

Section 5

Brakes

Service Procedures

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Brakes

Service Procedures

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Specifications

Front wheel brakes (disc brakes)

		Metric	US
Brake discs:	Diameter	263 mm	10.35"
	Thickness, new	14.3 mm	0.563"
	Min. thickness when reconditioned	13.14 mm	0.557"
	Max. warp	0.10 mm	0.004"
Brake linings:	Thickness, new	10 mm	0.394"
	Effective area, Girling	166 cm ²	25.7 sq.in.
	ATE	145 cm ²	22.5 sq.in.
Designation:	Girling	DB 818 FG	
	ATE	Ferodo 2441 FFG	
Wheel cylinders:	Area, Girling	10.25 cm ²	1.6 sq.in.
(4 per wheel)	ATE	10.17 cm ²	1.5 sq.in.

Rear wheel brakes (disc brakes)

		Metric	US
Brake discs:	Diameter	281 mm	11.06"
	Thickness, new	9.6 mm	0.378"
	Min. thickness when reconditioned	8.4 mm	0.331"
	Max. warp	0.10 mm	0.004"
Brake linings:	Thickness, new	10 mm	0.394"
	Effective area, Girling	100 cm ²	15.5 sq.in.
	ATE	105 cm ²	16.3 sq.in.
Designation:	Girling	DB 824 FF	
	ATE	Ferodo 2441 FFG	
Wheel cylinders:	Area, Girling	11.43 cm ²	1.8 sq.in
(2 per wheel)	ATE	11.33 cm ²	1.7 sq.in.

Master cylinder (tandem-type, step-bored)

Diameter:	secondary bore	15.75 mm	0.620"
	primary bore	22.3 mm	0.877

Brake lines

Outer diameter: 3/16"

Brake (reducer) valve (ATE BRM 18)

Operating pressure, 242 and 244	3 MPa	370 psi
245	4.5 MPa	640 psi

Power cylinder

Make: DBA, tandem 8"
Girling, tandem 8"

Ratio: 1:4

Parking brake

Brake drum:	Diameter	160.45 mm	6.32"
	Max. warp	0.15 mm	0.006"
	Max. out-of-round	0.2 mm	0.008"
Brake linings:	Effective area	176 cm ²	27 sq.in.

Tightening torques

Front brake caliper retaining bolts	90–100 Nm	65–70 lb.ft
Rear brake caliper retaining bolts	60–70	45–50
Wheel nuts	100–130	70–95
Master cylinder retaining bolts	30–50	20–35
Bleeder nipples	3.5–5.5	2.5–4.0
Brake pipe connections	8–12	6–9
Brake hose connections to brake (reducer) valve	12–16	9–12

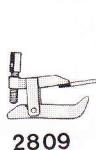
Group 50

Tools

Remarks

Brake calipers of make ATE are supplied for certain markets. Where the instructions for these differ from the other brake caliper make (Girling), the letters ATE will follow.

The following special tools are used for repair work on the brake system. The special tools are marked 999 or SVO (e.g., 999 2742 or SVO 2742).



2809



2917



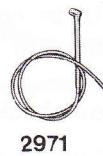
2918



2919



2920

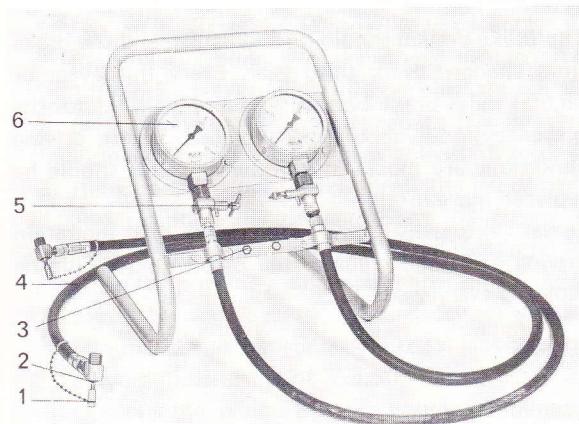


2971

Special tools

999 (SVO)

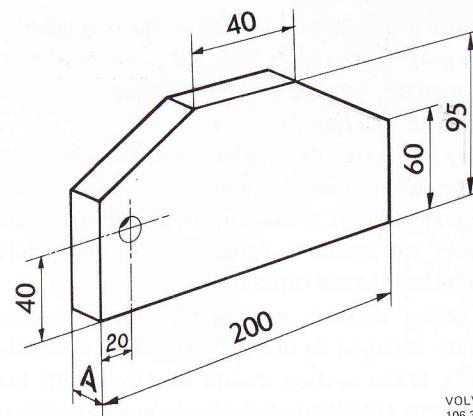
- 2809 Tool for pressing in piston
- 2917 Extractor for brake pads
- 2918 Tool for turning piston ATE
- 2919 Template for piston, ATE
- 2920 Nipple for testing, ATE
- 2971 Bleeder wrench



Tester 2741

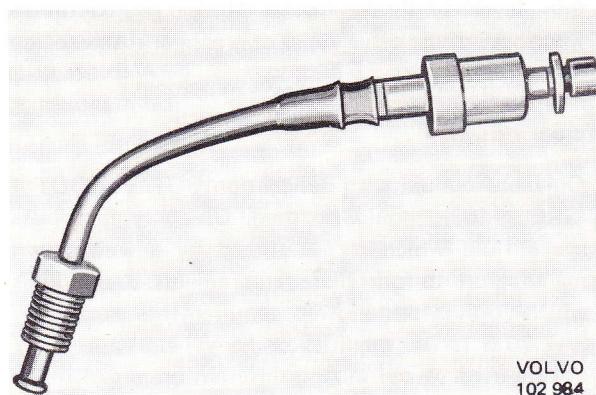
- 1. Protection cover
- 2. Connection nipple
- 3. Enlarging nipple
- 4. Hose
- 5. Bleeder tap
- 6. Pressure gauge

The tester 2741 is used to diagnose the brake system. Wooden inserts as shown facilitate removal of the brake caliper pistons. A brake bleeder unit of the type shown is required to maintain constant pressure when servicing the hydraulic system. A connection cover for the brake fluid container is also needed.

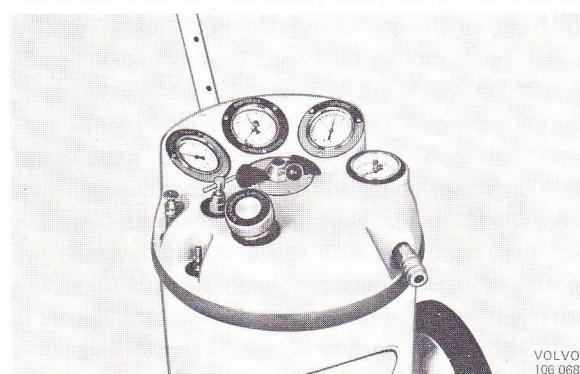
VOLVO
106 341

Wooden insert for brake calipers

AA = 15.5 mm (5/8") for front brake calipers
13 mm (1/2") for rear brake calipers



Connections



Bleeder unit

VOLVO
106 068

Cleaning

Hydraulic Brake System Component should be cleaned in clean brake fluid or special solvent which does not contain benzene (benzol).

Do **not** use gasoline, kerosene, trichloroethylene or alcohol with benzene for cleaning. Such solvents, as well as the slightest trace of mineral oil, attack rubber seals and cause them to swell out. For this reason, also hands should be washed with soap and water before internal parts are touched. It is an excellent idea to provide the mechanic working with hydraulic components with rubber gloves.

Final rinsing should be made in a cleaning agent free from impurities and after that the parts can be dried in the open air. Filtered and compressed air free from moisture can also be used.

It is very important that no alcoholic residue is left in the system when it is filled with brake fluid. Traces of cleaning alcohol in brake fluid reduces the boiling point and can result in formation of vapour which severely effects brake function.

After being cleaned and dried, the components should be emerged in brake fluid before assembling. Then the brake system should be filled with brake fluid as soon as possible in order to prevent corrosion attacks from air moisture.

To counteract corrosion on brake parts which are to be stored or for any other reason not emerged in brake fluid, coat plungers, cylinders and seals with a thin layer of brake paste. Under no condition whatsoever must other types of grease or rustproofing oil be used.

Brake Fluid

Only brake fluid with designation DOT 3 or DOT 4 (SAE J 1703) should be used. Use only first class brake fluid which is guaranteed by a well-known manufacture to fulfil these requirements. Brake fluids which only fulfil lower requirements (example: SAE 70 R 1, AE qualities or FS-VH-H 910 A) must not be used. Avoid mixing different brands of brake fluid.

Utmost cleanliness should be observed in order to prevent dirt from getting into the system when filling for instance the master cylinder. Only clean, unused brake fluid should be filled. Brake fluid which is expelled during, e.g. bleeding, must not be re-used.

During extended periods of time, it is normal that even first-class brake fluid gradually deteriorates through absorption of moisture and small impurities. Deteriorated brake fluid can be recognized by the fact that, compared with new brake fluid, it is darker or has changed colour, is relatively odourless and watery (that means when felt between the fingers it lacks the normal feeling of a light lubricating film). Such brake fluid should be replaced by new fluid. This should also be done when master cylinder and

wheel brake units are being overhauled. The brake should be overhauled and the brake fluid changed regularly, service scheduled at 45,000 miles or every third year. When driving under extremely hard conditions, like mountain driving or in humid climate, the brake fluid should be replaced every year.

Checking brake fluid level

Everytime the fuel tank is filled also the brake fluid level should be checked. The level in the master cylinder container should not be below the "Min" mark. This can be done without removing the cap. Every 6,000 miles or when necessary, top up to the "Max" container mark. Observe maximum cleanliness when filling fluid. Avoid spilling brake fluid onto paint work as it might be damaged. Check that the breather hole in the cap is not blocked.

Checking brake pads

Check the brake pads for wear regularly or at least every 6,000 miles. The pads should be replaced when they are worn down to a thickness of less than $1/8'' = 3$ mm. Under no circumstances must pads be worn down below $1/6'' = 1.5$ mm.

Function check

In addition to regular checks by the driver when driving, the brakes should be checked every 6,000 miles = 10,000 km. by a sharp point.

The service brake system should be checked to make sure that the function is correct. If necessary use proper testing equipment. Also check to make sure that there is no leakage and that the brake lines are not exposed to damage that may result in leakages. The parking brake should provide full braking power, the parking brake should be fully applied at notches 3–4. Otherwise adjust according to instructions.

Overhaul

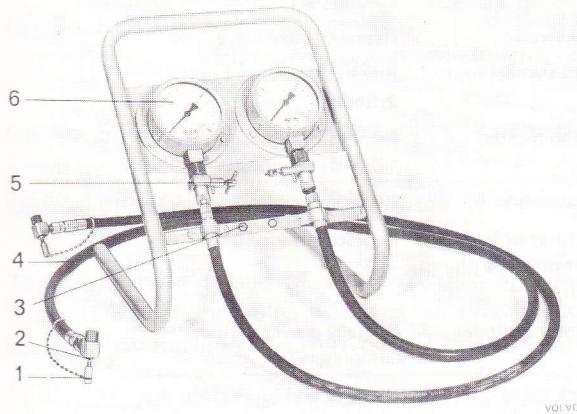
The brake system should be overhauled and the brake fluid changed every third year. Every third year or 45,000 miles brake system seals and air filter for the power cylinder should be replaced. Where driving conditions are mostly dusty the air filter should be replaced more often.

Under extremely hard conditions like mountain driving or humid climates the brake fluid should be replaced every year.

Service diagnosis

The following service diagnosis can be used when the service brake system is behaving unnormally or to prevent faults.

1. Check that the level of the brake fluid is up to the "Max" mark on the container. Top up if necessary.
2. Remove both inside bleeder nipples at one of the front brake calipers and connect tester 2741. For the ATF brakes also nipple 2920 is used.



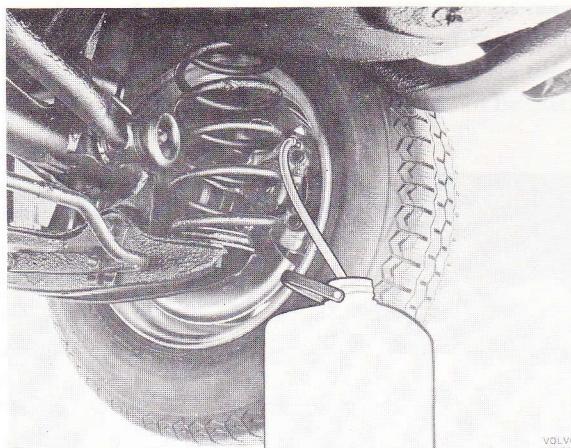
Tester 2741

- | | |
|----------------------|-------------------|
| 1. Protection cover | 4. Hose |
| 2. Connection nipple | 5. Bleeder tap |
| 3. Enlarging nipple | 6. Pressure gauge |

3. Depress the brake pedal several times to even out any vacuum in the power cylinder, thereby disconnecting it. When free, the brake pedal should be about level with the clutch pedal.
4. Apply and release the brake pedal while reading the pressure gauges of the tester. The pressure in both circuits should be observed. At 1420 psi = 100 kp/cm², the pressure must not differ more than 43 psi = 3 kp/cm².
5. Use an assistant or a pedal jack to apply the footbrake. Obtain a brake pressure of approx. 1420 psi = 100 kp/cm². Check pipes hoses and parts for damage and leakages. The pressure should remain unchanged for at least 15 seconds.
6. Remove the pedal jack. Depress the brake pedal and maintain the pressure. Start the engine. A considerable lowering of the pedal should be felt when the power cylinder starts operating.
7. Stop the engine after running for at least 1 minute. Use an assistant or a pedal jack to apply a hydraulic pressure of 355 psi = 25 kp/cm². Observe the pressure for a couple of minutes. The hydraulic pressure is not allowed to drop more than 70 psi = 5 kp/cm².
8. Check the warning valve. Connect the testing device to one of the bleeder nipples. Open. Apply the footbrake slowly with a

pedal jack. Check the pressure gauge when the warning light comes on. It should come on at the pressure difference of 70–210 psi = 5–15 kp/cm² between the circuits.

After testing, shut off the bleeder nipple and remove pedal jack.



VOLVO
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9. Check the brake (reducer) and (valve) of one circuit. Connect the tester to the bleeder nipple on the left rear wheel brake and to the upper nipple on one of the front wheel brakes. Apply the footbrake with the pedal jack and increase incoming pressure according to the table.

Model	Incoming pressure kp/cm ² (psi)		Outgoing pressure kp/cm ² (psi)	
242–	30	(427)	30	(427)
244	50	(711)	36–42	(512–597)
	100	(1422)	50–59	(711–839)
245	45	(640)	45	(640)
	65	(924)	52–57	(739–810)
	100	(1422)	62–69	(882–981)

Read incoming pressure on the pressure gauge for the front wheel brake. Read outgoing pressure on the gauge which is connected to the rear wheel brake.

The brake valve is correct if the pressure remains unchanged for at least 15 seconds.

10. Check the other brake valve the same way. Connect the tester to the right rear wheel brake and the inner, lower nipple of the front wheel brake.
11. Check up the vehicle so that the wheels rotate freely. Apply and release the brake. The wheels should be free half a second after the pedal has been released. The test should be made with and without vacuum in the power brake cylinder.

Service diagnosis

Test operation	Condition	Cause	Correction
3	Pedal too low or too high	Incorrect adjustment	Adjust
4	Fading pressure	Damaged brake line	Replace the damaged line
		Blocked hose	Replace hose
	Difference between circuits	Blockage in one of the circuits	See point 5
5	2.7 psi	Defective adjustment	Recondition master cylinder
	Pressure drops	External leakage	Tighten connections and replace line of recondition leaking part
		Leaking brake valve	Replace brake valve
		Leaking seal in wheel unit cylinder	Recondition wheel unit cylinder
		Leaking seal in master cylinder	Recondition master cylinder
6	The pedal does not go down	Leaking vacuum line	Replace vacuum line
		Blocked air filter or leaking seal for front pressure plunger in servo cylinder	Replace filter or seal
		Defective power cylinder	Replace power cylinder completely
7	The pressure drops more than 5 kp/cm ² (71 psi)	Leaking check valve	Remove and blow clean the valve and replace the seal ring. If insufficient, replace check valve.
		Leaking seal for outgoing thrust rod in power cylinder	Remove master cylinder and replace seal
		Internal fault in power cylinder	Replace power cylinder complete
	Pressure increases	Leaking rear sealing ring in power cylinder	Replace rear sealing ring
8	The parking brake warning lamp does not light	Wrongly adjusted switch Defective electrical parts	Adjust the switch Replace defective parts
	Footbrake warning lamp does not light	Defective switch	Replace switch
	Warning lamp does not go out when pistons have returned to normal position	Pistons seize	Replace warning valve
	Warning when pressure difference is other than 5–15 kp/cm ² (7–213 psi)	Defective warning valve	Replace valve
	9–10	Incorrect outgoing pressure	Defective valve
11	All wheel brakes fade	Incorrectly adjusted front pressure plunger in power cylinder	Adjust the pressure plunger
	A circuit fades	Blocked equalizing hole in master cylinder	Recondition the master cylinder
	The rear wheel brakes fade	Parking brake cable chafes Incorrectly adjusted parking brake	Replace the cable Adjust the parking brake
	A wheel brake fades	Defective brake valve Damaged brake line Blocked hose Worn sealing ring	Replace brake valve Replace line Replace hose Recondition wheel brake unit

Group 51

Wheel brake units

Replacing brake pads

Op. No. 517 = **Brake pads four wheels, replace**

Incl.: adjust parking brake, check piston movements, remove/install wheels

Op. No. 51721 = **Brake pads, replace**

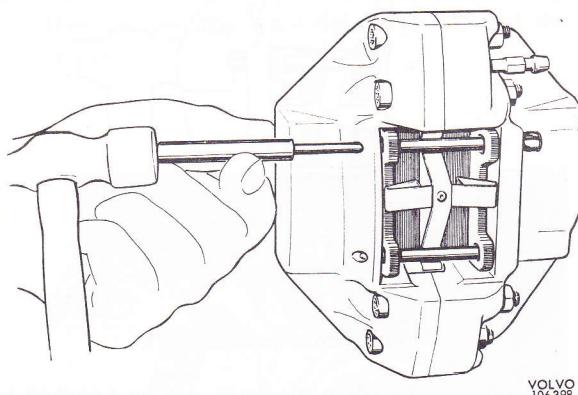
Incl. check piston movements, 2 wheels

Op. No. 51754 = **Brake pads and discs, 2 wheels, check**

Op. No. 51768 = **Brake pads and discs, 4 wheels, check**

The brake pads should be replaced when approx. 3 mm (1/8") of the lining thickness remains. On no account may the linings be worn down below 1.5 mm (1/16").

1. Remove the hub caps and slacken the wheel nuts slightly.
2. Jack up the vehicle and put stands under the rear axle and front jack attachments. Remove the wheel nuts and lift off the wheels.
- 3a. Girling: Remove the hairpin-shaped locking clips for the guide pins. Pull out one of the lock pins while holding the damper springs in place.
Remove the springs and the other lock pin.
- 3b. ATE: Tap out the upper guide pin with a drift, diameter 2.5 mm (9/64"), see Fig.

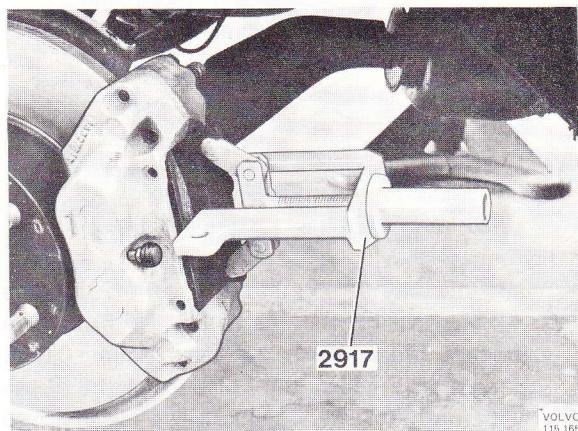


Removing guide pin, ATE

Take out the tensioning spring. Tap out the lower guide pin.

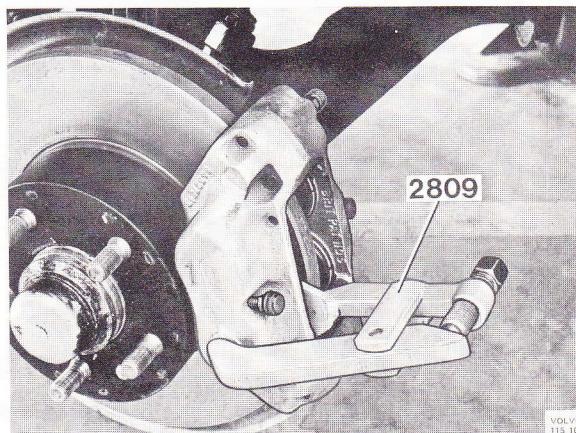
4. Pull out the pads with tool 2917, see Fig.
If the used pads are to be re-installed, mark them to ensure they are restored to their original position.

5. Carefully clean out the cavity in which the pads are located. Replace any dust covers that are damaged. If dirt has penetrated into the cylinder due to a damaged cover, recondition the brake unit. Check the friction area of the brake disc. Grind off rust, the brake pads should not be used for such removal.



Removing brake pads

6. To provide room for the new brake pads, press the pistons into the cylinders. The pistons can be pressed in evenly and without risk with tool 2809 according to Fig. below:

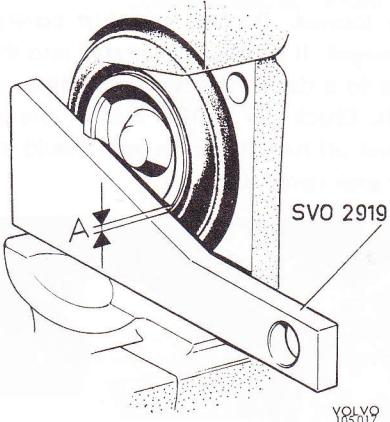


Pushing in piston

If done properly, the pistons can be pressed in perhaps more rapidly with another tool in the same way but, for example, if a screwdriver is used and wrongly applied, the pad, rubber seal and piston may be damaged. Note that when pressing in the pistons, the fluid brake level in

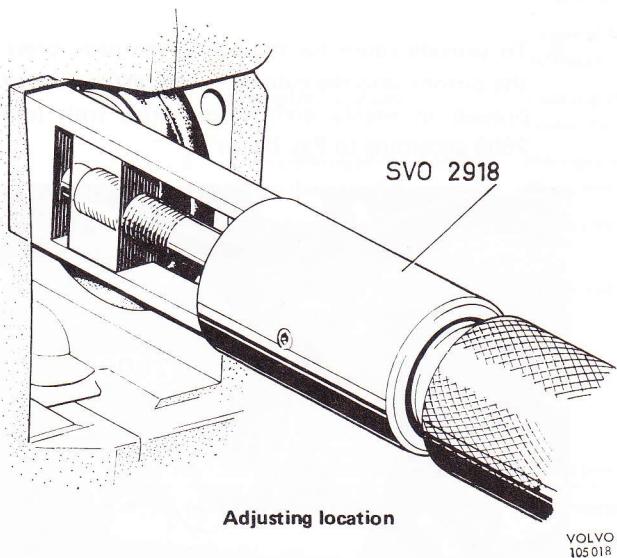
the container rises so that the brake fluid can spurt out.

7. Rear wheel brakes ATE: Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check position with template 2919, see Fig.



Checking location

The tolerance is $\pm 2^\circ$, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm = 0.04". If necessary, adjust the location of the piston with tool 2918. To do this, move the tool into position, see Fig:



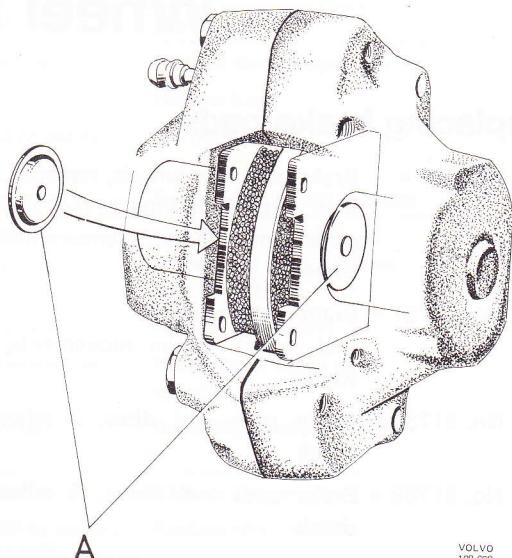
Adjusting location

Press the tool against the piston and force out the shoes by screwing in the handle. Turn the piston, release the tool and re-measure with the template.

- 8a. Girling: Install the new pads. If the caliper previously has been equipped with intermediate plates between pad and caliper, they should be re-installed.

If, on the other hand, round damper washers previously have been installed, they should be

re-installed, the smaller contact face towards the pad. Use a feeler gauge for the installation, never grease or glue. See Fig.

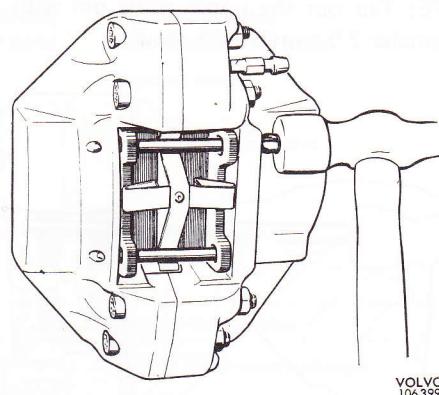


Rear brake caliper

A. Damper washers

Intermediate plates must not be installed in calipers equipped with round damper washers. Position one of the lock pins and install the damper springs and the other lock pin. Fix the pins with new locking clips. Check that the pads are movable.

- 8b. ATE: Install the new pads. Place one of the guide pins in position and tap it in with a hammer without help from a tool, see Fig:



Installation of guide pin, ATE

NOTE: The guide pin must not be knocked in with a drift which has a diameter smaller than the pin since the tensioning sleeve can then shear off the pin flange. Install a new tensioning spring for the pads. Install the other guide pin while pushing in the tensioning spring. Check that the pads can move.

9. After replacing brake pads, depress the brake pedal several times to check that the movement

is normal. Generally, the system does not require bleeding after replacing the brake pads.

10. Re-install the wheels after cleaning the contact surfaces and brake disc of sand, dirt, etc. Tighten the nuts sufficiently so that the wheels are securely held. Lower the vehicle and tighten finally the wheel nuts. Tighten each other nut a little at a time until all are finally tightened to a torque of 100–140 Nm (70–100 lb ft). Install the hub caps.

N.B. The function and lifetime of the linings will benefit if lengthy and hefty braking is avoided in the beginning.

Reconditioning wheel brake units

When working with the hydraulic system, observe the instructions under "Cleaning" and "Brake Fluid", Group 50.

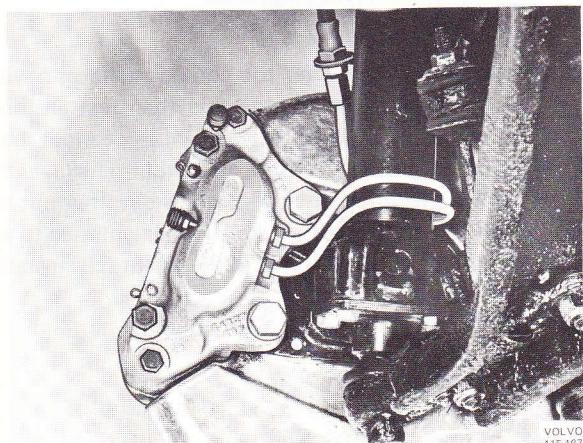
Front brake calipers

REMOVAL

Op. No. 52331 Brake caliper, front, rebuild one

Incl. remove and install caliper, replace piston seals and pads

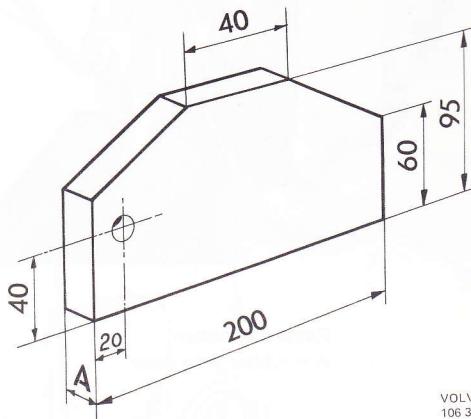
1. Remove the hub caps and slacken the wheel nuts slightly. Temporarily block the vent-hole in the brake fluid container cover to reduce leakage.
2. Jack up the front end and put stands under the front jack attachments. The control arms should be off-loaded so that the brake hoses can be installed in the correct position. Remove the wheel nuts and lift off the wheels.
3. Disconnect the brake lines at the caliper. See Fig. Then remove the retaining screws (2) and the caliper.



Front wheel brake

DISASSEMBLY

1. Remove the brake pads, see operations 3a and 3b under "Replacing brake pads".
2. Remove the retaining rings and the rubber dust covers. Place a wooden disc, see Fig. between the

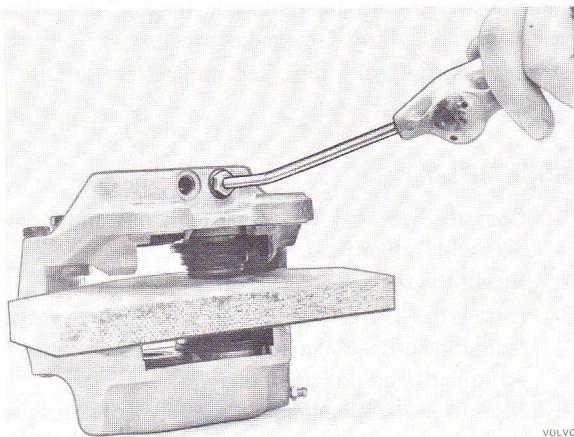


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Wooden insert for brake calipers

AA = 15.5 (5/8") for front brake calipers
13 mm (1/2") for rear brake calipers

pistons and press them out towards the disc with air see Fig.



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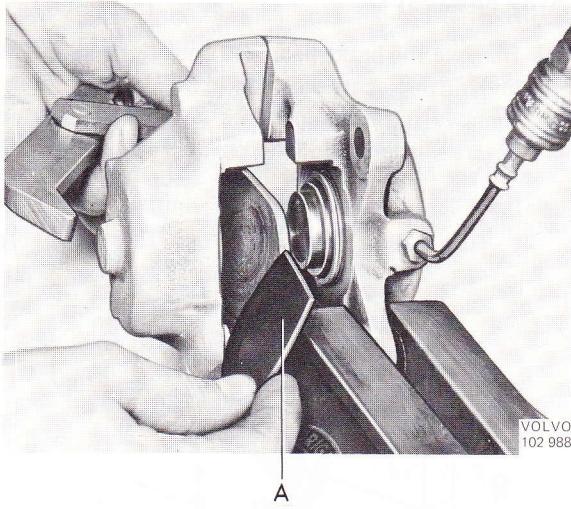
Removing pistons

1. Wooden disc

The pistons can then be easily removed. If a piston feels stiff to remove, use air pressure. Lever off the rubber covers.

3. Remove the seals with a blunt tool. Be carefull not to damage the edges of the grooves. Screw out the bleeder nipple and brake lines.

The brake caliper halves should not be separated. The reason for this is that subsequent assembly would require test pressure equipment and special fluid for the bolts.



Removing piston
A = rubber dust cover

VOLVO
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INSPECTION

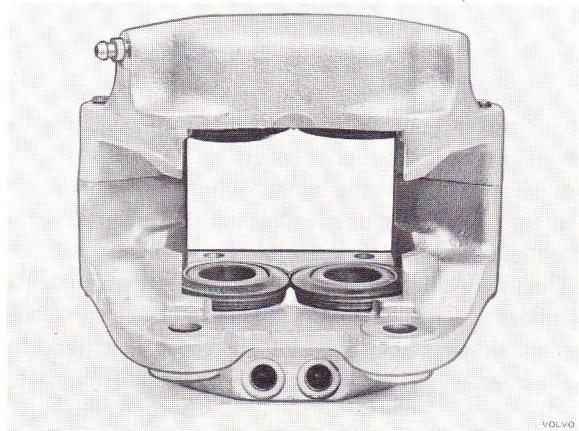
Before inspection, clean all the parts according to the instructions under "Cleaning", Group 50. Make sure the channels are clean.

Seals and rubber dust covers should be replaced. If cylinders are scored or scratched the complete cylinder housing should be replaced. Inspect the other parts and replace any damaged or worn.

Check also the brake disc, see under "Brake Disc", page 5-13

ASSEMBLY

1. Coat the working surfaces of pistons and cylinders with brake fluid.
2. Install the seals in the cylinders.
3. Install the pistons with the large diameter end facing inwards. Make sure the pistons are installed straight and not scratched.
4. Install the rubber cover on the piston and housing. Install the lock rings (Girling), see Fig.

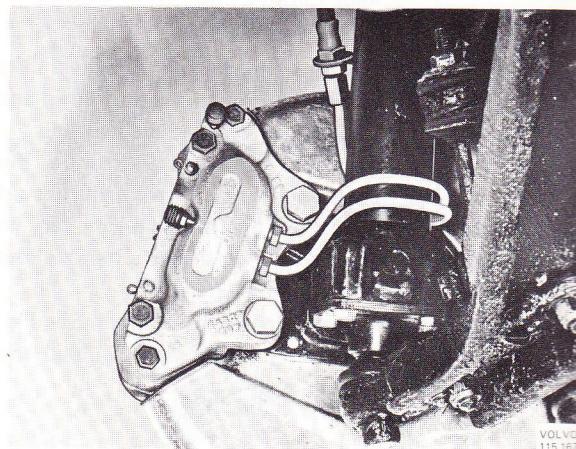


Front brake caliper

5. Install brake pads, see operations 8a and 8b under "Replacing brake pads".
6. Install bleeder nipples and brake lines.

INSTALLATION

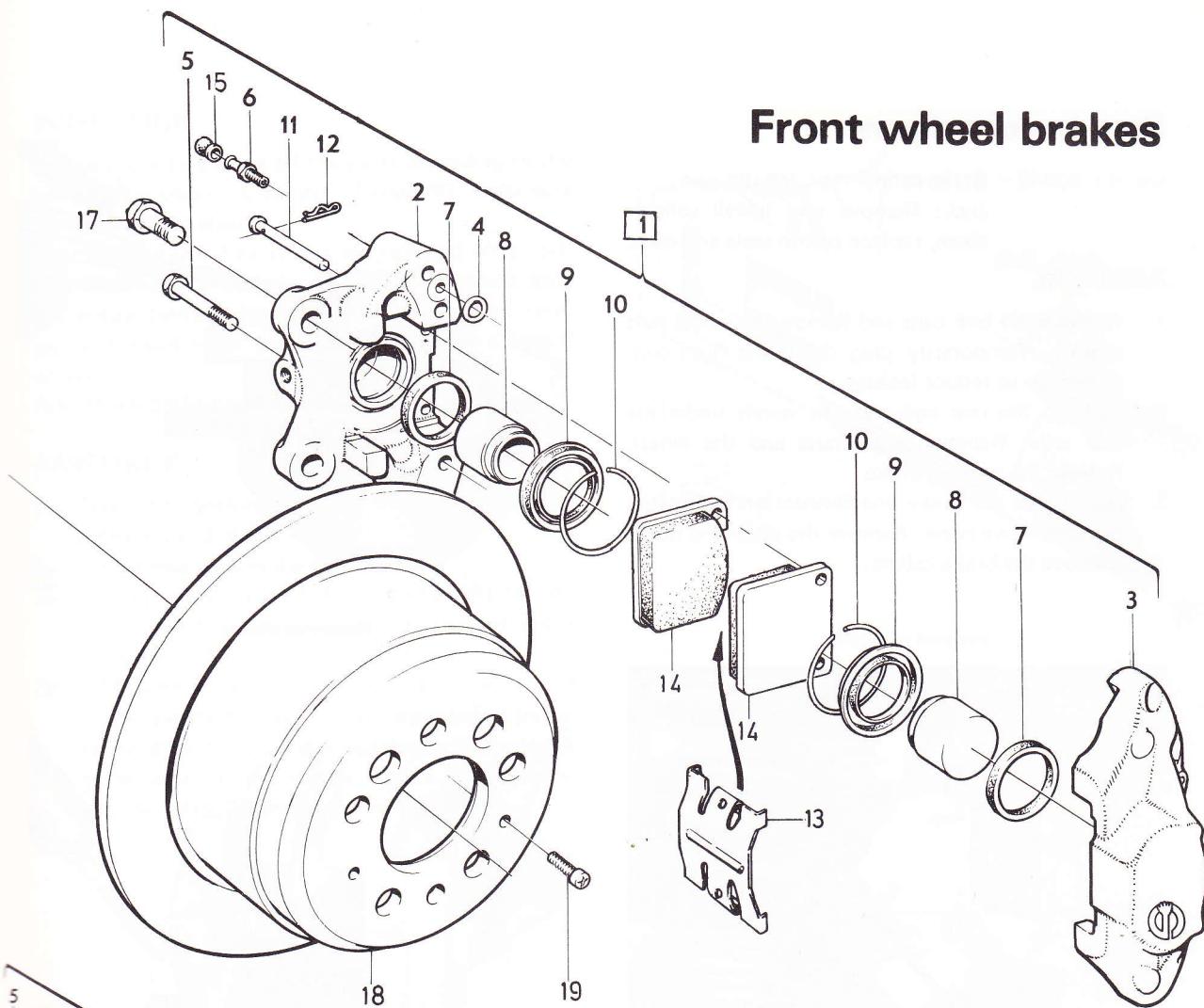
1. Position the calipers. Check that the contact surfaces of the retainer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc. Axial deviation is checked with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. The difference in measurement is max. $0.022'' = 0.010$ mm. The caliper should be parallel with the disc. This is checked by measuring the distance to the upper and lower support nibs in the caliper. The location of the brake caliper can be adjusted with shims, which are available in thicknesses of $0.008''$ and $0.016'' = 0.2$ and 0.4 mm. Install the attaching bolts after they have been coated with a couple of drops of Loctite, type AV. Check that the brake disc can rotate easily in the brake pads.
2. Connect the brake lines to the caliper. Remove the plug in the master cylinder reservoir cover.



Front wheel brake

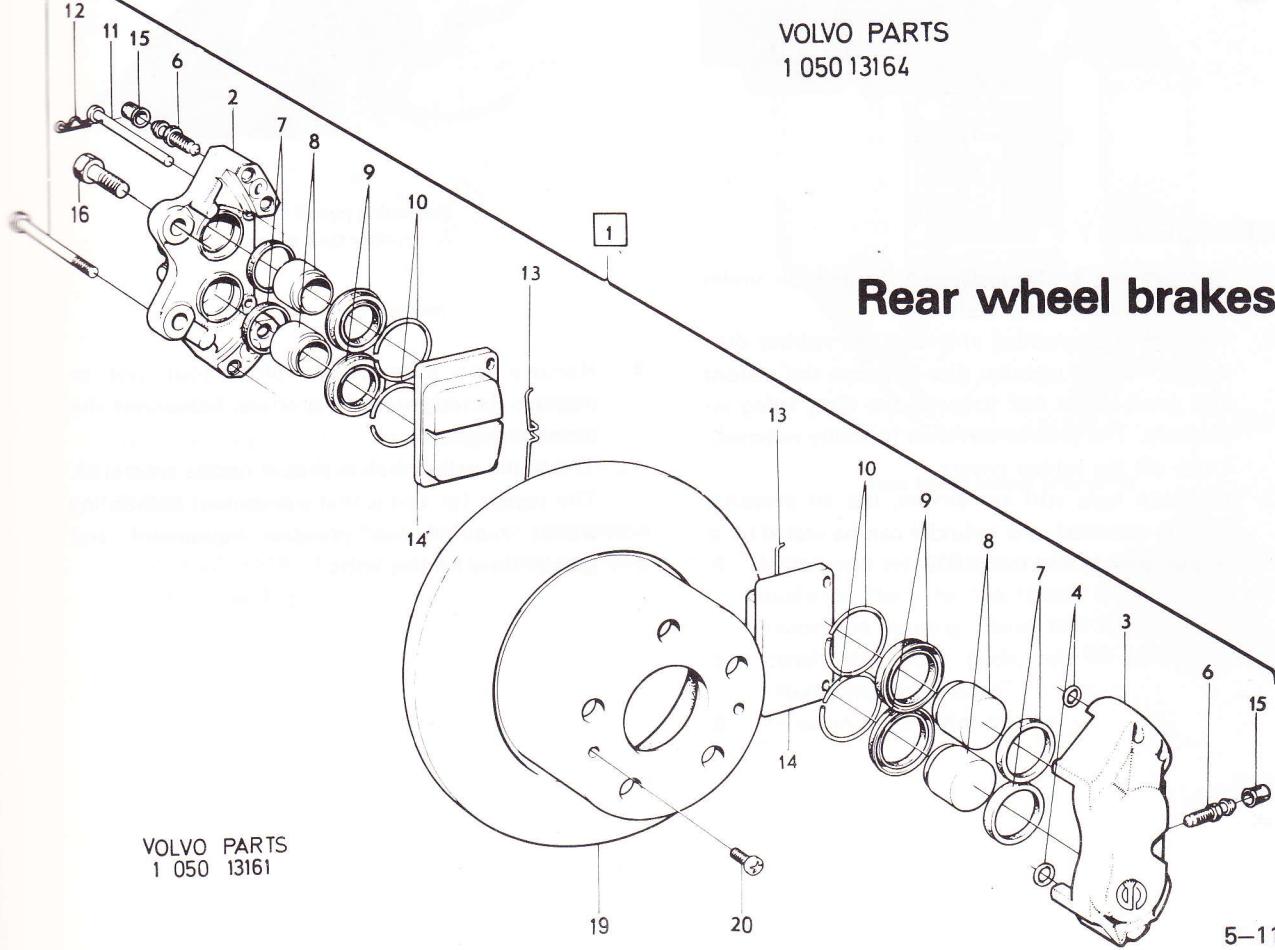
3. Install the wheel after the contact surfaces have been cleaned of dirt, etc., and then tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the vehicle and tighten the wheel nuts. Tighten every other nut a little at a time until all are finally tightened to a torque of 100–140 Nm (70–100 lb ft). Install the hub cap.
4. Bleed the brake system, see Group 52.

Front wheel brakes



VOLVO PARTS
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Rear wheel brakes



VOLVO PARTS
1 050 13161

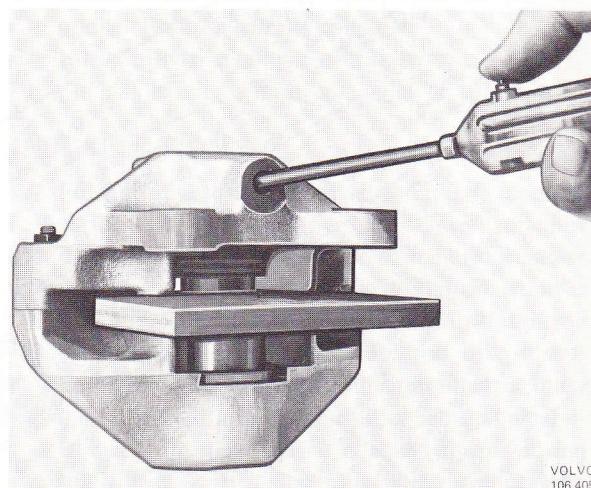
Rear brake calipers

Op. No. 52335 = Brake caliper rear, rebuild one

Incl.: Remove and install caliper,
clean, replace piston seals and pads.

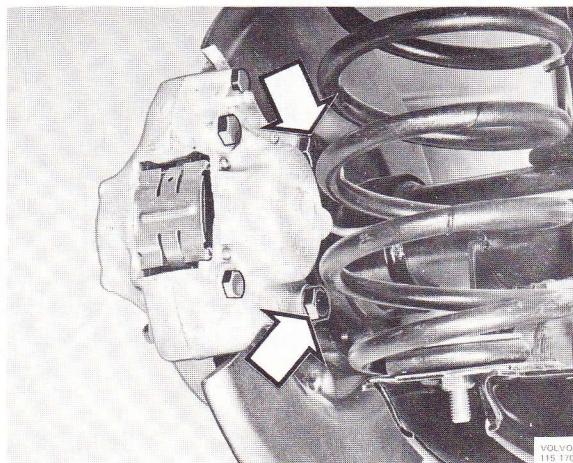
REMOVAL

1. Remove the hub caps and slacken the wheel nuts slightly. Temporarily plug the brake fluid container cap to reduce leakage.
2. Jack up the rear end and put stands under the rear axle. Remove wheel nuts and the wheel. Release the parking brake.
3. Disconnect the brake line connection and install the protective cover. Remove the attaching bolts. Remove the brake caliper.



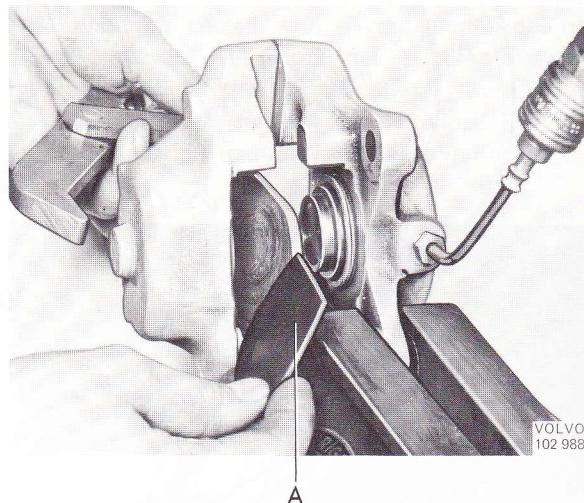
VOLVO
106 405

Removing piston



VOLVO
115 170

Rear wheel brake



VOLVO
102 988

Removing piston
A = rubber dust cover

DISASSEMBLY

1. Remove the brake pads, see 3a and 3b under "Replacing the brake pads".
2. Remove the retaining ring and the rubber dust covers. Place a wooden disc between the pistons and press them out towards the disc, using air pressure. The pistons can then be easily removed. Lever off the rubber covers.
3. If piston feels stiff to remove, use air pressure, see Fig removed, the cylinder can be sealed by a rubber washer and tool 2809:

4. Remove the seals with a blunt tool, not to damage the edges of the grooves. Screw out the bleeder nipple.
The brake caliper halves should not be separated. The reason for this is that subsequent assembling would require test pressure equipment and special fluid for the bolts.

INSPECTION

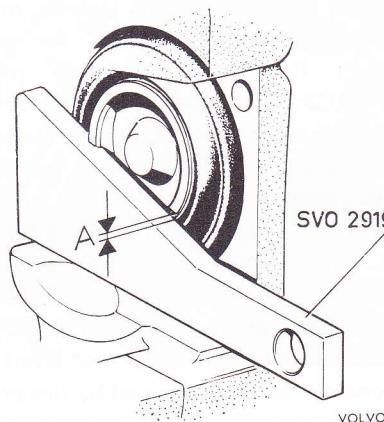
Before inspecting clean all the parts according to the instructions under "Cleaning", Group 50. Make sure the channels are clean.

Seals and rubber dust covers are replaced after each reconditioning. If cylinder is scored, scratched, etc., the entire cylinder housing must be replaced completely. Inspect other parts and replace any damaged or worn.

Also check brake disc, see "Brake Disc".

ASSEMBLY

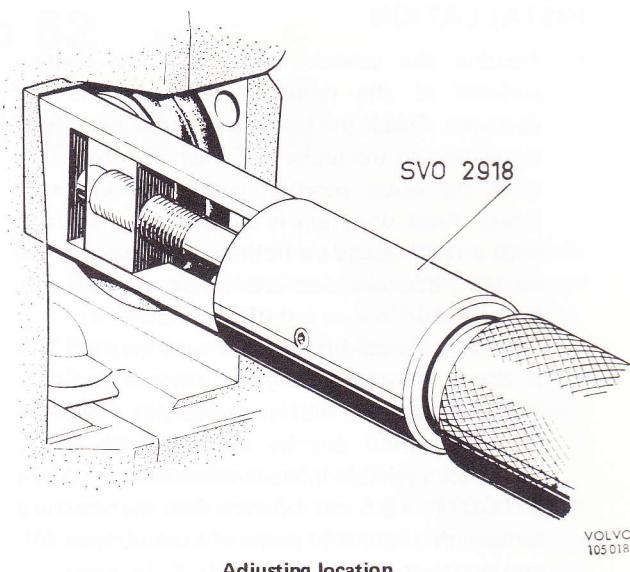
1. Coat the working surfaces of the pistons and cylinders with brake fluid.
2. Install new seals in the cylinders.
- 3a. Girling: Install one of the pistons in the caliper. Make sure the piston is installed straight and is not scratched.
- 3b. ATE: Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check the location with template 2919, see below:



Checking location

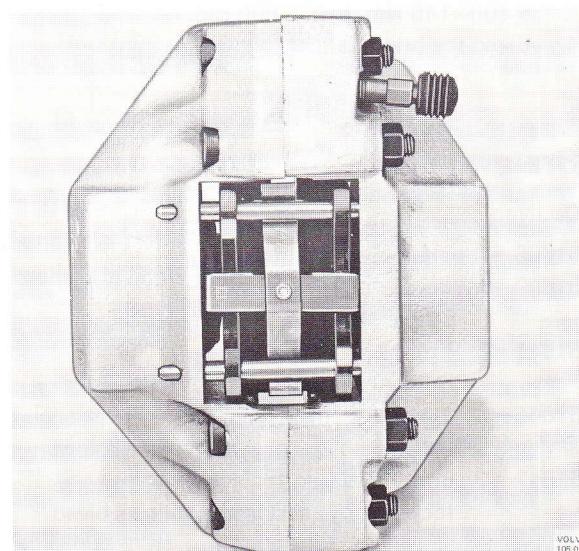
The tolerance is $\pm 2^\circ$, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. $0.040'' = 1 \text{ mm}$.

If necessary, adjust the location of the piston with tool 2918. To do this, move the tool into position, see Fig:



Adjusting location

Press it against the piston and force out the shoes by screwing in the handle. Turn the piston, release the tool and re-measure with the template.



Rear brake caliper assembled

4. Install and test the other piston in the same way as above. Place the new rubber dust covers on the piston and housing. Install new retaining rings.
5. Install the brake pads, see 8a and 8b under "Replacing brake pads".
6. Screw in the bleeder nipple.

INSTALLATION

1. Position the caliper. Check that the contact surfaces of the retainer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc when the drive shaft is at the outer position within the clearance limits. Axial deviation is checked by measuring with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. Permitted difference is $0.010'' = 0.25$ mm. The caliper should be parallel with the disc. This is checked by measuring the distance to upper and lower support nibs on the caliper. The brake caliper location can be adjusted with shims, which are available in thicknesses between 0.024 and $0.072'' = 0.6$ and 1.8 mm. Coat the attaching bolts with a couple of drops of Loctite, type AV, and then install them.
2. Connect the brake line. Remove the plug for the breather hole in the brake fluid container cover.
3. Clean the wheel contact surfaces and disc before installation of the wheel. Tighten the wheel nuts so much that the wheel cannot be moved. Lower the vehicle and tighten the wheel nuts finally. Tighten every other nut a little at a time until all are finally tightened to a torque of $10\text{--}100$ lb.ft = $100\text{--}140$ Nm. Install hub cap.
4. Bleed the brake caliper, see Group 52.

Brake disc

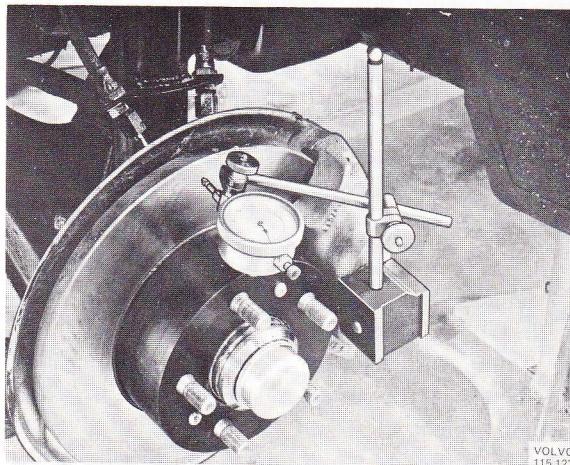
Op. No.

- 51603 = Brake disc run-out
51639 = Brake disc rear, replace
caliper removed
51641 = Front brake disc, replace
caliper removed
51645 = Brake disc, front, replace
Incl.: remove and install caliper, bleed
51647 = Brake disc rear, replace
Incl.: remove and install caliper, bleed

The brake disc should be examined with regard to friction surface, warp and thickness.

Small marks on the friction surface or linings are of minor importance, but radial scratches reduce the

braking effect and increase pad wear. The warp must not exceed $0.004'' = 0.1$ mm for the front wheel brakes and $0.006'' = 0.15$ mm for the rear wheel brakes at the outer edge of the disc and is measured.



Checking warp

VOLVO
115-123

First check that the wheel bearings are correctly adjusted and that the disc fits securely on the hub. The thickness is measured with, for example, a micrometer. It should not vary more than $0.0012'' = 0.03$ mm when the disc is rotated one turn, since this can cause a vibrating brake pedal.

If a fault is discovered during the inspection, the brake disc should be replaced.

When doing this, the brake caliper should first be removed. Then remove the lock bolts and lift off the brake disc. Tap on the inside of the disc with several light blows from a plastic hammer or similar tool.

If for some reason a new brake disc is not available, the old one can be reconditioned by fine-polishing or fine-turning. Accurate disc aligning is required and the turning should be equal on both sides.

After turning, the disc thickness may not be more than $0.050'' = 1.2$ mm less than original thickness, see "Specifications". The surface finish should be max. 3μ measured on an arbitrary diameter and max. 5μ measured radially. After reconditioning, the disc warp may not exceed $0.004'' = 0.1$ mm, and its thickness may not vary more than $0.0012'' = 0.03$ mm.

Group 52

Hydraulic Footbrake System

MASTER CYLINDER

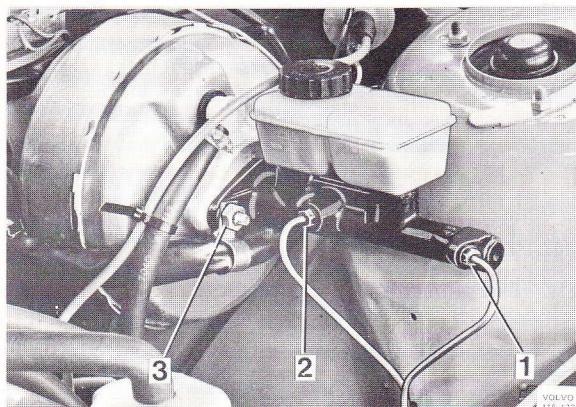
Op. No. 52114 = rebuild or replace master cylinder

When the master cylinder is removed, the brake pedal should not be depressed because the resulting abnormal position of the power cylinder parts may cause damage.

REMOVAL

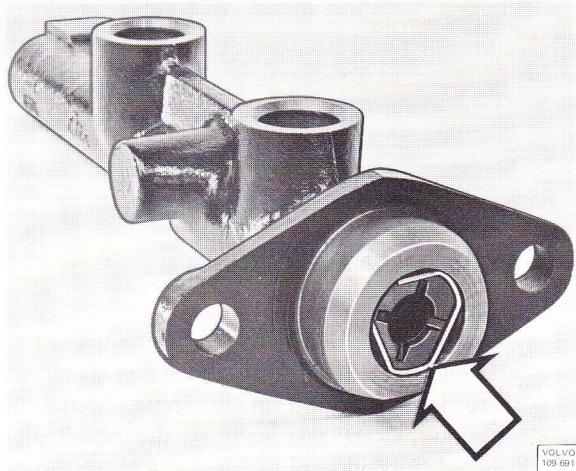
Place a cover over the fender and rags under the master cylinder in order to avoid possible damage to the paintwork from the brake fluid.

Remove brake lines (1 and 2, Fig. below) and fit plastic plugs. Then remove the retaining nuts (3) and remove the cylinder.

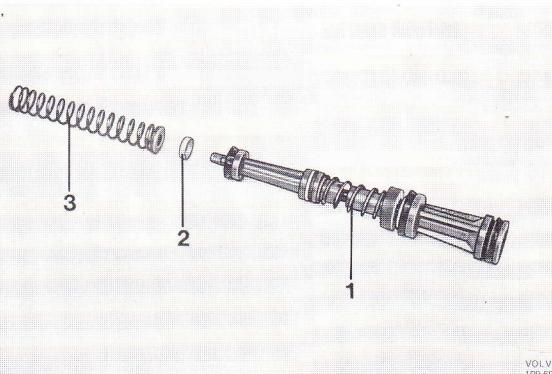


OVERHAUL

1. Remove filler cap and strainer and drain the cylinder for brake fluid.

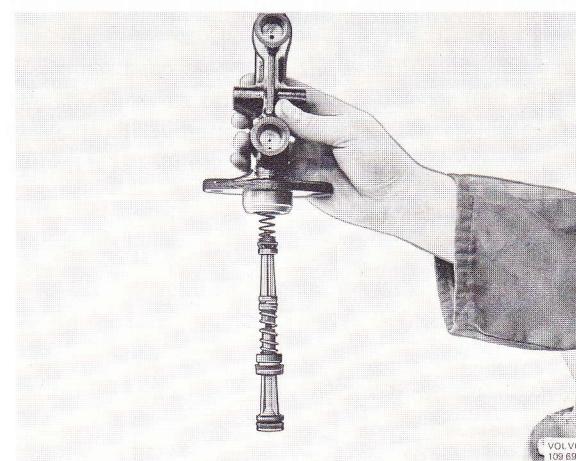


2. Remove the container by pulling it upwards. Remove the container seals from the master cylinder.
3. Remove the snap ring (Fig. below) Remove pistons and return spring.
4. Clean the master cylinder and all parts in alcohol or other suitable solvent. Blow compressed air through equalizing and overflow hole.
5. Examine the inside of the cylinder carefully. If scored or scratched, the cylinder should be replaced. Both pistons with connector sleeve and seals are replaced as an assembly.
6. Coat the cylinder with brake fluid and lubricate the piston seals with special brake grease (available at vendors). Then install pistons, spring seat and spring, see below:



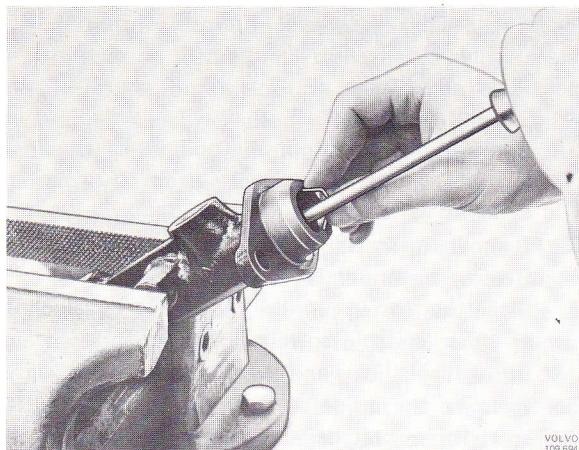
VOLVO
109 692

1. Piston assembly
 2. Spring seat
 3. Spring
7. Position the cylinder over the pistons and the spring:

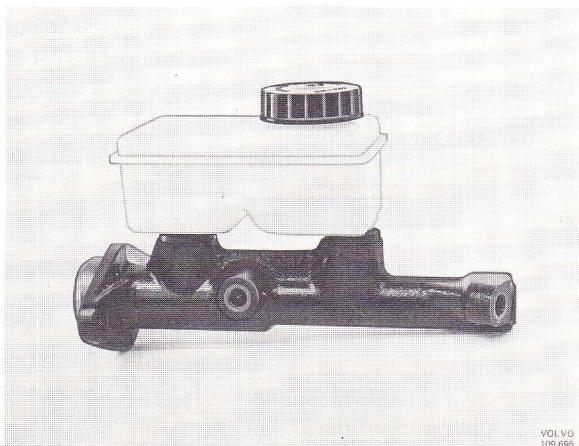


VOLVO
109 693

8. Install the snap ring for the pistons.



9. Install the brake fluid container with seals.



INSTALLATION

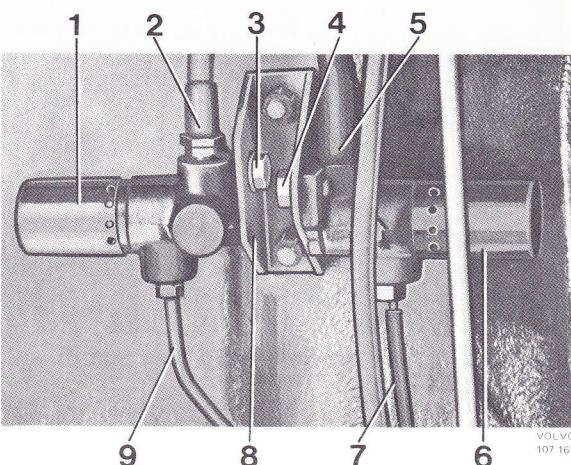
Position the master cylinder and install the retaining nuts. Connect the brake lines and bleed the brake system according to instructions.

Brake (reducer) valves

Op. No. 52431 = Replace brake reducer valve, one side, excl. bleed

CHECKS

For checking the brake valve with tester 2741, see separate instructions. The valve cannot be repaired if defective and must be replaced.

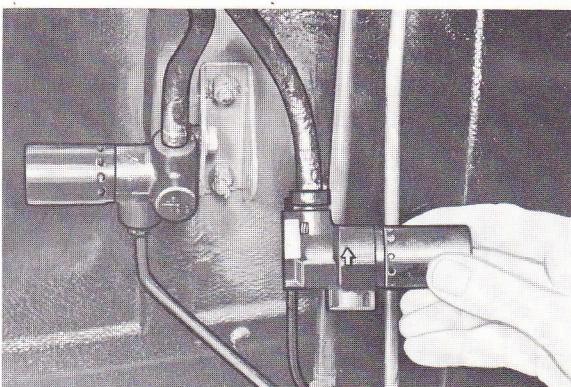


Brake valves

1. Left brake valve	6. Right brake valve
2. Brake hose to left rear wheel	7. From the master cylinder
3. Attaching screw	8. Bracket
4. Attaching screw	9. From the master cylinder
5. Brake hose to right rear wheel	secondary circuit

REPLACEMENT

1. Disconnect and plug connection (9) of the brake pipe. Loosen brake hose (5) maximum 1/4 turn at the valve. Remove attaching screw and valve from the brake hose:



Removing brake valve

2. Screw the new brake valve onto the brake hose with new seal. Position the valve and check that there is no tension in the hose. Install the attaching screw and connect the brake pipe. Tighten the connection. Bleed the brake system.

Brake lines

CLEANING

The brake lines can be cleaned by flushing with brake fluid or alcohol and then by blowing them clean with moisture-free, filtered, compressed air. This is to remove all brake fluid and dirt particles and should be made in connection with reconditioning of the hydraulic system and a new fitting.

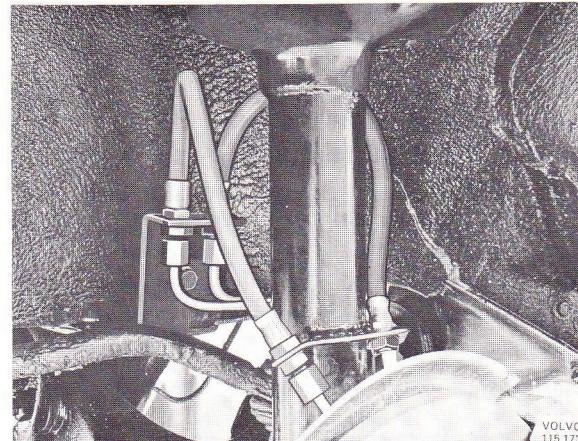
When reconditioning made, the brake service unit (see Group 50) can be connected to the master cylinder and then the system emptied through the bleeder nipple. The system should therefore be flushed with alcohol and blown clean with compressed air. The components of the hydraulic system should be taken out and checked to ensure that any dirt and flushing fluid have been effectively removed.

NOTE: See general instructions in Group 50 for requirements concerning cleaning agent. Do not top up with brake fluid which has been drained from the system.

REPLACING BRAKE LINES

If leakage occurs or if the brake lines have been exposed to such external damage that leakage or blockage can result, the damaged lines should be replaced according to instructions below. If the replacement concerns the front brake hoses, it should be made with no load on the front wheels.

1. To prevent unnecessary spilling of brake fluid, the existing filter cap on the master cylinder container should be temporarily replaced with one without breather hole.
2. Clean round the connections and remove the damaged brake line.
3. Take a new brake line, blow it clean internally with moisture-free, filtered, compressed air and fit it. Make sure the brake line lies in such a position that it does not chafe against anything during driving. Particularly important points are where the pipes pass the steering rod, where they must not come nearer than 10 mm (3/8").
If the pipe is not bent correctly, it should be adjusted manually **before** being installed. Bending a pipe which is already connected often results in deformation at the connections. The front brake hoses may only be installed according to following Fig..



Front wheel brake hoses

4. Bleed the brake system according to instructions below. Then re-install the filler cap with the breather hole on the container.

BLEEDING HYDRAULIC SYSTEM

Op. No. 52037 = Bleed all four wheel brakes

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

As soon as any part of the system has been removed, bleeding must be made. Air can also enter the system if there is too small a quantity of brake fluid in the container. If only one rear brake caliper has been removed and little brake fluid runs out, it is generally only necessary to bleed the brake caliper. Otherwise, bleed the entire system.

No brake fluid must be permitted to come into contact with friction surfaces or linings. Avoid spilling any fluid on the paintwork as this can damage it.

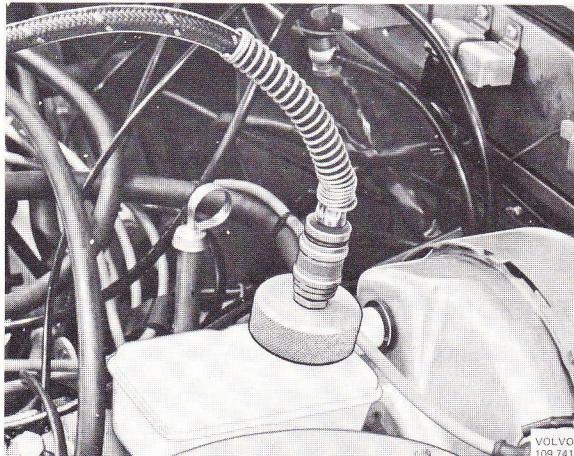
Should the car be on stands during the bleeding, the rear end should be higher than the front end.

When filling oil, the following should be observed: The brake fluid must fulfil the requirements according to DOT 3 or DOT 4 SAE J 1703). Brake fluid which has been bled from the system must under no circumstances be returned to the bleeder unit or the brake fluid container. Bleeding of the entire brake system is as follows:

BLEEDING THE BRAKE SYSTEM WITH BLEEDER UNIT

This procedure concerns bleeding when the brake master cylinder has been emptied of brake fluid. If the master cylinder has not been emptied, disregard 9, 10 and 11.

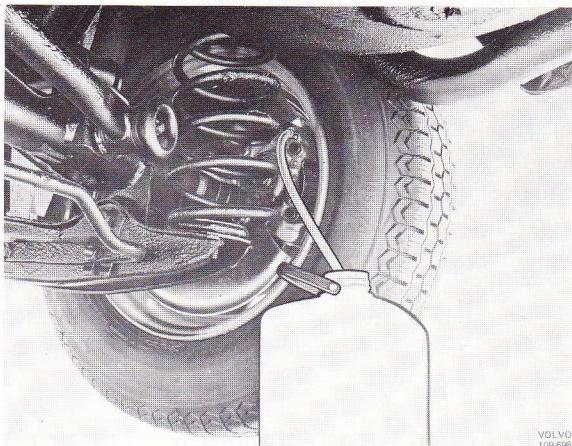
1. Put the vehicle on stands and remove the front wheels.
2. Connect the bleeder unit to the brake fluid container (Fig. below) and set the work pressure to $3.5-4 \text{ kp/cm}^2 = 50-60 \text{ psi}$.



3. Start on left front wheel. Connect hoses to all three bleeding nipples and route them into a collecting vessel:



4. Open the three bleeding nipples. Pump the brake pedal five times and then close the bleeding nipples.
5. Move the hoses and collecting vessel to the right front wheel. Open the nipples, pump the pedal five times and then close the nipples.
6. Connect one hose and the collecting vessel to the right rear wheel bleeding nipple:



VOLVO
109 698

7. Open the bleeding nipple. Check that the brake fluid does not contain any bubbles and close the nipple.
8. Connect hose and collecting vessel to left rear wheel. Open the nipple, check that the brake fluid does not contain any air bubbles and then close the nipple.
9. Re-connect the hoses and the collecting vessel to left front wheel, open the nipples, pump the pedal three times and close the nipples.
10. Repeat on right front wheel, pumping the brake pedal three times.
11. Repeat points 6, 7 and 8.
12. Check by depressing the brake pedal with a pedal force of approx. $20 \text{ kg} = 45 \text{ lbs}$. that there is no air in the system. The pedal travel may not exceed $60 \text{ mm} = 2 \frac{3}{8} \text{ inches}$ and the brake failure warning light must not light or flash. If incorrect, repeat steps 9, 10 and 11.
13. Disconnect the bleeder unit and check the brake fluid level.
14. Install protective caps on the bleeder nipples, install the front wheels and restore.

Bleeding without bleeder unit

"Manual bleeding".

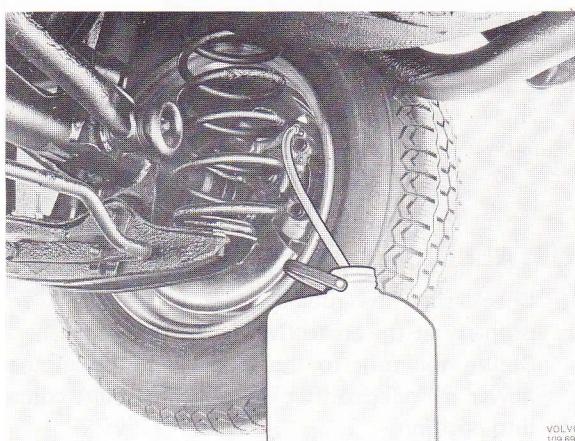
1. Put the vehicle on stands and remove the front wheels.
2. Check the brake fluid level.
NOTE: The fluid level should be watched throughout the procedure.
3. Start on left front wheel.
Connect hoses to the three bleeder nipples and immerse the other ends in brake fluid in a vessel.



VOLVO
109 697

The nipple connections should be tight and the hose ends always immersed.

4. Pump the pedal 10 times. Use assistants to open the nipples when depressing the pedal and close at the end of the stroke. All nipples should be opened and closed simultaneously.
5. Repeat the procedure at the right front wheel.
6. Depress the pedal 3–5 times, all nipples closed, to "level out" the master cylinder.
7. Connect one hose and the vessel at the rear right wheel bleeder nipple.



VOLVO
109 699

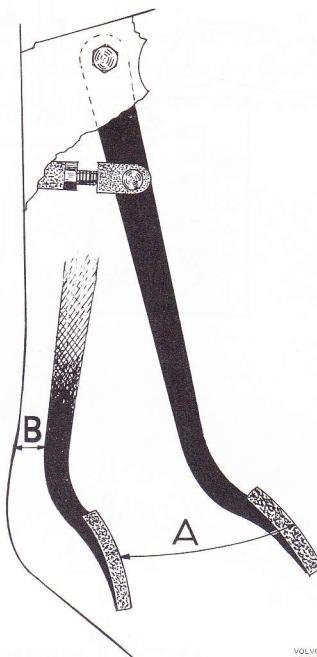
8. Open the nipple and "gravity bleed", no pumping of the pedal. Close the nipple when brake fluid free from bubbles comes out.
9. Repeat the rear left wheel.
10. To re-assure correct bleeding of the master cylinder, re-connect hoses and vessel at the three

nipples of the front left wheel. Open the three nipples and pump the pedal a few times. Close the nipples.

Adjusting brake pedal position

The brake pedal travel can be measured only when bleeding the two brake circuits simultaneously. The stroke A should be approx. 6.1" (145–165 mm) and the pedal bottom approx. 0.4" = 10 mm (B) from the floor.

Do not depress the brake pedal with the master cylinder removed. The resulting abnormal position will damage the power brake parts.



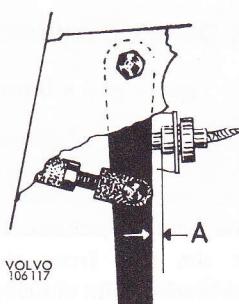
VOLVO
101 904

A = Approx. 6.1" (145–165 mm)

B = Approx. 0.4" (approx. 10 mm)

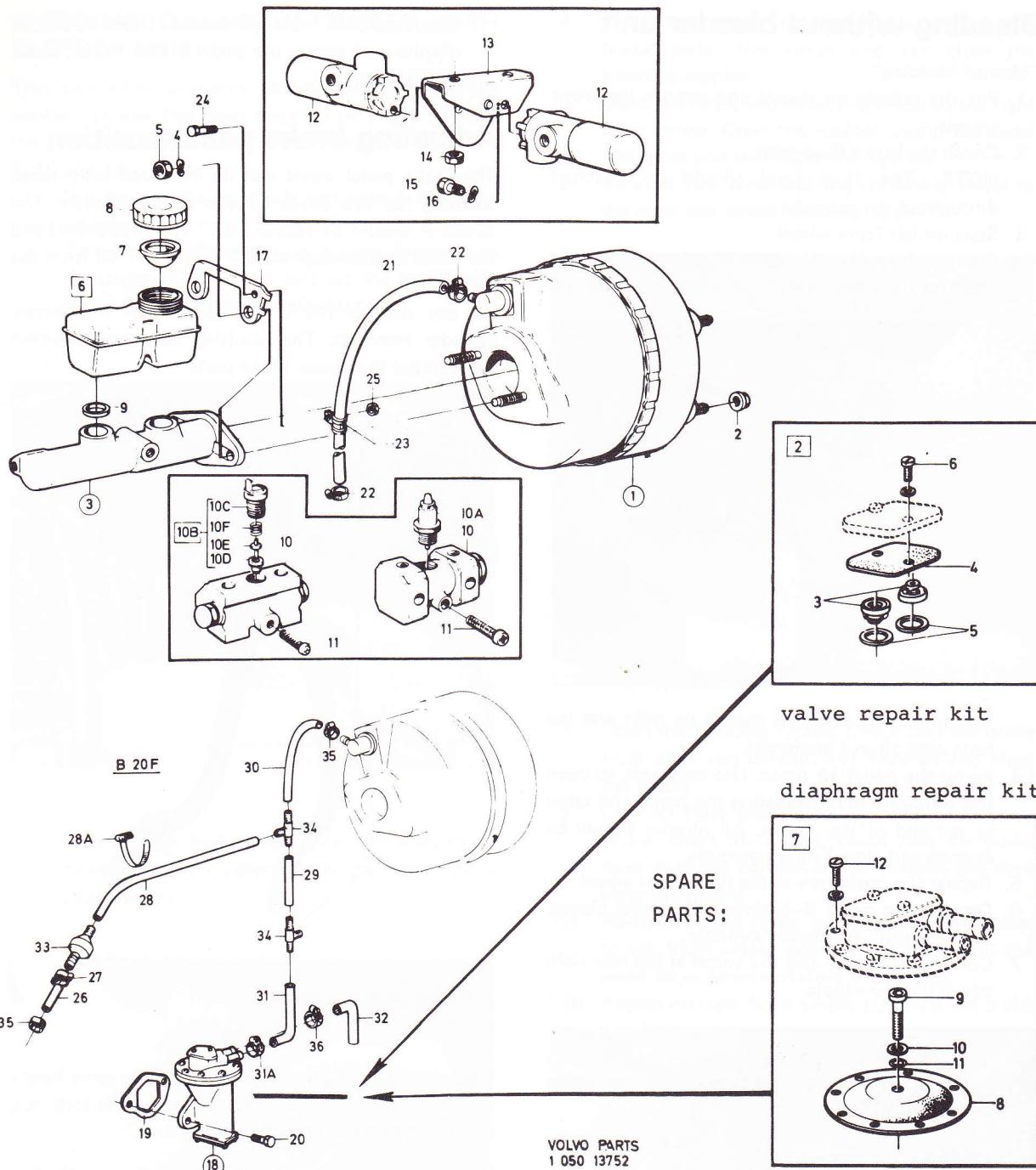
When released, the brake pedal should be same height as the clutch pedal. To adjust, slacken the lock nut, remove the cotter pin and turn the fork.

Adjusting brake warning light switch



VOLVO
106 117

The distance A should be 0.16" (2–6 mm). To adjust, release the retaining screws and move the bracket.



Replacing power cylinder

Op. No. 54124 = replace power booster

REMOVING

1. Remove the master cylinder. Disconnect the vacuum hose from the power cylinder.
 2. Disconnect the link from the brake pedal. Remove the bracket with clutch pedal stop.
 3. Remove the 4 nuts securing the power cylinder.
 4. Pull the power cylinder forwards and disconnect the fork from the link arm.

INSTALLING

1. Check that the rubber cover is pressed down properly at the protective washer for the cleaner. Secure the fork to the link arm. Push in the power cylinder so that the attaching bolts come into position.
 2. Place the resilient washers under the attaching nuts. Secure the cylinder.
 3. Fit the bracket for the clutch pedal. Secure the link arm to the brake pedal.
 4. Fit the vacuum hose. The connection for the vacuum hose should face downwards.
 5. Bleed the brake system.

Vacuum pump

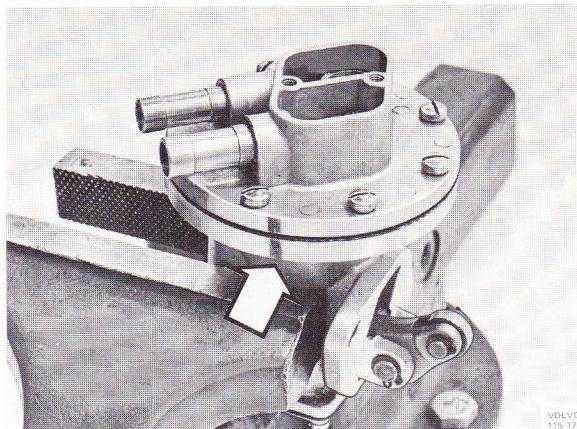
Op. No. 54126 = Replace vacuum pump

Op. No. 54127 = Rebuild vacuum pump, pump removed

Vacuum pump

Disassembly

1. Put the pump in a vise. Use soft jaws. Remove the valve housing cover.
2. Mark the position of the valve housing. Remove the valve housing.



VOLVO
115 174

3. Remove diaphragm, washers and spring from the pump.



VOLVO
115 175

4. Turn the pump upside down and remove the bottom cover.
5. Remove pump lever pin. Remove pump lever, pump rod and nylon bushing.

Assembly

1. Place the bushing on the pump rod. Install the rod in the pump housing.
2. Install lever and pin.



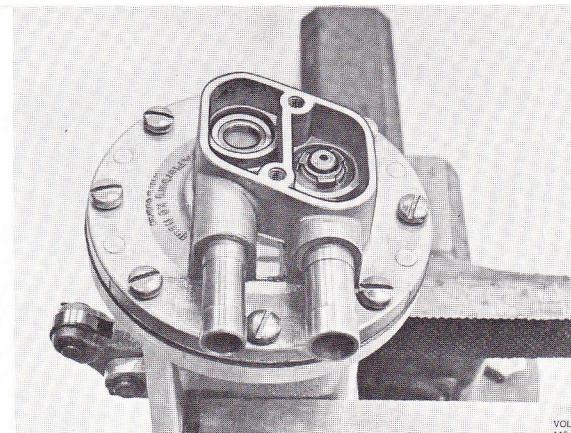
VOLVO
115 101

3. Install bottom cover and gasket.
4. Place washer and O-ring on the diaphragm screw. Apply locking fluid on the screw end.



VOLVO
115 102

5. Install diaphragm assembly.
6. Install valve housing according to marking.
7. Install valves and seals.



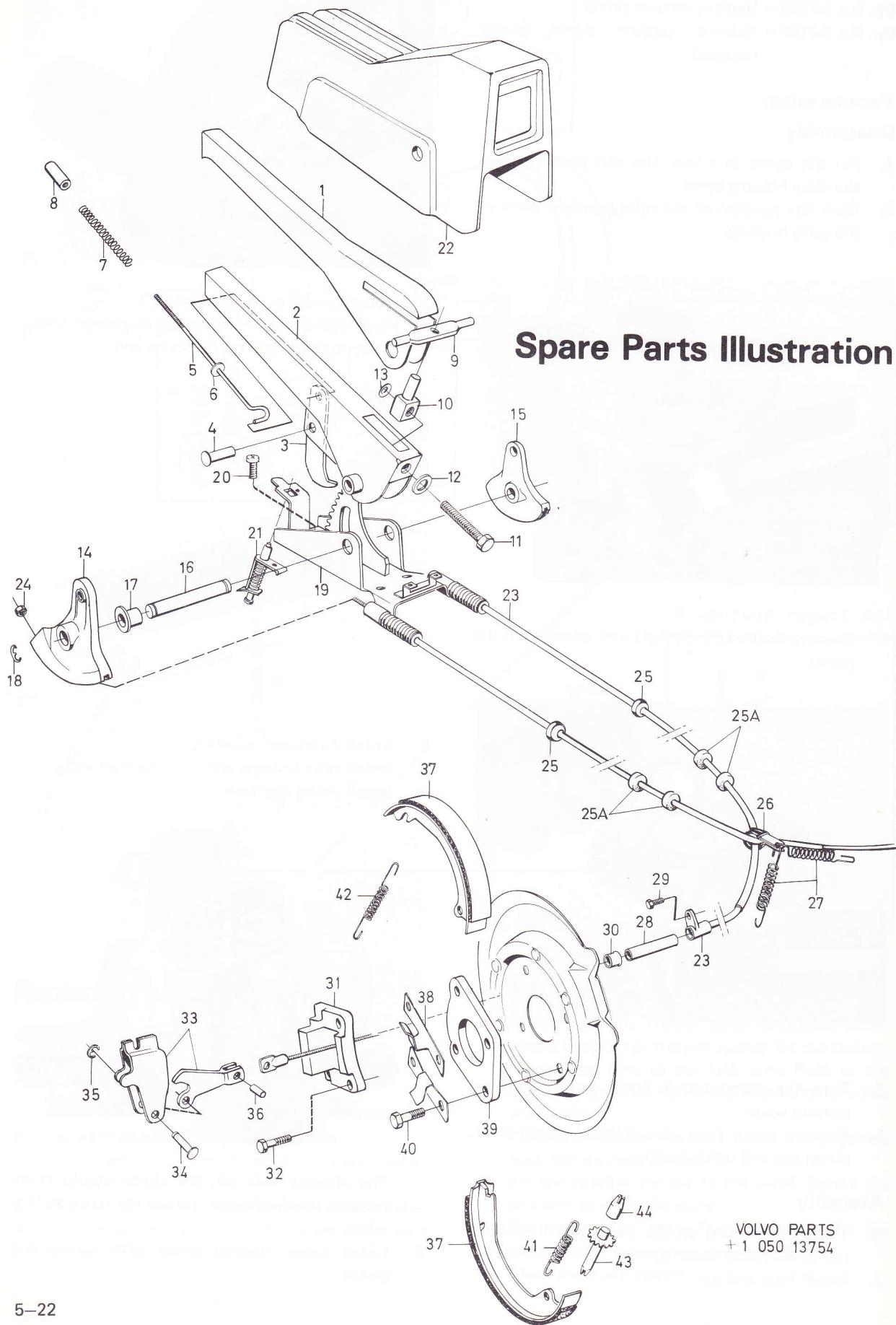
VOLVO
115 103

The domed side of the discs should point towards the diaphragm. Torque the screw to ft.lb = Nm.

8. Install valve housing cover with spring and gasket.

Group 55

Parking Brake



VOLVO PARTS
+1 050 13754

Adjusting parking brake

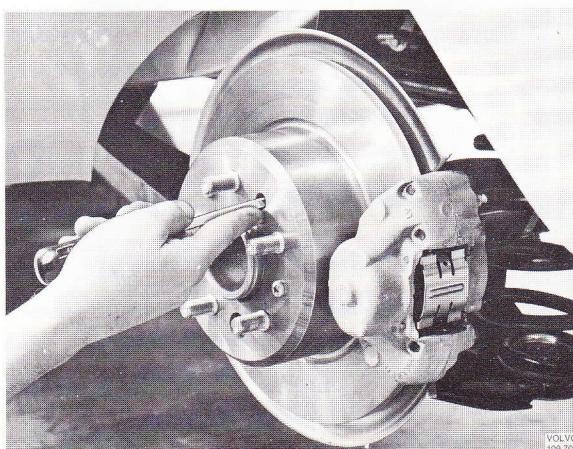
Op. No. 55102

The parking brake should be fully applied at notches 3–4. Otherwise adjust the parking brake as follows:

1. Remove the rear ash-tray.
2. Screw out the adjustment screw at the rear end of the parking brake lever so that the cables are slackened. The screw is accessible through the ash-tray hole by using a 17 mm socket with extension:



3. Put the rear end on stands and remove the rear wheels.
4. Align the brake drum so its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver:



Stop turning when the drum just about cannot be turned around, then turn back 4–5 teeth. Turn the brake drum and check that the brake shoes do not drag. If that is the case, turn back another 2–3 teeth.

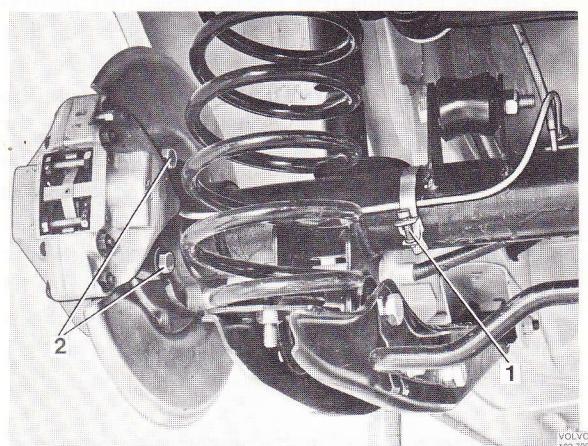
5. Install the wheels.
6. Tighten the wires with the adjustment screw at the rear end of the parking brake lever so that the brake is fully applied after 2–3 notches.
7. Install the ash-tray.

Replacing brake shoes

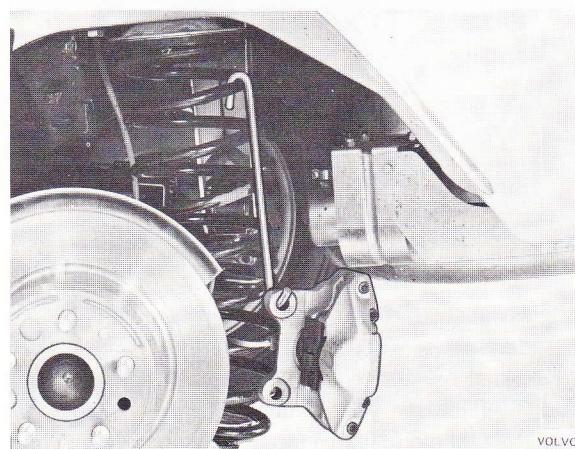
Op. No. 55204 = both sides

Op. No. 55214 = one side

1. Remove the rear ash-tray and screw out the adjustment screw at the rear end of the parking brake lever so that the cable is slackened.
2. Put the rear end on stands and remove the rear wheels.
3. Remove clamp (1) for the brake line. Screw out the retaining screws (2) for the yoke:

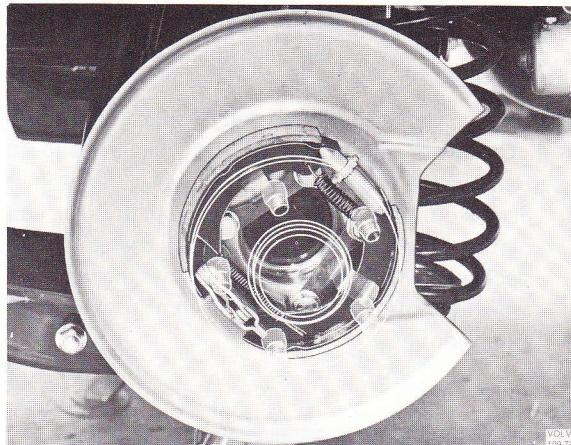
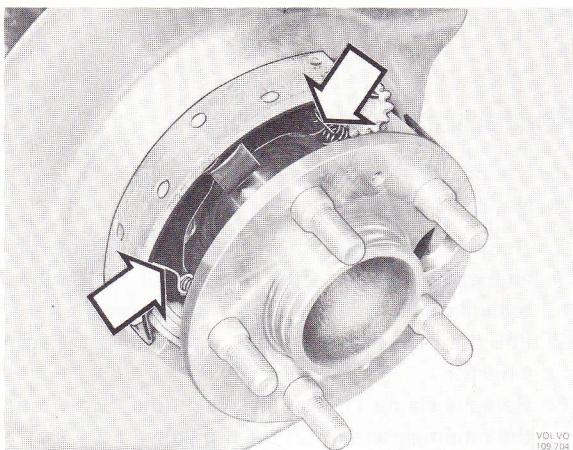


4. Hang up the brake yoke in a wire so that no sharp bends are made on the brake line:

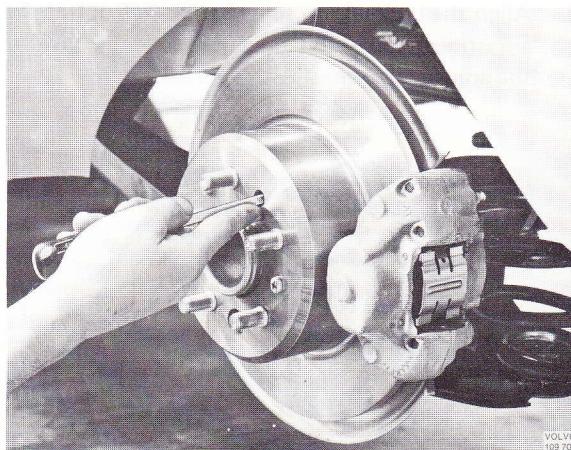
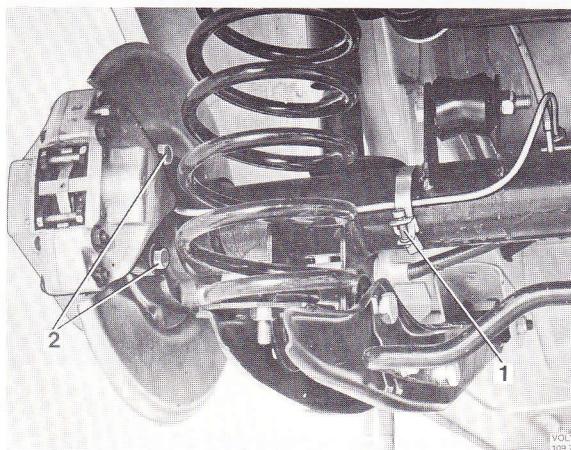


5. Remove the bolts for the brake drum and remove the drum.

6. Unhook the springs with a brake spring tool. Remove the brake shoes and the adjustment device:



7. Before installing new shoes, check that there is no oil leakage from the rear axle. Also check that levers, cables and adjustment devices are not worn or seize. The brake drums should be replaced if they are scored, convex or out of round more than 0.2 mm = 0.008". Clean the sliding surfaces for the brake shoes on the brake shields.
8. Apply a thin layer of heat resistant graphite grease on the brake shoe sliding surfaces on the brake shields, on the levers and on the adjustment devices.
9. Install brake shoes and lower return spring:



10. Install upper return spring and adjustment device:
11. Install brake drum and brake yoke. Use a locking fluid for the yoke retaining screws. Check that the brake disc is free from the brake pads.
12. Clamp the brake line to the rear axle:
13. Align the brake drum so its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver.

Stop turning when the drum just about cannot be turned around, then turn back 4–5 teeth. Turn the brake drum and check that the brake shoes do not drag. If that is the case, turn back another 2–3 teeth.

14. Install the wheels.
15. Tighten the wires with the adjustment screw at the rear end of the parking brake lever so that the brake is fully applied after 2–3 notches. Restore.

Replacing parking brake cable, one side

Op. No 55104 = replace both sides

Op. No. 55116 = replace both sides

1. Remove the parking brake lever cover. Disconnect the wire for the ash-tray light.
2. Slacken the wire by screwing out the adjustment screw.

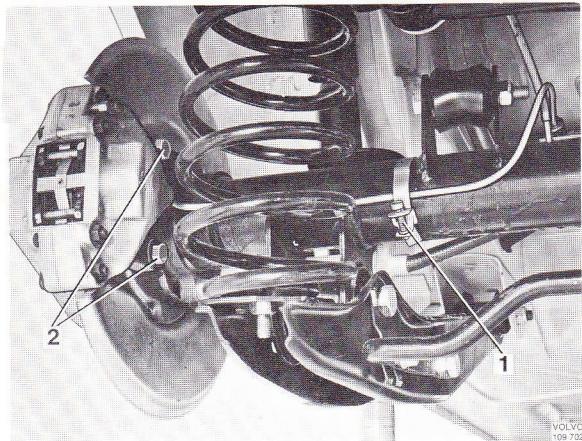


1. Adjustment bolt
2. Lock screw

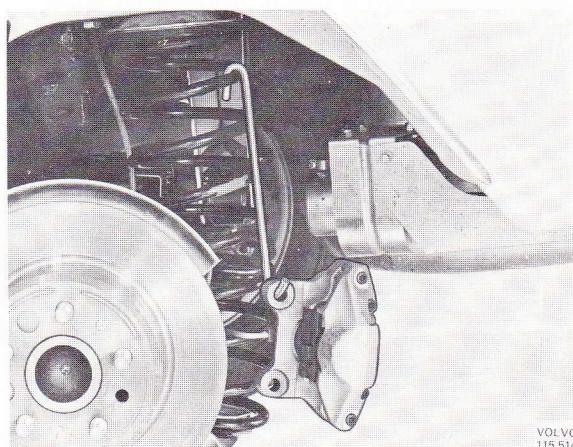
Remove nut (2) while retaining the cable with a small screwdriver at the end.

NOTE: The cables cross each other under the floor which means that left cable controls right wheel, and vice versa.

3. Lift the front end of the rear seat cushion, fold away the floor mat and loosen the clamps holding the wire to the floor.
4. Disconnect the wire end sleeve and rubber grommet from the rear seat support.
5. Put the rear end on stands and remove the rear wheel.
6. Remove the clamp (1), for the brake line. Remove the retaining screws (2) for the brake yoke:

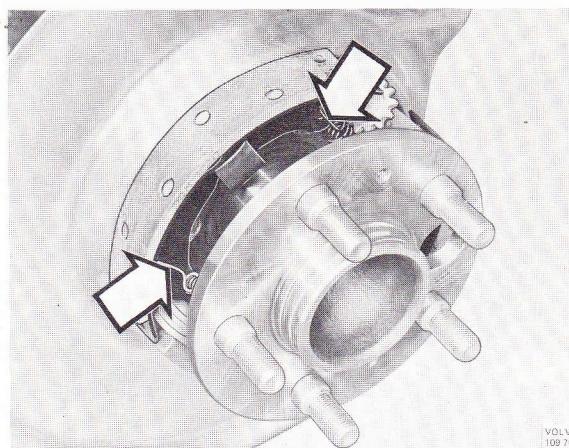


7. Hang up the brake yoke in a wire so that no sharp bends are caused on the brake line.



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8. Remove the brake drum.
9. Unhook the springs with a brake spring tool and remove the brake shoes:



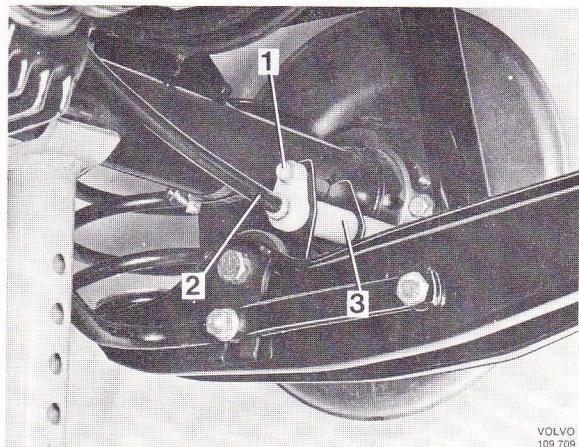
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10. Press out the lock pin retaining the cable to the lever:

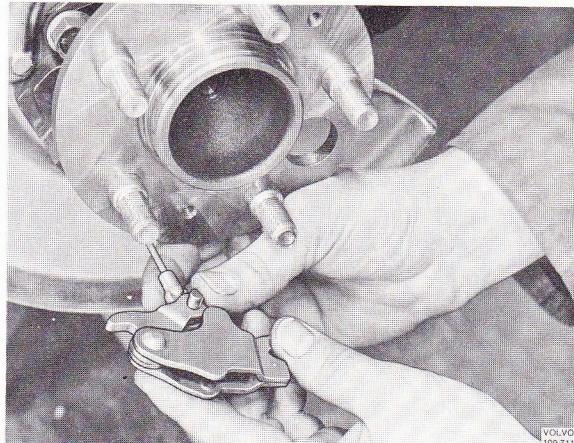


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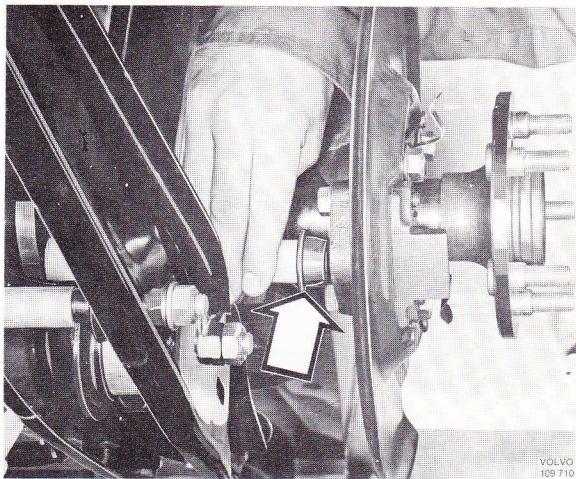
11. Remove the screw (1). Pull out the cable (2) and plastic tube (3) with rubber seal:



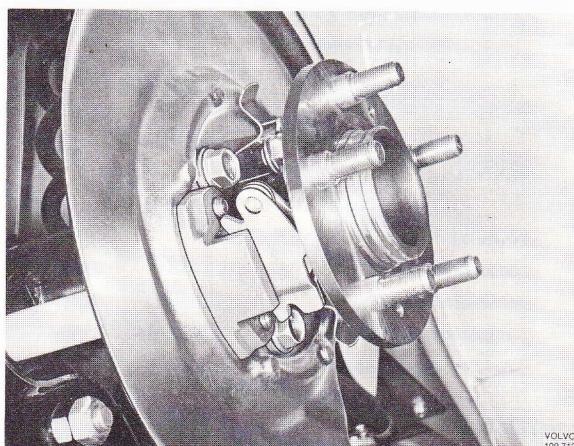
heat resistant graphite grease. Attach the lever to the cable:



12. Pull out the cable assembly from the center support and the floor passage.
13. Align the plastic tube through the bracket and install the rubber seal:



17. Push in the cable and locate the lever behind the rear axle flange:



14. Route the new cable through the center support and through the hole in the floor.
NOTE: The left wheel cable should be routed through the hole to the right of the propeller shaft, and vice versa.
Right wheel cable goes on top when they cross.
15. Route the cable through the plastic pipe and connect it to the bracket.
16. Lubricate the lever pivot as well as the sliding surfaces for the brake shoes with a thin layer of

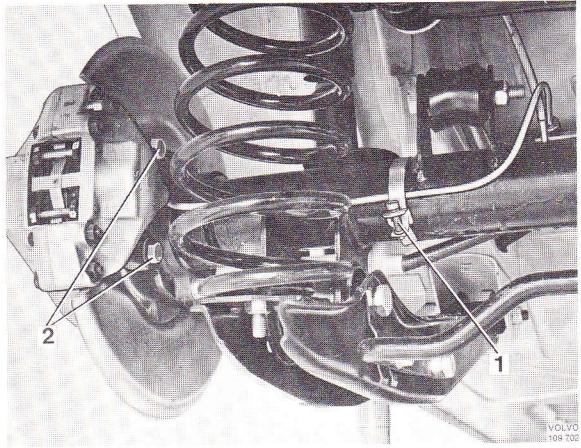
18. Apply a thin layer of graphite grease on the sliding surfaces for the brake shoes. Install brake shoes and lower return spring:



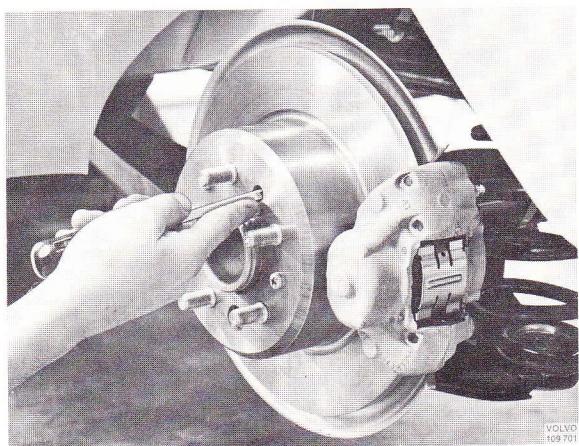
19. Install upper return spring and adjustment device:



20. Install brake drum and brake yoke. Use a locking fluid for the yoke retaining screws. Check that brake disc is free from the brake pads.
21. Clamp the brake line to the rear axle:

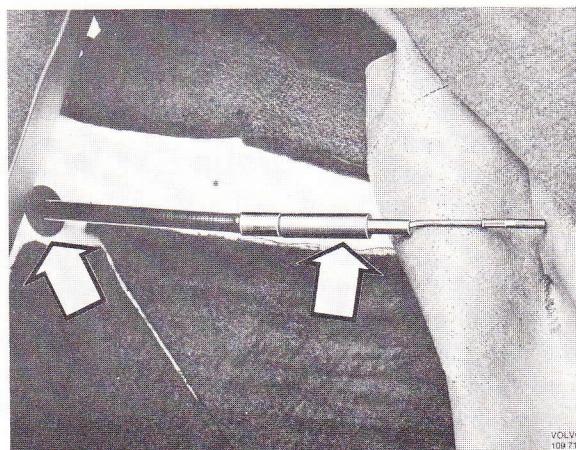


22. Align the brake drum so its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver:

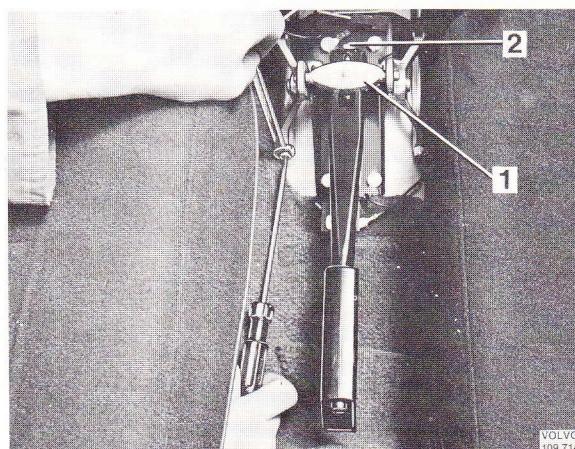


Stop turning when the drum just about cannot be turned around, then turn back 4–5 teeth. Turn the brake drum and check that the brake shoes do not drag. If that is the case, turn back another 2–3 teeth.

23. When replacing one cable, both side brake shoes should be adjusted.
Install the wheels.
24. Install rubber grommet and end sleeve and position cable end:



25. Install the two clamps holding the wire to the floor, fold down the mat and fit rear seat.
26. Thread on the nut so far that the cable end goes through the nut lock:
Stretch the cables so that the yoke (1) is perpendicular to the handbrake lever when applied.



27. Adjust the movement of the handbrake lever with the screw (2) at the rear end of the lever so that the brakes are applied at notches 2–3.
28. Re-connect the wire for the ash-tray light, install the cover over the handbrake lever. Lower the vehicle.

Section 5

Brakes

Description and theory of operation

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Group 51: Wheel brake units3

**Group 52: Hydraulic service
brake System**

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Brake warning valve 6
Brake (reducer) valve 6

Group 54: Power assist system

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One-way valves 10
Vacuum pump 10

Group 55: Parking brake11

Group 50

General

General information

The 240 is equipped with two independent brake systems.

The Service brake system is controlled by a brake pedal and operates on all four wheels through a hydraulic circuit.

The parking brake system controls by means of brake levers and cables. It operates both rear wheels mechanically.

The Fig. shows the arrangement of the service brake system which has disc brakes all round.

The hydraulic system comprises two separate circuits. The Master cylinder is split in two halves (tandem-type and step-bored). Each front brake caliper has two pairs of cylinders which are entirely separated from each other.

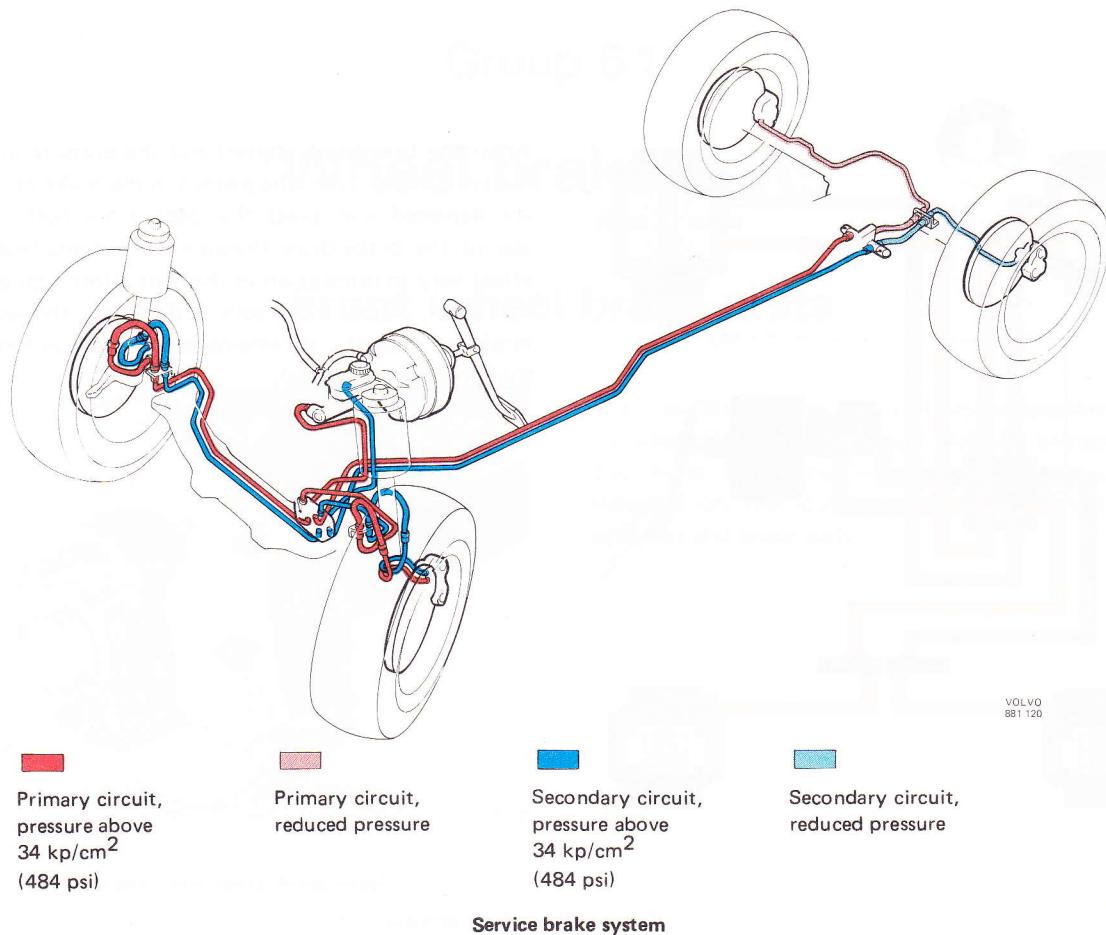
One brake circuit serves the front wheel brake lower

cylinders and right rear wheel. The other circuit serves the front wheel brake upper cylinders and left rear wheel.

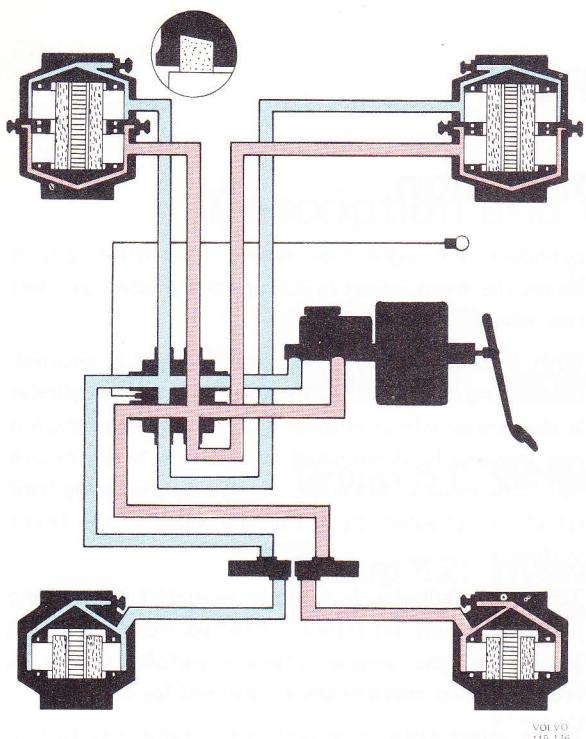
With such an arrangement, brake effect is ensured, should one of the brake lines fail. The master cylinder is step-bored which ensures a braking power which is not noticeably diminished should one brake circuit fail. The driver is, however, warned by a warning light which is activated by a warning valve in the brake system.

The servo cylinder is directly actuated by a brake pedal. Vacuum assistance, obtained from a vacuum pump and the engine intake manifold, results in reduced pedal pressure being required for braking.

Brake valves assist in providing a suitable distribution of braking power between front and rear wheel brakes.



Function



The hydraulic brake system is a triangular split two circuit system.

The primary circuit comprises:

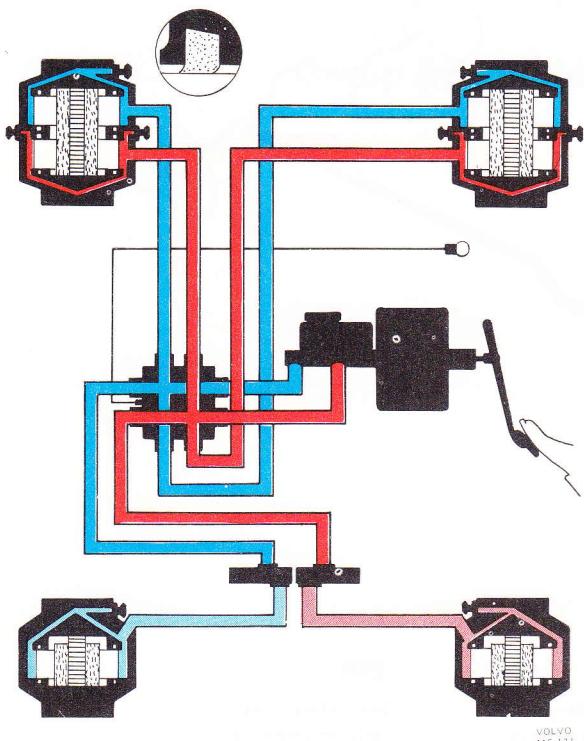
- Master cylinder rear bore
- Front wheel caliper lower cylinders
- Right side rear wheel brake.

Similarly the secondary circuit comprises:

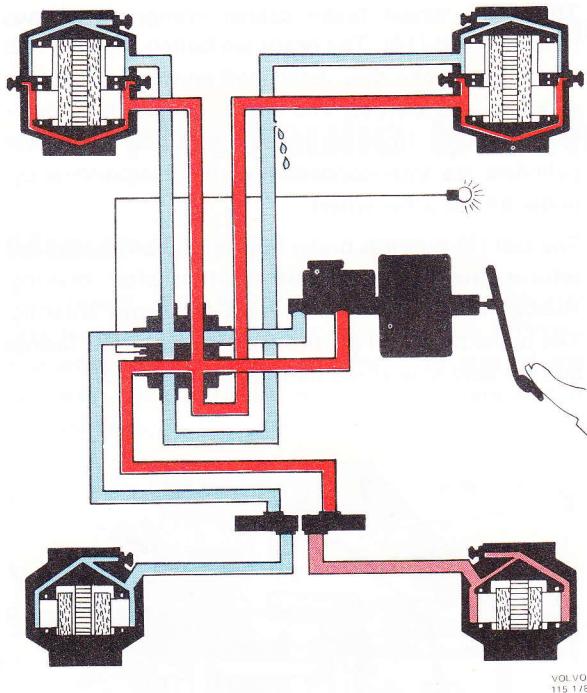
- Master cylinder front bore
- Front brake caliper upper cylinders
- Left side rear wheel brake.

The Master cylinder is of the tandem-type and step bore. Its function is in detail described in Group 52. Two separate lines are routed from the Master cylinder bores through a break line branch which is located at the front axle rear side. From this branch pipes are routed to the cylinders of the two brake circuits.

The brake line branch also contains the brake warning valve. It actuates a warning light on the instrument panel in case of excessive pressure drop in one of the brake circuit.



When the brakes are applied and the pressure in the Master cylinder rises, the pistons in the brake calipers are displaced and press the pads from both sides against the brake discs. Pressure applied and braking effect vary in proportion to the foot effort applied to the pedal. When the piston is displaced, the seal is tensioned laterally. It remains in this state as long as the footbrake is applied.



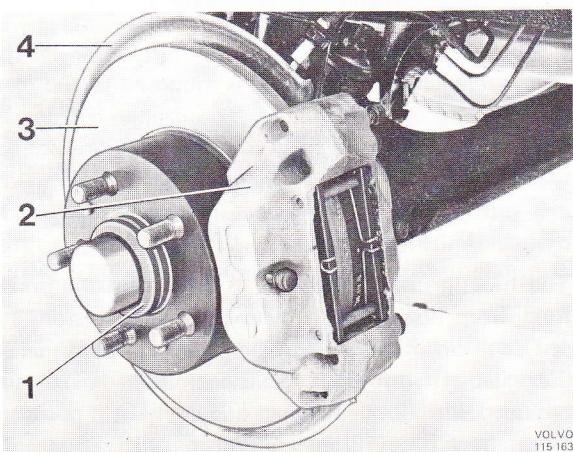
Should a leakage occur in one of the circuits, full braking effect can still be obtained on both front wheels and one rear wheel. When the pressure difference between the two brake circuits exceeds approx. 142 psi = 10 kp/cm², the piston in the warning valve is pressed over to one side and the warning light comes on. The warning light remains illuminated until the leakage in the circuit has been corrected and the warning switch returned to normal.

When the brake pedal is released, the hydraulic pressure on the piston ceases. Since with this system there is no residual hydraulic over pressure in the lines, the tension in the seals is sufficient to move the pistons back to a certain extent. This results in a clearance being formed between brake linings and brake disc. With such an arrangement, the linings will always be in the rest position at a certain distance from the brake disc, irrespective of wear. Of this reason the brakes are self-adjusting.

Group 51

Wheel brake units

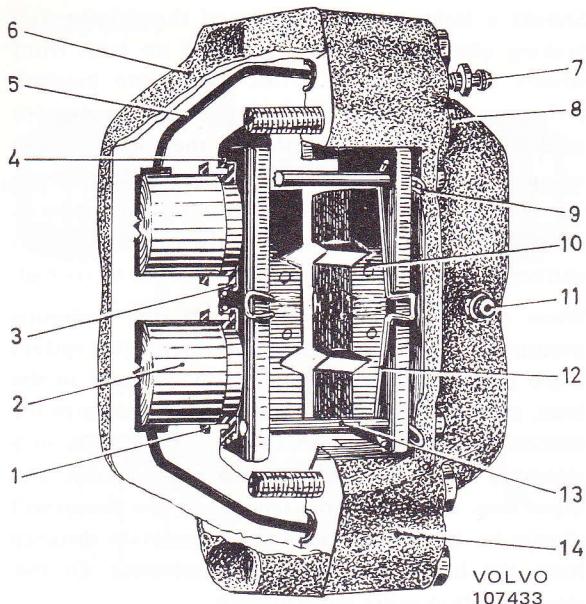
Front wheel brake units



The disc (3) is of cast iron and rotates together with the wheel hub point, the cover plate (4) protects the disc from dirt. The wheel brake calibre (2) is mounted on the stub axle. It houses wheel unit cylinders and brake pads.

Brake components, front wheel

- | | |
|------------------------|----------------|
| 1. Hub | 3. Brake disc |
| 2. Front brake caliper | 4. Cover plate |

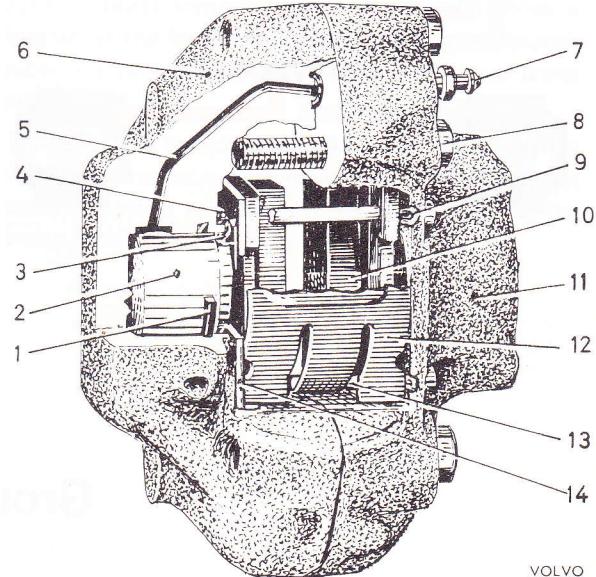


Front wheel brake caliper

- | | |
|-------------------------|--------------------------|
| 1. Seal | 8. Bolt |
| 2. Piston | 10. Brake pad |
| 3. Rubber dust cover | 11. Lower bleeder nipple |
| 4. Retaining ring | 12. Damping spring |
| 5. Channel | 13. Retaining pin |
| 6. Outer half | 14. Inner half |
| 7. Upper bleeder nipple | |

The front wheel brake caliper comprises of two heads (6) and (14). The heads are bolted together and bridge the brake disc. Each half contains two cylinders and two pistons. The upper cylinder is completely separated from the lower one. Upper and lower cylinders are inter-connected with corresponding cylinder on the other wheel.

The seal (1) prevents brake fluid from leaking out and returns the piston to rest position after braking. Rubber dust covers (3) prevent dirt from entering. The brake pads (10) are provided with bonded facings and are held in position by retaining pins (13).



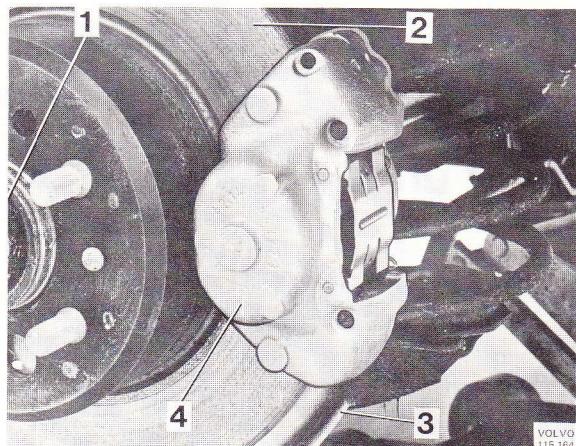
Rear brake caliper

- | | |
|----------------------|-----------------------------|
| 1. Seal | 8. Bolt |
| 2. Piston | 9. Retaining clip |
| 3. Rubber dust cover | 10. Brake pad |
| 4. Retaining ring | 11. Inner half |
| 5. Channel | 12. Damping spring (alt. 1) |
| 6. Outer half | 13. Retaining pin |
| 7. Bleeder nipple | 14. Washer |

The rear wheel brake caliper is mounted to the rear axle housing with a retainer. The caliper housing is divided in two halves (6) and (11). They are bolted together and bridge the brake disc. Each half contains one piston and one cylinder, inter-connected by a channel in the housing.

The function of the seal (1) is to prevent the brake fluid from oozing out and to return the pistons to rest position after braking. The rubber dust covers (3) prevent dirt from entering. The brake pads (10) are provided with bonded facings and are held in position by retaining pins (13).

Rear wheel brake units



Brake components, rear wheel

- | | |
|----------------|-----------------------|
| 1. Drive shaft | 3. Cover plate |
| 2. Brake disc | 4. Rear brake caliper |

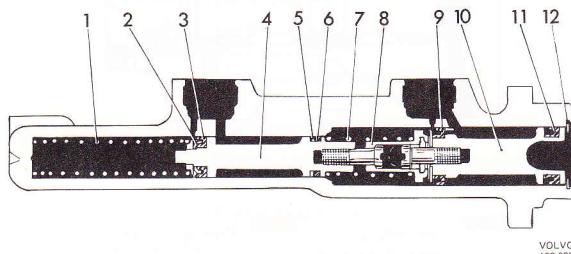
The brake disc (2) is of cast iron and fixed to the drive shaft. It rotates jointly with the hub. The cover plate (3) protects the disc from dirt.

Group 52

Hydraulic Service Brake System

Master cylinder

The master cylinder is of the tandem type and step-bored. The pistons are designed with different diameters and are linked together. The area of the secondary circuit piston is half the primary circuit cylinder area.



Master cylinder

- | | |
|---------------------|---------------------|
| 1. Spring | 7. Spring |
| 2. Spring seat | 8. Connector sleeve |
| 3. Seal | 9. Seal |
| 4. Secondary piston | 10. Primary piston |
| 5. Seal | 11. Seal |
| 6. Seal | 12. Snap ring |

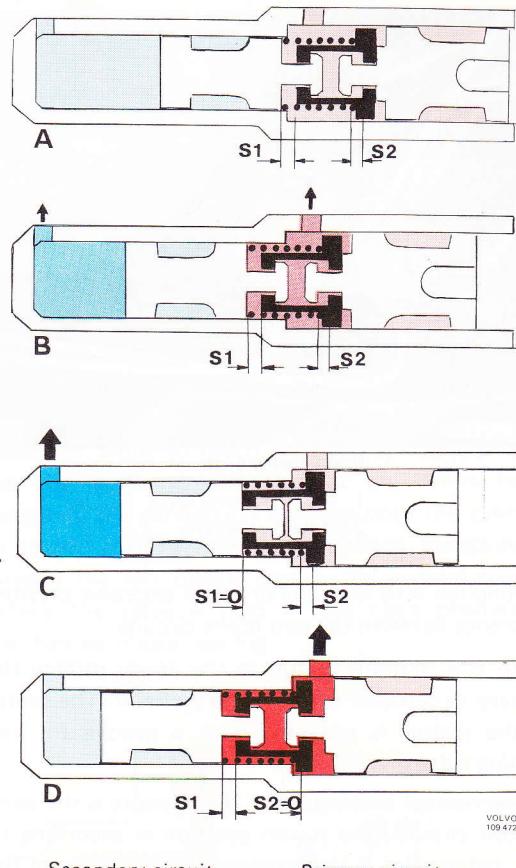
The connector sleeve (8) links the secondary piston (4) and the primary piston (10). This design provides only a small increase of the pedal travel in case of one brake circuit failure. It also provides double pressure in the remaining circuit.

These features result in a safer system, because a brake circuit failure is less noticeable for the driver. The brake failure warning light provides a visual trouble signal.

The master cylinder function as shown in "A" shows the pistons in rest position. When braking with both circuits functioning, the pistons take up position according to "B" and the pressure is equal in both circuits.

If there is a leakage in the primary circuit, see "C", there will be no pressure in front of the primary piston.

The primary piston is moved forwards (distance S 1) until the connector sleeve contacts the secondary piston. Thereafter also the secondary piston is moved mechanically and brake pressure builds up in the secondary circuit. As the secondary piston surface is only half of that of the primary piston, the same pedal pressure will double the pressure in the secondary circuit.



Secondary circuit	Primary circuit
Normal pressure	Normal pressure
Pressureless	Pressureless
Pressure doubled	Pressure doubled

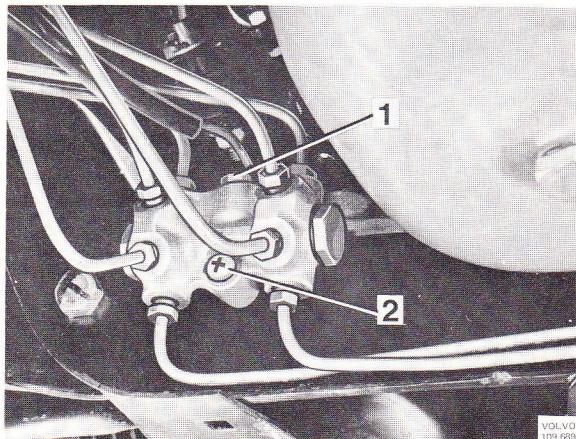
Master cylinder function

- A. Rest position
- B. Normal brake application
- C. Leakage in primary circuit
- D. Leakage in secondary circuit

In case of a leakage in the secondary circuit, see "D", the secondary piston is moved hydraulically by the primary piston. But the connector sleeve permits only a travel equal to measurement S 2. Thereafter both pistons are moved jointly. Also in this case double brake pressure will arise as the acting surface only is half of normal, or the difference between the primary piston's and the secondary piston's surfaces.

Brake warning valve

The brake warning valve is part of the brake line union. It is attached to the rear end of the front axle member:



Brake line branch

1. Brake warning valve
2. Retaining screw

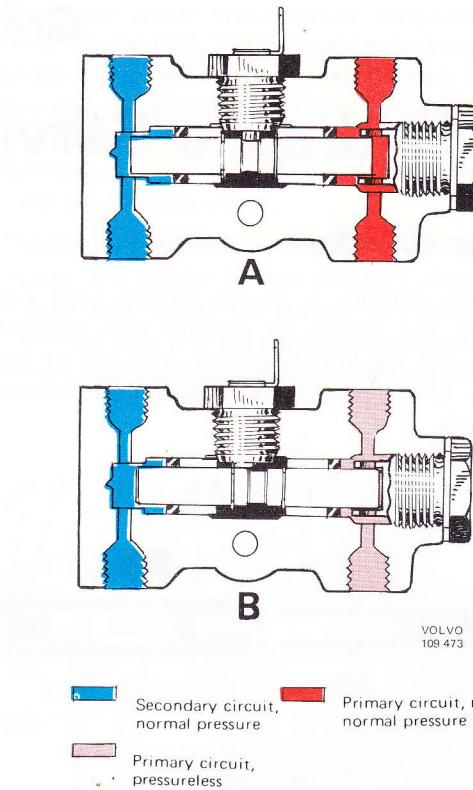
Its function is to warn the driver of excessive pressure difference between the two brake circuits.

There is a movable piston in the cavity joining the primary circuit and the secondary circuit. The center of the piston is provided with a groove for the warning valve pin.

During normal braking when the pressure is the same in both circuits, the piston position is according to "A", below. But if the pressure is lower in one of the circuits, for instance because of a leakage, the higher pressure will displace the piston. See "B". The warning valve pin will make a ground connection on the side of the piston groove. This will light the brake failure warning light on the dash panel.

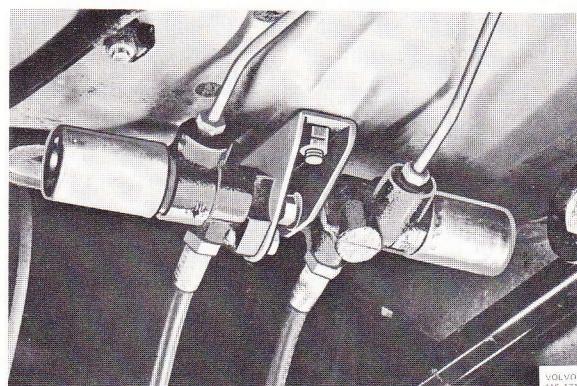
Brake (reducer) valve

A brake valve is connected to each of the rear wheel brake lines:

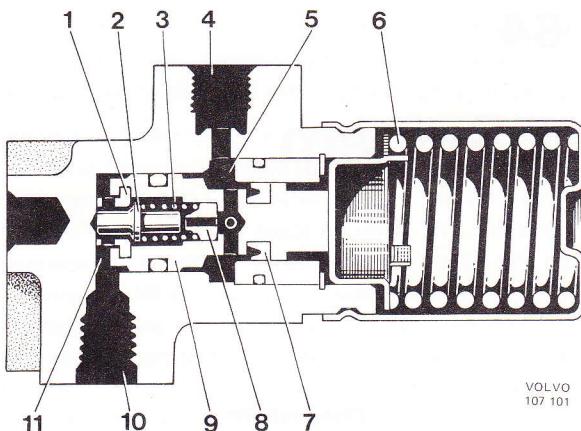


Brake line branch with brake warning valve

- A. Equal pressure in both circuits
- B. Lower pressure in one circuit (right side)



When ingoing brake pressure exceeds 485 psi = 34 kp/cm² (245: 710 psi = 50 kp/cm²) a reduction takes place in the valve. Increasing the pedal pressure increases the reduction and thereby the difference between the hydraulic pressure in the front wheel and rear wheel cylinders increases. This results in a distribution of braking force between both pairs of wheels. The design of the brake valve is shown below:



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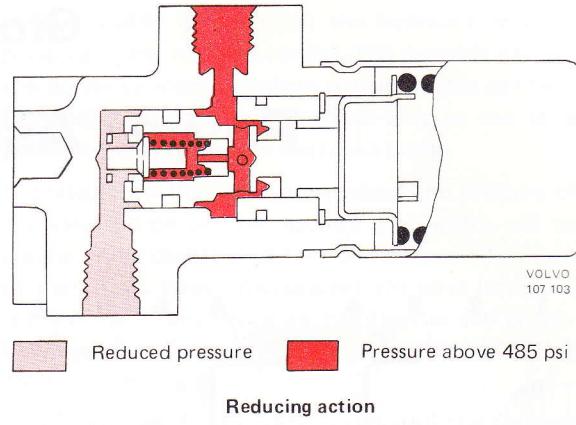
1. Valve seat
2. Valve
3. Valve spring
4. Connection to master cylinder
5. Cylinder
6. Spring
7. Piston seal
8. Equalizing valve
9. Piston
10. Connection to rear wheel brake cylinders
11. Cylinder

When the footbrakes are applied, the pressure from the master cylinder is transmitted via connection (4). The pressure then proceeds through cylinder (5), counterbore, past the valves (8) and (2) to cylinder (11) and then on through connection (10) to the rear wheel cylinders.

The hydraulic pressure per unit surface is equal on the different parts of the piston (9), but since its pressure surface is larger in cylinder (11) than in cylinder (5), the force developed will move the piston to the right of the figure. However, this is counteracted by the pressure from the spring (6).

When the hydraulic pressure approaches 485 psi = 34 kp/cm² (for 245: 710 psi = 50 kp/cm²) the spring pressure is overcome and the piston (9) is moved to the right. By pressure from the smaller spring (3), the valve (2) shuts the connection between the two cylinders and forms two separate systems, one for the front wheels and one for a rear wheel.

With continued increase in pressure in the master cylinder and front wheel cylinders, the hydraulic pressure in cylinder (5) moves the piston to the left so that the valve rod comes up against its stop and opens the valve, this causing the pressure in cylinder (11) to increase. Due to the larger pressure surface in this cylinder, the plunger is moved to the right again and the valve closes. In this way, the piston assumes a position of balance and the outgoing pressure from the brake valve will be lower than the incoming pressure, see Fig:



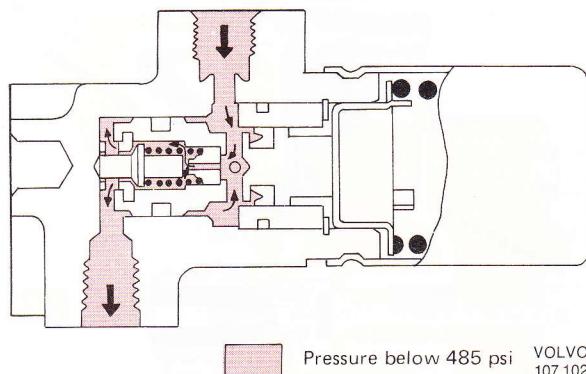
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Reduced pressure Pressure above 485 psi

Reducing action

The difference in these pressures is determined by the different areas and spring tension.

When the brake pedal is released, the pressure in line (4) drops. The piston (9) is moved to the right by the spring (6). When the pressure on the right side of the valve (2) drops so much that the hydraulic pressure on the left-hand side enables the valves to be actuated, the connection between both the cylinders is opened again. As the pressure drops, the spring (6) presses the left piston back to its original position where the valve is held in the open position by mechanical means, see Fig:



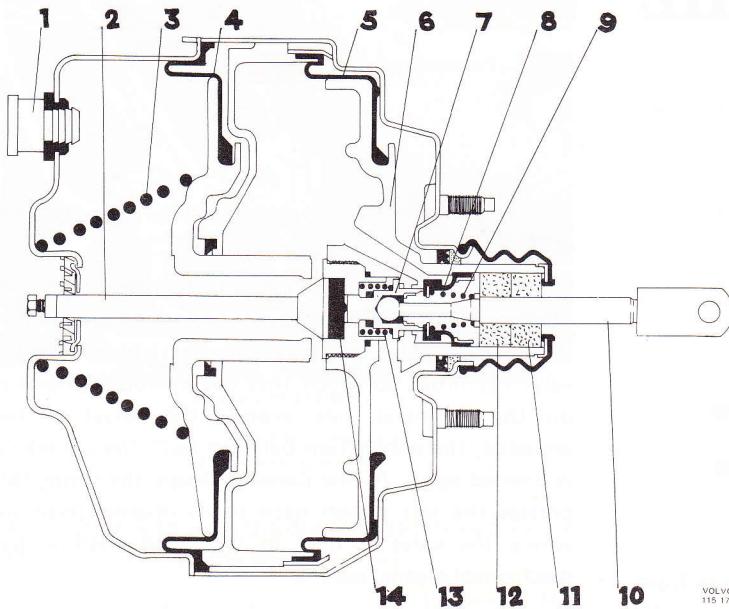
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Brake application

The equalizing valve (8) is provided with control channels which ensure an even flow of pressure through the valve.

Group 54

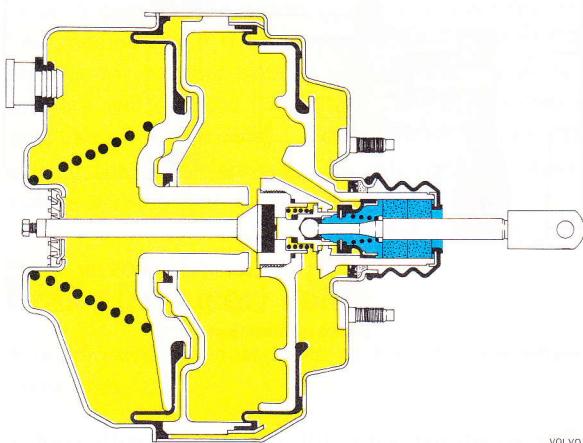
Power Assist System



Power cylinder

1. One-way valve
2. Front thrust rod
3. Return spring
4. Diaphragm, front
5. Diaphragm, rear
6. Guide housing
7. Valve piston seat
8. Seal assembly
9. Spring
10. Rear thrust rod
11. Filter
12. Filter
13. Spring
14. Reaction disc

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Max. partial vacuum Atmospheric pressure
Rest position

Power cylinder

The power-booster is located between the brake pedal and the master cylinder. It is powered by vacuum from a separate vacuum pump.

The vacuum pump is driven from the engine camshaft and provides power assist via a one-way valve and a vacuum tank. It is connected to the engine intake manifold which means there will still be some vacuum available in case the pump fails.

The power cylinder operates as follows:

With the system at rest, the parts are in the position shown. The thrust rod spring holds the thrust rod and the valve piston flexibly connected to it pressed to the right. Movement is limited by the stop plate. In this position, the valve plunger keeps the valve lifted from the seat in the guide housing, and this closes the air channel and opens the vacuum channel. Thus an

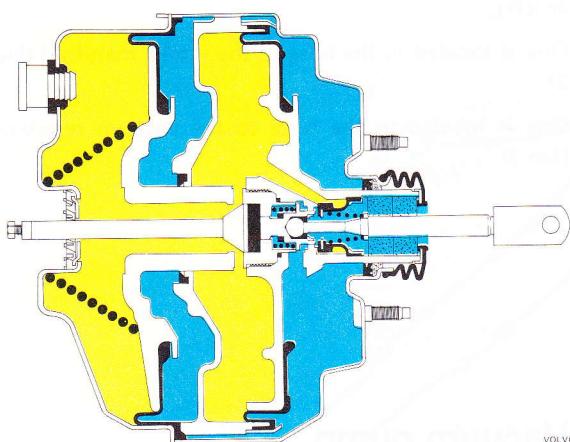
equivalent vacuum exists on both sides of the diaphragm which, together with the guide housing, is held pressed to the right end by the diaphragm spring.

When the brake pedal is depressed, rear thrust rod and valve piston are moved to the left (forwards). The valve spring causes the valve plate to move until it reaches the seat in the guide housing. This closes the connection between front and rear side of the diaphragm. When the piston continues moving, its movements are transferred via the reaction disc and front thrust rod to the master cylinder. When the seat of the valve piston leaves the plate, the connection between the rear side and the centre of the valve section is opened. Air from atmospheric pressure can then flow in behind the diaphragm. When there is partial vacuum on the front side of the diaphragm, it is moved, and also the guide housing, forwards. In this way, the force applied to the front thrust rod is increased. The parts of the power cylinder are in the position shown below, when the pedal pressure provides maximum power effect.

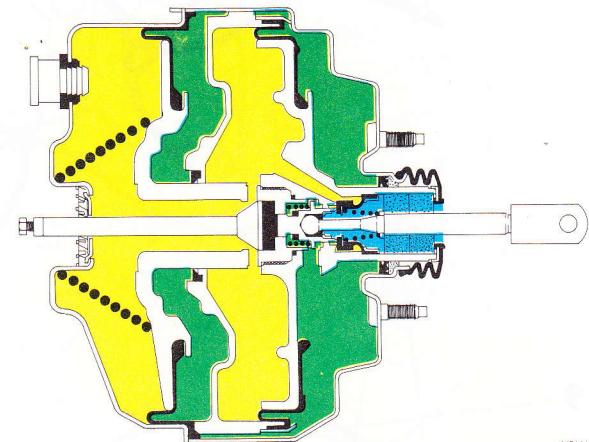
is thus unable to overcome the hydraulic counter-pressure in the master cylinder. The movable parts of the power cylinder therefore remain in this position. Constant braking is obtained as long as the same pressure is maintained on the brake pedal.

If pressure on the pedal is increased, the pressure of the valve piston on the reaction disc centre will be greater. This causes a certain displacement forwards of the piston. When this happens, the valve leaves the seat of the piston, more air can flow in and greater brake application is obtained until the new equalizing position is attained.

If the pressure on the pedal is reduced, the reaction disc can be thrust out still further. This causes the valve piston to lift the valve from the seat in the guide housing. The spaces on both sides of the diaphragm are thereby connected with each other, equal pressure arises, the guide housing is moved backwards by spring pressure and there is a reduction in the brake application. This procedure also reduces the contraction of the reaction disc periphery, so that the valve



Full brake application

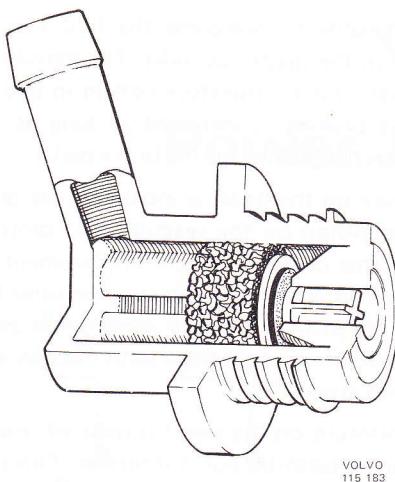


Partial brake application

If the pedal pressure is less than that mentioned above, the same procedure takes place in the beginning. During brake application, the hydraulic pressure in the master cylinder increases and also the counterpressure on the front thrust rod. The pressure of the guide housing is transmitted to the thrust rod through the outer part of the reaction disc. Because the disc is made of rubber, its periphery contracts while its centre tends to expand. This causes the guide housing to be moved further forwards than the valve piston and results in the seat of the piston reaching the valve shutting off the air supply. The pressure behind the diaphragm remains constant and

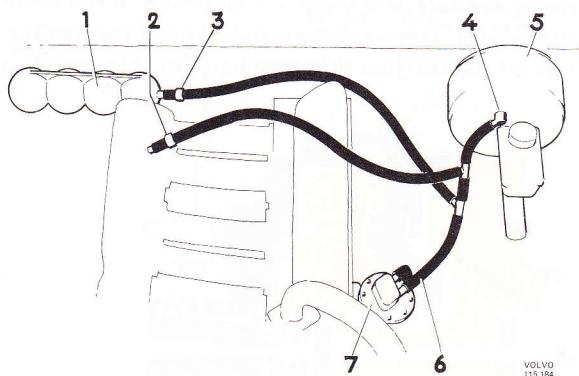
piston can return to the position shown below and the new equalizing position is reached. If the brake pedal is released fully, all the parts of the power cylinder are returned to rest position and the brakes released.

Should any fault occur with the vacuum supply, brake application can still take place due to the fact that the power cylinder functions as an extended thrust rod. As no power effect is then obtained, greater pressure on the pedal is of course required.



One-way valve

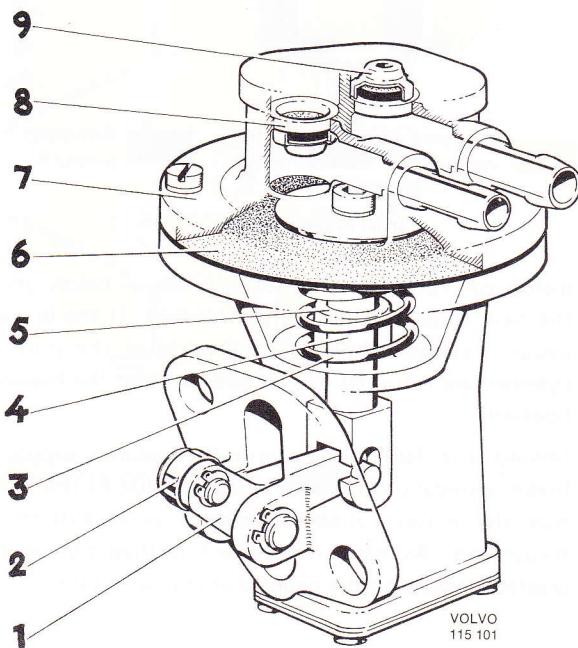
The vacuum system incorporates three vacuum valves. These valves will prevent air from flowing into power cylinder and vacuum tank.



One is located directly on the power cylinder (No 4 at left).

One is located in the hose to the intake manifold (No 2).

One is located in the hose to the vacuum reservoir (No 3).



Vacuum pump

It is diaphragm type, driven by the engine camshaft and located on the engine left side.

1. This lever transfers the cam-shaft movements to the pump rod
2. Roller with needle bearing
3. Pump spring
4. Pump rod
5. Nylon bushing
6. Pump diaphragm
7. Valve housing
8. Suction valve
9. Discharge valve (into the air)

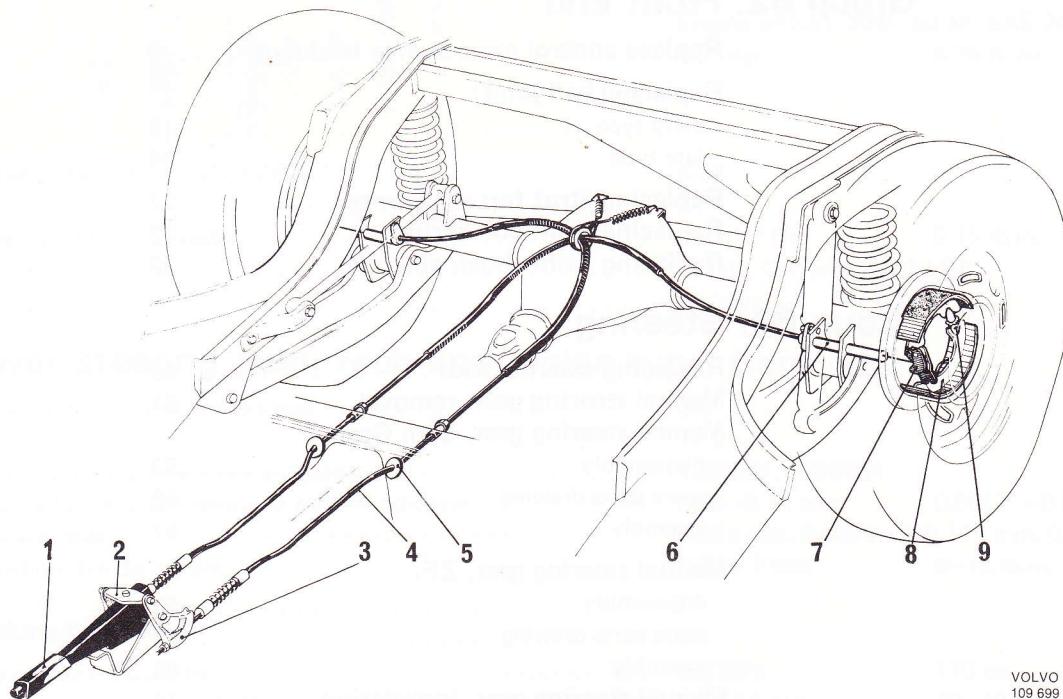
Group 55

Parking Brake

The design of the parking brake is shown below. The parking brake lever (1), which is located between the front seats, acts on two levers (3) via a yoke (2). Two cables (4) lead from the levers to the rear wheel brakes. The two cables are routed parallel with the propeller shaft tunnel inside the car and pass out under the floor through the rear seat support. The cables cross each other on top of the rear axle before connected to the brakes.

The pulling movements of the cables are transferred to the brake shoes via scissor-type levers (7) located between the shoe lower ends. There is an adjustment device (9) between the upper shoe ends.

Right wheel cable goes over left cable.



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Parking brake

1. Lever
2. Yoke
3. Lever
4. Cable
5. Rubber grommet
6. Plastic tube
7. Levers
8. Brake shoes
9. Adjustment device