



# SERVICE MANUAL

P 1200

Part 5

REAR AXLE

*Service Department*

AKTIEBOLAGET

**VOLVO**

GÖTEBORG SWEDEN

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## DESCRIPTION

There are two types of rear axle. Model I is characterized by the fact that the rear axle gear is fitted in a special carrier which is removable from the housing (Model I, ENV, see Illustration II). On the other type (Model II, Spicer, see Illustration III) the rear axle carrier and rear axle housing are assembled in one integral unit. The rear axle is of the hypoid type, that is to say, the drive pinion lies below the centre of the crown wheel which means that the propeller shaft can be fitted lower. One disadvantage of this is that there are greater stresses on the teeth of the pinion and crown wheel. Apart from the pressure normally exerted between the teeth, there is also a wiping action in hypoid gears. This makes great demands on the degree of adhesion of the oil used. That is why a special oil called hypoid oil must be used in hypoid gears since this oil has an excellent degree of adhesion to the gear teeth. The use of the wrong type of oil in hypoid gears can cause extremely rapid wear of the gears.

The rear axle gear consists of drive pinion, crown wheel and differential. The designs of the two types differ slightly. Model I is provided with adjusting nuts for taking up the differential carrier bearings and adjusting backlash. These are not fitted on Model II rear axles where the differential carrier bearings and backlash are adjusted by means of shims on the inside of the differential carrier bearings.

The differential carrier and the crown wheel are journaled in the rear axle gear carrier and the rear axle housing by two taper roller bearings. The crown

wheel is attached to the differential carrier by bolts which are locked with tab washers.

The differential consists of two differential pinion gears on a short shaft and two larger side gears carrying the axle shafts by means of internal splines. By virtue of their journaling, these gears can rotate and permit the axle shafts to rotate at varying speeds when the vehicle is being driven round curves. There is a washer under each differential gear and the pinion is journaled in taper roller bearings. The axial position of the pinion relative to the crown wheel is adjusted by means of shims under the rear pinion bearing outer ring. Pinion bearing adjustment is carried out by means of shims under the front pinion bearing inner ring.

Each axle shaft is also journaled at its outer end in a taper roller bearing. Bearing clearance is adjusted by means of shims under the brake backing plate. On the inside of each axle shaft bearing, there is a seal ring which, together with a felt ring on the outside of the bearing, prevents the oil in the differential from reaching the brake linings.

The rear axle suspension consists of two longitudinal support arms. The support arms are provided with two rubber bushings in which the rear axle housing is flexibly mounted. In order to take up rear axle torque relative to the longitudinal axis of the car, two torque rods are fitted to the body and to levers on the housing. A track bar prevents the body and rear axle from moving sideways in relation to each other. The principle of the rear axle suspension is shown in Illustration I.

## REPAIR INSTRUCTIONS

### Work that can be carried out with the rear axle fitted

#### Replacement of axle shaft seal ring

1. Remove the wheel and pull off the wheel hub as shown in Fig. 1. Use puller SVO 1791. Remove the brake backing plate after having placed a wooden block under the brake pedal and loosened the brake line from the backing plate.

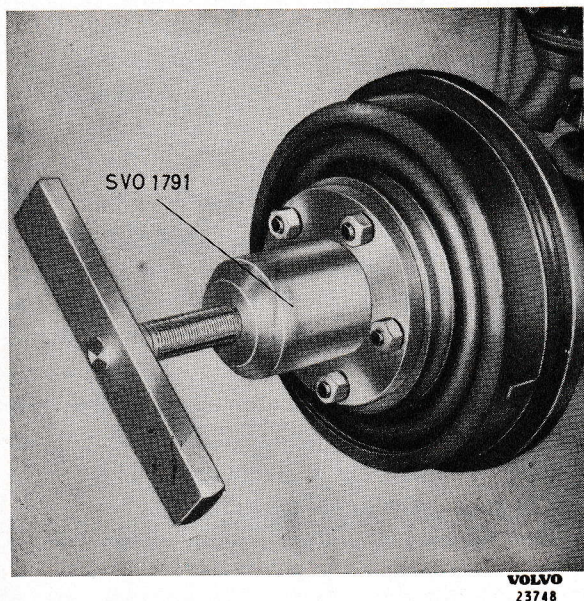


Fig. 1. Removing a wheel hub.

2. Pull out the axle shaft, Fig. 2. Use puller SVO 2204. (SVO 1804 can be used on Model I rear axles.)
3. Pull out the seal ring by using tool SVO 4078 (Fig. 3).
4. Drive in the new seal ring. Make sure that it lies correctly. Use tool SVO 1803 as shown in Fig. 4.
5. Remove any oil or grease that there may be on the brake backing plate. Replace the brake linings if there is any oil or grease on them.
6. Fit the axle shaft and brake backing plate. Use a new felt washer.
7. Check the axle shaft end play. See the directions under the heading "Assembling".
8. Replace the cross key if it has been removed, and then fit the hub and wheel.

9. Air-vent the brake lines and adjust the brakes. Follow the directions given in Part 7.
10. Check the oil level in the rear axle.

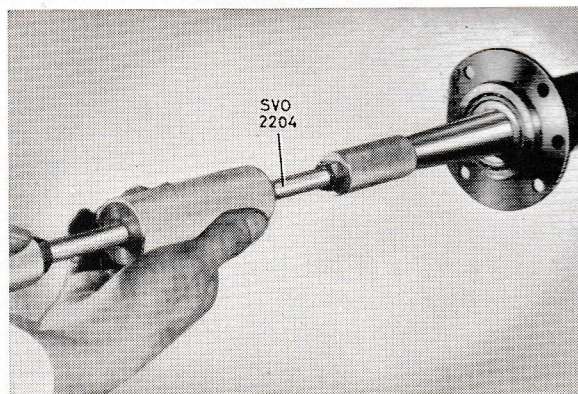


Fig. 2. Removing the axle shaft.

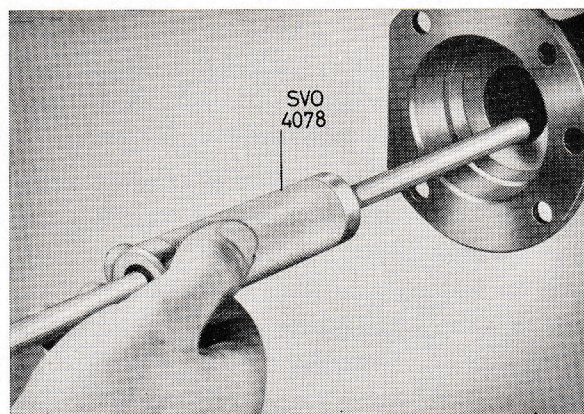


Fig. 3. Removing the seal ring.

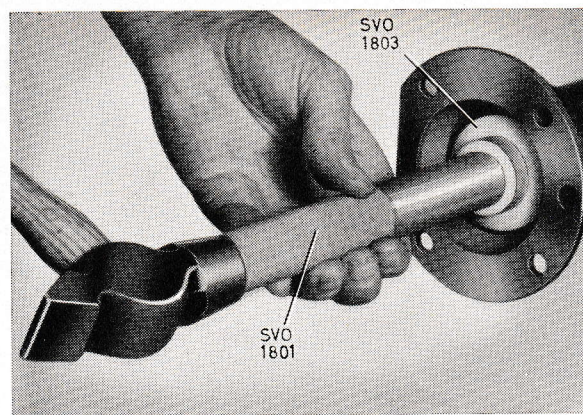


Fig. 4. Fitting the seal ring.

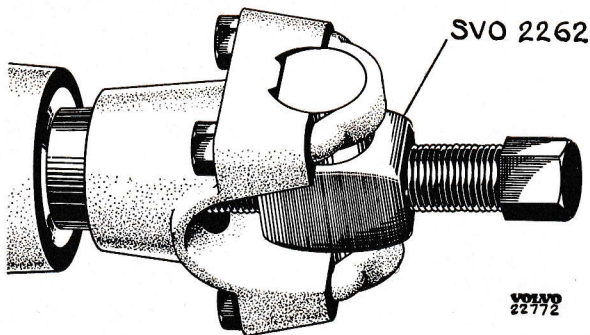


Fig. 5. Removing the flange.

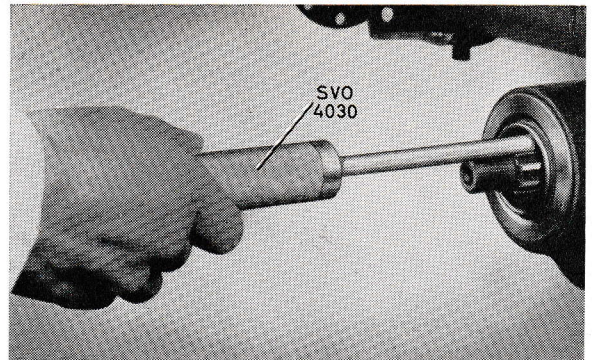


Fig. 6. Removal of seal ring.

### Replacement of pinion seal ring

1. Disconnect the rear section of the propeller shaft from the flange on the pinion. Check the looseness of the pinion in its bearings. If it is loose, this must be remedied before a new seal ring is fitted.
2. Remove the flange nut by using wrench SVO 2409 as rapport. Pull off the flange with tool SVO 2262. See Fig. 5. Remove the oil seal ring by using tool SVO 4030 as shown in Fig. 6.
3. Insert a new paper gasket and fit the new seal ring with an SVO tool as shown in Fig. 7. (See the tool list on page 20—23 for the SVO tools used on the various rear axles).
4. Press on the flange by using an SVO tool as shown in Fig. 8.
5. Re-connect the propeller shaft.

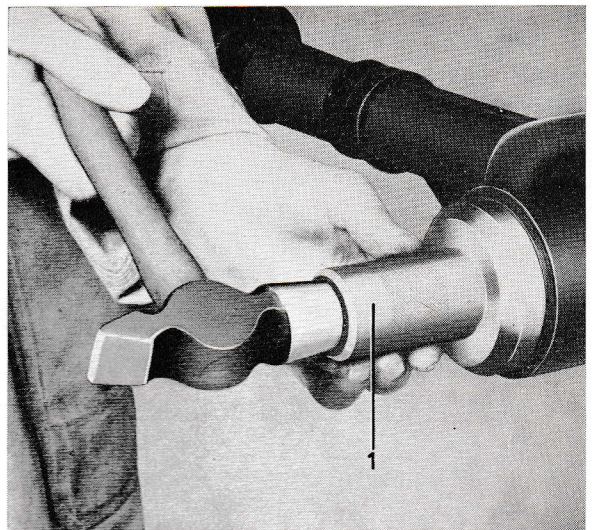


Fig. 7. Fitting of seal ring.

1. SVO tool, see tool list.

### Replacement of axle shaft and/or bearing

1. Remove the wheel and pull off the hub as shown in Fig. 1. Use puller SVO 1791. Remove the brake backing plate after having placed a wooden block under the brake pedal and loosen the brake line from the backing plate.
2. Pull out the axle shaft as shown in Fig. 2. Use tool SVO 2204. (SVO 1804 can be used on Model I rear axles.) Check and replace the seal ring if necessary.
3. Press off the bearing as shown in Fig. 9 and then fit the new one (see the tool list on page 20—23 concerning SVO tools).
4. Fit the axle shaft, shims and brake backing plate.

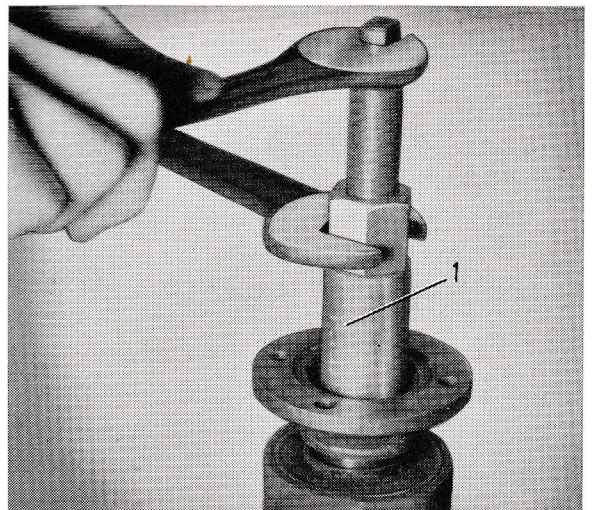


Fig. 8. Fitting the flange.

1. Press tool, see tool list.

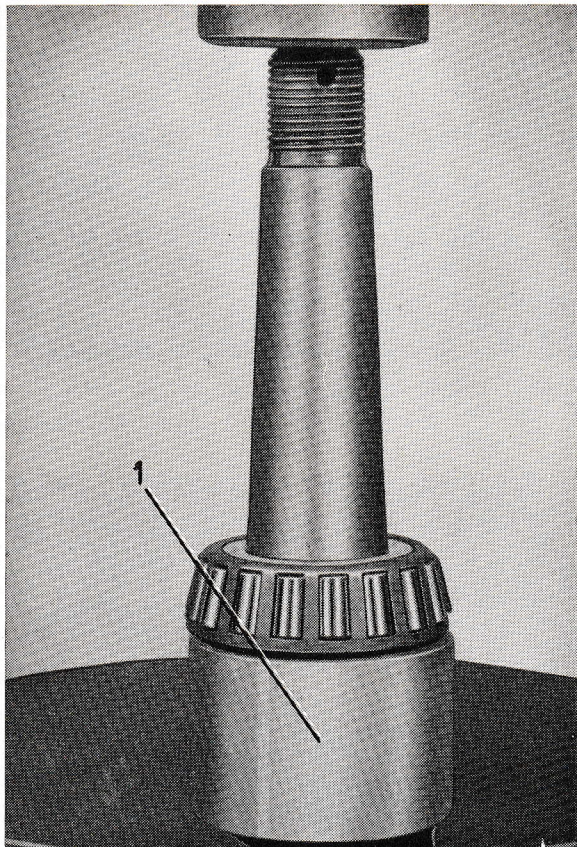


Fig. 9. Removal of axle shaft bearing.

1. Ring, see tool list.

5. Check the axle shaft end play and adjust if necessary. Follow the directions given under the heading "Assembling".
6. Fit the cross-key, hub and wheel.
7. Air-vent the brake lines and adjust the brakes. Follow the directions given in Part 7.
8. Check the oil level in the rear axle.

## Repair instructions for the model I rear axle

### Removing the rear axle gears

(See page 9 and 16 concerning the removal and fitting of the complete rear axle.)

1. Loosen the rear wheel nuts (7, Illustration II) jack up the car and then block it up so that the wheels are about 4" above the floor.

2. Screw out the oil drain plug on the underside of the gear housing and allow the oil to run out while the axle shafts are being removed.
2. Lift off the rear wheels and remove the rear axle nuts (2).
3. Pull off the rear wheel hubs (6) together with the brake drums. Use puller SVO 1791, Fig. 1. (The handbrake should be released and the brake shoes backed up if necessary).
4. Disconnect the brake line at the brake backing plates (place a wooden block under the brake pedal to prevent it from being depressed by mistake).
5. Remove the four bolts (46) for the brake backing plates and remove same. Make sure that the shims (47) are not lost or damaged.
6. Pull out the axle shafts (11) with tool SVO 2204 (SVO 1804 can be used) and lift them clear, Fig. 2.
7. Disconnect the propeller shaft from the pinion flange (21).
8. Loosen the bolts (13) retaining the rear axle carrier (14) and lift this off.

### Disassembling of rear axle gears

1. Place the rear axle in fixture SVO 4110. Check that the cap (37) for the differential carrier is marked. If not, mark one side with a punch. Remove the cap bolts (44).
2. Remove the adjusting nuts (34) and the bearing rings. Lift out the differential and ring gear.
3. Loosen the nut (22) by using wrench SVO 2409 as rapport. Pull off the flange (21) with tool SVO 2262, Fig. 5. Press out the pinion (18).
4. Pull out the seal ring (20) with puller SVO 4030 from the forward end of the pinion housing, Fig. 6. Take out the paper gasket, the metal washer (19) and the roller bearing (25).
5. Drive out the bearing outer rings, Fig. 10, if required. Use tool SVO 4063 for the forward and SVO 4064 for the rear bearing ring together with the standard handle, SVO 1801. Be careful not to lose the shims (28).
6. If required, pull off the rear bearing (29) from the pinion, Fig. 11. Use puller SVO 2392.

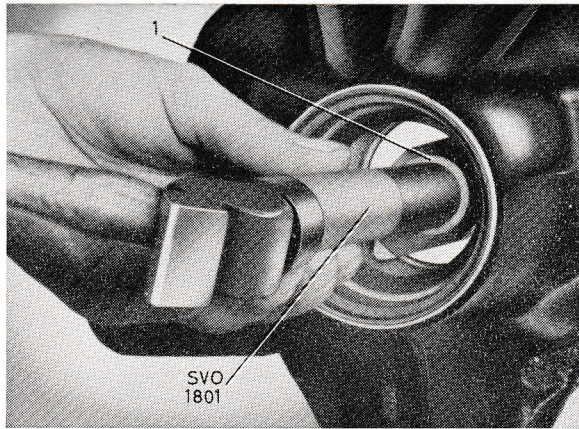


Fig. 10. Removing the bearing ring.  
1. Drift, see text.

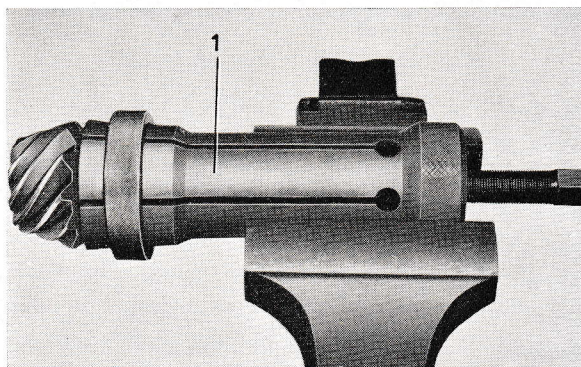


Fig. 11. Removing the rear pinion bearing.  
1. Puller SVO 2392.



Fig. 12. Removing the lock pin.

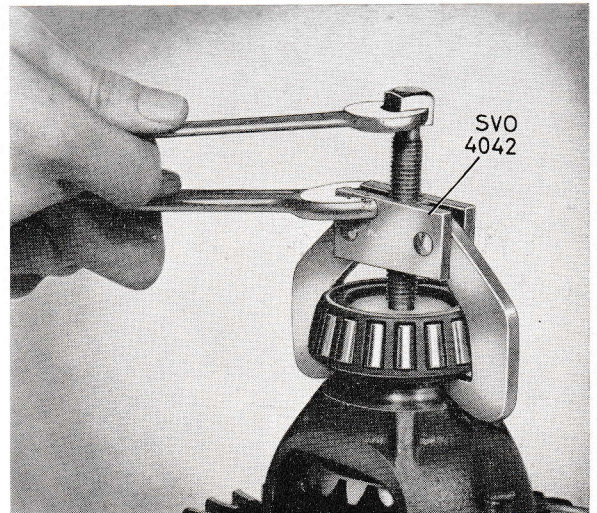


Fig. 13. Removing the differential carrier bearing.

### Disassembling of differential

1. Loosen the ring gear bolts and remove the crown wheel (17).
2. Drive out the lock pin (30) for the differential pinion gear shaft (31), see Fig. 12. Then drive out the shaft with a suitable drift and remove the spacer. The gears (38,41) can then be removed together with the thrust washers (39,42).
3. If required, pull off the differential carrier bearing (33). Use puller SVO 4042, see Fig. 13.

### Inspecting

The various components must be thoroughly cleaned before inspection can be carried out. All bearing races and bearings must be thoroughly examined. All bearing races, rollers and retainers must be free from damage. Replace if damaged. The drive pinion and the crown wheel gear must be examined thoroughly for damage on their teeth. Cracks in the teeth can result in pieces loosening while the vehicle is being driven. These pieces can come between the gears and can cause extensive damage in the rear axle gear. If there is damage, both the crown wheel and drive pinion must be replaced. These (the crown wheel and drive pinion) are sold in complete sets since they are matched in a special machine to ensure the correct backlash and silent operation.

Examine the differential gears for cracks and damage on the teeth. The differential gears should

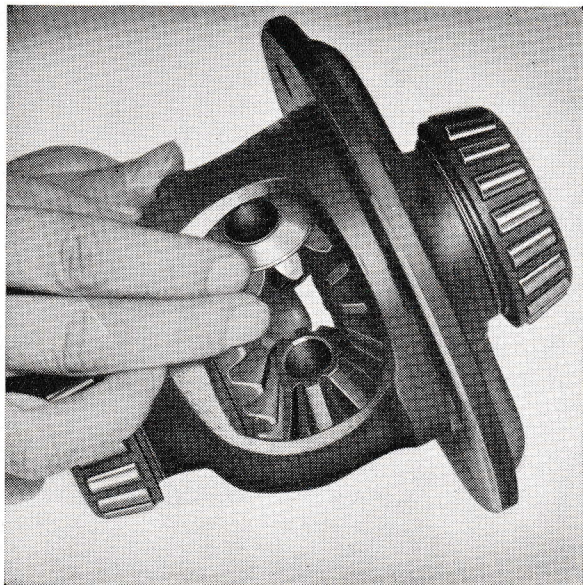


Fig. 14. Fitting the differential pinion gears.

be fitted in a clean and dry condition in the differential carrier together with the shaft and thrust washers so that looseness and wear can easily be determined. If there is looseness, the parts concerned should be replaced. The thrust washers should be free from any unevenness.

Examine to determine if the flange cylindrical part, which goes in the seal ring, is worn or scratched. If this is the case, replace the flange together with the seal ring.

Inspect the axle shafts. Shafts that are distorted or damaged in any way should be replaced.

Examine the seal rings and replace them if they are damaged or worn.

See that there are no cracks on the rear axle housing. Check that the brackets for the support arms and track bar are in good condition.

## Assembling

### Assembling of differential

1. If the differential has been disassembled, the differential side gears (38) and the thrust washers (39) are fitted in the differential carrier (43). Then "roll" in the differential pinion gears (41) (both simultaneously) with the recessed thrust washers (42), see Fig. 14.
2. Insert the spacer block (32) and drive in the shaft (31).
3. Fit the differential carrier in a vice and fit one axle shaft in the differential side gear on one

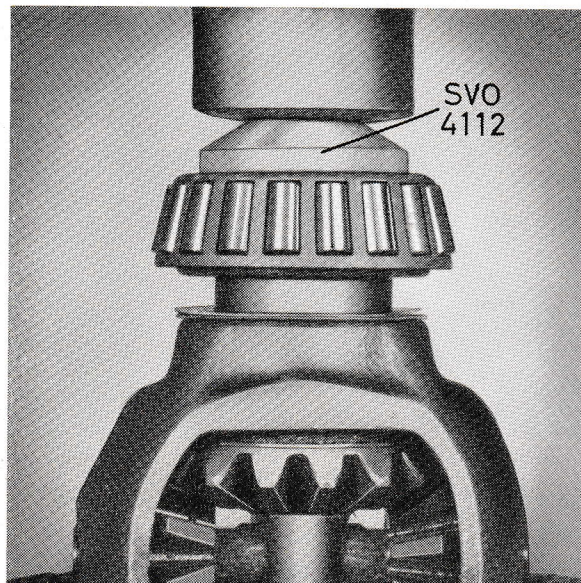


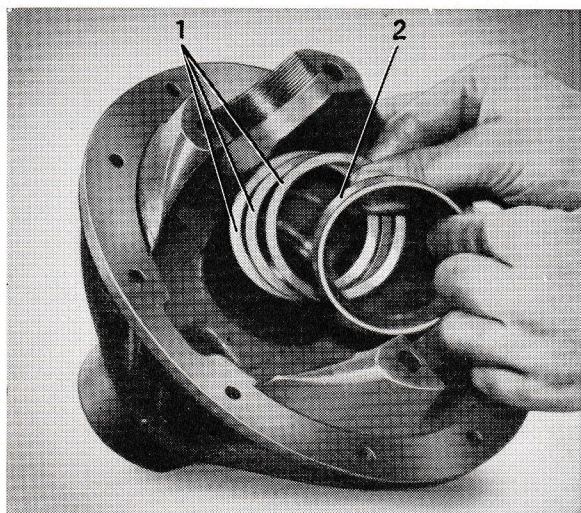
Fig. 15. Fitting the differential carrier bearing.

side. The differential should then run so stiffly that it can only be turned with difficulty by hand with this shaft. If it runs too easily, new thrust washers (39) are fitted. The plain washers are available in oversizes. Note that equally thick washers should be fitted under corresponding gears. When this adjustment has been carried out, the lock pin (30) for the shaft is fitted.

4. Fit the crown wheel (17) and make sure that the contact surfaces are clean and even. Tighten the bolts (15) to the degree of torque shown in the specifications and lock with the tab washers (16).
5. Press on the differential carrier bearings (33) as shown in Fig. 15. Use tool SVO 4112 and the standard handle SVO 1801 for the bearings.

### Assembling of rear axle gears

1. Replace the number of shims (28) which were under the pinion bearing outer ring when disassembling, see Fig. 16. Then press in the front and rear outer rings with the press tool SVO 4047 as shown in Fig. 17. Make sure that the rings do not chafe or lie at an angle in the housing.
2. Press the rear pinion bearing (29) onto the pinion (18). Use tool SVO 2395 as shown in Fig. 18.

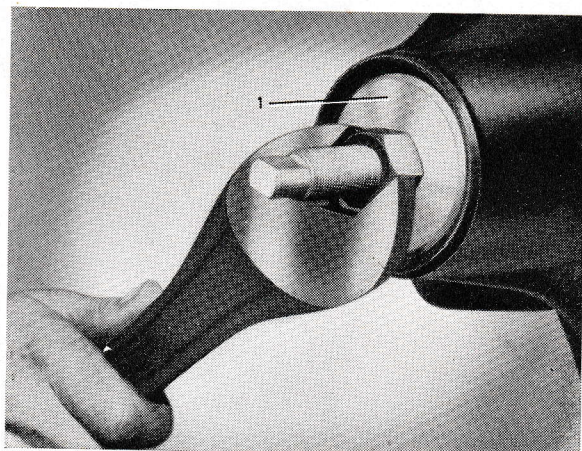


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Fig. 16. Fitting shims.

1. Shims.      2. Bearing ring.

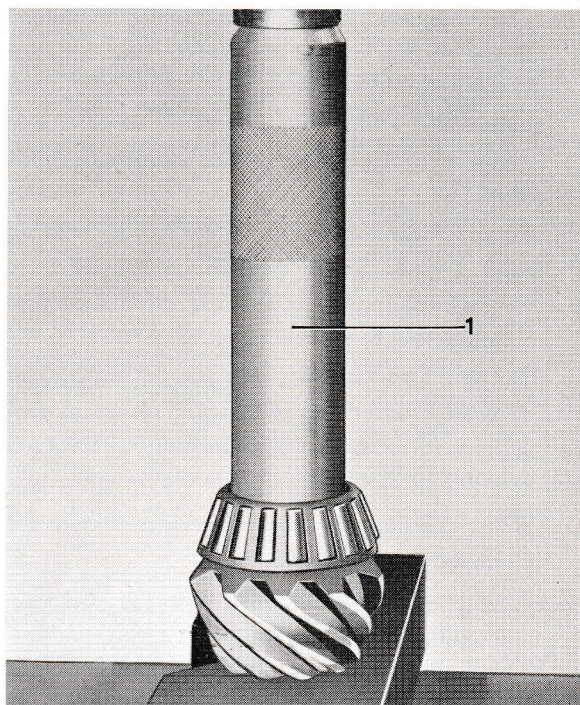
3. Insert the pinion in the housing and then fit the spacer ring (27), the same number of shims (26) there were when disassembly was carried out, and the front pinion bearing (25). Then place the tool SVO 2409 and the press tool SVO 2304 and SVO 4049 respectively on the front end of the pinion, see Fig. 19. (SVO 2304 is used for pinions with  $\frac{5}{8}$ "—18 threads and SVO 4049 for pinions with  $18 \times 1.5$  mm threads. The simplest method for checking to see whether a pinion is of early or late production is by looking at the flange nut. A pinion of early production with  $18 \times 1.5$  mm threads is fitted with castle nut and split pin whilst a late production pinion with  $\frac{5}{8}$ "—18



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Fig. 17. Fitting the bearing rings.

1. Press tool SVO 4047.



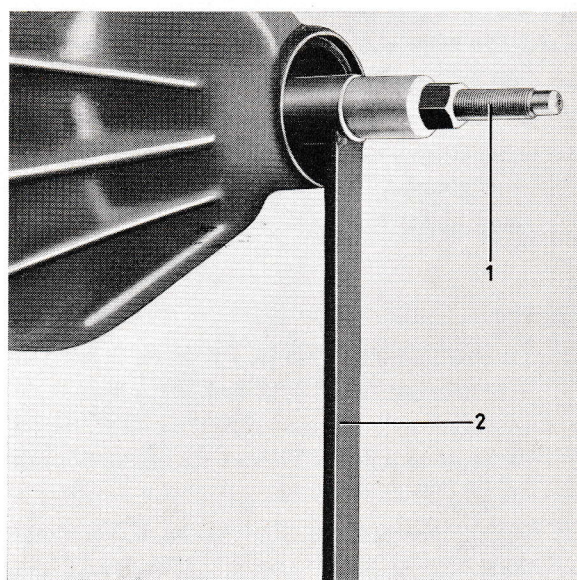
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Fig. 18. Fitting the rear pinion bearing.

1. Sleeve SVO 2395.

threads has a "Nyloc" type lock nut). Press in the pinion with the aid of the press tool.

4. Replace the press tool with a washer and nut. Tighten the nut to a torque of max. 150 lb.ft. The pinion should be relatively easy to turn



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Fig. 19. Fitting the pinion.

1. Press tool, see text.      2. Wrench SVO 2409.

(1.7—3.5 lb.in.). There must be no looseness. If the pinion rotates too stiffly, the forward bearing should be removed by pressing out the pinion and fitting more shims. If there is looseness or the pinion rotates too easily, shims should be removed.

5. Fit the differential with crown wheel bearing races, cap (37) and adjusting nuts (34). Do not tighten the cap bolts (44) more than that it is possible to turn the adjusting nuts.
6. The rear axle is now ready for the adjustment of tooth contact and backlash. Follow the directions given under the heading "Rear axle gear adjustment", page 17.
7. When adjustments have been carried out the wrench SVO 2409 is removed.
8. Fit the metal washer (19) and the seal ring (20) with gasket. For the sealing ring, use tool SVO 2410, see Fig. 7. Then press on the flange with the help of the press tool as shown in Fig. 8. Fit the washer (24) and the nut (22) which should be tightened to the torque shown in the specifications.
9. Carry out final adjustment of the differential bearings and secure the adjusting nuts. Adjustment is carried out in the following way: Tighten the cap bolts and then loosen them one quarter of a turn. Place a dial indicator against the back of the crown wheel. Tighten the adjusting nuts until looseness just disappears. Then tighten the adjusting nut on the tooth side of the crown wheel  $1\frac{1}{2}$ —2 segments. Check the backlash which should be 0.1—0.2 mm (0.004—0.008").
10. After the adjusting nuts and the cap bolts have been secured, the rear axle gear can then be fitted to the rear axle housing.

### Fitting

1. Lift the rear axle gear into position in the rear axle housing. Make sure that the gasket is not damaged and that the sealing surfaces are undamaged and clean. Tighten the bolts evenly all the way around.
2. Connect the propeller shaft to the pinion flange.
3. Pack ball bearing grease into the rear axle bearings and insert axle shafts (11). Drive in the outer bearings with the sleeve SVO 1807 as shown in Fig. 20.

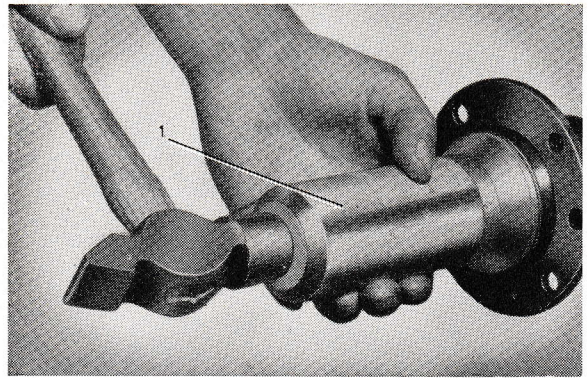


Fig. 20. Fitting the bearing ring.

1. Sleeve SVO 1807.

4. Fit the brake backing plates as shown in Fig. 21, the shims (47) which were removed earlier, and the felt washers (8) on both sides, and tighten the bolts (46) finally. Examine the rubber sleeve where the handbrake cable passes through the brake backing plate. Replace the sleeve if necessary. Strike the ends of the axle shafts with a mallet so that the bearing outer rings come into their correct position.
5. On late production models the shims on the right-hand side have been replaced by a 0.059" (1.5 mm) thick washer. Adjustment must, therefore, be carried out on the left-hand side. Fit a dial indicator on this side using attachments SVO 4054 and SVO 4148, which are fitted on

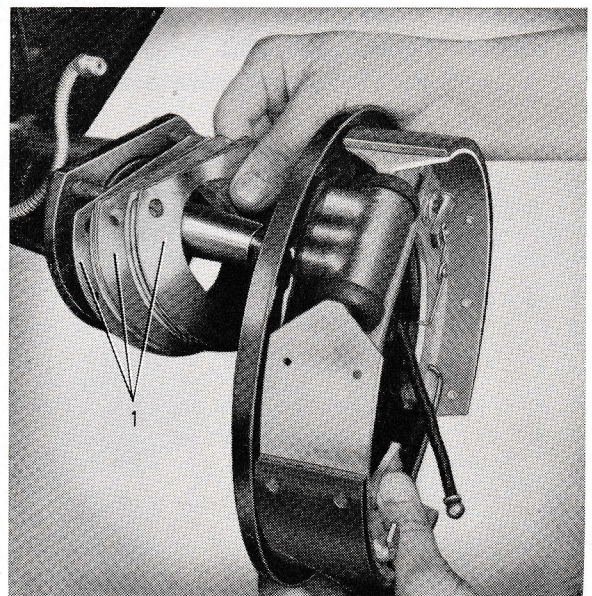


Fig. 21. Fitting the brake backing plate.

1. Shims.

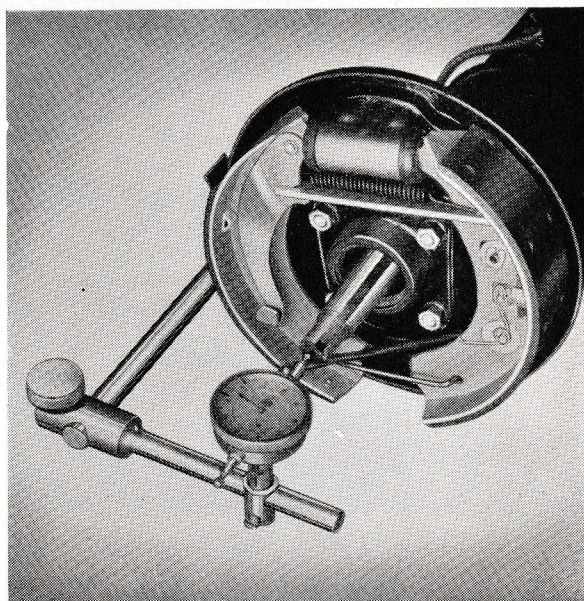


Fig. 22. Measuring axle shaft end play.

the brake backing plate. Place the point of the indicator on the axle shaft end and zero the indicator. See Fig. 22.

6. Pull the shaft out and in several times and read off the indicator. The reading should be between 0.0008" (0.02 mm) and 0.0047" (0.12 mm). If the reading obtained is higher or lower than these figures, shims are used (47). These are available in thickness of 1.0 mm, 0.35 mm and 0.1 mm.
7. When the axle shaft end play has been adjusted, the brake hydraulic line and the handbrake cable are fitted on both sides. The hub (6) with drum is fitted on each side and the wheels are fitted. The brakes should be air-vented and adjusted according to the directions given in Part 7.
8. Fill up with oil. *Use only hypoid oil.*

## Repair instructions for the model II rear axle

### Removing the rear axle

1. Loosen the rear wheel nuts (1, Illustration III) and nuts (3) on the axle shafts (11). Jack up the rear end of the car fairly high by means of a jack under the rear axle. Put chocks in front of the front wheels. Fit stands under the body in front of the rear wheels. Remove the rear wheels.
2. Disconnect the rear section of the propeller shaft from the flange (20) on the pinion (16) and disconnect the brake line from the master cylinder to the rear axle at a point level with the rear universal joint (place a wooden block under the brake pedal).
3. Loosen the track bar, the shock absorbers and the shock absorber bands from the rear axle as well as the handbrake cable at the adjusting point.
4. Slacken the support arm nuts. Lower the rear axle and remove the springs. Slacken the torque rod bolts and remove the rear axle.
5. Clean the rear axle thoroughly externally and drain off the oil.

### Diassembling of rear axle

Before disassembling, it is advisable measure up the axle shaft end play and crown wheel backlash as it is then easier to determine any faults and remedy them.

1. Place the rear axle in a stand or a couple of V-blocks at a suitable working height. Pull off the rear wheel hubs with puller SVO 1791 as shown in Fig. 1.
2. Disconnect the brake lines on the rear axle from the brake backing plates. Remove the brake backing plates from the rear axle housing. Be careful not to lose the shims.
3. Remove the axle shafts (11). Use puller SVO 2204 as shown in Fig. 2. Press the roller bearing (9) off the axle shafts if required. Use ring SVO 1806 as shown in Fig. 9.
4. Remove the seal rings (10) with the help of puller SVO 4078 as shown in Fig. 3.
5. Remove the inspection cover (42) from the rear axle housing.
6. Check the marking of the caps (32,41) and the housing. If there are no markings or they are difficult to see, mark one side with a punch. Remove the caps.
7. Fit the tool SVO 2394 in the holes in the rear axle housing as shown in Fig. 23. Fit an indicator so that the expansion of the drive pinion carrier can be read off. Tighten the tensioning screw so that the carrier is expanded not more than 0.3 mm (0.012"). Remove the indicator. Lift out the differential case with the ring gear.

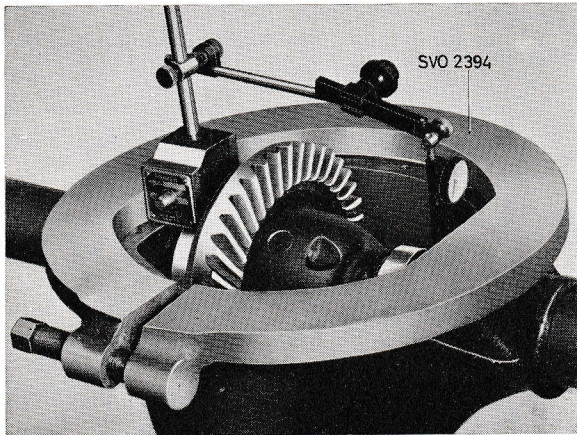


Fig. 23. Removing the differential.

8. Remove the nut (21) for the flange (20) by using wrench SVO 2409 as rapport. Pull off the flange with puller SVO 2262 as shown in Fig. 5. Press out the pinion (16).
9. Remove the seal ring (18) with the help of SVO 4030 as shown in Fig. 6. Then remove the washer (17), the forward pinion bearing (23) and the shims (24).
10. Drive out the bearing outer rings if required, see Fig. 24. Use the standard handle SVO 1801 and the drift SVO 4064 for the forward ring and SVO 2207 for the rear ring. Be careful not to lose the shims (25) under the rear ring.
11. Pull the rear bearing (26) from the pinion (16) if required, using puller SVO 2164, see Fig. 25.

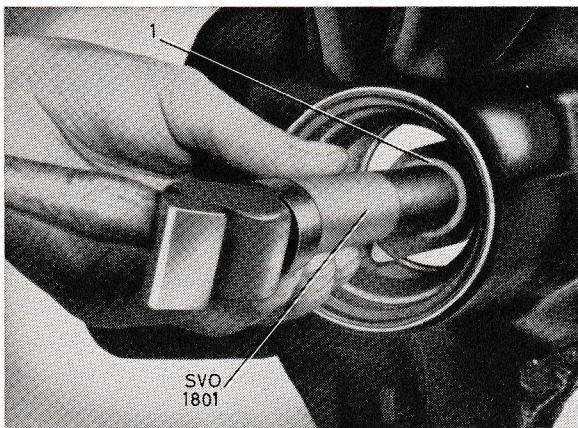


Fig. 24. Removing the bearing ring.

1. Drift, see text.

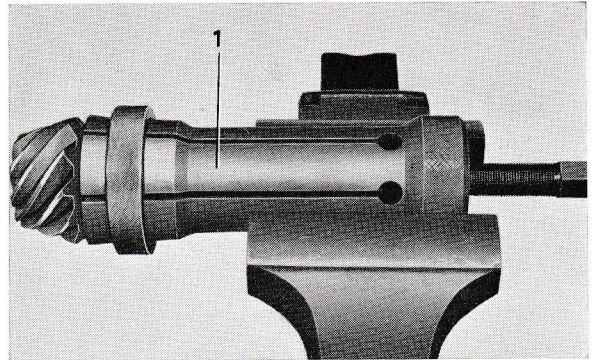


Fig. 25. Removing the rear pinion bearing.

1. Puller SVO 2164.

### Diassembling of differential

1. Loosen the bolts (38) and remove the crown wheel (15).
2. Drive out the lock pin (27), see Fig. 26 and then the differential gear shaft (28). Take out the spacer block (29). Remove the gears (33, 36) and the thrust washers (34, 37).
3. Pull off the differential carrier bearings (13, 31) with puller SVO 4042, see Fig. 27. Do not lose the shims (14, 30).

### Inspecting

All component parts must be thoroughly cleaned before inspection is carried out. Examine all bear-

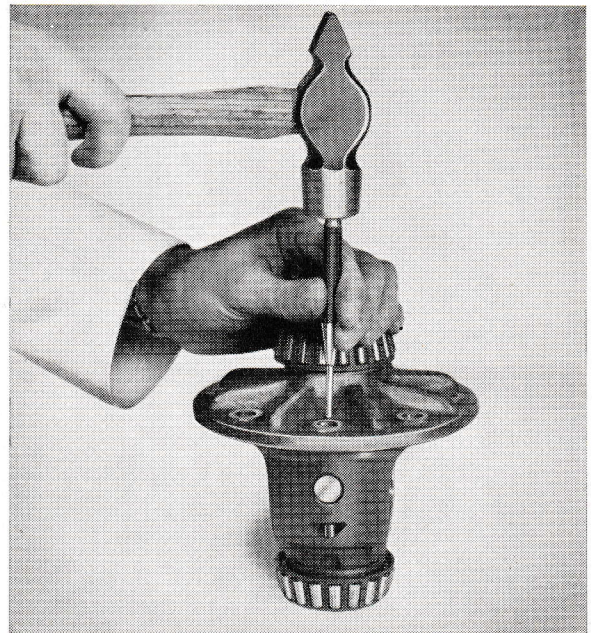


Fig. 26. Removing the lock pin.

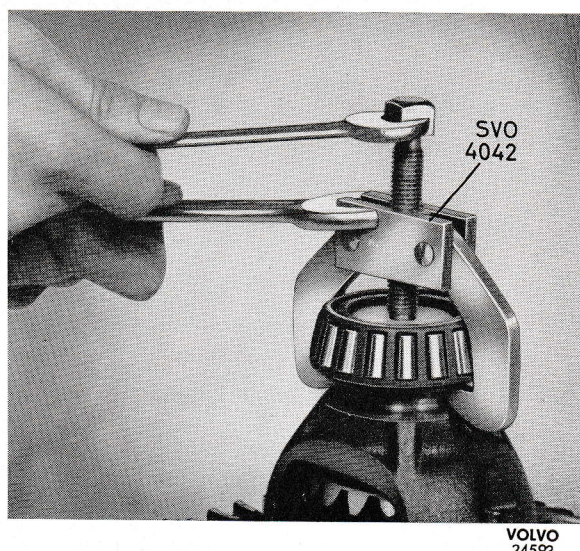


Fig. 27. Removing the differential carrier bearing.

ing races and bearings. There should be no sign of damage on the races, the rollers or the retainers. Replace bearings if there is any sign of damage. Examine the drive pinion and the crown wheel for damage on the teeth. Damage on the teeth surfaces can result in small pieces loosening while the car is being driven. These pieces can come between the gears and cause extensive damage. If there is any sign of damage, both the crown wheel and the drive pinion should be replaced. The crown wheel and drive pinion are available only in complete sets since they have been matched in a special machine to obtain the correct tooth contact and silent operation.

Examine the differential gears for cracks and damage on the teeth. The gears are cleaned and dried and fitted into the differential carrier together with the shaft and the thrust washers so that looseness and wear can be determined more easily. If there is looseness, the components concerned are replaced. The thrust washers should be free from any unevenness.

Examine the cylindrical part of the flange which goes in the seal ring, for wear and scratches. If there are any signs of these defects, the flange together with the seal ring should be replaced.

Inspect the axle shafts. Deformed or damaged shafts should be replaced.

Examine the seal rings and replace them if they are damaged or worn.

Make sure that the rear axle housing is free from cracks.



Fig. 28. Fitting the differential pinion gears.

Check that the brackets for the support arms and the track rod are free from damage.

## Assembling

### Assembling of differential

1. Insert the differential side gears (33) with the thrust washers (34) in the differential carrier (40). Then "roll" in the differential pinion gears (36) together with the recessed thrust washers (37) (both gears simultaneously), see Fig. 28.
2. Lay in the spacer block (29) and then drive in the shaft (28).
3. Check the differential. If there is looseness, new thrust washers must be fitted. The plain washers (34) can be replaced either by oversize

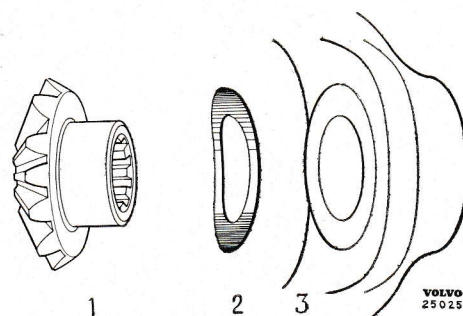


Fig. 29. Fitting spring thrust washers.

1. Differential pinion.
2. Thrust washer.
3. Differential carrier.



Fig. 30. Fitting the differential carrier bearing.

washers or spring thrust washers. Fit the spring thrust washers correctly. The "back" should be turned to face the differential carrier, see Fig. 29. After the washers have been checked and replaced if necessary, the lock pin (27) is fitted.

4. Fit the crown wheel (15). Make sure that the contact surfaces are clean and free from burr. Tighten the bolts (38) to the degree of torque shown in the specifications and secure with the tab washers (39).

#### Assembling the rear axle

1. Press in the differential carrier bearings (13, 31) without shims. Use drift SVO 4112, see Fig. 30.

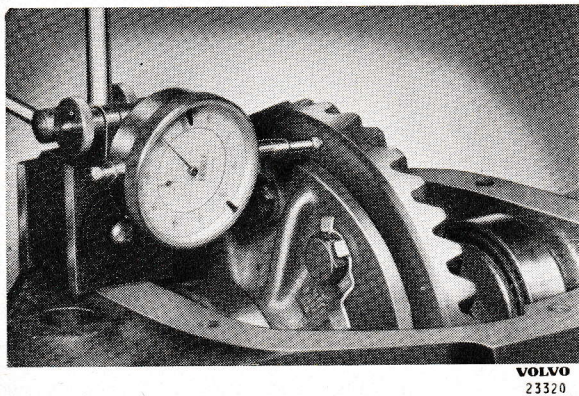


Fig. 31. Measuring the differential end play.

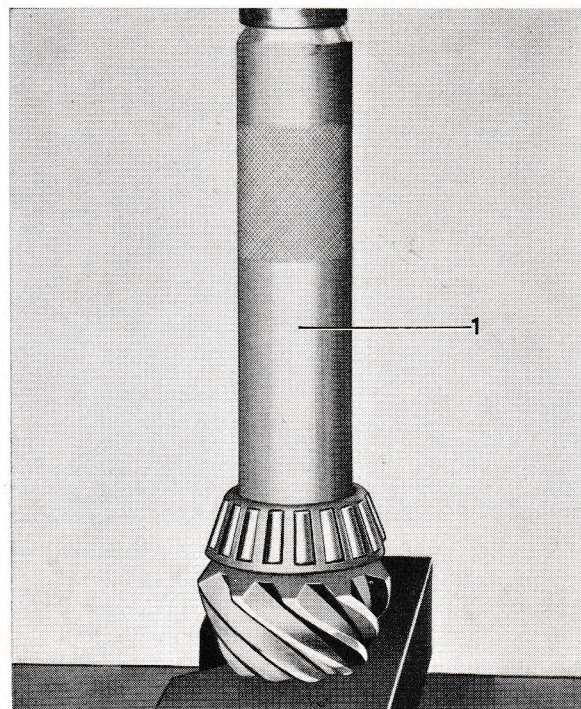


Fig. 32. Fitting the rear pinion bearing.

1. Sleeve SVO 2395

Place the differential carrier with the crown wheel and roller bearing in the housing. Measure the end play. This can be done in two ways, either by using a dial indicator or a feeler gauge. Whichever method is used, measuring must be carried out accurately in order to obtain the correct result. If a dial indicator is used, it is placed against the back side of the ring gear, see Fig. 31. The differential (notice also the outer rings for the bearings) is pushed

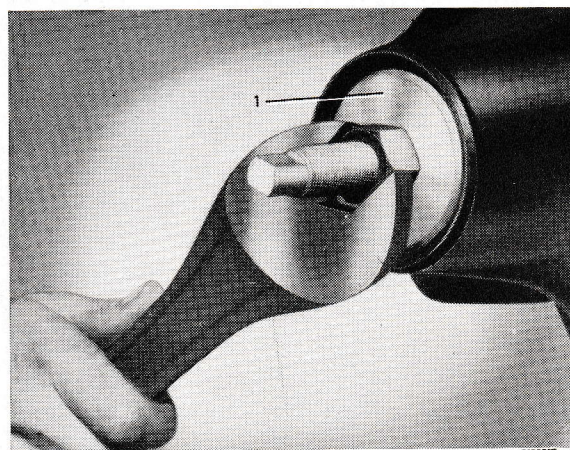
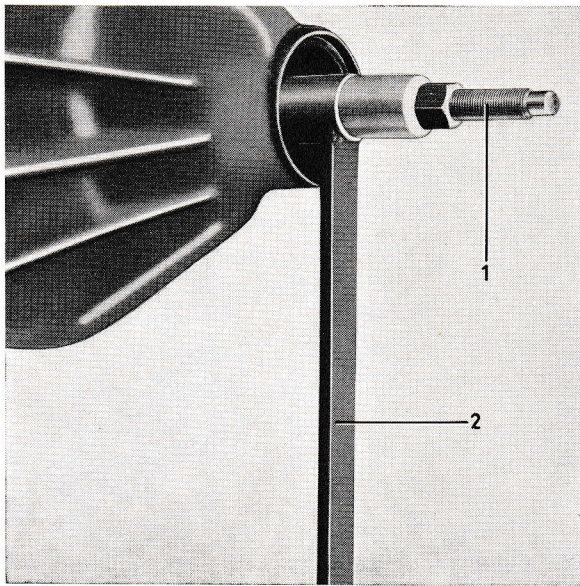


Fig. 33. Fitting the bearing rings.

1. Press tool SVO 2206.



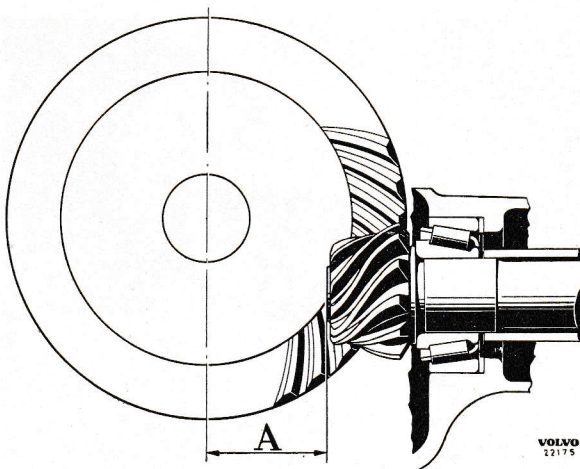
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Fig. 34. Fitting the pinion.

1. Press tool SVO 1845
2. Wrench SVO 2404

first in one direction after which the indicator is set to zero. The differential is then pushed in the other direction and the end play measured. If the feeler gauge method is to be used, two gauges are required. These are stuck down between the outer ring and the bearing position in the carrier. Add 0.2 mm (0.0080") to the reading obtained to give the total thickness of the shims to be used when assembling.

2. Press the rear bearing (26) onto the pinion (16). Use tool SVO 2395, see Fig. 32.
3. Replace the same number of shims (25) for the rear pinion bearing outer ring as were there



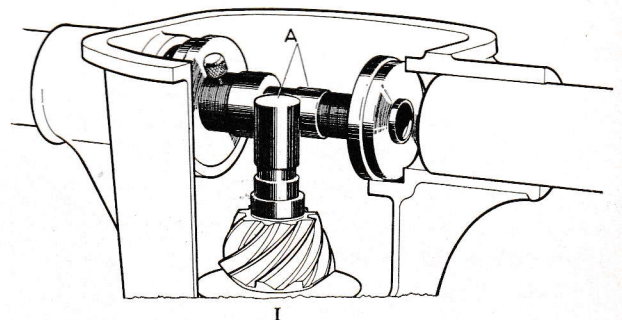
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Fig. 35. Pinion position.

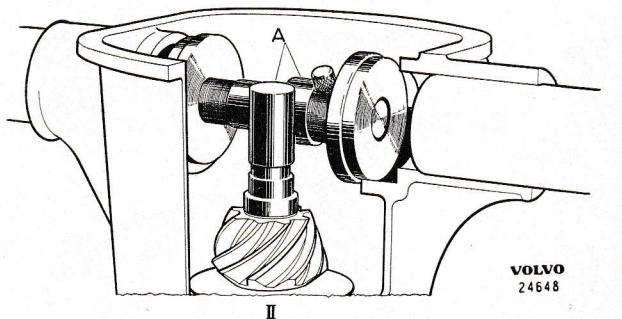
A. Nominal measurement = 2.25".

when disassembly was carried out, into the housing and then press in the outer rings using press tool SVO 2206 as shown in Fig. 33. Make sure that the rings do not chafe or are not at an angle in the housing.

4. Insert the pinion into the housing and fit on the same number of shims (24) there were when disassembly was carried out, the forward pinion bearing (23) and the washer (17). Fit the tool SVO 2404 and the press tool SVO 1845 on the forward end of the pinion and tighten in the pinion as shown in Fig. 34.
5. Replace the press tool SVO 1845 with a washer and nut. Tighten the nut to a torque of 200—220 lb.ft. Then check the bearing adjustment. The pinion should be relatively easy to turn. There must be no looseness. Adjustment may be carried out by means of the shims (24) on the forward pinion bearing.
6. The pinion should have a certain nominal measurement (A, Fig. 35) to the crown wheel centre line. Due to tolerances in manufacture, however, there are variations from the nominal measurement. This is shown on the ground surface on the pinion by means of a figure with



I



II

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Fig. 36. Placing the measuring tool.

- A. Measuring tool SVO 2393.
- I. Location, type Spicer mod. 23.
- II. Location, type Spicer mod. 27.

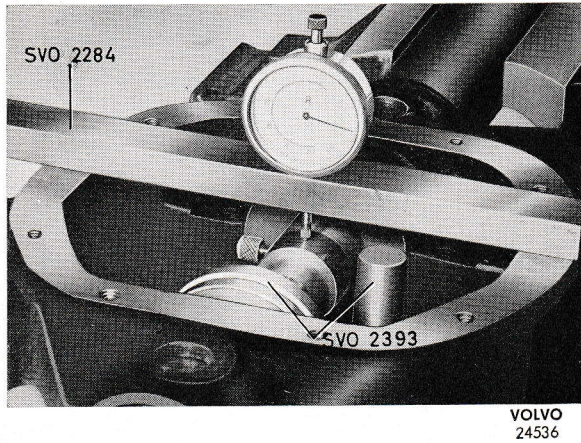


Fig. 37. Zero-setting the indicator.

a + or — sign. If there is a + sign then the nominal measurement must be increased but if there is a — sign then the nominal measurement is decreased. The figure on the pinion shows the deviation in thousandths of an inch.

The pinion position is checked by using a dial indicator, an indicator retainer SVO 2284 and the measuring tool SVO 2393 which consists of two parts: a pinion calibrator and a gauge.

The procedure is as follows:

Place the pinion calibrator on the ground surface and the gauge in the differential bearing positions as shown in I Fig. 36. Place the dial indicator retainer on the housing and zero the indicator against the gauge, Fig. 37. Then move over the indicator retainer so that the indicator is against the pinion calibrator, see Fig. 38. If the pinion is marked 0 then the gauge and the calibrator should be on the same level. If the

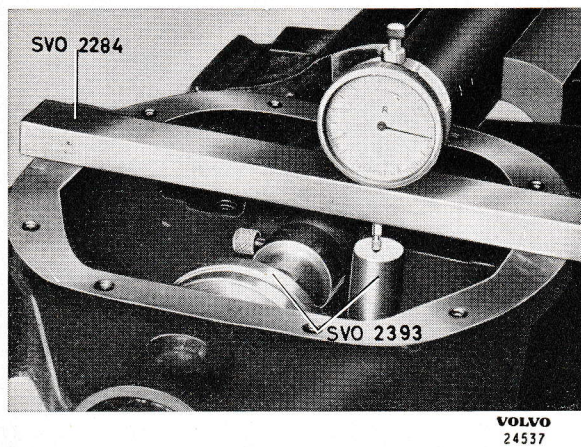


Fig. 38. Measuring the pinion position.

Conversion table, inches to millimetres	
inches	millimetres
0.001	0.025
0.002	0.051
0.003	0.076
0.004	0.102
0.005	0.127
0.006	0.152
0.007	0.178
0.008	0.203
0.009	0.229

pinion is marked — then the pinion gauge should be higher than the jig and if it is marked + then the pinion calibrator should be lower than the gauge if the setting is correct. Adjustment is carried out by adding or removing shims under the rear pinion bearing outer ring. If the pinion bearing has the correct adjustment an equal number of shims must be added or removed at the same time under the forward pinion bearing.

An example: The pinion is marked + 2.

The pinion calibrator should then be  $0.002'' = 0.05$  mm below the adjuster gauge. Measurement shows that, in point of fact, the pinion calibrator on the pinion is  $0.006'' = 0.15$  mm above the gauge. The pinion must be lowered  $0.006'' + 0.002'' = 0.008''$  ( $0.15 + 0.05 = 0.20$  mm) so shims corresponding to this thickness (measured with a micrometer) should be removed from under the rear pinion bearing outer ring.

7. After the pinion position has been checked and adjusted if necessary, the tension on the pinion bearings is once again checked.
8. Place the differential (without shims for the bearings) in the housing. Measure the differential axial clearance (the play between the pinion and differential outer position). This can be measured either with a dial indicator against the back side of the ring gear or with two feeler gauges. Note the clearance obtained.
9. In certain cases, the backlash is stamped on the crown wheel (for example B/L 0.004). This backlash figure should be subtracted from the clearance figure noted in point 8 above.

An example. The crown wheel is marked B/L 0.004 (0.10 mm). Shims required in accordance with point 1 are:

Clearance noted  $1.5 \text{ mm} + \text{tension } 0.2 \text{ mm} = 1.7 \text{ mm}$ .

Clearance noted in point 8 = 1 mm.

Shim thickness on ring gear side =  $1 \text{ mm} - 0.10 \text{ mm} = 0.9 \text{ mm}$ .

Shim thickness on opposite side =  $1.7 - 0.9 = 0.8 \text{ mm}$ .

If the backlash is not stamped on the crown wheel use instead the mean value (0.15 mm) of the backlash (0.10—0.20 mm).

An example. Clearance obtained  $1.4 \text{ mm} + \text{tension } 0.2 \text{ mm} = 1.6 \text{ mm}$ .

The clearance noted in point 8 = 0.95 mm.

The thickness of shims on the crown wheel side =  $0.95 - 0.15 = 0.8 \text{ mm}$ .

The thickness of shims on the opposite side =  $1.6 - 0.8 = 0.8 \text{ mm}$ .

10. Pull off the differential carrier bearings with puller SVO 4042. Fit shims of the thickness calculated under the bearings and then press them into position.
11. Fit tool SVO 2394 and an indicator dial on the rear axle housings. Tighten the tension nut so that the rear axle housing is tensioned out not more than 0.3 mm (0.012"). Remove the dial indicator. Lay in the differential and bearings. Then remove tool SVO 2394.
12. Fit the caps (32, 41) with their bolts and tighten the bolts. Fit a dial indicator against the back side of the ring gear as shown in Fig. 39. Rotate the crown wheel and check the run-out. This may not exceed 0.08 mm (0.003").
13. Check the backlash as shown in Fig. 40. This should agree with the value given in the spe-

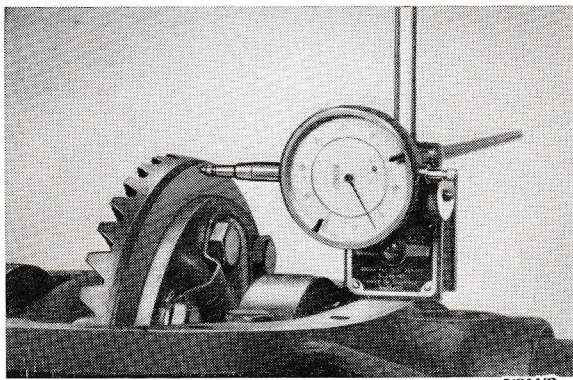


Fig. 39. Measuring the crown wheel run-out.

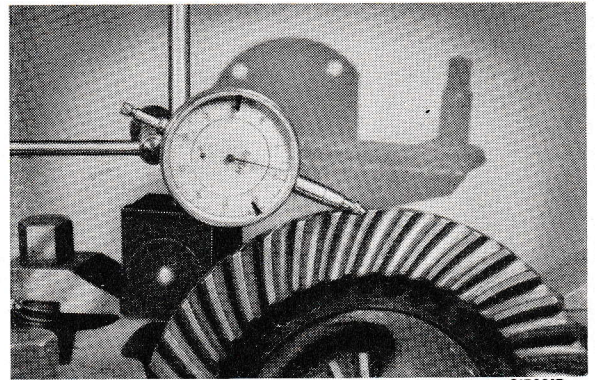


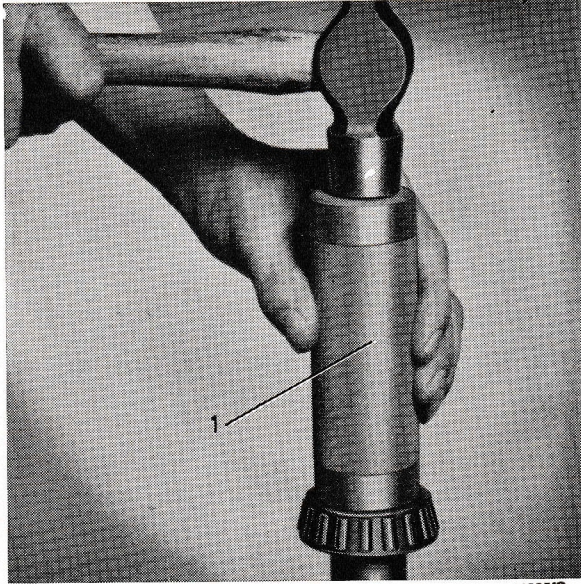
Fig. 40. Measuring the crown wheel backlash.

cifications or the value stamped on the ring gear. Backlash should be at least 0.04" (0.1 mm).

14. Check the setting by painting some of the crown wheel teeth and noting the tooth contact in accordance with the instructions given under "Rear axle gear adjustment" below.
15. After final adjustment, remove the wrench SVO 2404.
16. Fit the metal washer (17) and the seal ring (18) together with the paper gasket. Use tool SVO 2403 for the seal ring. Then press on the flange (20) with the help of SVO 1845. Fit the washer (22) and the nut (21). Tighten the nut to the torque shown in the specifications.
17. Loosen the cap bolts. Then smear the threads of the bolts and bolt holes with sealing compound — Permatex 3 — Form — A Gasket or corresponding compound of another make. In this way the through holes are sealed and the bolts are secured. Then tighten the bolts to the torque shown in the specifications.
18. Fit the inspection cover and gasket.

### Assembling of rear axle

1. Drive in the seal rings (10) for the axle shafts (11) with drift SVO 1803 as shown in Fig. 4.
2. Drive the bearings (9) onto the axle shafts if they have been removed. Use SVO 1805 as shown in Fig. 41.
3. Pack in the bearings with heat-resistant grease. Insert the axle shafts into the rear axle housing. Drive in the bearing outer rings with the sleeve SVO 2205 as shown in Fig. 42.



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Fig. 41. Fitting the axle shaft bearings.

1. Sleeve SVO 1805.

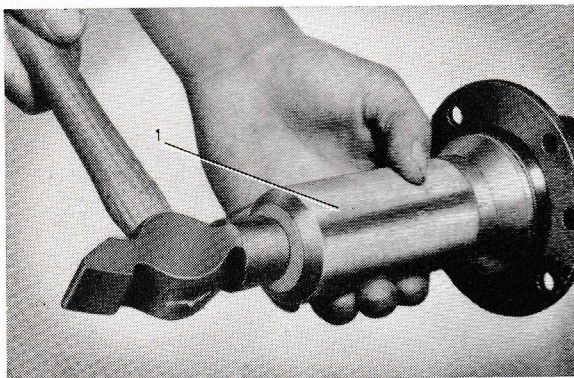
4. Fit the brake backing plates, shims (46), retain-er (8) and felt seal. See Fig. 43.

Check axle shaft end play and adjust if nec-essary. See Fig. 44. See the specifications for the permissible end play.

5. Connect the brake line on the brake backing plate and then fit the hubs and brake drums.

### Fitting

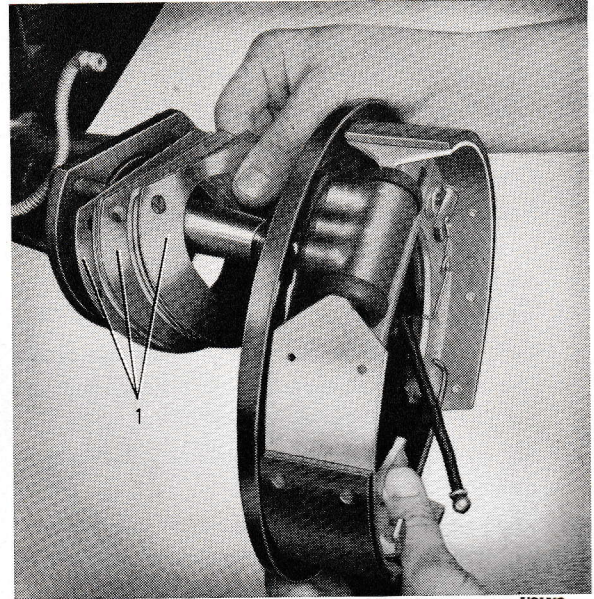
1. Lift up the rear axle and fit the torque rods. Insert the support arms into the holes in the body and fit on rubber pads, washers and nuts. The nuts should only be screwed on a couple of threads.
2. Fit the spring retainers and rubber pads in



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Fig. 42. Fitting the bearing ring.

1. Sleeve SVO 2205.



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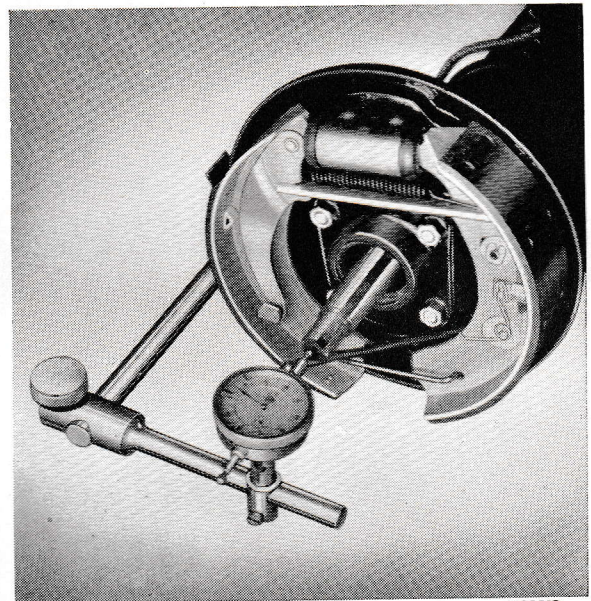
Fig. 43. Fitting the brake backing plate.

1. Shims.

place. Lift up the rear axle with the jack. Tight-ten the nuts for the support arms. Fit shock absorbers, shock absorber bands and track bar.

3. Fit the universal joint at the flange. Connect the brake fluid line. Connect the handbrake cables. Air-vent the brakes and adjust the hand-brake.
4. Fit on wheels and wheel nuts. Lower the car and tighten the wheel nuts.

**Use only hypoid oil.**



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Fig. 44. Measuring axle shaft end play.

## Rear axle gear adjustments

When the rear axle gears are assembled, it is extremely important to ensure that the ring gear and drive pinion are correctly fitted relative to one another. This concerns not only backlash but also tooth contact. When the tooth contact is correct, the stresses to which the teeth are subjected when the car is driven are distributed over the greater part of the teeth surfaces. In this way, tooth breakage and abnormally high gear wear are avoided and the gears run quietly. The instructions given below can serve as a guide when this work is being carried out.

First check the crown wheel run-out with a dial indicator. The run-out may not exceed the value given in the specifications.

In order to describe tooth contact in a simple way, the various parts of the gear teeth have been given special names. See Fig. 45 which shows one of the teeth on the crown wheel. *Note.* Adjustment is carried out on the basis of the contact obtained on the crown wheel teeth.

The driving side is the side subjected to pressure from the pinion when the car is driven forwards.

The reverse side is the side which is subjected to pressure when the car is reversed and when the engine is used to brake the car in forward travel.

The narrowest and the broadest ends of the tooth are called the toe and the heel respectively. The toe lies nearest the centre while the heel is furthest out on the crown wheel.

In order to obtain a clear picture of tooth contact, the crown wheel teeth on both sides are coated with

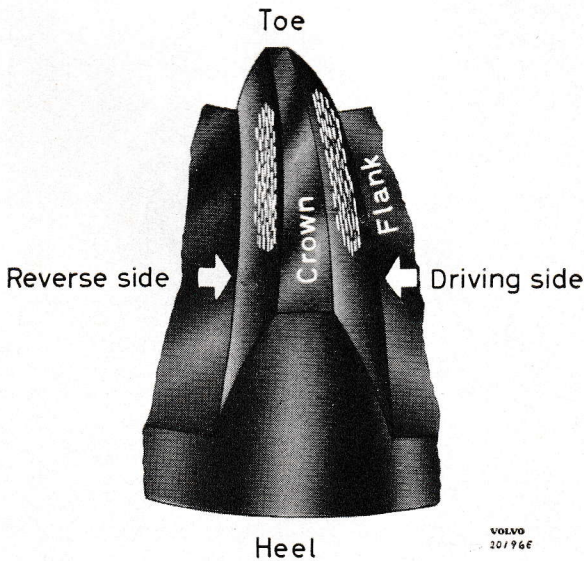
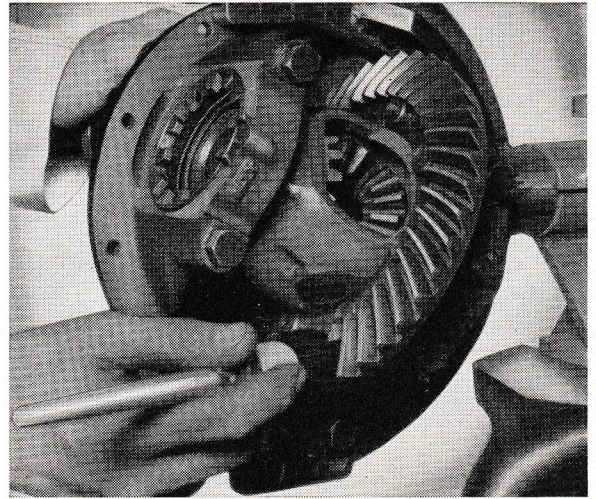


Fig. 45. Correct tooth contact.

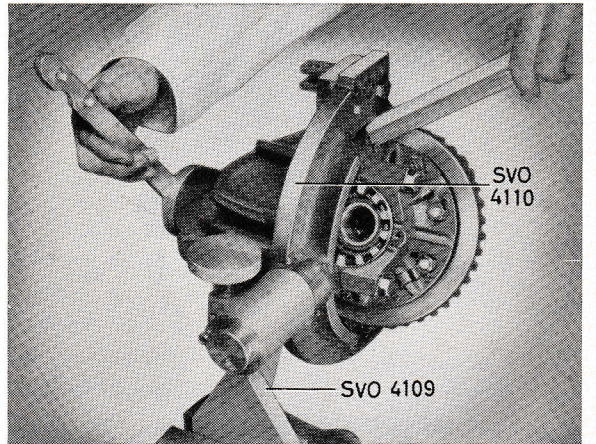


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Fig. 46. Coating the teeth with marking paint.

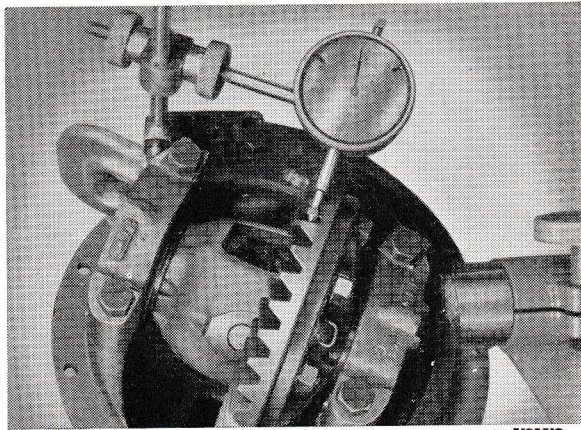
marking paint consisting of red lead mixed with engine oil. This marking paint must not be too thin since this can cause faulty impressions of tooth contact. All the teeth are coated with marking paint as shown in Fig. 46. The pinion is then rotated 10—12 turns in each direction at the same time as the crown wheel is braked hard by using a wooden wedge or similar device as shown in Fig. 47. The marking paint on the crown wheel teeth is thus removed where the pinion teeth contact them so that a clear picture of the tooth contact extent and position is obtained. The correct tooth contact is shown in Fig. 45.

*Note.* The pattern is almost rectangular in shape and is, on the driving side, half-way up the tooth but nearer the toe than the heel. On the reverse side it is rather higher than on the driving side but otherwise similar.



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Fig. 47. Rotating the rear axle gears.



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Fig. 48. Measuring backlash.

Tooth contact adjustment is carried out by altering the position of the pinion relative to the crown wheel. This is done by adding or removing shims at the rear pinion bearing outer ring. At the same time, however, an equal number of shims must be added or removed at the forward bearing so that the pinion bearing adjustment is not altered.

Every time the pinion position is altered, the backlash must be checked and adjusted. See Fig. 48. On a hypoid gear, the tooth contact pattern moves diagonally over the teeth and in different directions on the driving and reverse sides.

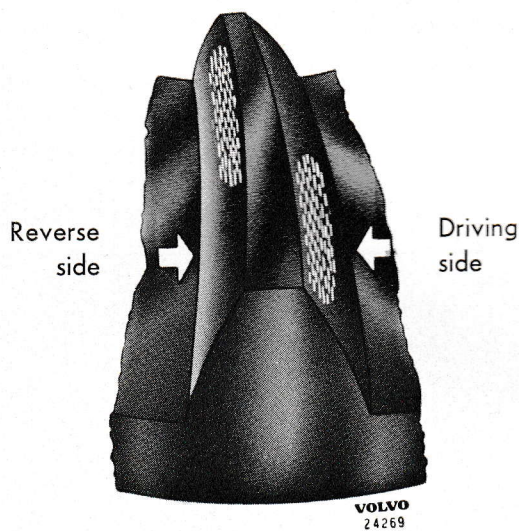
If the pinion is moved inwards, the contact pattern moves from a high position at the heel on the driving side, Fig. 49, to a low position at the toe, Fig. 50. On the reverse side the pattern moves at the same time from a high position at the toe, Fig. 49, to a low position at the heel, Fig. 50.

The tooth contact pattern on the driving side moves thus in the same direction as the pinion. If the pattern lies too near the heel, the pinion is moved inwards and if it lies too near the toe, then the pinion is moved outwards.

When the pattern has come into the correct position on the driving side, the pattern on the reverse side is noted. If the gear is correctly adjusted then the two patterns lie opposite each other.

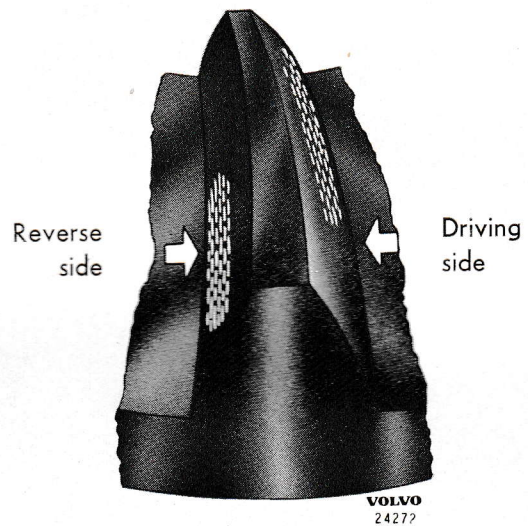
The adjustment procedure is carried out as follows:

1. Adjust the backlash to the value stated in the specifications.
2. Cover the teeth with marking paint and rotate the pinion while the crown wheel is being braked.
3. Note the position of the tooth contact pattern and adjust as described above. Every time the position of the pinion is altered, checking should be carried out and the backlash adjusted.



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Fig. 49. Faulty tooth contact.



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Fig. 50. Faulty tooth contact.

## FAULT TRACING

The faults in a rear axle become apparent as noise, overheating leakage or drive shaft breakage. The noise is usually in the form of a growling or whining sound.

FAULT	
CAUSE	REMEDY

### Noise possibly accompanied by excessively high temperature

Wrong type of oil in rear axle.	Drain off all the oil. Examine the rear axle gears. Flush out the rear axle housing. Fill with hypoid oil.
Oil level too low.	Top-up with oil.
Excessive bearing tension on gears or drive shafts.	Remove the gears (drive shafts) and adjust the bearings.
Faulty backlash.	Remove the gears, adjust the backlash and tooth contact in accordance with instructions.
Faulty tooth contact.	Remove the rear axle gears and replace worn bearings.
Worn bearings.	Replace.
Distorted rear axle housing.	Replace.
Distorted rear axle.	Replace.

### Thumping sound in rear axle gears when accelerating or decelerating

Examine first to ensure that this is not caused by worn universal joints.

Worn washers on differential gears.	Fit new dished washers and oversize plain washers.
Worn differential gears or differential shaft.	Replace worn parts.
One of the drive gears is loose on its hub.	Tighten loose nuts.
Worn splines on shafts or in gears.	Replace worn parts.

### Leakage

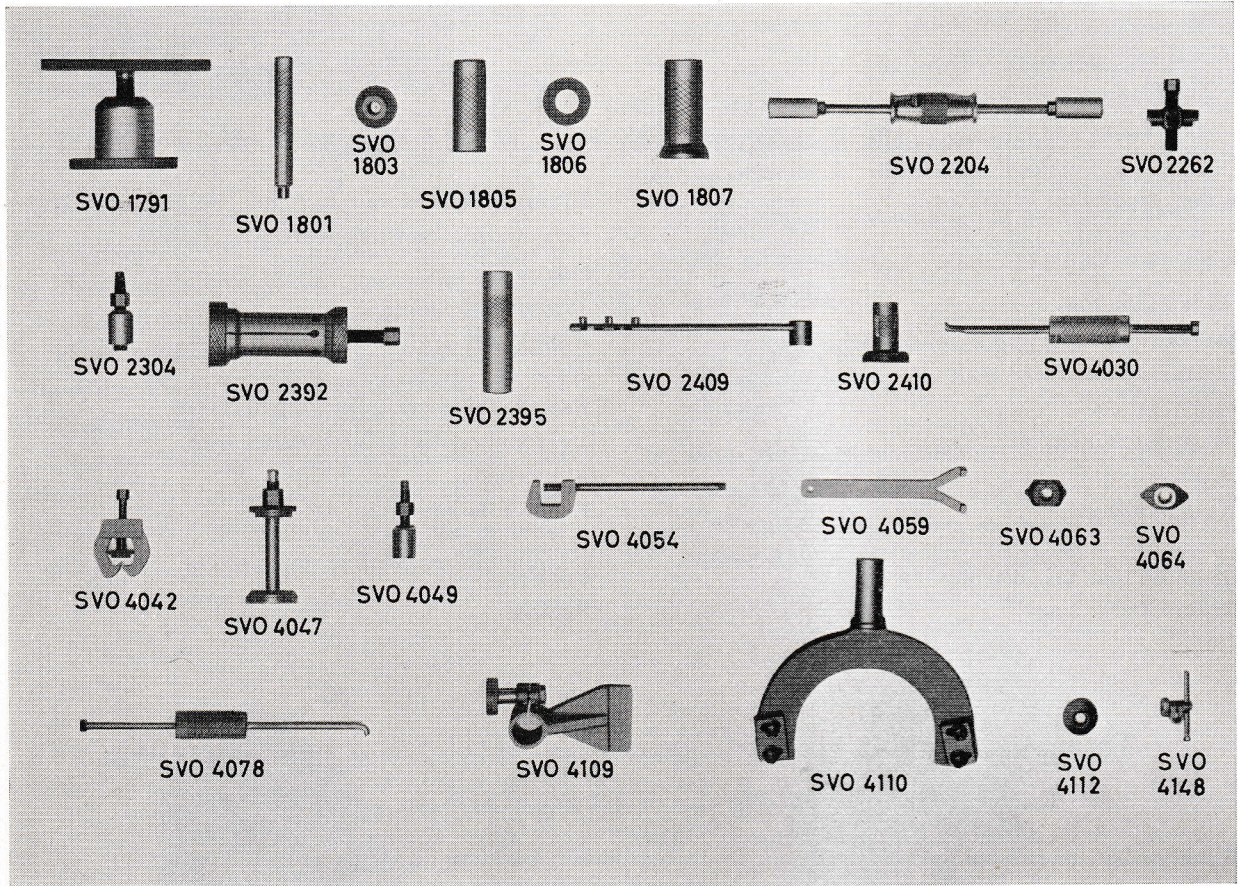
If leakage occurs, check first that the ventilation hole in the rear axle housing is not blocked.

Leakage at drive shafts (oil on brake linings).	Replace the sealing ring inside the bearing and the felt washer.
Leakage at the pinion.	Replace the sealing ring and the paper gasket. If necessary, adjust or replace the pinion bearing.
Leakage between the rear axle housing and rear axle carrier.	Check that the sealing surfaces are clean and even, replace the gasket.

# TOOLS

The following tools are required for carrying out repairs on the rear axle.

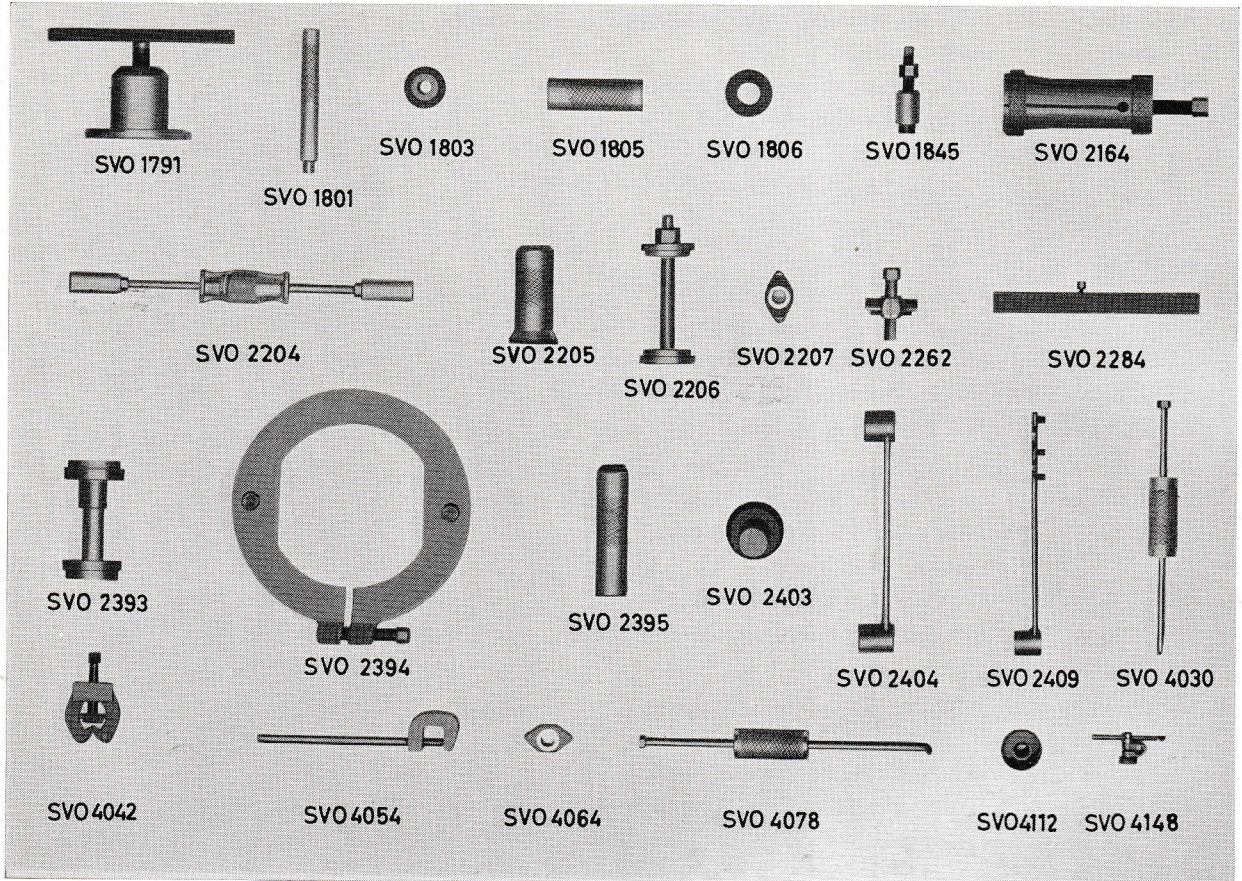
## Tools for rear axle, type I



**VOLVO**  
24790

Number	Description	Remarks
SVO 1791	Puller for wheel hub	
SVO 1801	Standard handle 18×200 mm	
SVO 1803	Tool for fitting drive shaft sealing rings	
SVO 1805	Drift for fitting drive shaft bearings	
SVO 1806	Counter-ring for removing and fitting drive shaft bearings	
SVO 1807	Fitting sleeve for drive shaft bearing outer ring	
SVO 2204	Puller for drive shaft	
SVO 2262	Puller for flange	
SVO 2304	Press tool for flange	For pinions with $\frac{5}{8}$ "—18 thread
SVO 2392	Puller for rear pinion bearing	
SVO 2395	Fitting sleeve for rear pinion bearing	
SVO 2409	Wrench for flange and for fitting pinion	
SVO 2410	Tool for fitting pinion sealing ring	
SVO 4030	Puller for pinion sealing ring	
SVO 4042	Puller for differential carrier bearings	
SVO 4047	Fitting tool for pinion bearing outer rings	
SVO 4049	Press tool for fitting flange	For pinions with 18×1.5 mm thread
SVO 4054	Attachment for dial indicator gauge	Used together with SVO 4148 and indicator gauge
SVO 4059	Wrench for adjusting nut	
SVO 4063	Drift for removing front pinion bearing outer ring	
SVO 4064	Drift for removing rear pinion bearing outer ring	
SVO 4078	Puller for drive shaft sealing ring	
SVO 4109	Attachment for fixture SVO 4110	
SVO 4110	Fixture for rear axle gears	Used together with SVO 4109
SVO 4112	Drift for fitting differential carrier bearings	
SVO 4148	Retainer for dial indicator gauge	Used together with SVO 4054

Tools for rear axle, type II



VOLVO  
24791

Number	Description	Remarks
SVO 1791	Puller for wheel hub	
SVO 1801	Standard handle 18×200 mm	
SVO 1803	Drift for fitting drive shaft sealing ring	
SVO 1805	Fitting sleeve for drive shaft bearing	
SVO 1806	Counter-ring for removing and fitting drive shaft bearing	
SVO 1845	Press tool for fitting flange	Used together with SVO 2404
SVO 2164	Puller for rear pinion bearing	
SVO 2204	Puller for drive shaft	
SVO 2205	Fitting sleeve for drive shaft bearing outer ring	
SVO 2206	Fitting tool for pinion bearing outer rings	
SVO 2207	Drift for removing rear pinion bearing outer ring	
SVO 2262	Puller for flange	SVO 4068 can be used
SVO 2284	Retainer for dial indicator gauge	
SVO 2393	Measuring tool for adjusting pinion	
SVO 2394	Expanding frame for removing and fitting differential	
SVO 2395	Fitting sleeve for rear pinion bearing	
SVO 2403	Fitting tool for pinion sealing ring	
SVO 2404	Tool for fitting pinion	
SVO 2409	Wrench for flange	
SVO 4030	Puller for pinion sealing ring	
SVO 4042	Puller for differential carrier bearings	
SVO 4054	Dial indicator gauge attachment	Used together with SVO 4148 and indicator gauge
SVO 4064	Drift for removing front pinion bearing outer ring	
SVO 4078	Puller for drive shaft sealing ring	
SVO 4112	Fitting sleeve for differential carrier bearings	
SVO 4148	Retainer for dial indicator gauge	Used together with SVO 4054

## SPECIFICATIONS

ENV: Number of teeth and serial number stamped on the front part of casing.

Spicer: Number of teeth and reduction ratio stamped on nameplate on lower part of inspection cover.

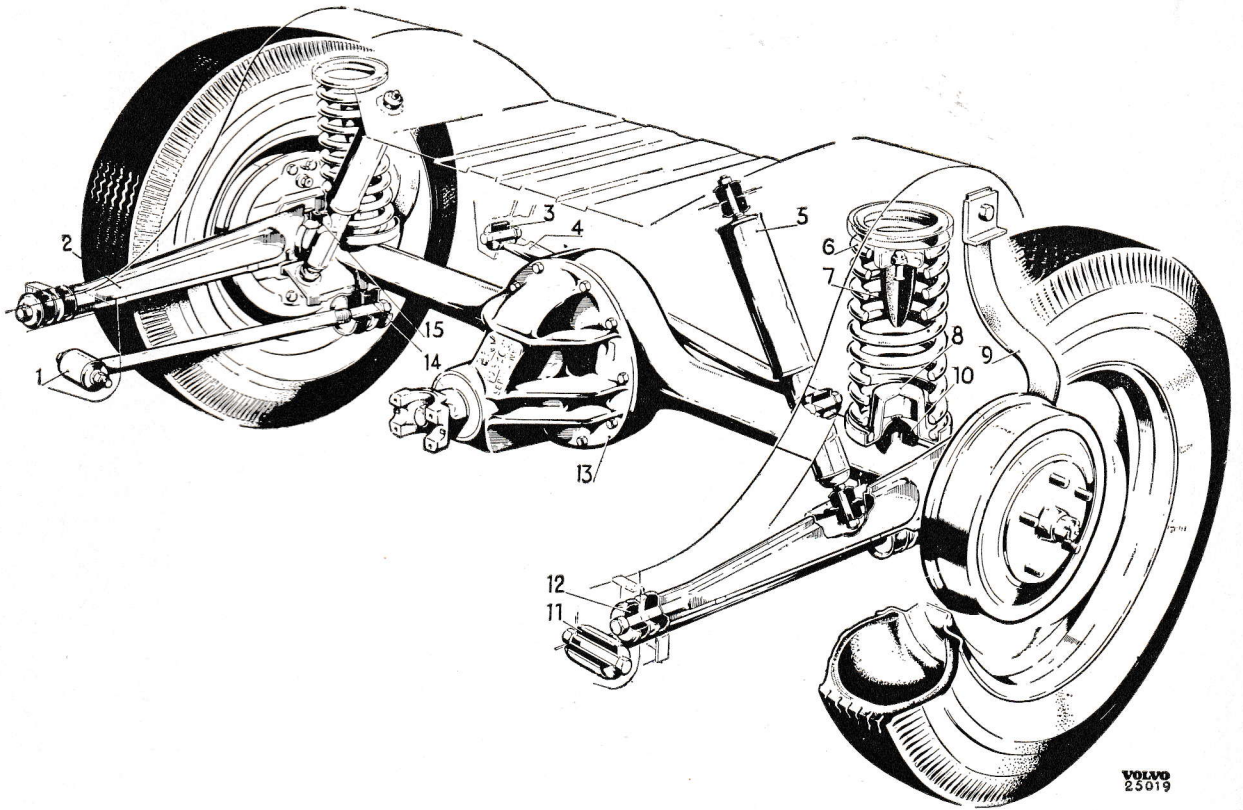
Type .....	Semi-floating
Track width .....	1315 mm (51 3/4")
End play for drive shafts, ENV .....	0.02—0.12 mm (0.0008—0.0047")
Spicer .....	0.07—0.20 mm (0.003—0.008")

### Rear axle

Type .....	Hypoid
Reduction ratio .....	4.56:1 ( <sup>9</sup> / <sub>41</sub> )
Axial throw, crown wheel .....	max. 0.08 mm (0.0031")
Tooth flank clearance (pinion—crown wheel) .....	0.10—0.20 mm (0.004—0.008")
Tension for pinion bearing, ENV .....	2—4 kgcm (1.7—3.5 lb.in.)
Spicer .....	9—14 kgcm (8—12 lb.in.)
Lubricant .....	Hypoid oil
viscosity .....	SAE 80
Oil capacity .....	1.3 litres (2 1/4 Imp. pints = 2 3/4 US pints)

### Tightening torques

ENV	Kgm	Lb. ft.
Flange .....	max. 20	max. 150
Cap .....	" 5.5—6	" 40—45
Crown wheel .....	" 5.0—5.5	" 36—40
 Spicer		
Flange .....	" 28—30	" 200—220
Cap .....	" 8.5—10	" 60—70
Crown wheel (3/8"—24 thread) .....	" 5.5—7	" 40—50
(7/16"—20 thread) .....	" 7—8.5	" 50—60

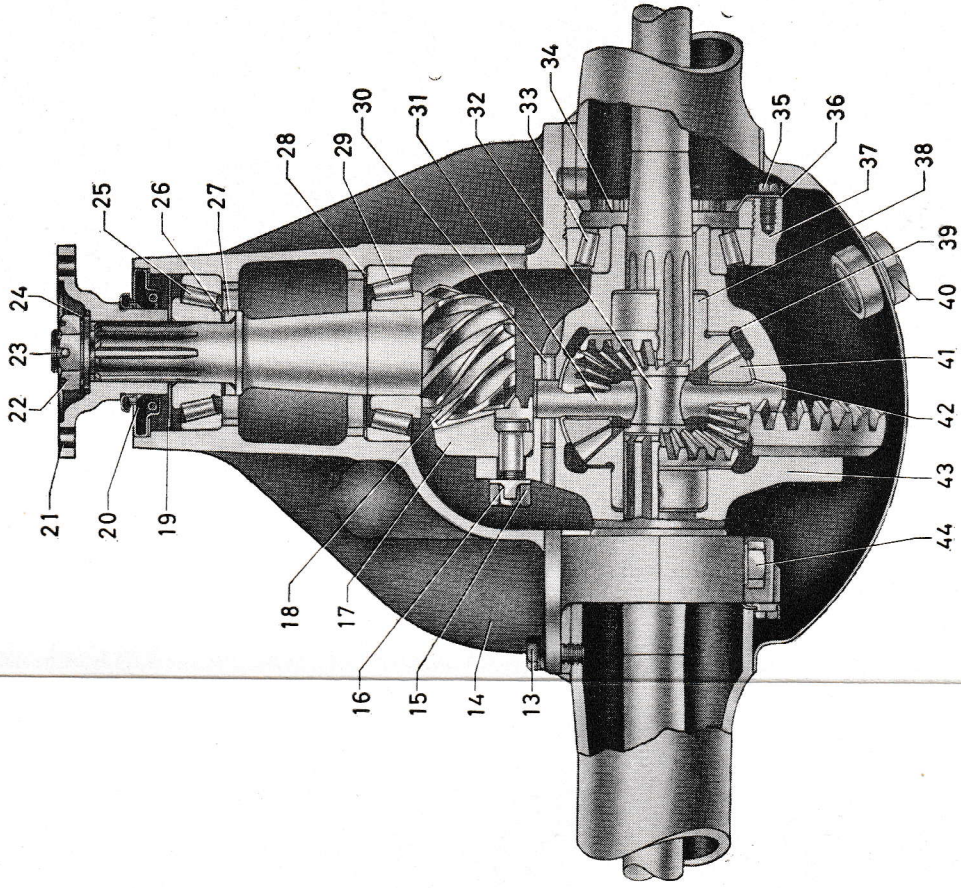


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*Illustration 1. Rear axle suspension.*

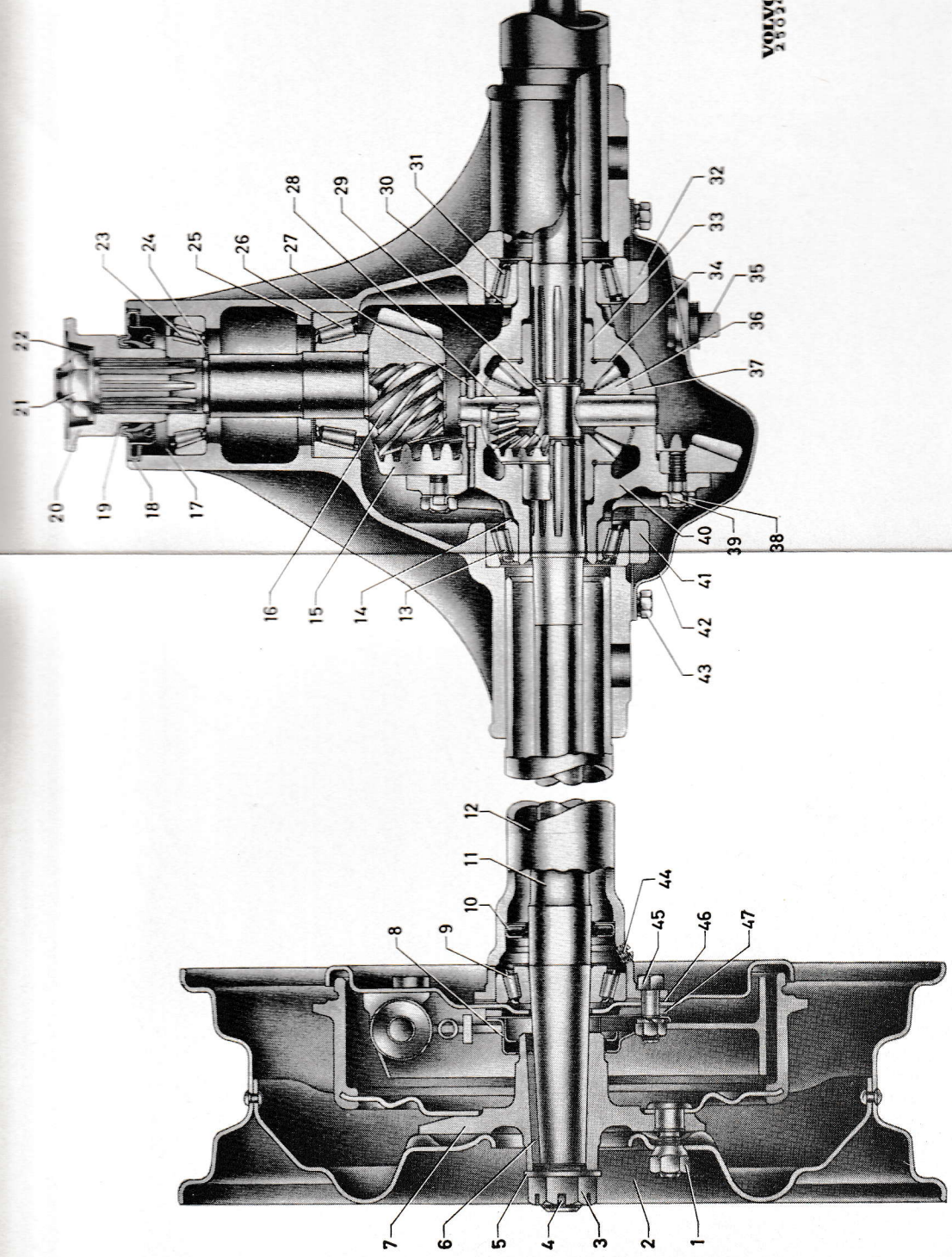
- |                                 |                                    |
|---------------------------------|------------------------------------|
| 1. Torque rod                   | 9. Shock absorber band             |
| 2. Support arm                  | 10. Rubber pad                     |
| 3. Rubber bushing for track bar | 11. Rubber bushing for torque rod  |
| 4. Track bar                    | 12. Rubber bushing for support arm |
| 5. Shock absorber               | 13. Rear axle                      |
| 6. Spring                       | 14. Rubber bushing for torque rod  |
| 7. Rubber buffer                | 15. Rubber bushing for support arm |
| 8. Spring retainer              |                                    |

1. Rim
2. Castle nut
3. Split pin
4. Washer
5. Key
6. Wheel hub
7. Wheel nut
8. Retainer with felt seal
9. Roller bearing
10. Sealing ring
11. Axle shaft
12. Rear axle housing
13. Bolt with spring washer
14. Rear axle carrier
15. Locking washer
16. Crown wheel
17. Drive pinion
18. Washer
19. Sealing ring
20. Flange
21. Castle nut
22. Split pin
23. Washer
24. Forward pinion bearing
25. Shims
26. Shims
27. Spacing ring
28. Rear pinion bearing
29. Locking pin
30. Shaft
31. Thrust block
32. Differential carrier bearing
33. Adjusting nut
34. Bolt
35. Locking washer
36. Cap for bearing
37. Differential side gear
38. Thrust washer, plain
39. Plug, oil filling
40. Differential pinion
41. Thrust washer, convex
42. Differential carrier
43. Bolt for bearing cap
44. Plug (early prod.)
45. Bolt with nut and spring washer
46. Shim
47. Washer
- 48.



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Illustration II. Model I rear axle (ENV).



- 1. Wheel nut
- 2. Rim
- 3. Castle nut
- 4. Split pin
- 5. Washer
- 6. Key
- 7. Wheel hub
- 8. Retainer with felt seal
- 9. Roller bearing
- 10. Sealing ring
- 11. Axle shaft
- 12. Rear axle housing
- 13. Differential carrier bearing
- 14. Shims
- 15. Crown wheel
- 16. Drive pinion
- 17. Washer
- 18. Sealing ring
- 19. Dust seal
- 20. Flange
- 21. Nut
- 22. Washer
- 23. Forward pinion bearing
- 24. Shims
- 25. Shims
- 26. Rear pinion bearing
- 27. Locking pin
- 28. Shaft
- 29. Thrust block
- 30. Shims
- 31. Differential carrier bearing
- 32. Cap
- 33. Differential side gear
- 34. Thrust washer, plain
- 35. Plug, oil filling
- 36. Differential pinion
- 37. Thrust washer, convex
- 38. Bolt
- 39. Locking washer
- 40. Differential carrier
- 41. Cap
- 42. Cover
- 43. Bolt with spring washer
- 44. Plug (early prod.)
- 45. Bolt with nut and spring washer
- 46. Shims
- 47. Washer

Illustration III. Model II rear axle (Spicer).