

SERVICE MANUAL

VOLVO
P 1800

Export Service Department

AKTIEBOLAGET

VOLVO

GÖTEBORG · SWEDEN

BRAKES

DESCRIPTION

The P1800 is equipped with two brake systems independent of each other. One of these, the footbrake, is controlled by a brake pedal and operates on all four wheels through a hydraulic system. The other brake system, the handbrake, is operated by means of a brake lever and influences both the rear wheels mechanically.

FOOTBRAKE

The design of the footbrake is shown in Figs. 7-1—7-5.

The front wheel brake units are of the disk brake type. The disks (14, Fig. 7-1) are of steel and are attached to the hubs with which they rotate. A retainer (13) is fitted at each steering knuckle for the wheel unit cylinders and brake blocks, known as calipers. In addition, protective covers for the brake disks are also fitted on the steering knuckles. The brake blocks

(9, Fig. 7-3) are provided with cast-in facings. When braking, one of the facings is pressed against the inner side of the brake disk by a large hydraulic plunger (10) and the other against the outer side by two smaller plungers (2). When braking ceases, the facings are moved back just enough so that they are always at a certain minimum distance from the brake disk. This means that the front wheel brake units are self-adjusting.

The rear wheel brakes are of the drum type. The upper end of the brake shoes rests against a double-acting wheel unit cylinder (9, Fig. 7-1) and the lower end against an adjusting device (10).

When the brake pedal (7, Fig. 7-1) is depressed this influences the plunger in the master cylinder (5) by means of a thrust rod (6). The hydraulic pressure in the master cylinder then rises and is transmitted through the brake fluid to the servo-brake cylinder

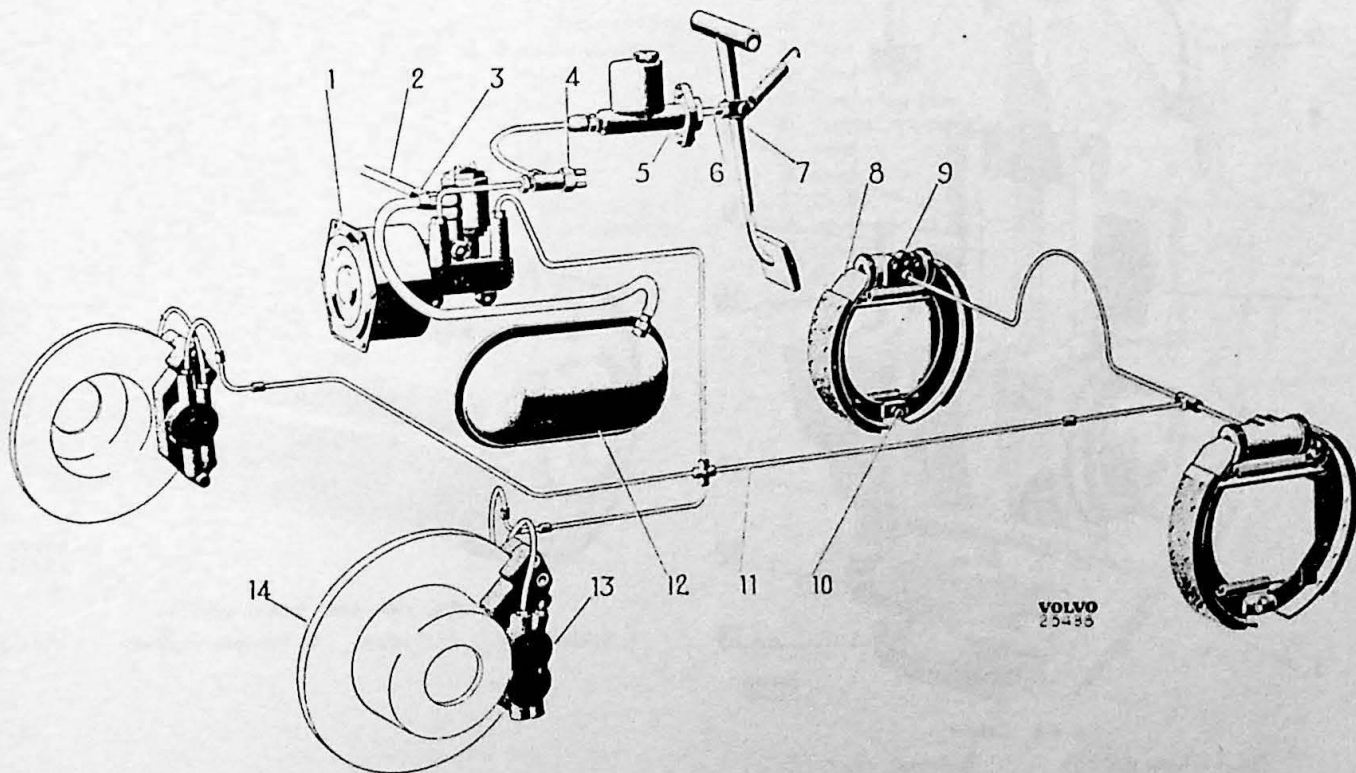


Fig. 7-1. Footbrake system

- | | | |
|----------------------------|------------------------|-----------------|
| 1. Servo-brake cylinder | 6. Thrust rod | 11. Brake line |
| 2. Vacuum line from engine | 7. Brake pedal | 12. Vacuum tank |
| 3. Non-return valve | 8. Brake shoe | 13. Caliper |
| 4. Brake contact | 9. Wheel unit cylinder | 14. Brake disk |
| 5. Master cylinder | 10. Adjusting screw | |

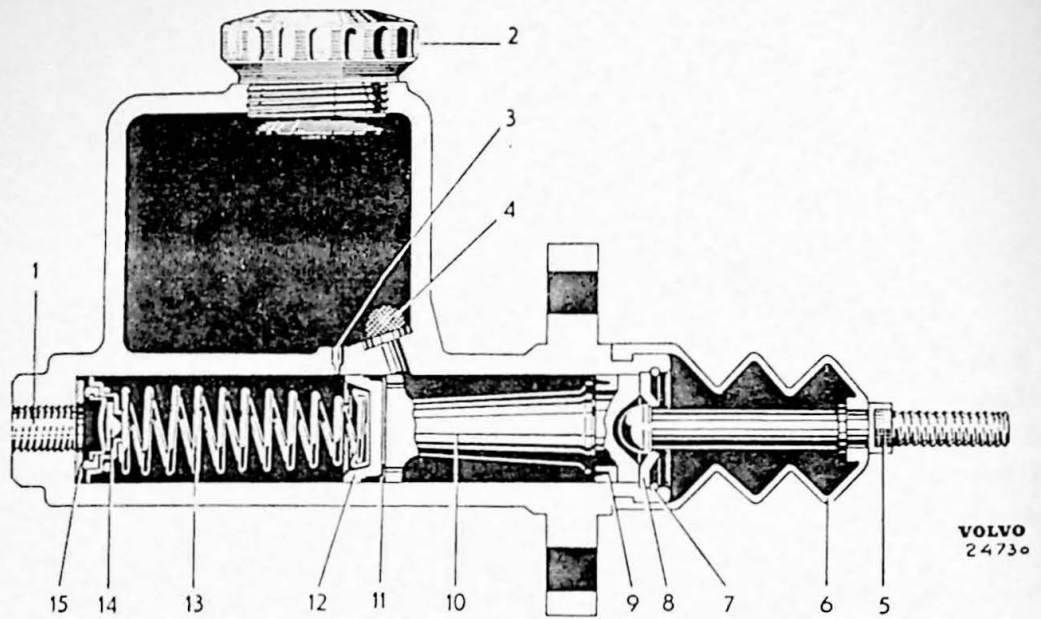


Fig. 7-2. Master cylinder

- | | | |
|------------------------------|-----------------|-------------|
| 1. Connection for brake line | 6. Rubber cover | 11. Washer |
| 2. Plug | 7. Lock ring | 12. Packing |
| 3. Equalising hole | 8. Stop washer | 13. Spring |
| 4. Strainer | 9. Packing | 14. Valve |
| 5. Thrust rod | 10. Plunger | 15. Washer |

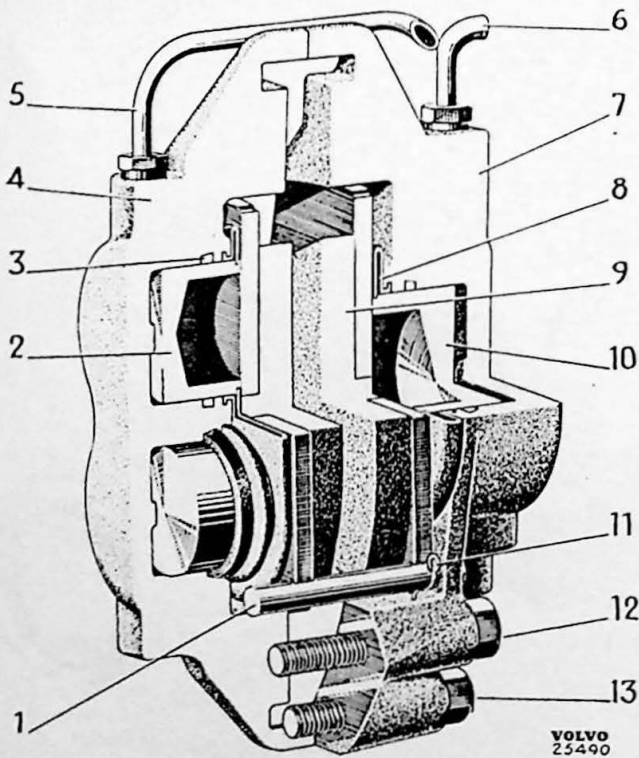


Fig. 7-3. Caliper

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|--------------------|-------------------|
| 1. Guide pin | 8. Rubber cover |
| 2. Outer plunger | 9. Brake block |
| 3. Plunger packing | 10. Inner plunger |
| 4. Outer housing | 11. Locking clip |
| 5. Connecting line | 12. Bolt |
| 6. Brake line | 13. Bolt |
| 7. Inner housing | |

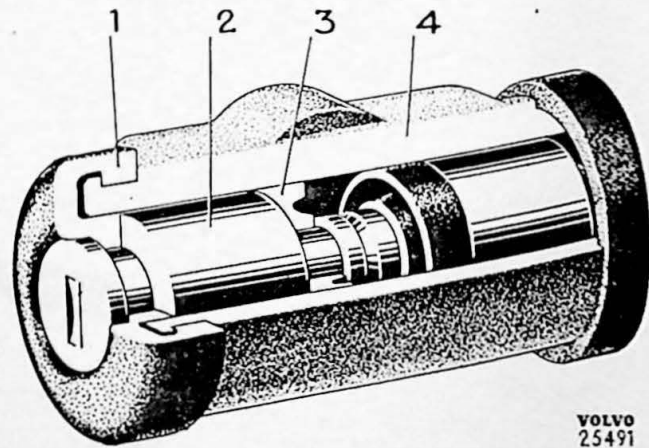


Fig. 7-4. Rear wheel cylinder

- | | | | |
|----------------|------------|--------------------|------------|
| 1. Rubber seal | 2. Plunger | 3. Plunger packing | 4. Housing |
|----------------|------------|--------------------|------------|

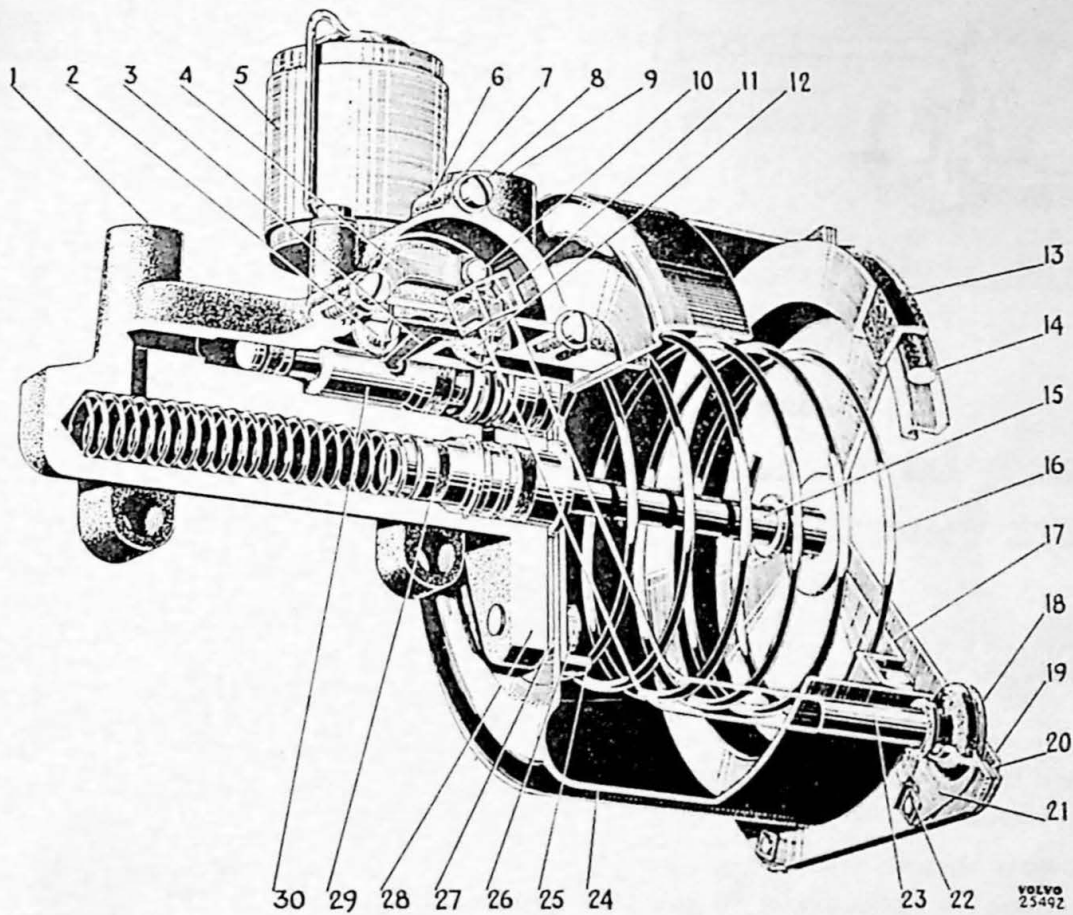
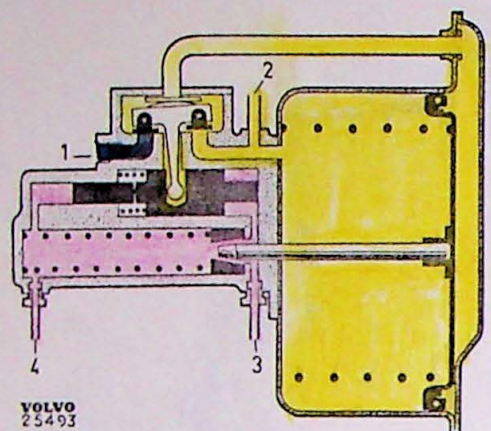


Fig. 7-5. Servo-brake cylinder

- | | |
|------------------------------|---------------------|
| 1. Connection for brake line | 16. Return spring |
| 2. Air valve | 17. Plunger |
| 3. Valve arm | 18. Rubber bushing |
| 4. Spring | 19. Cover |
| 5. Air filter housing | 20. Gasket |
| 6. Valve housing | 21. Plate |
| 7. Cover | 22. Screw |
| 8. Screw | 23. Connecting pipe |
| 9. Vacuum connection | 24. Vacuum cylinder |
| 10. Screw | 25. Plate |
| 11. Yoke | 26. Screw |
| 12. Vacuum valve | 27. Gasket |
| 13. Plunger packing | 28. Housing |
| 14. Rubber ring | 29. Plunger |
| 15. Plunger rod | 30. Control plunger |



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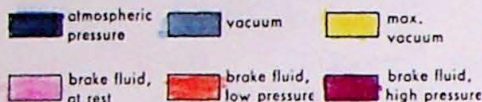


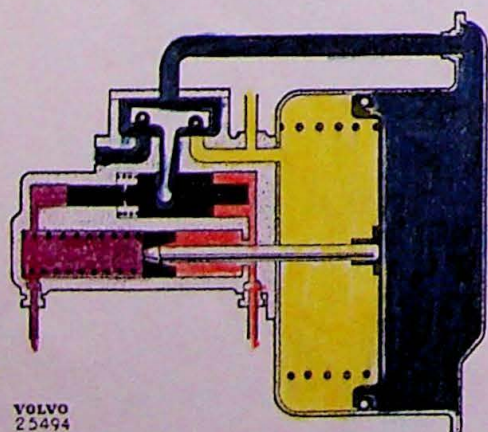
Fig. 7-6. Rest position

- | | |
|---------------------|-------------------------|
| 1. From air filter | 3. From master cylinder |
| 2. From vacuum tank | 4. To wheel brake units |

(1) where it is boosted. The pressure then moves out to the wheel unit cylinders (9 and 13) in which the plungers are pressed outwards and apply the brakes.

The servo-brake cylinder functions as described below. Regarding the significance of the colors on the figures, see Fig. 7-6.

When the system is at rest (Fig. 7-6) the control plunger is kept pressed to the right so that the air valve remains closed and the vacuum valve open. The same vacuum therefore exists on both sides of the vacuum plunger which is kept pressed to the right by the return spring. When the pressure in the master cylinder rises, the hydraulic pressure in the servo-brake cylinder also rises to the same extent. Since the right-hand pressure surface of the control plunger is larger than the left, the plunger is moved to the left. When this happens the valve arm also moves, the vacuum valve closes, the air valve opens and air flows into the right side of the vacuum plunger.

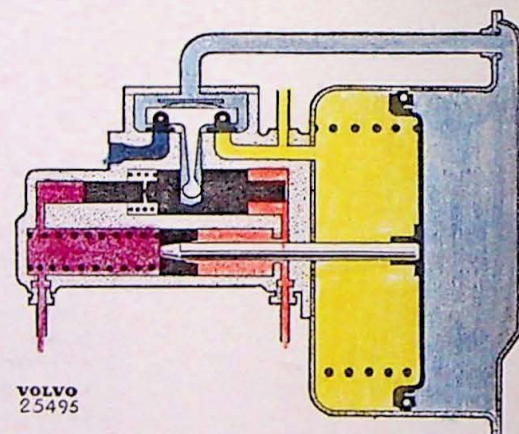


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Fig. 7-7. Applying brakes

Since there is vacuum on the left-hand side of the plunger, this is moved to the left together with the plunger rod. When this happens the connection between the master cylinder and brake lines is first closed and the hydraulic pressure to the left of the pressure plunger increases. In this way the outgoing brake pressure is boosted, see Fig. 7-7.

The outgoing hydraulic pressure and the pressure on the left-hand side of the control plunger increases as more air enters. If the pressure on the brake pedal and therefore the hydraulic pressure on the large, right side of the control plunger remains unaltered, this is finally overcome and the plunger is pressed to the right, see Fig. 7-8. When this happens the valve arm is influenced so that the air valve also closes. The pressure to the right of the vacuum plunger remains constant and is not able to overcome the



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Fig. 7-8. Constant braking

hydraulic resistance in the pressure cylinder. The moving parts of the servo-brake cylinder therefore remain in this position and constant braking is obtained as long as the same pressure is maintained on the pedal.

If the pressure on the pedal is decreased, the hydraulic pressure on the right-hand side of the control plunger is also decreased and the plunger is moved further to the right. The valve arm is then turned so that the vacuum valve opens. The spaces on both sides of the vacuum plunger thus have a free passage between each other, the pressure equalizes and the plunger is moved to the right by spring pressure. The pressure of the plunger rod on the hydraulic plunger decreases and this plunger is pressed back to the right so that the outgoing brake pressure decreases. If the pedal is released completely, all the parts of the servo-brake cylinder will return to the rest position and the brakes will disengage.

REPAIR INSTRUCTIONS

FOOTBRAKE

Front wheel brake units

Replacing brake blocks

The brake blocks should be replaced when about 1/8" (3 mm) of the facing thickness remains. Under no circumstances may the facings be worn down to below 1/16" (1.5 mm).

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place blocks under the lower control arms. Unscrew the wheel nuts and lift off the wheel.
3. Remove the hairpin-shaped locking clips and guide pins for the brake blocks. Pull out the blocks, see Fig. 7-10.
4. Carefully press the plungers into the wheel unit cylinders and fit the new blocks. Refit guide pins and locking clips.
5. Depress the brake pedal several times and check that the movement feels normal.
As a rule air-venting need not be carried out after replacing the brake blocks.
6. Lift on the wheel after having cleaned the contact surfaces between the wheel and hub free from sand and dirt and tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the car and tighten the wheel nuts. Tighten every other nut a little at a time until all are tightened to a torque of 70—100 lb.ft. (10—14 kgm). Fit the hub cap.

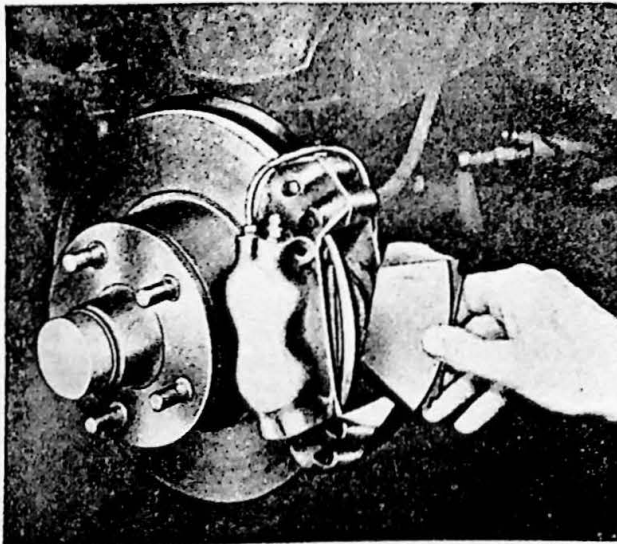


Fig. 7-10. Fitting the brake blocks

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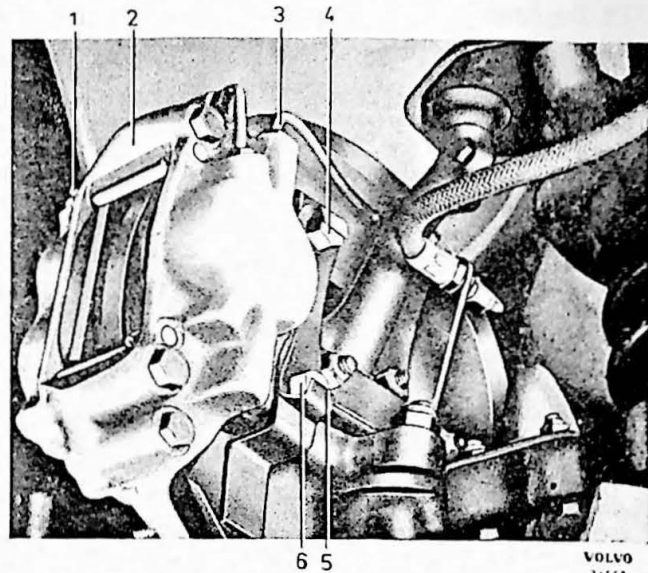


Fig. 7-11. Caliper, fitted

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

Reconditioning wheel unit cylinders

Removing

1. Remove the wheel, see operations 1—2 under "Replacing the brake blocks".
2. Clean the caliper externally.
3. Disconnect the brake line (3, Fig. 7-11) and plug the connection. Bend up the locking washer (5) and unscrew the attaching bolts (4 and 6). Lift off the caliper (2) complete, see Fig. 7-12.

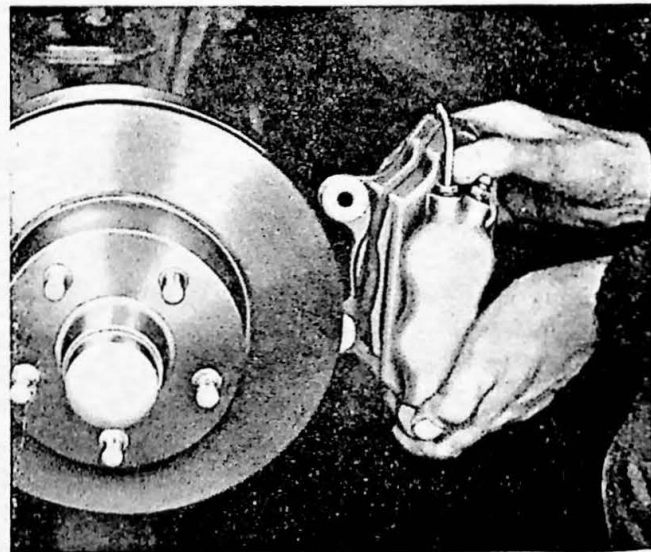


Fig. 7-12. Removing the caliper

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Disassembling

1. Remove the hairpin-shaped locking clips (11, Fig. 7-3) and guide pins (1). Pull out the brake blocks (9).
2. Remove the plungers and pull off the rubber cover (8).
3. Remove the sealing rings (3) from the cylinders with the help of a blunt tool. Be careful to ensure that the edges of the grooves are not damaged.

Inspection

Before inspection wash all parts in methylated spirits. Plungers and cylinders should be examined very carefully. There must be no scoring, scratches or rust on the polished surface. Damaged plungers should be replaced. Minor damage in the cylinder can as a rule be eliminated by means of honing. To do this both sides of the caliper are taken apart. The machining procedure varies with different tools so that it is not possible to give a general description. Follow the manufacturer's instructions. Clean the cylinders carefully after honing and check that the channels are free.

Assembling

1. Coat the working surfaces of plungers and cylinders with brake fluid.
2. Fit new sealing rings (3, Fig. 7-3) in the cylinders. Place the rubber covers (8) in position and ensure that they enter the cylinder grooves.
3. Fit the plungers with the closed end first. Press the plungers in fully and see that the rubber covers come into the plunger grooves.
4. Place the brake blocks (9) in position. If the two halves of the caliper have been disassembled, assemble these. Tighten the inner large attaching bolts (12) to a torque of 45—50 lb.ft. (6.2—7 kgm) and the outer smaller ones (13) to 25—30 lb.ft. (3.5—4.2 kgm). Fit guide pins and locking clips.

Fitting

Check that the contact surfaces of the caliper and retainer are clean and undamaged since it is of vital importance that the caliper takes up the correct position in relation to the brake disk. Fit the caliper see Fig. 7-11.

Check that the brake disk can run freely between the brake plates. Place on locking washer (5) and tighten the attaching bolts (4 and 6) and lock them. Connect the brake line (3) and air-vent the wheel unit cylinders. Fit the wheel, see operation 6 under "Replacing the brake blocks".

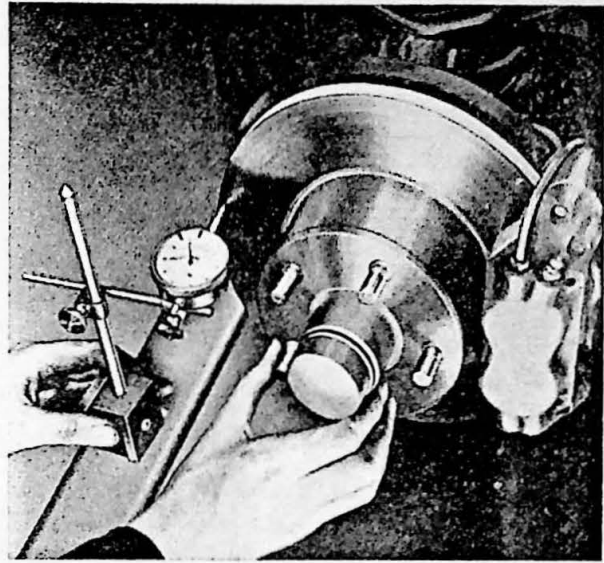


Fig. 7-13. Checking run-out

Brake disk

The brake disk should be examined as regards the friction surface and run-out. There must be no rust or scratches on the friction surface. Run-out must not exceed 0.004" (0.1 mm) and is measured as shown in Fig. 7-13. Check first that the wheel bearings are correctly adjusted and that the disk fits securely to the hub.

The brake disk can be reconditioned by precision turning or precision grinding. Machining should be done together with the hub. The thickness of the disk after machining must not be less than 0.48" (12.2 mm) and surface texture should be max. 3μ at a random diameter and max. 5μ measured radially. After reconditioning, the disk should not throw more than 0.004" (0.10 mm).

If the brake disk cannot be reconditioned as described above, or if it is cracked or damaged, it should be replaced together with the hub. Regarding procedure for this, see under "Replacing or adjusting front wheel bearings", Part 6.

Rear wheel brake units

Disassembling

1. Remove the hub cap and split pin in the drive shaft. Slacken the castle nut and wheel nuts slightly. Jack up the car and place blocks under the rear axle. Remove the wheel.
2. Release the handbrake. Pull off the hub with tool SVO 1791, see Fig. 7-14.
3. Place clamp SVO 4074 over the wheel unit cylinder so that the plungers cannot be pressed out. Remove the upper return spring with the help of

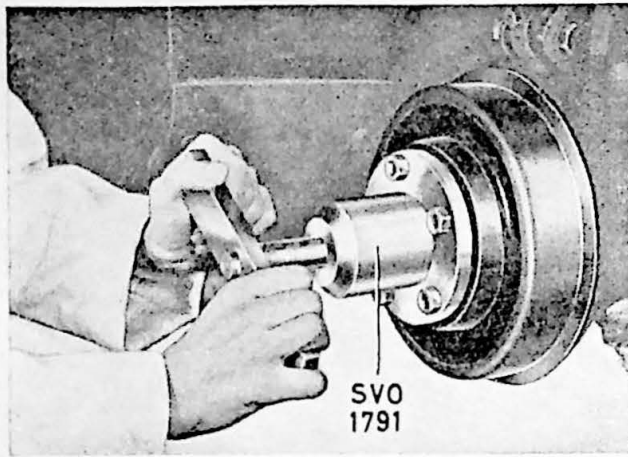


Fig. 7-14. Removing the hub

a pair of brake spring pliers. Pull down the front shoe into the groove on the brake backing plate, hold against the guide pin on the back side of the backing plate and turn and then remove the locking clamp. Lift out the shoe, see Fig. 7-15.

4. Remove the rear shoe in a corresponding manner and disconnect it from the handbrake cable. Unhook the return springs and if necessary the handbrake link.
5. Screw in the adjusting screw slightly. Remove the adjusting plungers, see Fig. 7-16.

Replacing brake linings

The brake linings should be replaced at the latest when they have been worn down level with the rivet heads.

1. Press out the rivets with the drift provided for the purpose in the rivet press. Then wash the shoes clean and dry them.

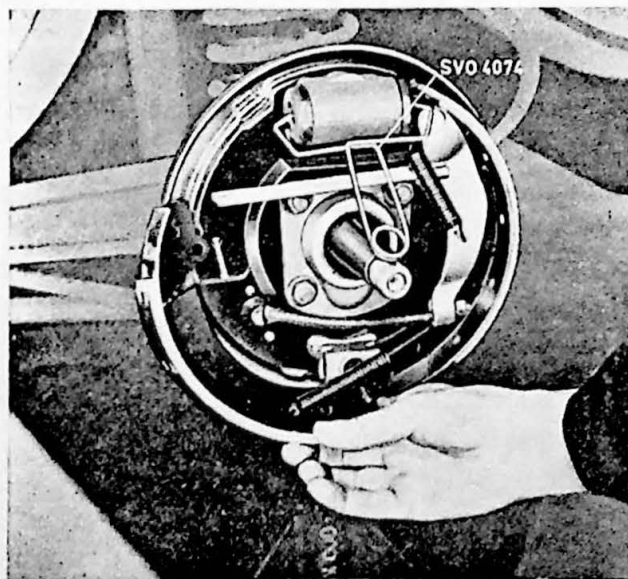


Fig. 7-15. Removing brake shoes

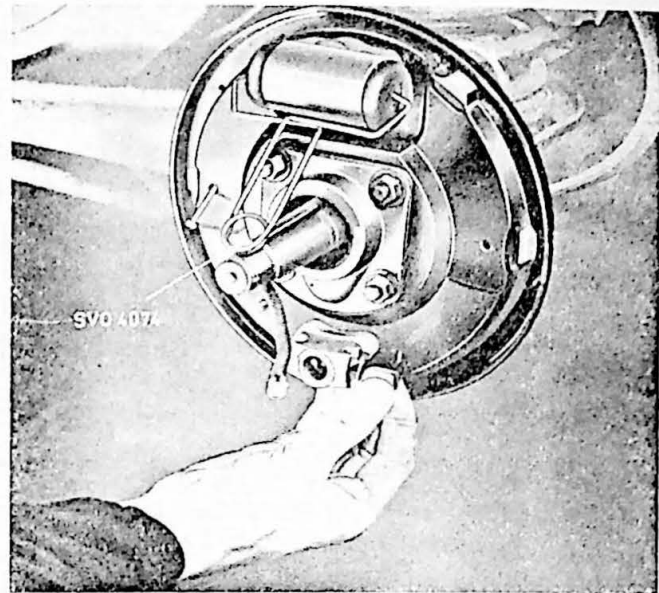


Fig. 7-16. Removing adjusting plunger

2. Rivet on the ready-made original linings. The front lining is placed towards the lower end of the shoe and the rear lining towards the upper end, see Fig. 7-18.

Use rivets as shown in the specifications and a rivet press with suitable drift. Begin riveting from the center and continue outwards to the ends. Check after riveting that the brake lining beds down properly along its entire length.

3. In order to obtain best results, the linings should be ground in a special grinding machine. Check that the lining has a radius of 0.008—0.016" (0.2—0.4 mm) less than that of the brake drum.

Reconditioning wheel unit cylinder

Loosen the clip, pull off the rubber seals (1, Fig. 7-4) and take out the plungers (2) with packings (3). Wash all parts in methylated spirits.

Carefully examine the cylinder internally. There must be no scoring, scratches or rust on the polished surface. Such damage can be eliminated by honing the cylinder. The procedure for doing this varies with different machines so that the respective manufacturer's instructions should be followed. Clean the cylinder carefully after honing when the air-venting nipple should be removed.

The clearance between the plunger and cylinder should be 0.0015—0.0035" (0.038—0.090 mm) and is measured as shown in Fig. 7-17. If the clearance exceeds 0.0035 (0.090 mm), test with a new plunger. If this does not help, the wheel unit cylinder must be replaced.

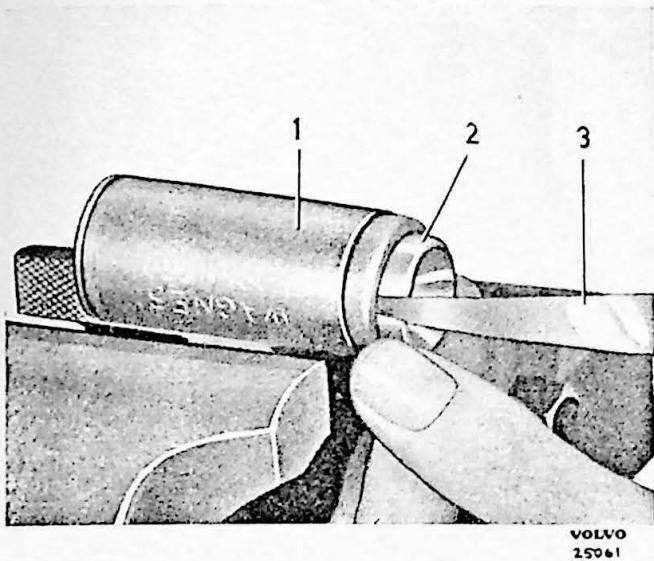


Fig. 7-17. Checking clearance

1. Wheel unit cylinder 2. Plunger 3. Feeler gauge

Examine packings and other parts for wear and damage. Damaged or worn parts should be replaced.

Assemble the parts in the reverse order to disassembling. When doing so, dip plungers and packings in brake fluid. The location of the parts is shown in Fig. 7-4.

Brake drums

The friction surface and radial throw of the brake drums should be checked. Radial throw must not exceed 0.006" (0.15 mm). If the friction surface is concave, scratched or cracked, the brake drum should be replaced. Rust spots and minor scratches can, however, be polished out or ground away in a machine.

Assembling

1. Screw back the adjusting screw and fit the adjusting screws after having cleaned them and coated them lightly with heat-resistant grease. Check that the plungers move easily.
2. Fit the lever on the rear brake shoe. Hook on the handbrake cable and return springs. Place the shoe in position and fit the guide pin and locking clip. Ensure that the head of the guide pin comes into the countersink of the clip.
3. Place the handbrake link into position ensuring that it is turned correctly. Hook on the lower return spring and fit the front brake shoe with guide pin and locking clip. Hook on the upper return spring with brake spring pliers. Remove SVO 4074. Fit the spring clip (5 Fig. 7-18).
4. Check that springs and locking washers are

properly in position and that the linings are free from burr, grease and dirt.

5. Check that the key fits properly in the drive shaft and fit the hub with brake drum. Place on the washer and tighten the castle nut. If the wheel unit cylinder has been removed, this should be air-vented, see under "Air-venting the hydraulic system". Lift on the wheel after having cleaned the contact surfaces between wheel and hub free from sand and dirt and tighten up the nuts sufficiently so that the wheel cannot be displaced on the hub. Adjust the brake, see under "Adjusting the wheel brake units". Lower the vehicle and tighten the wheel nuts.

Tighten every other nut a little at a time until all are tightened to a torque of 70–100 lb.ft. (10–14 kgm). Tighten the castle nut properly and lock it with a split pin. Fit the hub cap.

Master cylinder

Observe the greatest possible care when working on the hydraulic system. Wash the hands with soap and water before cleaning the internal parts. These should be cleaned with methylated spirits. Gasolene, kerosene or spirit containing bensol must not be used.

Fill up with first-class brake fluid only which fulfils the requirements of SAE 70 R 3. Fluids which only fulfil the requirements of SAE 70 R 1 or what is known

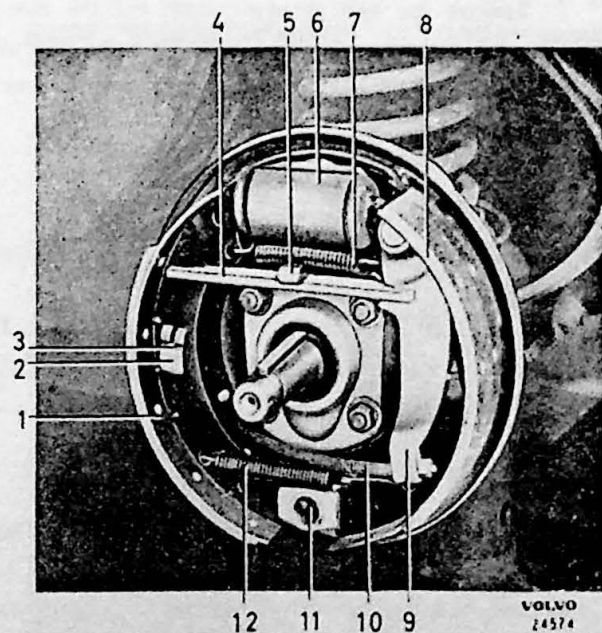


Fig. 7-18. Rear wheel brake unit

- | | |
|------------------------|-----------------------------|
| 1. Front brake shoe | 7. Upper return spring |
| 2. Locking clip | 8. Rear brake shoe |
| 3. Guide pin | 9. Lever |
| 4. Link | 10. Return spring for lever |
| 5. Spring clip | 11. Adjusting device |
| 6. Wheel unit cylinder | 12. Lower return spring |

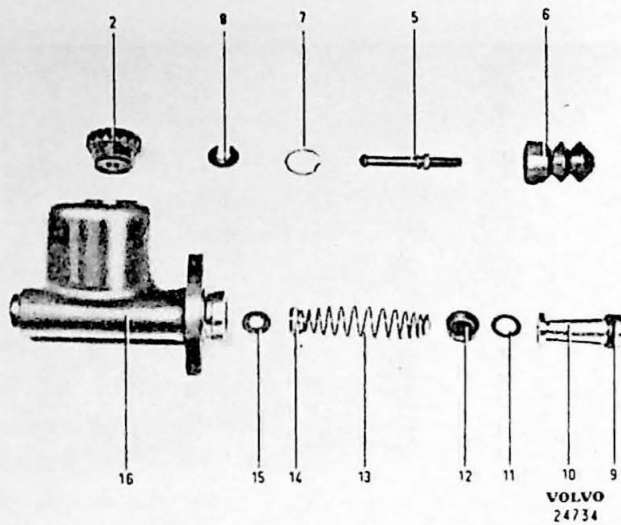


Fig. 7-19. Master cylinder

- | | |
|-----------------|----------------------|
| 2. Plug | 11. Washer |
| 5. Thrust rod | 12. Packing |
| 6. Rubber cover | 13. Spring |
| 7. Locking ring | 14. Valve |
| 8. Stop washer | 15. Washer |
| 9. Packing | 16. Cylinder housing |
| 10. Plunger | |

as HD quality, should not be used. Avoid spilling brake fluid on the paintwork as this can cause damage.

Removing

1. Remove the split pin and bolt for brake pedal. Unhook the return spring. Remove the rubber cover.
2. Disconnect the connection for the brake line. Remove the two attaching bolts for the master cylinder. Pull out the master cylinder carefully. Avoid spilling brake fluid on the paintwork as it will cause damage.

Disassembling

1. Unscrew the plug (2, Fig. 7-2 and 7-19) and empty out the brake fluid.
2. Pull back the rubber cover (6) and remove the locking ring (7), washer (8) and thrust rod (5). Shake out all parts from the cylinder.

Inspection

Before inspection all parts of the master cylinder should be washed in methylated spirits. Examine the cylinder carefully internally. There must be no scoring, scratches or rust on the polished surface. Such damage can as a rule be eliminated by honing the cylinders. The procedure for doing this varies with different makes of tool so that a general description cannot be given. Therefore follow the

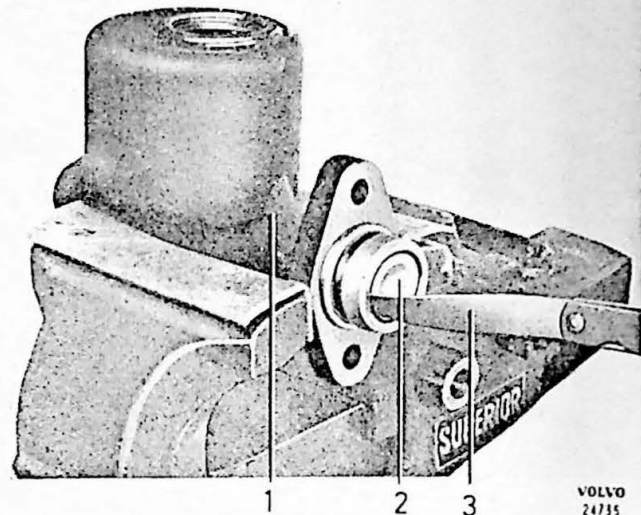


Fig. 7-20. Checking the clearance

1. Master cylinder 2. Plunger 3. Feeler gauge

manufacturer's instructions. Clean the cylinder carefully after honing and check that the holes are free.

The clearance between plunger and cylinder should be 0.0023—0.0047" (0.06—0.12 mm) and is measured as shown in Fig. 7-20. If the clearance exceeds 0.0047" (0.12 mm), test with a new plunger. If this does not help, the master cylinder must be replaced.

Examine packings, valves and other parts for wear and damage. Damaged or worn parts should be replaced.

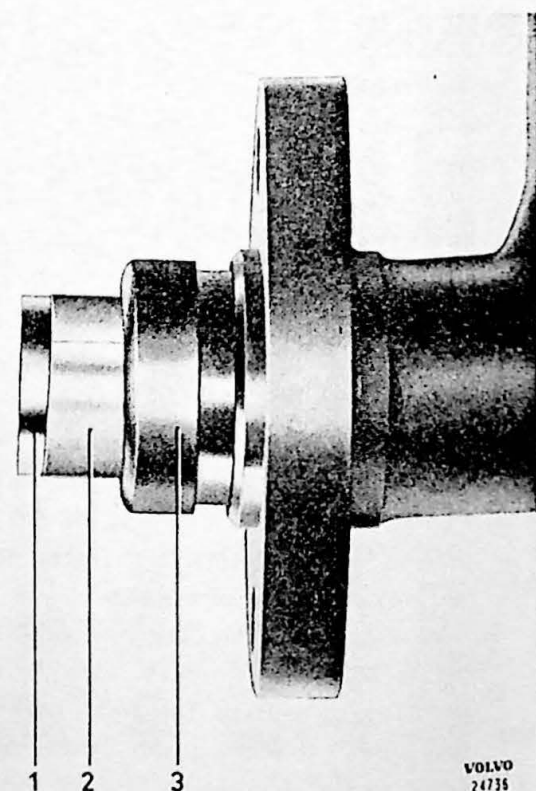
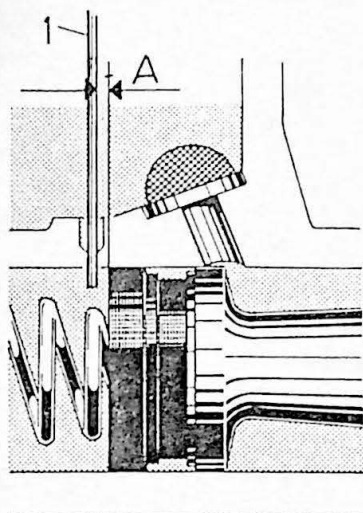


Fig. 7-21. Fitting the plunger

1. Plunger 2. Brass foil 3. Master cylinder



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Fig. 7-22. Checking equalizing hole

1. 0.020" (0.5 mm) wire A = approx. 0.020" (0.5 mm)

Assembling

1. Fit the washer (15, Fig. 7-19) in the bottom of the cylinder.
2. Place the packing (12) on the spring guide. Dip the packing in brake fluid and fit it together with the spring and valve. Place the washer (11) in the cylinder.
3. Pull the packing (9) on the plunger and turn it as shown in the figure. Dip the plunger in brake fluid and fit it. Be careful to ensure that the packing (9) is not damaged. Preferably use a piece of brass foil shaped like a tube as a guide for the packing, see Fig. 7-21. Compress the spring and fit thrust rod (5), washer (8) and locking ring (7).
4. Check that the equalizing hole is free by inserting a 0.02" (0.5 mm) wire through the hole, see Fig. 7-22. It should then be possible to press the plunger in approx. 0.020" (0.5 mm) before the wire gets caught. Be careful to ensure that the packing is not damaged. Check also that there is clearance for the thrust rod (5).
5. Fit the rubber cover (6).

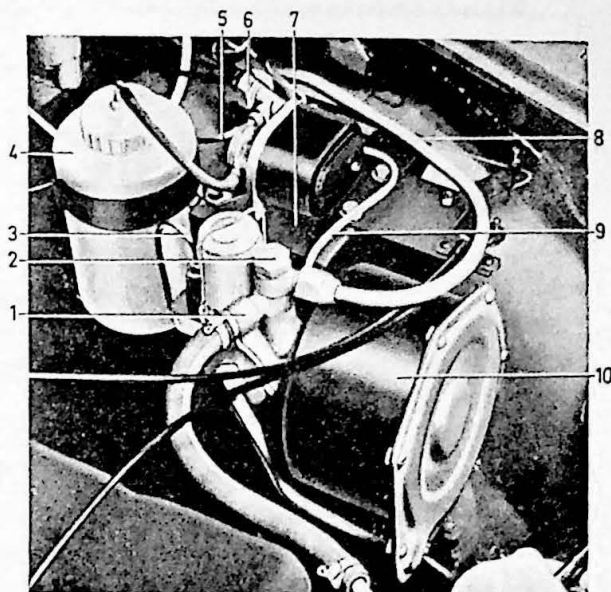
Fitting

Fitting is done in the reverse order to removing. Do not forget the split pin in the pedal bolt. Fill up with brake fluid and air-vent according to the instructions given under "Air-venting the brake system".

Servo-brake cylinder

Removing

Disconnect the hydraulic lines (3, 5 and 9, Fig. 7-23) and plug them. Remove the container (4) and banjo

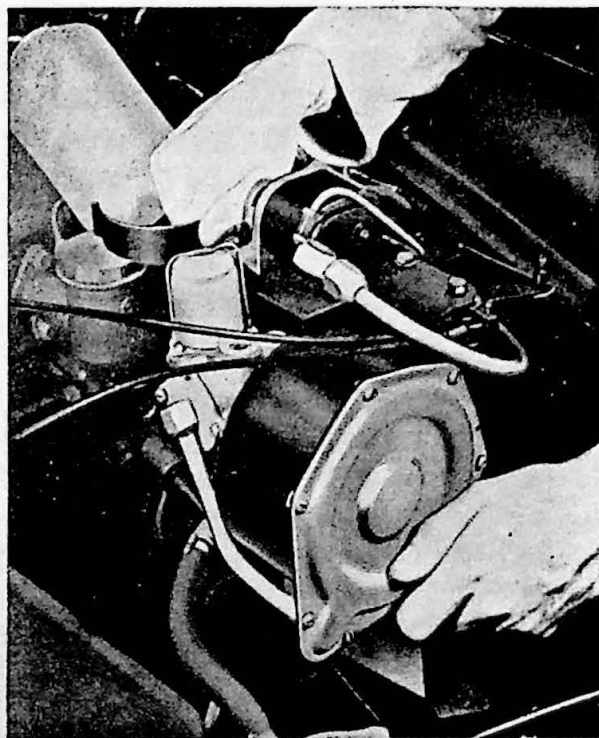


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Fig. 7-23. Servo-brake cylinder fitted

- | | |
|------------------------------------|--------------------------|
| 1. Non-return valve | 6. Brake contact |
| 2. Banjo screw | 7. Bracket |
| 3. Outgoing brake line | 8. Vacuum lines |
| 4. Retainer | 9. Ingoing brake line |
| 5. Brake line from master cylinder | 10. Servo-brake cylinder |

screw (2) for the vacuum lines. Unscrew the four attaching bolts for the bracket (7) and lift up the servo-brake cylinder complete with bracket, see Fig. 7-24. Remove the three attaching bolts and separate the servo-brake cylinder from the bracket.



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Fig. 7-24. Removing the servo-cylinder

Disassembling

1. Remove the air filter from the servo-brake cylinder.
2. Unscrew the screws (22, Fig. 7-5) when the cover (19) will be lifted off by the spring loaded plunger. Remove cover, packing (20), plunger (17) and return spring (16). Unscrew the three bolts (26) and remove the cylinder (24) from the housing (28).
3. Remove the cover (7) from the valve housing (6). Unscrew the bolts (10) and lift out the yoke (11), spring (4) and valve arm (3).
4. Remove the packing (27) and strike the housing against a wooden object so that the plug (2, Fig. 7-25) falls out. Remove the control plunger (7).
5. Remove the sleeve (17), packing (16) and spacing sleeve (15). Remove the locking ring (14) with a pair of suitable pliers and lift out the other parts.

Inspection

Before inspection all parts should be washed in clean spirit. Place the cleaned parts on a clean cloth and observe the utmost cleanliness when continuing the work.

Inspect all parts for wear and other damage. All packings and otherwise damaged or worn parts should be replaced. If the plunger rod is damaged, the complete vacuum plunger should be replaced.

Assembling

1. Take a new plunger (12, Fig. 7-25) with inner packing (10) fitted. Fit the plunger packing (11) and turn it as shown in the figure. Place the spring (8) on the plunger. Dip the plunger in brake fluid and insert the unit into the cylinder. Fit the washer (13) and press it in so that a new locking ring (14) can be fitted. Place the packing (16) on the spacing sleeve (15) and fit in. Place the sleeve (17) in position.
2. Place the packings (5 and 6) onto the control plunger and turn them as shown in the figure. Fit washers, spring (3) and locking ring (19). Dip the plunger in brake fluid and fit it as shown in Fig. 7-25. Turn the plunger so that the valve arm (3, Fig. 7-5) can be fitted in its hole.
3. Fit the valves (2 and 12, Fig. 7-5) onto the valve arm (3) and place the unit in position in the housing. Fit the spring (4), yoke (11), washers and bolts (10). Test the function by pressing the control plunger (30) backwards and forwards (Fig. 7-26) when the valve should close and open respectively. In the normal position the valve nearest the flange

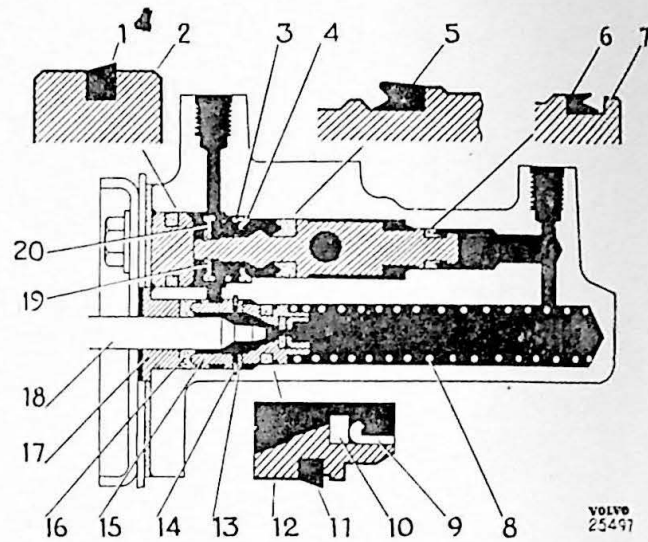


Fig. 7-25. Hydraulic control parts

1. Packing	8. Spring	15. Spacing sleeve
2. Plug	9. Sleeve	16. Packing
3. Spring	10. Packing	17. Sleeve
4. Washer	11. Packing	18. Plunger rod
5. Packing	12. Plunger	19. Locking ring
6. Packing	13. Washer	20. Washer
7. Control plunger	14. Locking ring	

should be open and the other one closed. Fit the packing and cover (7) with vacuum line. A suitable tightening torque for the bolts is 2—3 lb.ft. (0.3—0.4 kgm).

4. Place the packing (1) on the plug (2) and fit it so that the packing flange comes inwards, see Fig. 7-25. Let the plug project about 1/16" (1—2 mm) outside the flange. Place the plate (21, Fig. 7-5) onto the vacuum line and the new gasket (27), cylinder (24) and plate (25) into their positions and insert the connecting pipe (23) through the rubber bushing (18). Tighten the three bolts (26) to a torque of 10—12 lb.ft. (1.4—1.8 kgm).

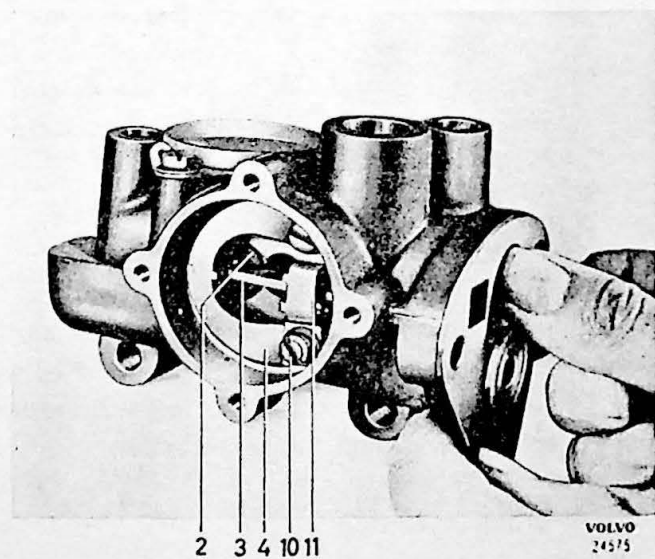


Fig. 7-26. Testing the control device

2. Air valve	10. Screw
3. Valve arm	11. Yoke
4. Spring	

5. Check that the vacuum cylinder (24) is still clean internally. Place the return spring (16) in position. Fit the vacuum plunger (17) complete with new rubber ring (14) and insert the plunger rod (15) carefully into the bushing. No lubrication should be done. Place on a new gasket (20) and bolt on the cover (19) and plate (21). A suitable tightening torque for the bolt is 2—3 lb.ft. (0.3—0.4 kgm).
6. Fit a new air filter insert and place on the cover and yoke.

Testing

After assembling, the servo-brake cylinder should be tested. This can be done in a test-bench as shown in Fig. 7-27. Testing should preferably be carried out as follows:

1. Connect the vacuum line (7) to the servo-brake cylinder hydraulic inlet. When doing this, brake fluid should naturally be emptied from the cylinder. Plug the hydraulic outlet. Start the vacuum pump and open the vacuum valve (11). When a vacuum of 10.7 lb./sq.in. (0.75 kg/cm²) has been reached (Gauge 1), close the valve (11). The servo-brake cylinder should maintain a vacuum of at least 10 lb./sq.in. (0.7 kg/cm²) for five seconds. Then disconnect the vacuum line and open the hydraulic outlet.
2. Connect the line (9) to the servo-brake cylinder hydraulic inlet. Close the shut-off valve (3) and open the inlet valve (13). Check through the sight glass (6) that there is sufficient brake fluid for air-venting. Operate the pump (15) until brake fluid begins to run out the servo-brake cylinder hydraulic outlet.
3. Connect the line (10) to the outlet and the vacuum line (7) to the vacuum connection, see Fig. 7-27. Open the valve (11) so that the gauge (1) shows 10.7 lb./sq.in. (0.75 kg/cm²). Check that the shut-off valve (3) is closed and that the valves (13 and 14) are open. Pump up the ingoing hydraulic pressure until the gauge (4) shows 498 lb./sq.in. (35 kg/cm²). The outgoing hydraulic pressure (Gauge 5) should then show at least 950 lb./sq.in. (67 kg/cm²). Then open the shut-off valve (3) when the gauges (4 and 5) should immediately return to zero. Repeat this test operation a few times.
4. Remove the servo-brake cylinder air filter and plug the air intake hole. Set in 10.7 lb./sq.in. (0.75 kg/cm²) vacuum (Gauge 1). Shut the valve (3) and open the valves (13 and 14). Pump up the

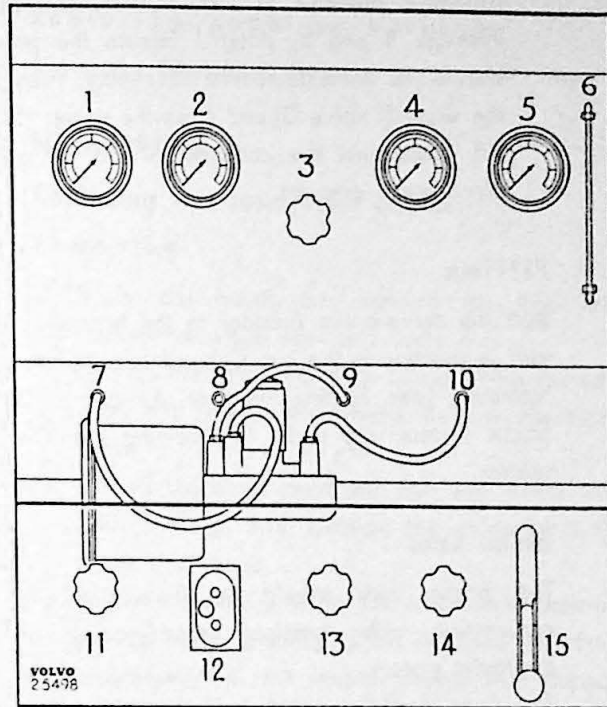


Fig. 7-27. Connections for testing

1. Gauge for constant vacuum
2. Gauge for control vacuum
3. Hydraulic shut-off valve
4. Gauge for hydraulic inlet pressure
5. Gauge for hydraulic outlet pressure
6. Sight glass
7. Connection for constant vacuum
8. Connection for control vacuum
9. Connection for hydraulic inlet
10. Connection for hydraulic outlet
11. Vacuum valve
12. Switch for vacuum pump
13. Hydraulic inlet valve
14. Hydraulic outlet valve
15. Hydraulic pump

ingoing hydraulic pressure to a value exceeding 50 lb./sq.in. (3.5 kg/cm²). The ingoing and outgoing pressure should then be equal (Gauges 4 and 5). After the test, open the shut-off valve (3), remove the plug and refit the air filter.

5. Check that the gauge (1) shows 10.7 lb./sq.in. (0.75 kg/cm²) vacuum. Close the valve (3) and check that the valves (13 and 14) are open. Pump up the ingoing pressure to 35.6 lb./sq.in. (2.5 kg/cm²) (Gauge 4). The outgoing pressure (Gauge 5) should then show at least 50 lb./sq.in. (3.5 kg/cm²). Open the shut-off valve (3).
6. Set in 10.7 lb./sq.in. (0.75 kg/cm²) vacuum on the gauge (1). Then close the vacuum valve (11). After a period of 1 minute 40 seconds the vacuum should not decrease more than so that the gauge (1) shows 5.7 lb./sq.in. (0.4 kg/cm²). After the test disconnect vacuum line (7) from the servo-brake cylinder.
7. Close the shut-off valve (3) and check that the valves (13 and 14) are open. Pump up the

hydraulic pressure to 1100 lb/sq.in. (77 kg/cm²) (Gauges 4 and 5). After 1 minute the pressure should not have decreased noticeably. Then open the shut-off valve (3) and close the valves (14 and 13). Disconnect the connections and lift off the servo-brake cylinder.

Fitting

Bolt the servo-brake cylinder to the bracket and fit unit in position in the car. Connect vacuum lines and hydraulic lines. Fit the container. Air-vent the whole brake system, see under "Air-venting the hydraulic system".

Brake lines

The brake lines should be flushed through in conjunction with complete reconditioning of the hydraulic system.

The lines are disconnected at the wheel cylinders one by one and flushed with clean spirit. Flushing should preferably be done by filling the master cylinder with spirit and then carrying out repeated brake movements with the pedal. When the master cylinder has been reconditioned, it is filled with brake fluid after which the lines are flushed free from spirit. All spirit must be thoroughly removed from the brake lines otherwise gas bubbles can arise in the system causing spongy pedal action. With leakage or when the effect is such that leakage can be suspected, the damaged line should be replaced. This is preferably done in accordance with the instructions given below.

Note that the pipes are tapered in a special way differing from those on our other cars. Therefore use only original spare parts intended for this car.

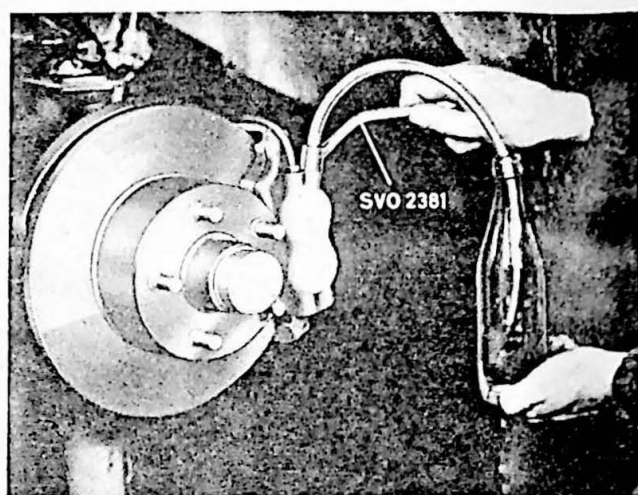
1. Remove the damaged brake line.
2. Take a complete new brake line, blow it clean internally and fit it.

Make sure that the brake line lies in such a position that it cannot chafe while driving. Particularly important points are where the pipes pass the rear spring attachments on the rear axle, where the pipe must not come nearer than 3/8" (10 mm) and where they pass the support arms.

3. Air-vent the hydraulic system.

Air-venting the hydraulic system

A sign that there is air in the system is that the brake pedal can be depressed without any appreciable resistance or if it feels spongy.



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Fig. 7-28. Air-venting

When any part of the system has been removed, air-venting must be carried out. Air can also enter the system if there is too small a quantity of brake fluid in the reservoir. If, for example, only one wheel unit cylinder has been removed, it is usually sufficient to air-vent this only. If, on the other hand, the master cylinder or lines from this have been removed, the whole brake system must be air-vented.

Air-venting the whole brake system is done as follows:

1. Clean round the filling cover on the master cylinder. Unscrew the cover and if necessary top up with brake fluid. Use only first-class brake fluid fulfilling the requirements of SAE.70 R 3. Fluid which only fulfills the requirements of SAE 70 R 1 or HD quality, should not be used. Disconnect the servo-brake cylinder by screwing out the banjo screw (2, Fig. 7-23).
2. Clean the air-venting nipple. Fit on the wrench SVO 2381 with a hose on the air-venting nipple and let the other end of the hose hang down in the fluid in a collecting vessel, see Fig. 7-28.
3. Open the nipple and have somebody press down the brake pedal slowly. Close the nipple before releasing the pedal otherwise air can be sucked in since there is no non-return valve between the master cylinder and lines. Repeat this procedure as long as there are air bubbles in the fluid running out.
4. Air-vent the remaining wheels in the same manner. Between each operation, check that there is sufficient brake fluid in the reservoir.
5. Connect the vacuum lines by screwing in the banjo screw.

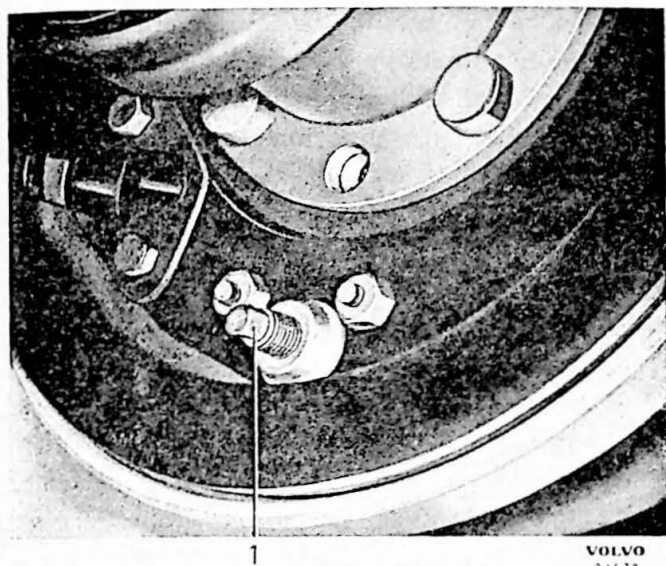


Fig. 7-29. Adjusting device for rear wheel brake unit
1. Adjusting screw

Adjusting the footbrake

The front wheel disk brakes are designed so that the linings are always at a certain minimum distance from the brake disk regardless of wear. The front wheel brakes are therefore self-adjusting and no manual adjustment of the position of the brake plates needs to be carried out.

When the brake pedal can be depressed too far down towards the floorboards this usually means that the rear wheel brake linings are worn and that the brake shoes require adjusting. If it is suspected that the linings are worn, the brake drum should be removed for checking this. The adjusting device permits adjustments even if the linings are worn down to the rivets and such wear can lead to the rivets damaging the brake drums. The linings should be inspected regularly every 12 500 miles (20 000 km) Adjusting is done as follows:

1. Lift up the rear end and place blocks under the rear axle. Release the handbrake.
2. Turn the adjusting screw (1, Fig. 7-29) clockwise until the brake drum locks. Then turn back the screw until the drum can rotate freely.
3. Adjust the other rear wheel in the same manner. Lower the car.

Brake pedal

Adjusting position of brake pedal

When the brake pedal is released it takes up the same position as the clutch pedal. The position is adjusted by slackening the lock nut and turning the pressure rod to the master cylinder. Do not forget to tighten the lock nut.

Replacing pedal or bushings

See under "Reconditioning the pedal shaft", Part 2.

HANDBRAKE

Replacing the handbrake cables

Removing

1. Apply the handbrake, remove the hub cap, slacken the wheel nuts and castle nut.
2. Jack up the rear end, place blocks under the rear axles and remove the wheels. Release the handbrake.
3. Pull off the brake drum and hub with puller SVO 1791, see Fig. 7-14. Unhook the cable from the brake shoe lever.
4. Loosen the screws at the cable sleeve attachment in the brake backing plate. Remove the front attachment of the cable sleeve with support rubber. Unhook the cable from the clevis and pull the cable forwards.

Fitting

1. Place the rubber support on the cable sleeve. Insert the cable into the brake backing plate and hook it onto the lever.
2. Hook the cable onto the clevis.
3. Tighten the bolt in the brake backing plate. Fit the cable sleeve front attachment and ensure that the clamp enters the groove on the sleeve. If necessary, slacken the adjusting nut. Fit the support rubber in its bracket.
4. Fit on the hub with brake drum and wheels. Tighten the castle nut and wheel nuts sufficiently for the drum and wheels to position correctly.

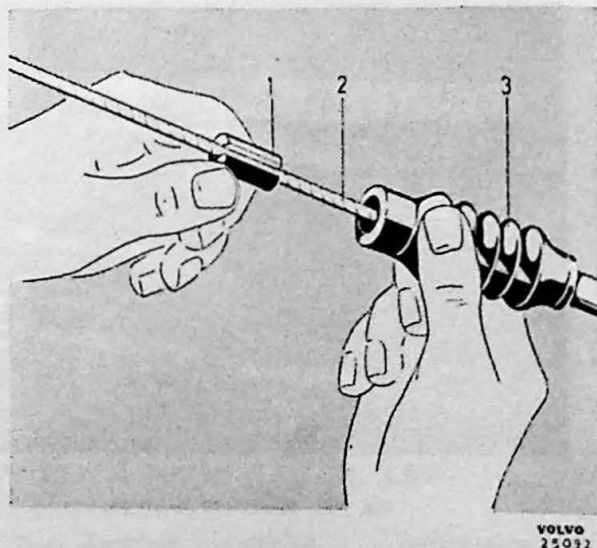


Fig. 7-30. Fitting the rubber cover
1. Sealing plug 2. Cable 3. Rubber cover

5. Adjust the handbrake. Lower the car and tighten the wheel nuts to a torque of 70—100 lb.ft. (10—14 kgm). Tighten and lock the castle nuts. Fit on the hub cap.

Replacing the rubber cover

If the handbrake cable rubber cover has been damaged for any reason, it must be replaced as otherwise water and dirt can penetrate and cause the brake to rust on.

For this replacement there is a special rubber cover available with sealing plugs (part nos. 86850 and 86851 respectively). When replacing, the pull-rod is removed from the lever and the cable unhooked from the clevis. Cut off the old cover and fit on the new one. Hook on the cable to the clevis and refit the pull-rod. Fit the slotted sealing plug (1, Fig. 7-30) on the cable (2) and press it into the rubber cover (3).

Replacing the brake lever or ratchet part

1. Release the handbrake and remove the protective cover over the segment.
2. Remove the split pin and washer at the shaft lever (6, Fig. 7-31). Turn the pull-rod (7) so that it can be removed from the handbrake lever. Remove the ratchet segment (1).
3. Unscrew the bolts for the support attachment (8) and drive out the stud and attachment. Lift off the lever (3).
4. Unscrew the locking screw and remove the yoke (5) and button (4). Take out the spring from the lever. Remove the rivet (2) and take out the thrust rod (6, Fig. 7-9) and pawl (18).

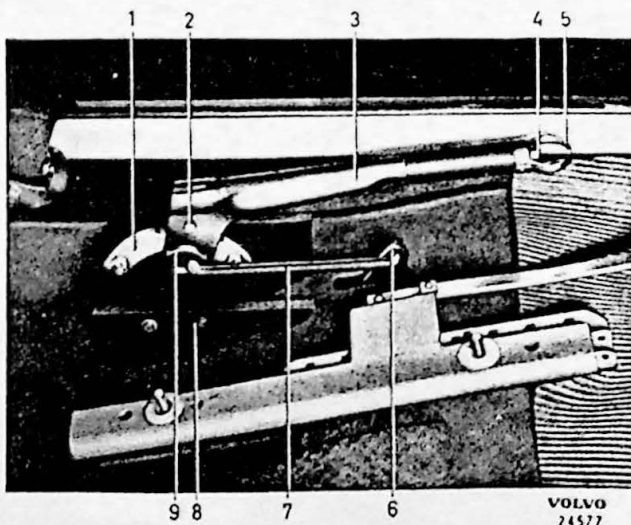


Fig. 7-31. Handbrake lever

- | | | |
|--------------------|-----------|-----------------------|
| 1. Ratchet segment | 4. Button | 7. Pull-rod |
| 2. Rivet | 5. Yoke | 8. Support attachment |
| 3. Handbrake lever | 6. Lever | 9. Lever |

5. Fit the new parts in the reverse order. Ensure that the rivet is secure but without interfering with the movement of the pawl. Lubricate the bushings with a thin coating of ball-bearing grease. Do not forget to lock the pull-rod.

Replacing the handbrake shaft

1. Lift up the rear end and place blocks under the rear axle.
2. Release the handbrake and disconnect the pull-rod (7, Fig. 7-31) from the shaft lever (6).
3. Remove the split pin and stretch the cables so that the pull-rod (2, Fig. 7-9) can be removed from the shaft lever. Remove the support attachment and lift off the shaft (21).
4. Lubricate the bushings in the new shaft with a thin coating of ball bearing grease. Check that the studs of the support attachments are undamaged. Fit the shaft in the reverse order to removing.

Adjusting the handbrake

The handbrake should give full brake effect at the fourth-fifth notch. If not, the handbrake should be adjusted. Before adjusting, make sure that the trouble is not in the wheel brake units. The rear wheel brakes should therefore first be adjusted, see "Adjusting the footbrake". The handbrake is adjusted by moving the clevis on the pull-rod, see Fig. 7-32. Tighten the nuts well after adjusting.

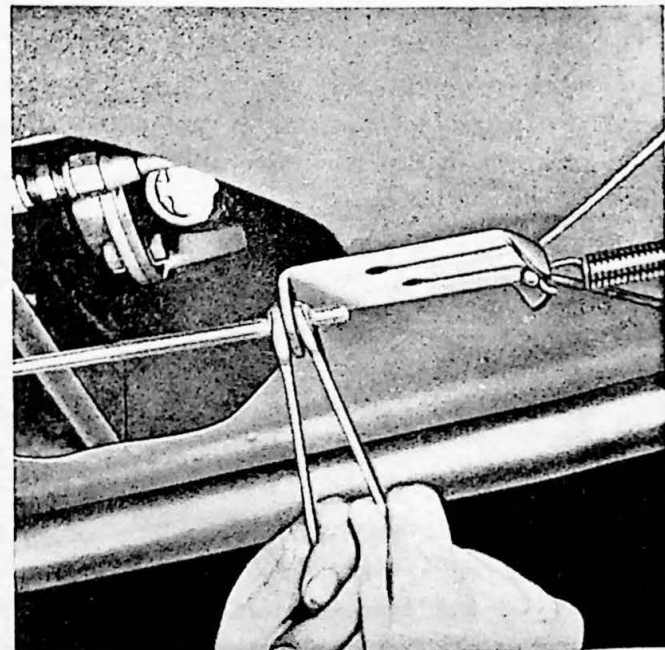


Fig. 7-32. Adjusting the handbrake

FAULT TRACING

FAULT

Reason _____ Remedy

No or poor braking effect

Too little brake fluid in the system.	Fill up with brake fluid. Check for leakage. Air-vent the system.
Air in the hydraulic system.	Air-vent the system.
Leakage in the hydraulic system.	Check and repair the leakage. Air-vent the system.
Defective master cylinder.	Replace the master cylinder.
Brakes wrongly adjusted.	Adjust the brakes.
Unsuitable brake linings.	Replace with original brake linings.
Grease or oil on the brake linings.	Replace the brake linings. Check the sealing ring.

The car pulls to one side when braking

Grease or oil on one of the brake linings.	Replace the linings. Check the sealing ring.
Unevenly adjusted brakes.	Adjust the brakes.
Out-of-round or uneven brake drum.	Replace or grind the drum.
Defective wheel unit cylinder.	Recondition the wheel unit cylinder.
Excessive play in the wheel bearings or faulty wheel alignment.	Adjust the front end.
Uneven tire pressure.	Adjust the tire pressure.
Unevenly worn tires.	See Part 8.

The brakes bind

Brakes wrongly adjusted.	Adjust the brakes.
Moisture on the brake linings.	Brake repeatedly until the fault disappears.
Excessive play in wheel bearings.	Adjust the bearings.
Brake linings worn out.	Replace the linings.
Brake linings glazed owing to contamination with oil.	Replace the linings and repair the leakage.
Damaged or loose brake linings.	Replace the linings.
Loose brake backing plate or retainer.	Tighten the brake backing plate or retainer.
Out-of-round brake drum.	Replace or grind the drum.
Broken return spring.	Replace the spring.

Brake drag on one of the rear wheels

Brakes wrongly adjusted.	Adjust the brakes.
Broken return spring.	Replace the return spring.
Handbrake cable chafing.	Lubricate or replace the handbrake cable.
Brake line to the wheel blocked or damaged.	Clean or replace the line.
In extremely cold weather: poor quality brake fluid.	Change the brake fluid.

Brake drag on one of the front wheels

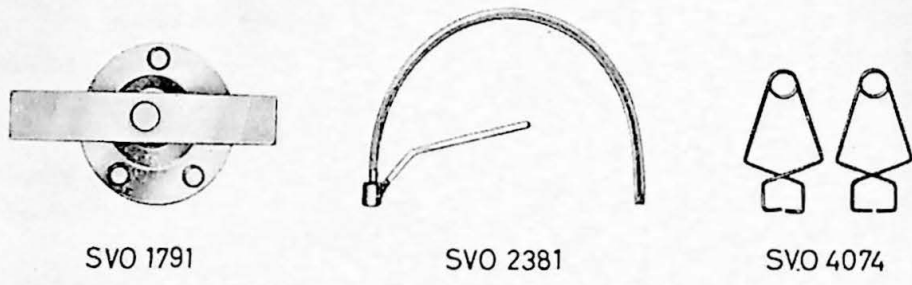
Brake line to the wheel blocked or damaged.	Clean or replace the line.
Plungers binding.	Recondition the wheel unit cylinders.
In extremely cold weather: poor quality brake fluid.	Change the brake fluid.

Noisy brakes

Brake linings worn out.	Replace the linings.
Dirt in the brake drums.	Clean the drums and linings.
Brake drums vibrate.	Fit damping springs on the outside of the drums.

TOOLS

The following special tools are used for repairs to the brake system.



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Fig. 7-33. Special tools

- SVO 1791 Puller for hub
- SVO 2381 Wrench for air-venting nipple
- SVO 4074 Spring clips for wheel unit cylinder

SPECIFICATIONS

FRONT WHEEL BRAKES

Type	Disk brakes
Brake disk:	
External diameter	10.86" (276.5 mm)
Thickness, new	0.500—0.504" (12.7—12.8 mm)
reconditioned	Min. 0.480" (12.2 mm)
Run-out	Max. 0.004" (0.1 mm)
Brake linings:	
Number per wheel	2
Thickness	0.421" (10.7 mm)
Effective area per wheel	14.3 sq.in. (92.5 cm ²)
Wheel unit cylinders:	
Number per wheel	3
Diameter, inner cylinder	2 1/8" (53.98 mm)
outer cylinders	1 1/2" (38.1 mm)
Tightening torque, inner bolts (12, Fig. 7-3)	45—50 lb.ft. (6.2—7 kgm)
outer bolts (13, Fig. 7-3)	25—30 lb.ft. (3.5—4.2 kgm)

REAR WHEEL BRAKES

Type	Drum brakes
Brake drums:	
Diameter	9" (228.6 mm)
Radial throw	Max. 0.006" (0.15 mm)
Brake linings:	
Width	2" (50.8 mm)
Thickness	3/16" (4.76 mm)
Length	8.66" (220 mm)
Effective area per wheel	34.56 sq.in. (223 cm ²)
Rivets for brake linings, size	11/64 x 7/64" (6.7 x 4.4 mm)
number per shoe	10
Wheel unit cylinder:	
Internal diameter	7/8" (22.23 mm)
Clearance between plunger and cylinder	0.0015—0.0035" (0.038—0.090 mm)
Return spring for brake shoe:	
Force required for an overall (external) length of:	
for upper spring 3.74" (95 mm)	22—27.5 lb (10—12.5 kg)
for lower spring 5.20 (132 mm)	17.6—22 lb (8—10 kg)

MASTER CYLINDER

Internal diameter	7/8" (22.23 mm)
Clearance between plunger and cylinder	0.0023—0.0049" (0.6—0.12 mm)

BRAKE LINES

External diameter	3/16"
Length, master cylinder — branch-off, left-hand drive	11 1/2" (292 mm)
branch-off — servo-brake cylinder	10" (254 mm)
servo-brake cylinder — branch-off	31 1/2" (800 mm)
branch-off — right-hand brake hose	30 3/4" (781 mm)
branch-off — left-hand brake hose	18 3/4" (476 mm)
brake hose — wheel unit cylinder	10" (254 mm)
branch-off — rear axle	83 1/2" (2120 mm)
branch-off — right-hand rear wheel	37 1/4" (946 mm)
branch-off — left-hand rear wheel	17 1/2" (445 mm)

SERVO-BRAKE CYLINDER

Make and designation	Girling AHV 550 MK 2
Diameter of vacuum cylinder	5 1/2" (139.7 mm)
Test values at a vacuum of 10 lb/sq.in. (0.7 kg/cm ²):	
Outgoing hydraulic pressure at an ingoing pressure of	
35.6 lb/sq.in. (2.5 kg/cm ²)	Min. 50 lb/sq.in. (3.5 kg/cm ²)
Outgoing hydraulic pressure at an ingoing pressure of	
50 lb/sq.in. (3.5 kg/cm ²)	Min. 95 lb/sq.in. (6.7 kg/cm ²)
Tightening torque, bolts for valve housing cover	2—3 lb.ft. (0.3—0.4 kgm)
bolts for vacuum cylinder	10—12 lb.ft. (1.4—1.8 kgm)
bolts for vacuum cylinder cover	2—3 lb.ft. (0.3—0.4 kgm)