supplement the new pump with brackets, pulley and other parts, see Fig. 6-103. 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, this resulting in noise in the pump.

1. Place the pump in position and connect up the oil lines with new seals fitted.
2. Fit the attaching bolts and other components, see Fig. 6-103. Tension the drive belt so that it can be pressed in about 5 mm (3/16") halfway. Tighten the bolts and the connections.
3. Fill with oil and bleed, see under "Oil filling and bleeding".

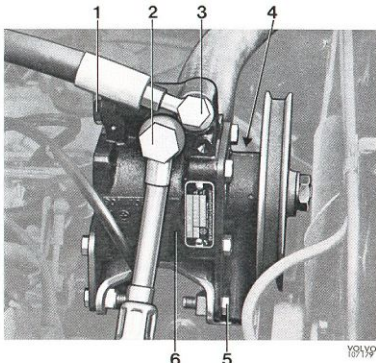


Fig. 6-103. Power pump, fitted

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

Reconditioning power pump

DISASSEMBLING

1. Unscrew the nut (1, Fig. 6-104) and pull off the pulley. If necessary use puller 2279. Remove the brackets.

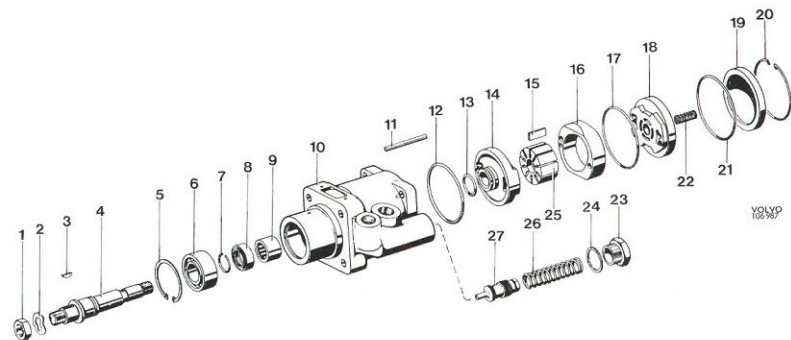


Fig. 6-104. Power pump disassembled

- | | | |
|-------------------|------------------------|--------------------------|
| 1. Nut | 10. Housing | 19. Cover |
| 2. Washer | 11. Pin | 20. Circlip |
| 3. Key | 12. O-ring | 21. O-ring |
| 4. Shaft | 13. O-ring | 22. Spring |
| 5. Circlip | 14. Inner plate | 23. Plug |
| 6. Bearing | 15. Blade | 24. Packing |
| 7. Circlip | 16. Intermediate piece | 25. Rotor |
| 8. Sealing ring | 17. O-ring | 26. Spring |
| 9. Needle bearing | 18. Outer plate | 27. Control valve piston |

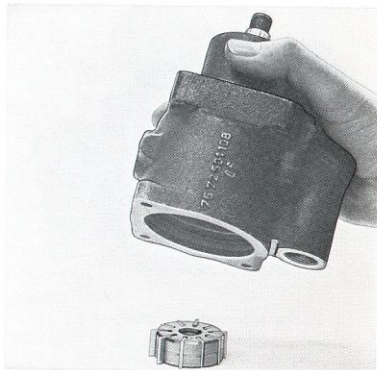


Fig. 6-105. Removing rotor

Y&P

2. Remove the circlip (20) with polygrip pliers.
3. Remove the cover (19), spring (22) and plate (18). Use polygrip pliers.
4. Shake out the intermediate piece (16) and rotor (25), see Fig. 6-105. If it is not easy to remove the intermediate piece, allow it remain until later on.
5. Remove the circlip (5) at the drive end.
6. Carefully press out the shaft (4).
7. Press the plate (14) out of the housing. The intermediate piece should follow at the same time, if not already removed.
8. Screw out the plug (23) and shake out the spring (26) together with the valve (27).
9. Press out the needle bearing (9) and sealing ring (8) at the same time with tool 2996, see Fig. 6-106.
10. Take the O-rings out of the housing.

INSPECTING

Clean all parts

1. Check the shaft (4, Fig. 6-104) for scoring from the sealing ring and needle bearing. Check the threads and lands for damage. If the bearing (6) is damaged, it can be removed after the circlip (7) has been taken off.
2. Check the needle bearing (9) and replace if necessary.
3. Check the plates (14 and 18) for wear and scoring.

4. Check the rotor (25), intermediate piece (16) and blade (15) for wear. The blade should go easily into the rotor. These parts are replaced together in sets.
5. Check that the control valve piston (27) does not jam in the housing bore. Make sure that the piston has the same tolerance group as the housing, that is, that the numbers agree ("1" and "2" or "11").
Screw the control valve piston apart. When doing this, do not hold round the steering surfaces but use polygrip pliers at the holes. Take care of the parts, clean and inspect. If there is any damage, replace the piston complete.
Assemble the parts. The number of washers will determine the opening pressure.
6. Blow all channels in the housing clean.

ASSEMBLING

Before assembling, all parts should be well cleaned and lightly oiled. All seals should be replaced with new ones.

1. Press the needle bearing (9, Fig. 6-104) into the housing with the help of drift 2996, see Fig. 6-107. The bearing should be pressed in until the tool bottoms so that the needle bearing outer edge is 37.0—37.2 mm (1.45—1.46") from the edge of the housing.

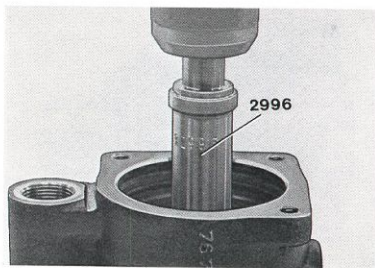


Fig. 6-106. Removing sealing ring

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Fig. 6-107. Fitting needle bearing

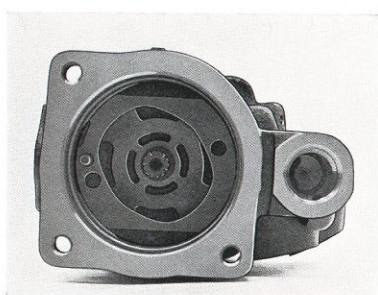


Fig. 6-109. Intermediate piece fitted

2. Apply universal grease between the lips of the sealing ring (8) and press it in with drift 2997.
3. Place the O-ring (12) in position in the inner groove of the housing.
4. If the bearing (6) has been removed, press the shaft into the bearing. Fit the circlip (7) in its groove.
5. Fit the shaft with bearing. Fit the circlip (5) in its groove.
6. Place the O-ring (13) in its groove on the plate (14). Fit the plate as shown in Fig. 6-108.
7. Fit the intermediate piece (Fig. 6-109). The small hole on the pin and the other two opposite the plate holes.

8. Place the O-ring (17) in position in the housing.
9. Fit the rotor (25) with the smooth drill against the drive side. Fit the 10 blades (15) with the rounded surface facing outwards towards the intermediate piece (Fig. 6-110).
10. Fit the plate (18) on the intermediate piece according to Fig. 6-111. The pin should be in one of the two outer holes.
11. Place the O-ring (21) in its groove (Fig. 6-112). Fit the spring (22) and cover as shown in Fig. 6-112. Hold the cover down with pliers and fit the circlip (20) in its groove.
12. Fit the control valve piston (Fig. 6-113). Fit the spring (26), packing (24) and plug (23).
13. Fit the nipple, brackets and pulley, see Fig. 6-47.

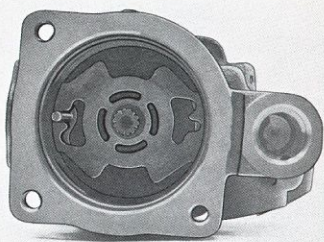


Fig. 6-108. Inner plate fitted

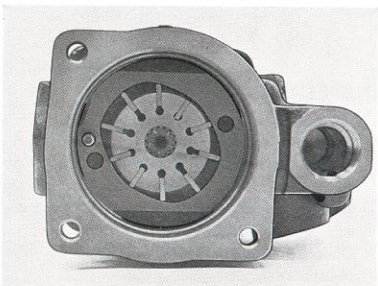


Fig. 6-110. Rotor blade fitted

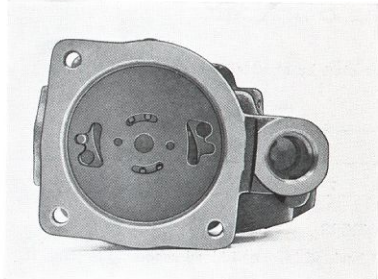


Fig. 6-111. Outer plate fitted

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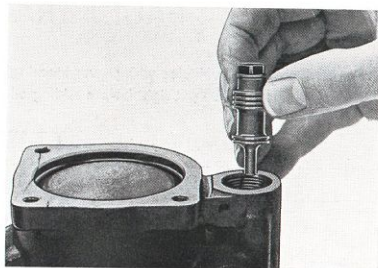


Fig. 6-113. Fitting control valve

YOLVO
107018



Fig. 6-112. Fitting cover

YOLVO
107017

Replacing oil filter

When changing the oil, which is normally done only in connection with replacement of the power 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.

FAULT TRACING SCHEME

When fault tracing in vehicles with power steering, always start by checking the oil level, see page 31. Any leakage must be put right before adding oil.

REASON	FAULT	ACTION
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THE CAR WANDERS

Too low oil level or air in system.

Abnormal loading.

Unsuitable tyre equipment.

Faulty wheel adjustment.

Loose steering parts.

Check oil level and bleed according to page 31.

Distribute loading.

Shift wheels.

Check and adjust wheels.

Check and tighten up.

THE CAR PULLS TO ONE SIDE

Too low or uneven air pressure in tyres.

The front spring have fatigued or have different height.

A roller bearing is too tight.

Faulty tracking.

Bent steering rod.

Incorrect camber.

Check air pressure (see Part 7).

Remove and check spring (see Part 7).

Check the bearings. Replace damaged bearings and adjust (see Part 7).

Check-measure the body and straighten up if necessary. (See Part 8).

Replace damaged rod.

Check and adjust the camber. Pulling can be influenced by giving the wheels different inclination with the tolerance.

STEERING STIFF TO RIGHT AND LEFT

Too low oil level or air in system.

Pump control valve jams or is blocked.

Filter blocked, channel blocked.

Excessive caster.

Jamming ball joints.

Damaged sealing rings in power steering gear.

Check oil level or bleed according to page 31.

Remove, clean and check control valve.

Remove filter, clean channel.

Check and adjust the caster.

Replace ball joint.

Recondition or replace steering gear.

STEERING HEAVY EITHER TO LEFT OR TO RIGHT

Pressure builds up only on one side of the power piston.

Recondition or change power steering gear.

HEAVY STEERING WITH RAPID STEERING WHEEL TURNS

Pump pulley belt slips.

Pump control valve blocked.

Pump has too little capacity.

Air in the power system.

Tension or replace pulley belt.

Remove, clean and check the control valve.

Recondition the pump.

Bleed the system, fill oil according to page 31.

FRONT WHEEL SHIMMY

Air in system.

Unbalanced or warped wheels.

Incorrect wheel adjustment.

Loose or worn front wheel bearings.

Bleed the system.

Balance the wheels and eventually align (see Part 7).

Check the wheel adjustment.

Adjust or replace bearings.

SHOCKS AND JARRING IN THE STEERING WHEEL

Too low oil level or air in the system.

Axial play on steering shaft.

Worm loose.

Looseness in other steering components.

Check the oil level or bleed according to page 36.

Adjust the pressure point.

Recondition worm.

Tighten or replace worn component.

THE STEERING WHEEL CONTINUES TO FULL LOCK

Incorrect adjustment on steering valve.

Recondition steering gear.

NOISE FROM OIL PUMP

Too low oil level or air in the system.

Worn pump.

Check the oil level or bleed according to page 36.

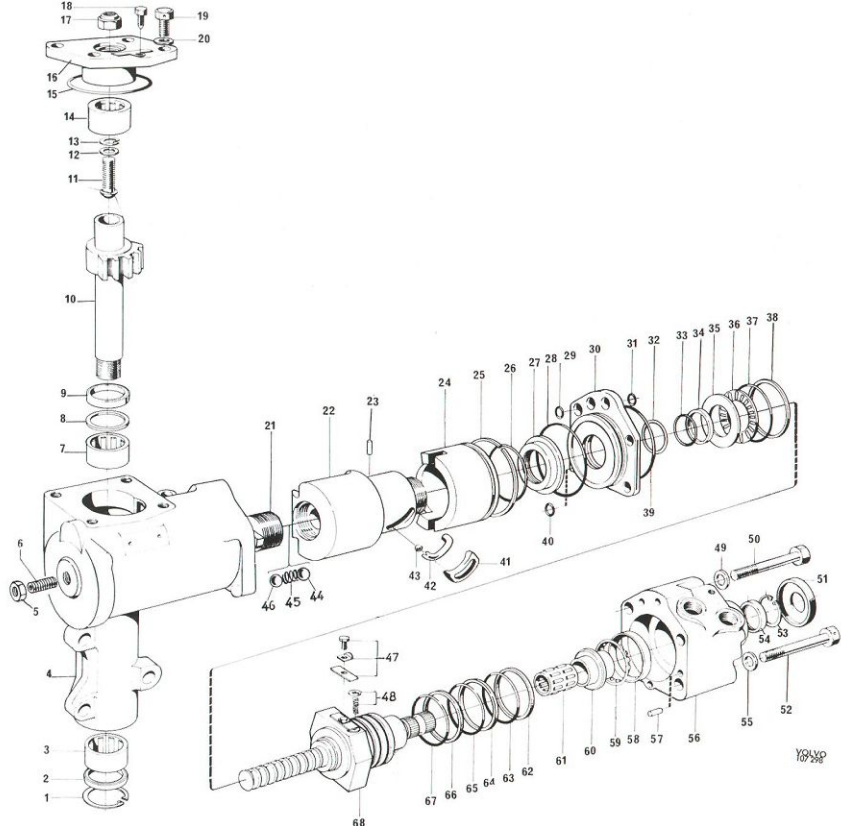
Recondition the pump.

OIL LEAKAGE

Defective seals or bad connections.

Clean and wipe dry the steering gear on the outside.

Test-run and load the steering gear. Locate the leakage.



- 1. Circlip
- 2. Lower sealing ring
- 3. Needle bearing
- 4. Housing
- 5. Locknut
- 6. Adjuster screw
- 7. Needle bearing
- 8. Washer
- 9. Upper sealing ring
- 10. Steering shaft
- 11. Adjuster screw
- 12. Adjuster washer
- 13. Circlip
- 14. Needle bearing

- 15. O-ring
- 16. Cover
- 17. Locknut
- 18. Bleeder screw
- 19. Bolt
- 20. Washer
- 21. Plug
- 22. Piston
- 23. Pin
- 24. Steeve
- 25. Piston ring
- 26. O-ring
- 27. Ring nut
- 28. O-ring

- 29. O-ring
- 30. Cover
- 31. O-ring
- 32. Shim
- 33. O-ring
- 34. Packing washer
- 35. Bearing washer
- 36. Needle bearing
- 37. O-ring
- 38. Packing
- 39. O-ring
- 40. O-ring
- 41. Packing
- 42. Pipe halves

- 43. Ball
- 44. Valve ball
- 45. Spring
- 46. Valve ball
- 47. Lock parts
- 48. Valve parts
- 49. Washer
- 50. Bolt
- 51. Rubber cover
- 52. Bolt
- 53. Circlip
- 54. Sealing ring
- 55. Washer
- 56. Valve housing

- 57. Guide pin (only early prod.)
- 58. Bearing ring
- 59. Ball bearing
- 60. Bearing sleeve
- 61. Needle bearing
- 62. Packing
- 63. O-ring
- 64. Packing
- 65. O-ring
- 66. Packing
- 67. O-ring
- 68. Worm

Illustration A. Steering gear disassembled

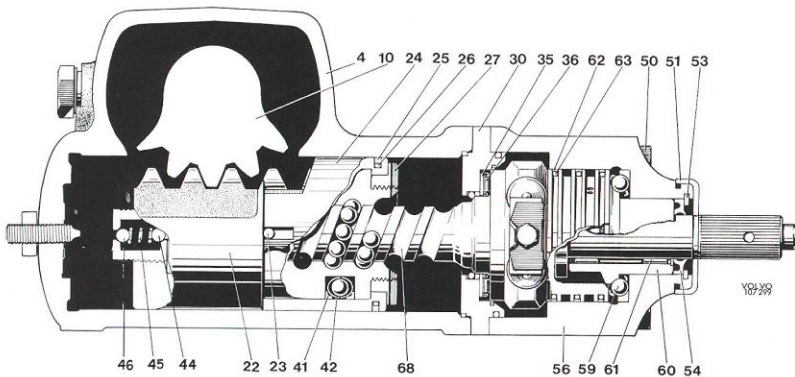
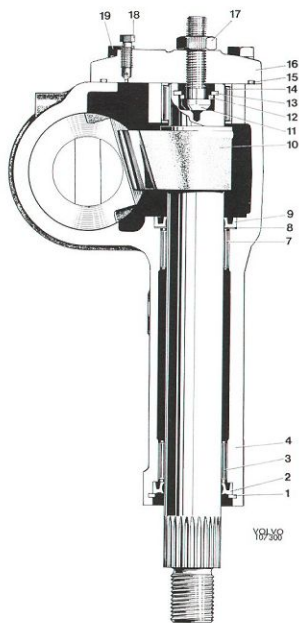


Illustration B. Steering gear assembled



1. Circlip
2. Lower sealing ring
3. Needle bearing
4. Housing
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjuster screw
12. Adjuster washer
13. Circlip
14. Needle bearing
15. O-ring
16. Cover
17. Locknut
18. Bleeder screw
19. Bolt
22. Piston
23. Pin
24. Sleeve
25. Piston ring
26. O-ring
27. Ring nut
30. Cover
35. Bearing washer
36. Needle bearing
41. Packing
42. Pipe half
44. Valve ball
45. Spring
46. Valve ball
50. Bolt
51. Rubber cover
53. Circlip
54. Sealing ring
56. Valve housing
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Packing
63. O-ring
68. Worm