DESCRIPTION OF THE ATE DISC BRAKE (DUNLOP LICENSED)

General

The ATE disc brake is of a very simple design and basically consists of a pot-shaped disc, or rotor, and a brake caliper assembly (see Fig. 1).

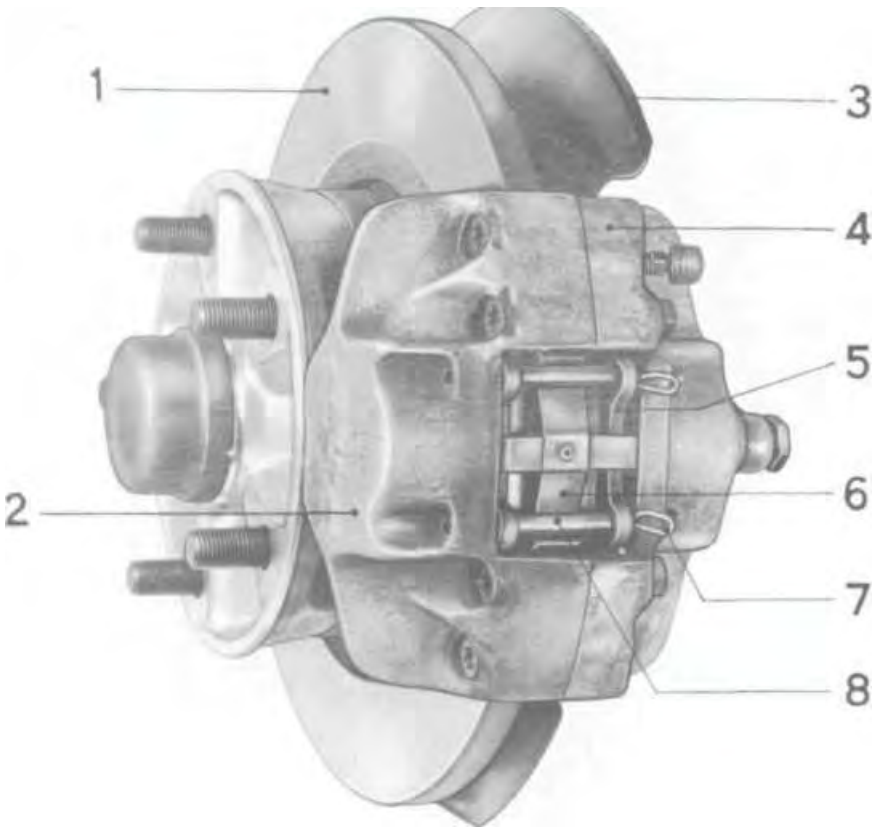


Fig.

1 Brake disc	3 Disc shroud	5 Brake pad segment	7 Pin retainer
2 Caliper cover	4 Caliper base housing	6 Cross-spring	8 Retaining pin

The front wheel disc is attached to the wheel hub by appropriate bolts and centered on the hub collar.

The rear wheel disc also is attached by the hub collar. However, even though the disc is attached to the hub by two countersunk screws, the main load is carried by the wheel lugs.

The brake caliper straddles the disc. Two bolts attach the caliper to its carrier flange at the Shockabsorber strut at front, and the axle guiding arm at rear.

The caliper base housing (Pt. 4, Fig. 1) and the caliper cover housing (Pt. 2, Fig. 1) are bolted together by four bolts, thus forming the caliper assembly.

Each caliper assembly half (base and cover) has a brake cylinder with piston; piston sealing is by means of an O-ring embedded in a groove machined into the cylinder wall.

Dust boots have been provided to protect the brake cylinders and pistons against contamination by road dirt, dust, or moisture. The dust boot is secured to the housing collar by a clamping ring, and to the piston through snap fit in a groove provided for that purpose.

Each brake pad segment (brake pad with base plate) has axial freedom in its slot in the housing and is guided by two retaining pins which are secured by pin retainers.

A cross-spring, located under the retaining pins and exerting pressure upon the brake pad segments, ensures that the segments do not rattle and also serves as a brake pad wear indicator.

The brake disc is protected against coarse dirt and direct water spray by an inboardly mounted disc shroud.

N O T E !

When the brakes are to be put to hard use, such as in competition driving or the like, it will be of advantage to remove the disc shrouds to facilitate better cooling and, thus, extend brake pad life. However, in such cases it is absolutely necessary to install deflector shields (Part Nr. 901.351.801/802. 15) on the front wheel brakes.

N O T E !

When spraying the underbody with corrosion preventives, make sure that the brake disc assemblies are covered.

Disc Brake Schematic

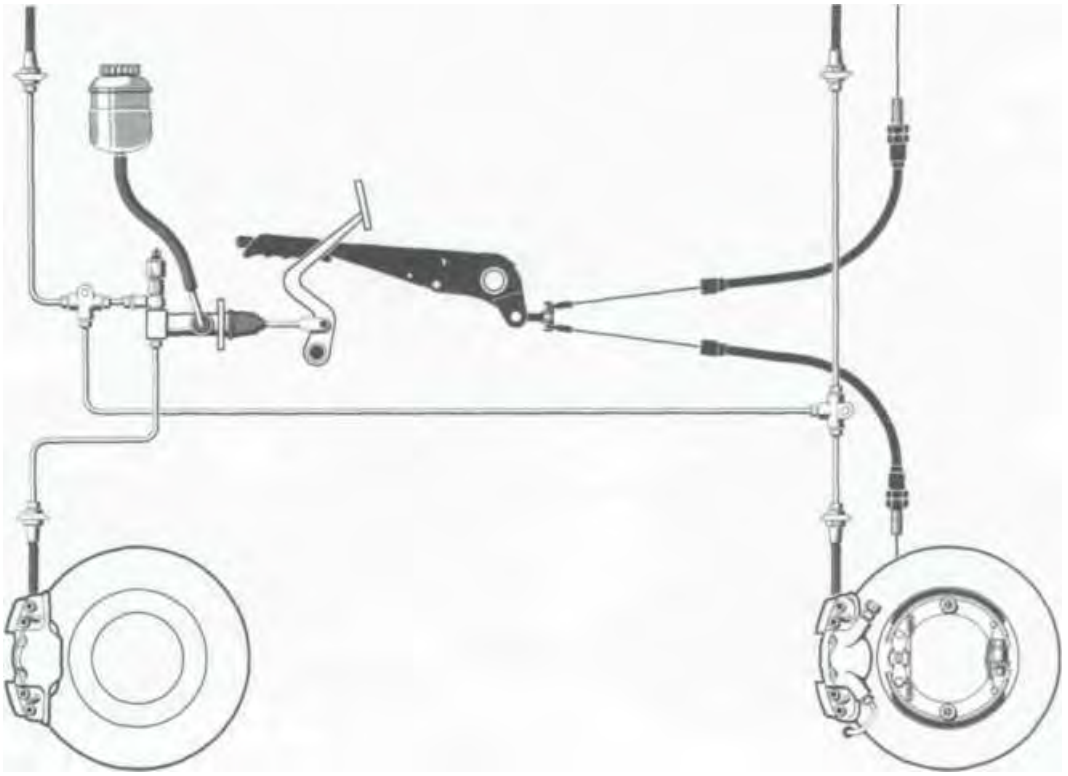
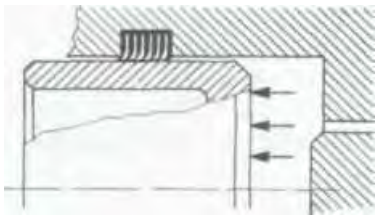


Fig. 2

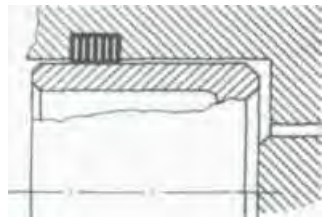
Brake Function Description

When the foot brake is applied, the piston in the brake master cylinder is forced forward, transmitting hydraulic pressure to the brake cylinders in the calipers through hydraulic lines. The hydraulic pressure acts on the pistons in the brake calipers, squeezing the brake pad segments against both sides of the rotating discs and creating the friction required for braking. The amount of braking force is determined by the amount of pedal pressure.

As soon as the brake pedal is released, pressure in the hydraulic system collapses and the unbraked condition is regained, as follows: The O-ring embedded in the brake cylinder groove and sealing the piston under light tension, has rolled slightly sideways due to friction created by piston drag at time of application of the brake (see Fig. 3). As the pressure collapses in the hydraulic system, freeing the piston, the O-ring rolls back into its original position and drags the piston along, moving it slightly away from the brake pad segment (see Fig. 4). Since pressure no longer is applied to the brake pad segments, the disc becomes free to rotate and the unbraked condition is regained.



Brake Condition Fig. 3



Unbraked Condition Fig. 4

Brake Master Cylinder

The brake master cylinder has a purging check valve which ensures a complete negation of pressure in the hydraulic system. Contrary to the normal designs, the check valve cone has a small purging passage 0.7 mm (.276") diameter which also permits quick repumping under rapid pedal actuation such as when refilling or bleeding the system without the use of a filling or bleeding tank.

The hydraulic fluid reservoir is located below the forward luggage compartment.

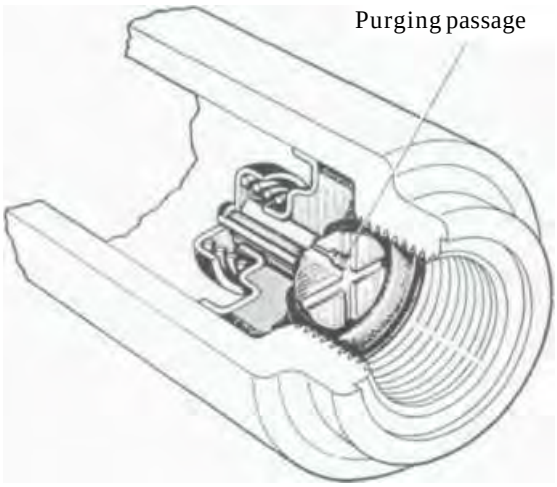


Fig. 5

Fig. 6

CAUTION !

This brake master cylinder is not interchangeable with brake master cylinders utilized in drum-type brake system. For this reason the brake master cylinder bears an identifying plastic band which reads "This cylinder has a special check valve" (German: "Zylinder hat Spezialbodenventil"). The master cylinder has a bore diameter of 19. 05 mm (. 750").

Brake Calipers

The brake calipers differ in size for front and rear wheels and are thus not interchangeable.

The cylinder diameter is 48 mm (1. 890") for front wheels. 35 mm (1. 378") for rear wheels.

Brake Discs

The front wheel disc diameter is 11.1" (282 mm), rear disc diameter 11.2" (285 mm). When new, the front wheel discs have a thickness of . 500" to 492" (12. 7 to 12. 5 mm), rear discs .394" to .386" (10. 0 to 9. 8 mm), or .413" to .406" (10. 5 to 10. 3 mm).
Damaged disc surface may be redressed although removal of base metal must not exceed . 02" (0. 5 mm) per disc side, whereby the coarseness depth of the finished surface must be less than . 00024" (0. 006 mm). The permissible disc thickness variation at the braking surfaces is . 0012" (0. 03 mm) and must be kept within this limit since otherwise the brakes will have a tendency to chatter. In addition, when reconditioning brake discs the lateral runout must not exceed . 0020" (0. 05 mm); this measurement should be made as close to the outer edge of the rim as possible.

Caution

The brake disc may be dressed only symmetrically, that is, equally on both sides. (See disc surface information on page ST 2, Fig. 4 and 5, and machine dressing data on page ST 3.)
Recondition brake discs only when absolutely necessary.

Brake thickness wear limit when worn symmetrically is .43" (11. 0 mm) in front, and .33" (8. 5 mm) in the rear.

Automatic Brake Pad Adjustment

The brake pads of the disc brakes require no adjustment (hand brake components excepted) since this happens automatically. The self-adjusting device is contained within the pistons in the brake calipers; it includes an arresting element which, in connection with a stud in both the caliper base housing and its cover, performs the automatic pad adjustment.

The self-adjusting device, together with the inherent pad clearance it provides, cannot be changed or repaired. In the event of malfunctions it is necessary to replace the complete piston assembly.

Hand Brake

The hand brake is of the Duo-Servo type and provides a good braking effect through the application of the self-energizing effect. The pot-shaped part of the rear wheel discs serves as a brake drum so that both are in one unit.
The linings are bonded to the shoes. Only Porsche-recommended brake linings may be used.
Hand brake action is mechanical, to rear wheels only.
The hand brake and foot brake are two completely separated systems.

Hand Brake Function Description

When the hand brake is set, two brake shoes in each rear wheel expand against the brake drum contained within the rear brake discs through force transmitted over brake drum contained within the rear brake discs through force transmitted over brake cables and mechanical expanders. Forward or rearward rotation of the wheels creates a self-energizing effect by the advancing primary shoe. Since the floating adjusting assembly also is the anchoring point for both shoe and increases its braking force. Consequently, the secondary shoe receives sufficient braking pressure, the braking effectiveness being equally good in both directions of rotation.

Hand Brake Expander

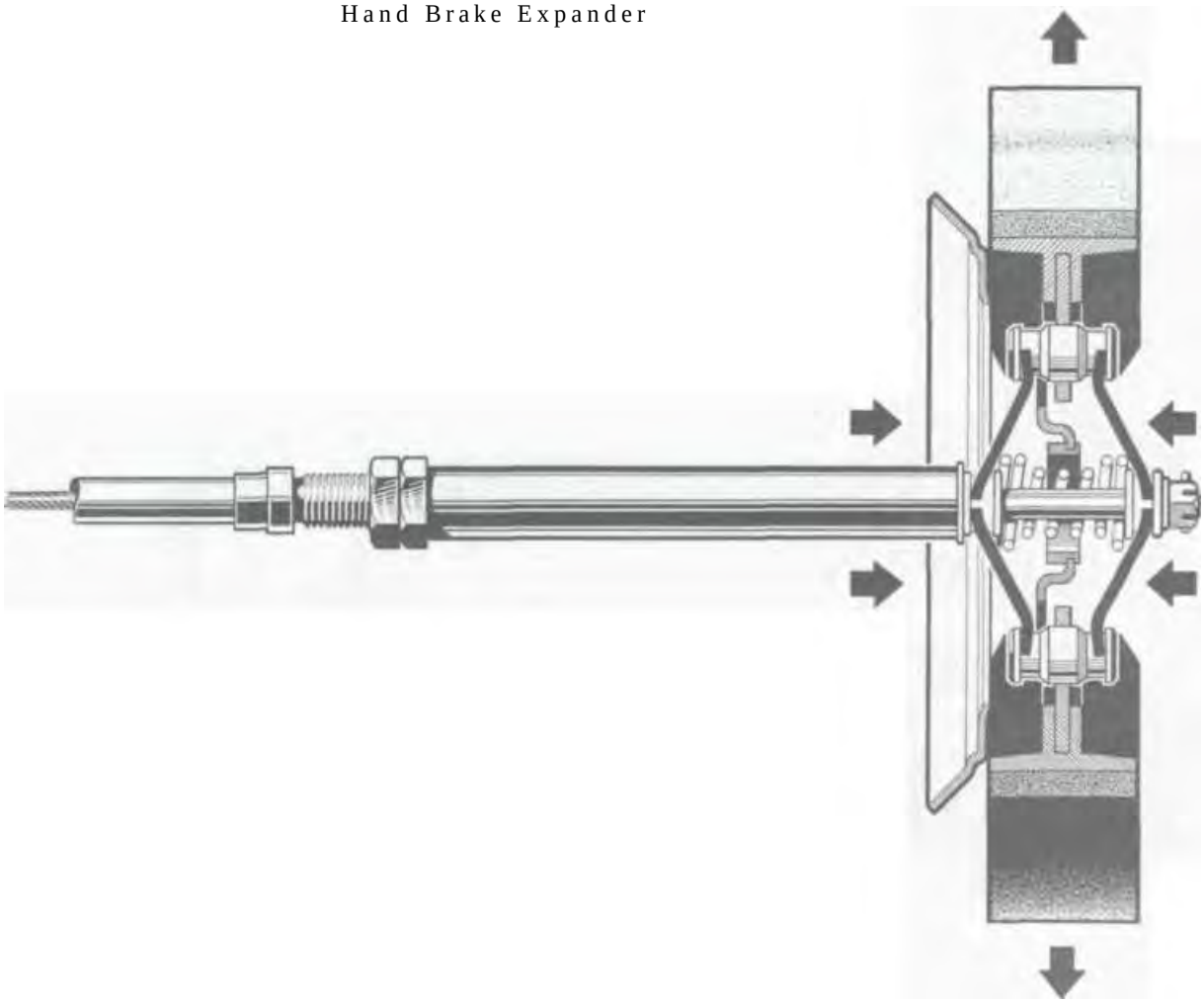


Fig. 7

Brake Data

Foot brake
Effective braking area per wheel front 52. 5 cm^2 (8.14sq.in.) rear 40. 0 cm^2 (6. 20 sq. in.)
Total effective braking area 185. 0 cm^2 (28. 68 sq. in.)

Hand brake
Brake drum diameter 180. 0 mm (7. 087")

Brake lining width 32. 0 mm (1. 26")

Total effective braking area 210. 0 cm^2 (32.55 sq. in.)

Rear Wheel Brake

Cross - sectional View

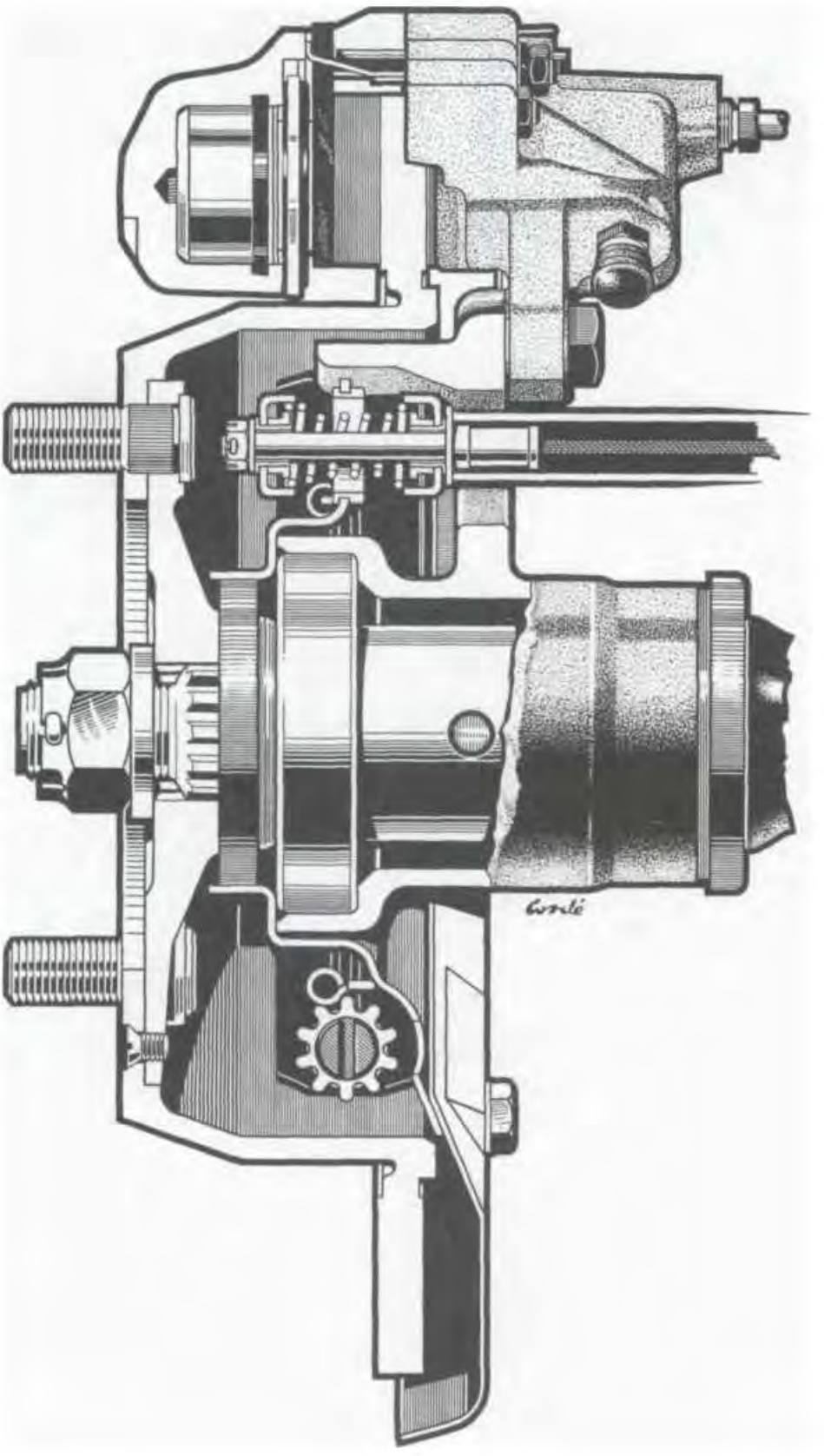


Fig. 8

Special Tools:

P 36b Disc holder and wrench guide
P 42a Torque wrench. 75 mkp
P 44a Extension
P 83 Piston depressor
P 84 Piston aligner
P 86 Brake pad remover
P 87 Gauge holder (for checking lateral runout)
P 294 Oil seal installer
P 296 Rear axle nut socket
P 297 Rear hub remover

REMOVING AND INSTALLING BRAKE MASTER CYLINDER 1 Ti

Removal

1. Place car on stands.

2. Detach accelerator pedal from pressure rod by pulling pedal back. Unfasten floormat (left front) and remove.

3. Remove floorboard retaining nut and withdraw floorboard.

Fig. 9

4. Withdraw rubber boot from brake master cylinder.

5. Drain brake fluid reservoir.

6. Remove retaining nuts and bolts from bottom shield and withdraw it.

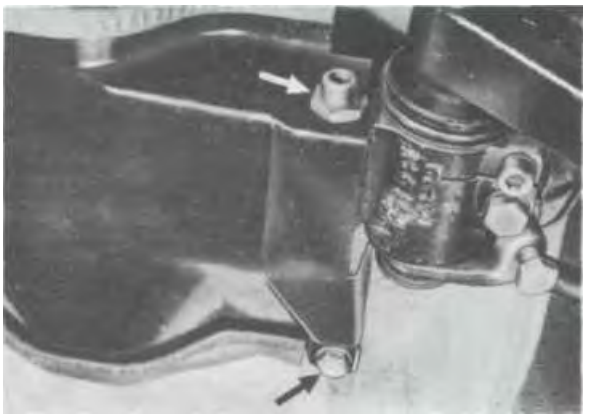


Fig. 10

7. Detach hydraulic lines and stop-light switch wires from brake master cylinder.

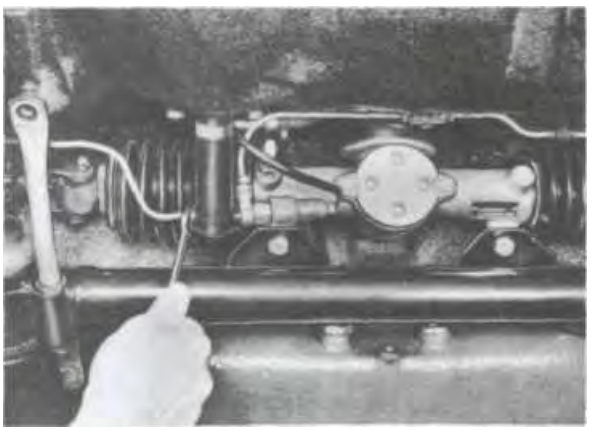


Fig. 11

8. Loosen hose clamp at hose which connects fluid reservoir with master cylinder and withdraw hose.

9. Remove retaining nuts from master cylinder mounting flange and withdraw master cylinder.

Fig. 12

Installation

1. When installing the master cylinder, at the same time properly position the piston rod. Also, the flange should be sealed with sealing compound to prevent entry of water into the car's interior.

2. Place new spring washers under the retaining hex nuts and tighten to 2. 5 mkp (18 Ibs/ft).

3. Provide a clearance of approx. 1 mm (. 04") between piston rod and piston in master cylinder. (Loosen lock nut on piston rod and turn rod as appropriate).

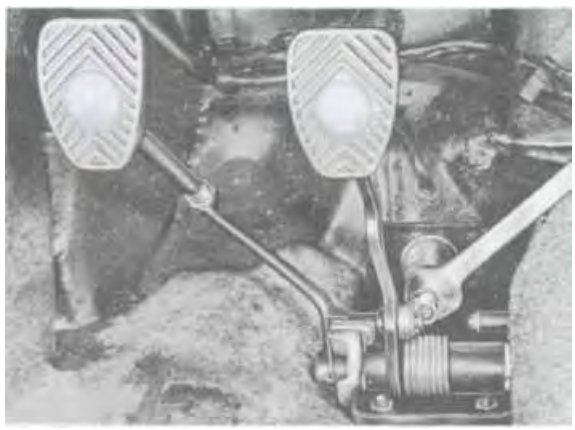


Fig. 13

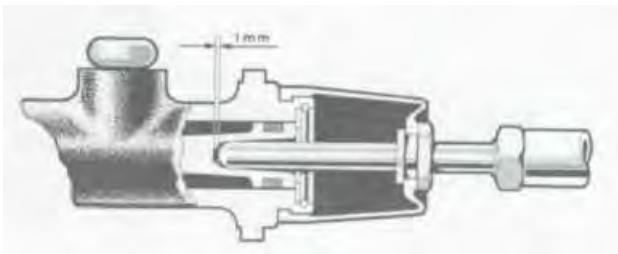


Fig. 14

4. Check venting passage in fluid reservoir cap for possible obstructions.

5. Refill system with new brake fluid.

6. Bleed brake system (see 11 Ti and 12 Ti).

7. Check brake lights.

8. Install bottom shield and tighten retaining nuts to 6, 5 mkp (47 Ibs/ft), and bolts to 4,7 mkp (34 Ibs/ft).

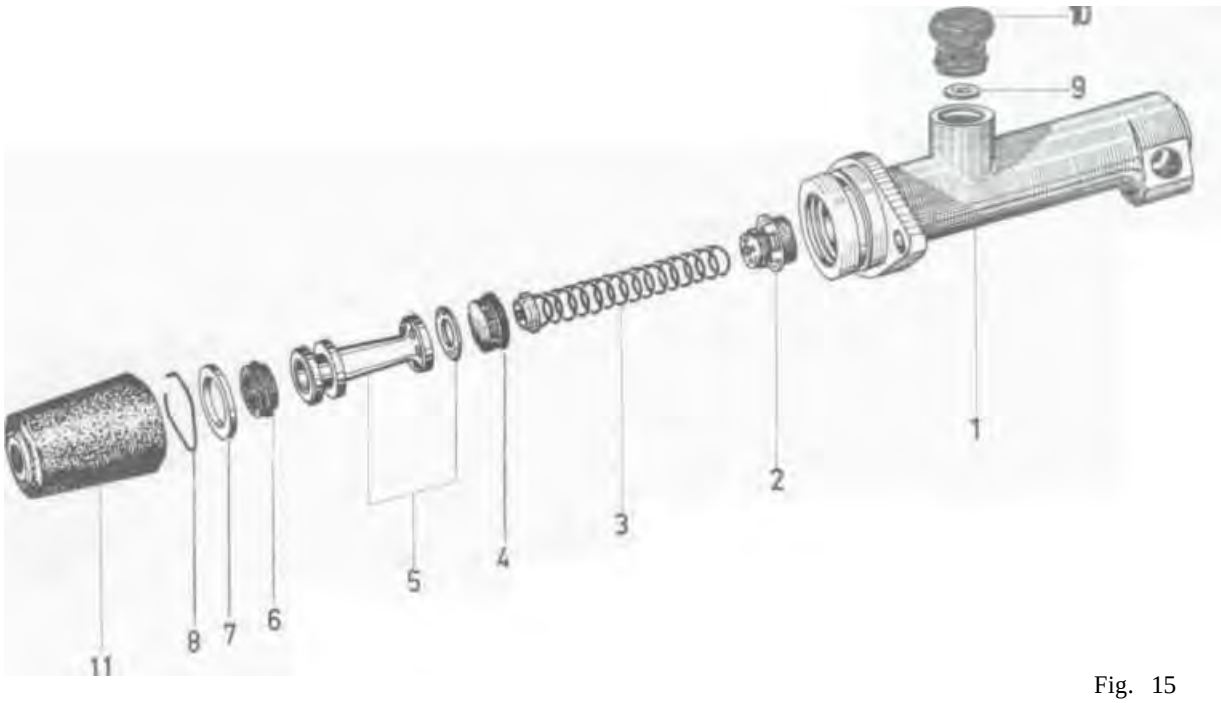


Fig. 15

1 Housing
2 Special check valve
3 Spring
4 Primary piston cup
5 Piston with washer
6 Secondary piston cup
7 Piston stop plate
8 Lock ring
9 Washer
10 Rubber grommet
11 Rubber boot

D i s a s s e m b l y

1. Fasten master cylinder in a vise under light pressure (use jaw covers).

2. Withdraw lock ring with a small screwdriver.

Fig. 16

3. Withdraw piston stop plate, piston with secondary piston cup and washer.

4. Applying approx. 1 atm (15 psi) air pressure, blow out the primary piston cup, remove spring and check-valve.

Reassembly

Note the following at reassembly:

1. Clean all parts using alcohol only.

2. Check parts for wear. The cylinder intake passage must be free of dirt or other obstructions such as burr. Check the purging passage for possible obstructions. The clean and dry piston must move in the cylinder with suction drag when moved either way.

3. Lightly coat the cylinder bore, piston surface, and piston cups with ATE brake cylinder paste.

4. See Fig. 15 for order of reassembly (do not fail to install the piston washer).

5. Ensure good seating of the lock ring.

REPLACING BRAKE PADS

General

Brake pad wear is influenced, among others, by driving habits and road conditions. Accelerated brake pad wear may be expected when driving on wet and dirty roads (winter-serviced) as well as through hard use of the brakes (high-temperature conditions).

The thickness of the brake pads must be visually inspected in the course of all servicing operations.

Clearance must be in evidence between the cross-spring and the brake pad segment (see Fig. 17). The wear limit has been reached when the brake pad segment touches the cross-spring or when the pad lining has worn to a thickness of 2 mm.

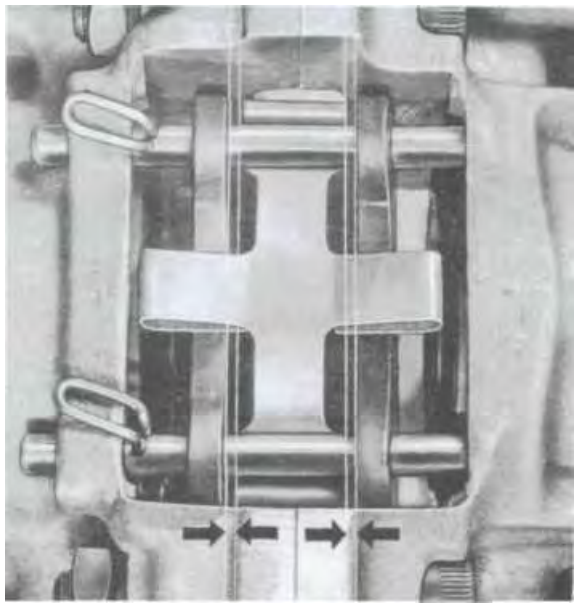


Fig. 17

The installed thickness of the brake pad segment (lining plus supporting plate) is approx. 15 mm. The pads installed in front and rear wheel brakes are of different size and, thus, are not interchangeable.

Two types of brake pads are available, i. e., one type is for normal driving while the other is for competition use. The pads designed for competition use wear slower but require higher pedal pressures.

The pads are marked on the lining plate. The competition pads (Textar 1431 G), for instance, bear the making "TE 10". The proper brake pad type may be determined by consulting the Porsche spare parts catalogue.

Prior to the onset of the cold season, we recommend to replace the competition pads against those designed for normal driving. Only Porsche - approved brake pads may be installed.

The front and rear wheel pairs must always be equipped with one type of brake pads. Although it is permissible to replace individual brake pads, we suggest that at lest all pads of a given axle (wheel pair) be replaced at any one time.

CAUTION:

Used brake pads must be marked prior to removal from the calipers to ensure that they are reinstalled in the same position. It is not permissible to change the original position of the brake pads by switching these from one place to another.

3Ti Changing Brake Pads

1. Place car on stands and remove wheels.

2. Withdraw pin retainers.

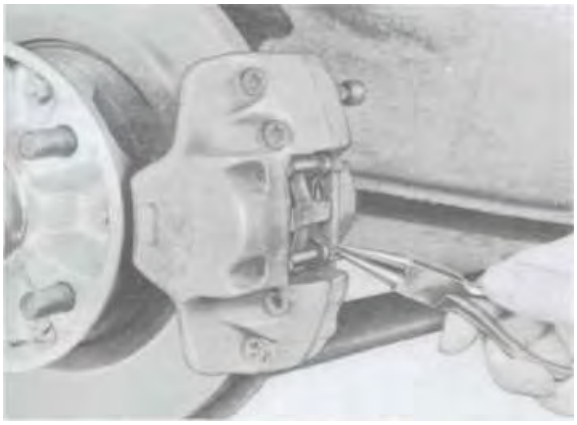


Fig. 18

3. Push retaining pins towards the car while depressing the cross-spring.

Fig. 19

4. Mark original position of brake pads which are still

5. Withdraw brake pad segments with the aid of the P 86 remover.

CAUTION!

Do not insert the attaching dowels of the remover too deeply since this could engage into the cover shield and make pad withdrawal not possible.

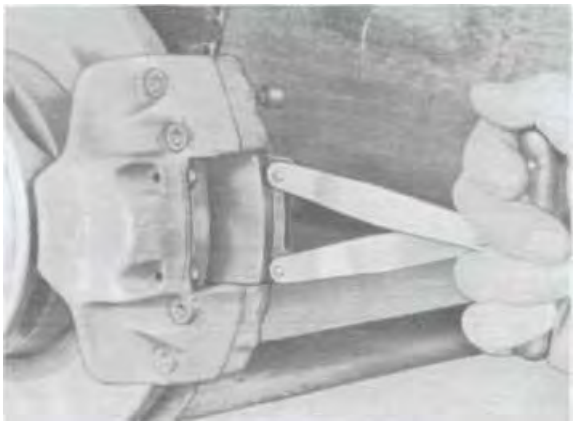


Fig. 20

6. Push pistons fully back with the aid of the P 83 piston depressor; if not available, a hard-wood block may be used instead. Do not use other tools due to the possibility of damaging the piston or brake disc (see Fig. 21).

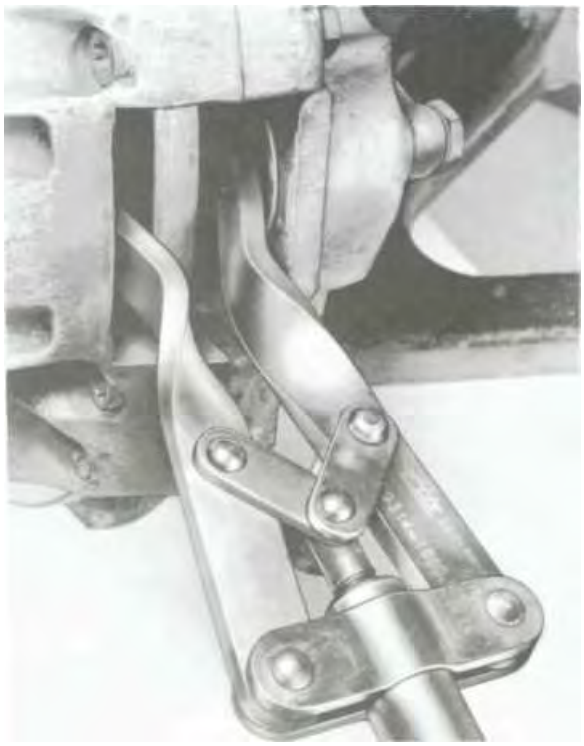


Fig. 21

CAUTION!

Brake fluid retreats into the fluid reservoir when the brake pistons are pushed back. To prevent overflowing, drain the reservoir first. The draining device should be one used exclusively for hydraulic brake fluid and must not come into contact with other matter.

7. Clean the brake pad contact surface in their slots in the calipers; do not use mineral solvents or sharp-edged tools - if necessary, use alcohol.

8. Check dust boots and clamping rings for damage, replace hard or porous boots.

9. Clean brake discs with fine emery cloth and smoothen any evident disc wear ridge (top and bottom).

10. Install new brake pads in the caliper slots, together with retaining pins, cross-spring, and pin retainers; check pin retainers and if worn or deformed in any way, replace. The brake pads must hang free in their caliper slots (absence of binding).

11. Proceed likewise at the other brake calipers.

CAUTION!

Repeatedly depress the brake pedal as far as possible, before the car is driven, to force the brake piston into proper position; thereupon check the hydraulic fluid level in the reservoir and replenish if necessary.

Conditioning the Brake Pads

An inherent characteristic of factory-new brake pads is to fade once during the conditioning period of approx 200 km (125 miles) - a phenomena which does not reoccur thereafter. During this period, the brake should not be used hard and severe application of the brakes should not be practiced from high speeds unless an emergency situation should be faced. New brake pads should be conditioned through moderate pedal pressure at reasonable intervals. It is only after this conditioning period that the brakes reach their full braking effectiveness.

4Ti REMOVING AND INSTALLING FRONT WHEEL BRAKES

Special Tools:

P 83 Piston depressor

P 86 Brake pad remover

P 87 Gauge holder (for checking lateral runout)

Removal

1. Place car on stands and remove wheels.

2. Remove brake pads (see Points 2 to 5, Section 3Ti).

3. Detach hydraulic line at banjo connection in brake caliper (first slightly depress brake pedal depressor, and lock in that position, to keep the brake fluid from draining out of the fluid reservoir).

4. Remove caliper retaining bolts, withdraw caliper and shield.

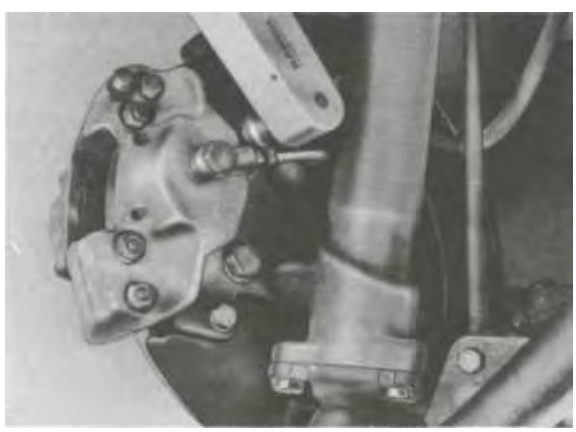


Fig. 22

5. Remove bearing cap from wheel hub by prying around the cap's circumference.

Fig. 23

6. Loosen Allen lock nut in the wheel bearing clamping nut, unscrew clamping nut and withdraw thrust washer.

Fig. 24

7. While holding the brake disc with both hands at two opposite points, pull it off with a strong yank (strongly seated disc should be removed with a puller - in no case may the disc be hit with a hammer or mallet).

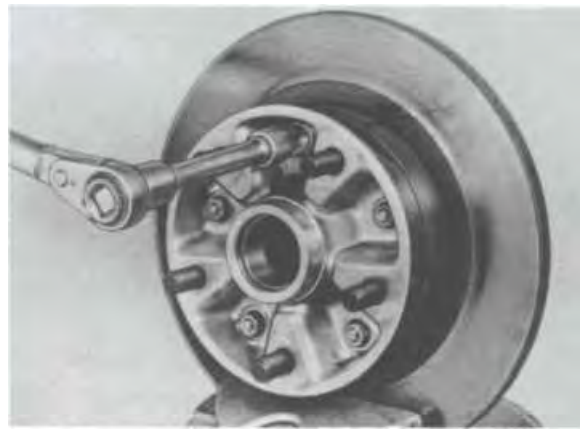


Fig. 27

8. Remove retaining bolts from disc shroud and withdraw shroud.

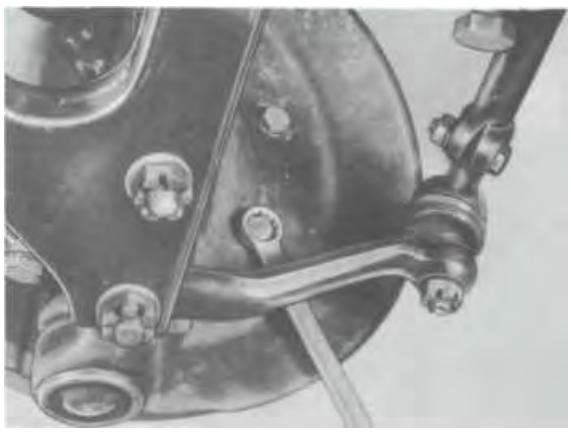


Fig. 25

9. Remove retaining bolts from brake carrier and withdraw carrier.

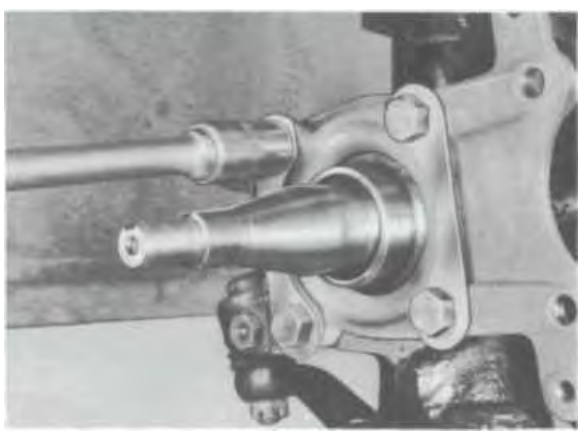


Fig. 26

10. Mark brake disc and wheel hub, remove attaching bolts, and detach disc from hub.

Installation

Install in reversed order of the above by noting the following points:

1. Clean all parts from dirt and grease remnants.

2. Join disc and hub so that markers match.

3. Torque bolts attaching disc to hub to 2. 3 mkp (16.6 Ibs/ft).

4. Check wheel bearings, spacer, and seal for good condition, replace if necessary.

5. Install both bearings with approx 50 cm^3 (or 45 g - 1. 6 oz.) Lithium multipurpose grease.

6. Using new safety strips for brake carrier retaining bolts, tighten bolts to 4,7 mkp (34 Ibs/ft).

7. Tighten shroud retaining bolts to 2.5 mkp (18 Ibs/ft).

8. Ensure proper wheel bearing adjustment (see Group S, page S 14).

9. The brake disc must not have lateral runout in excess of 0. 2 mm (. 008"). Check disc for lateral runout with the P 87 gauge (see 9 Ti).

10. Using new spring washers, torque (front) caliper retaining bolts to 7 mkp (50. 6 Ibs/ft).

11. Install all brake pads in their original positions.

12. Bleed brake system (see 11 Ti and 12 Ti).

Special Tools:

P 83 Piston depressor
P 86 Brake pad remover
P 87 Gauge holder (for checking lateral runout)

Removal

1. Place car on stands and remove wheels.

2. Remove brake pad segments (see Points 2 to 5. Section 3 Ti).

3. Remove disc shroud retaining bolts and withdraw shrouds.

Fig. 28

4. Detach hydraulic line from caliper (first slightly depress brake pedal with pedal depressor, and lock in that position, to keep the brake fluid from draining out of the fluid reservoir).

5. Remove caliper retaining bolts and withdraw caliper.

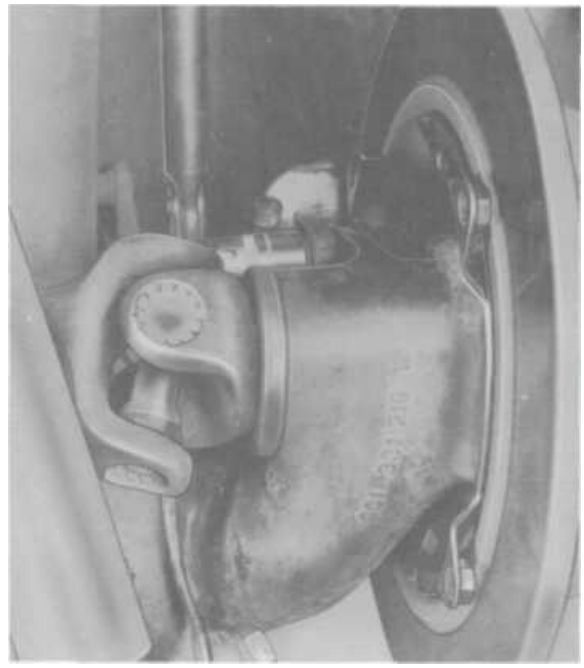


Fig. 29

6. Remove countersunk screws from brake disc and detach disc.

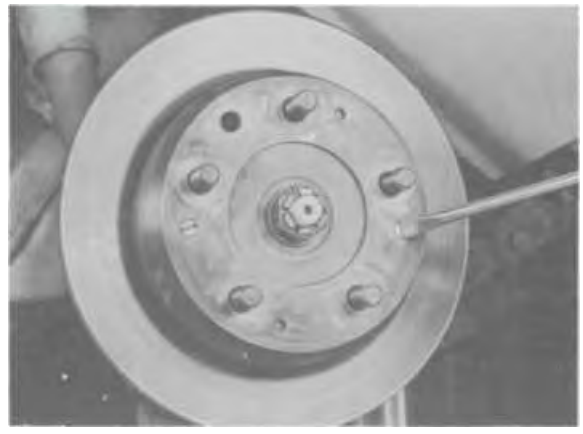


Fig. 30

7. Remove cotter pin, castellated nut, and washer from brake cable and pull cable out towards the car.

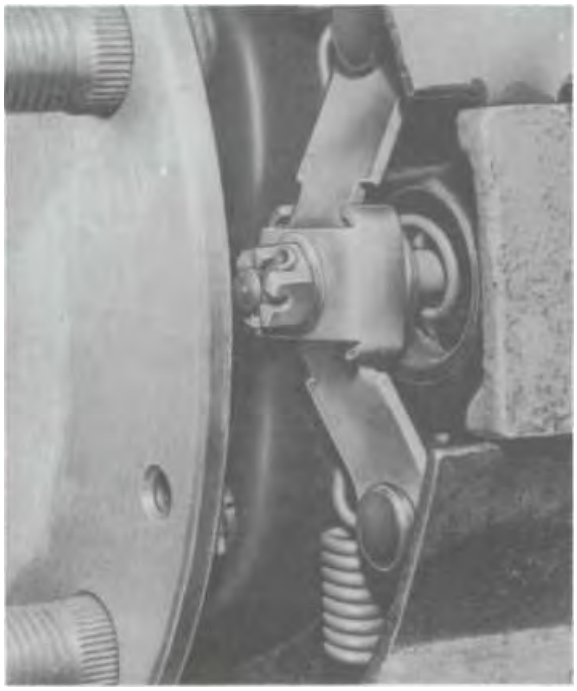


Fig. 31

8. Remove mechanical expander and spring.

9. Remove spring retainer disc from holddown pin in upper brake shoe while pulling the brake shoe outward (withdraw spring by turning, pull the pin out through the back).

Fig. 32

10. Raise upper brake shoe with a screwdriver, withdraw adjusting assembly, and unhook spring.

Fig. 33

11. Remove spring retainer disc from holddown pin in lower brake shoe and withdraw spring and pin.

12. Remove both shoes by moving towards front of car and unhook the special return spring.

Installation

Install in reversed order of the above by noting the following points:

1. Clean all parts.

2. Worn or oily brake linings should be replaced (use only Porsche-approved brake linings).

3. Insert brake cable from behind and slide inner part of expander onto cable.

NOTE:
Do not fail to install the washer between spacer tube and expander.

4. Install the special return spring in such way that the spring coils are oriented towards the axle center.

Fig. 34

5. Insert both brake shoes, with the special return spring installed, from front to rear onto the brake carrier plate.

6. Install holddown pins, springs, and spring retainer discs.

7. Insert inner expander into seats in brake shoes.

8. Raise the upper brake shoe with a screw-driver and insert hand brake adjusting assembly so that the adjusting sprocket is down in the right brake and up in the left brake.

9. Install second return spring.

10. Turn adjusting nut in cable conduit all the way back.

11. Install spring, second expander half, washer, and castellated nut: tighten castellated nut until one of its slots clears the cotter pin orifice, then safety with a new cotter pin.

NOTE:
Recheck expander assembly for proper seating in the shoes.

12. The brake disc must not have lateral runout in excess of 0.2 mm (. 008"). Check disc for lateral runout with the P 87 gauge (see 9 Ti).

13. Using new spring washers, torque (rear) caliper retaining bolts to 6 mkp (43.4 lb-ft).

14. Install all brake pads in their original positions.

15. Bleed brake system (see 11 Ti and 12 Ti).

16. Adjust hand brake (see 7 Ti).

6Ti REMOVING AND INSTALLING HANDBRAKE CARRIER PLATE

Special Tools:

P 36b Disc holder and wrench guide
P 42a Torque wrench, 75 mkp
P 44a Extension
P 83 Piston depressor
P 86 Brake pad remover
P 87 Gauge holder (for checking lateral runout)
P 294 Oil seal installer
P 296 Rear axle nut socket
P 297 Rear hub remover

Removal

1. Go through steps described in Points 1 to 7, Section 5 Ti.

2. Remove cotter pin from half-axle castellated nut and remove nut with special tools P 42a. P 36b. P 44a. and P 296.

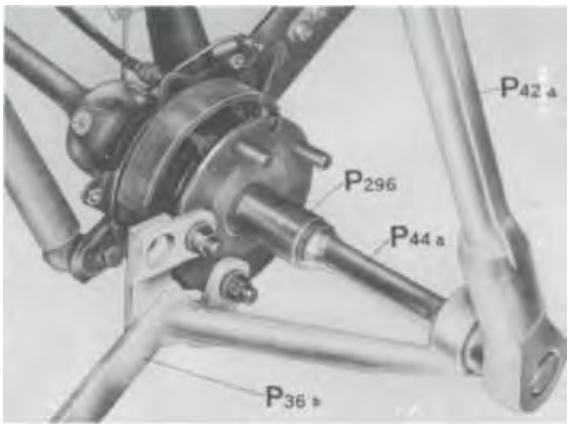


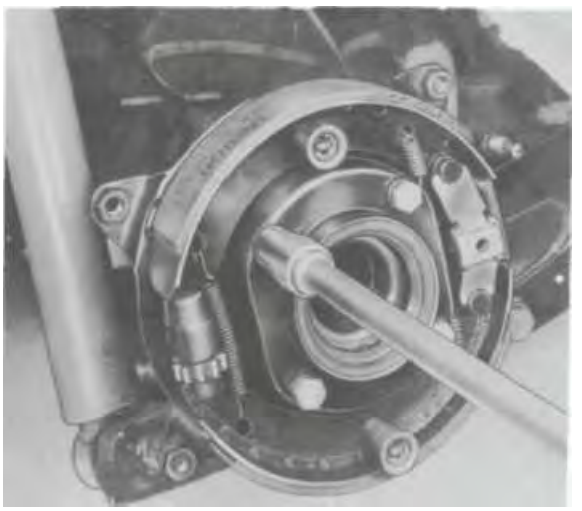
Fig. 35

3. Remove half-axle Allen retaining bolts at universal joint, drive the axle out and remove.

4. Drive rear hub out with special tool P 297.

Fig. 3G

5. Remove brake carrier plate retaining bolts and withdraw carrier plate.



Installation

Note the following points during reassembly:

1. Clean all parts.

2. Check oil seal in brake carrier plate, replace if necessary (use special tool P 294).

3. Pack ballbearing and rollerbearing with multi-purpose Lithium grease.

4. Use new O-ring, placing it into position with a little grease; ensure that it is in proper place.

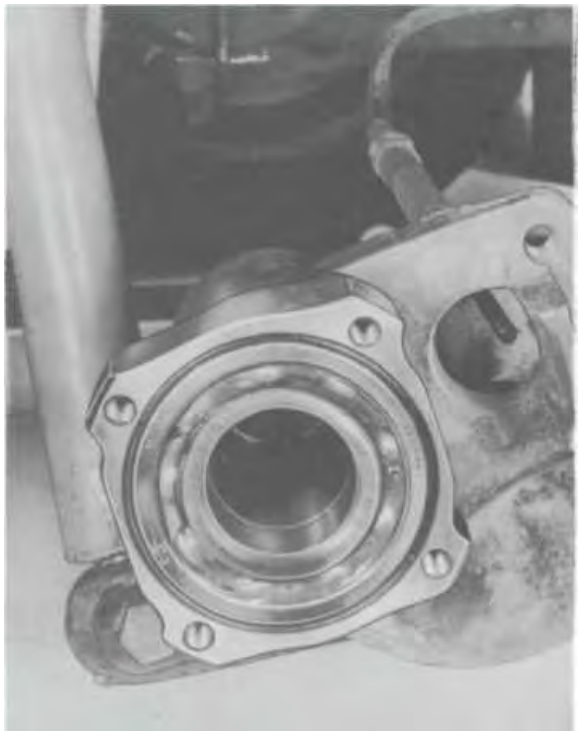


Fig. 38

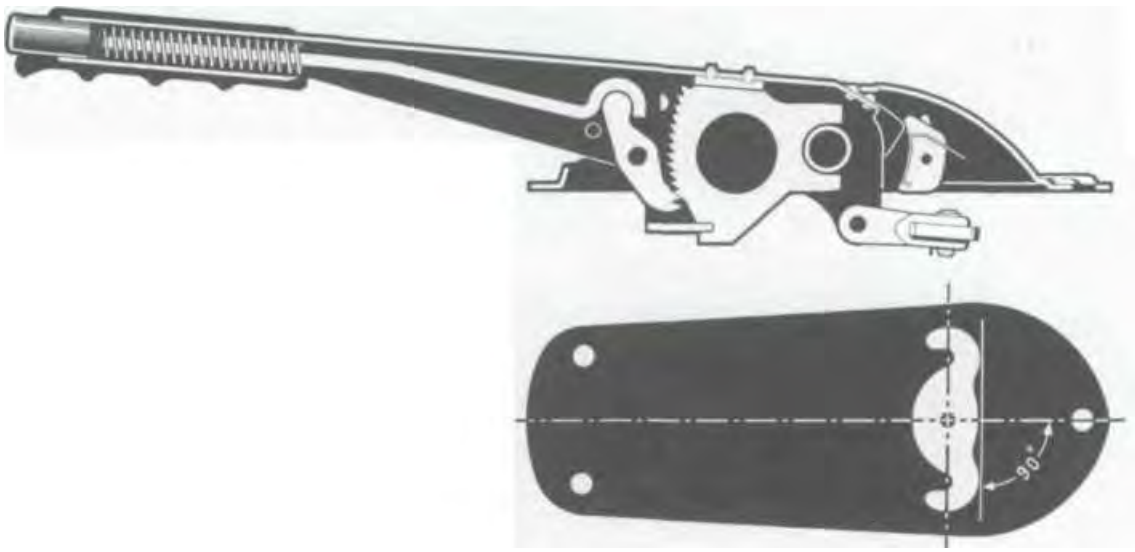
5. Torque brake carrier plate retaining bolts to 2. 5 mkp (18 Ibs/ft).

6. Torque castellated nut of half-axle to 30 - 35 mkp (217 - 253 Ibs/ft).

7. Torque Allen bolts of half-axle flange to 4.7 mkp (34 Ibs/ft).

8. Using new spring washers, torque (rear) caliper retaining bolts to 6 mkp (43.4 Ibs/ft).

9. Note steps outlined in Points 14 to 16, Section 5 Ti.



Cross-section of Handbrake Lever with Cable Equalizer Fig. 39

Adjusting

1. Place car on stands and remove rear wheels.

2. Release handbrake and push brake pads of rear disc brakes back so that the discs rotate freely.

3. Loosen cable conduit adjusting nuts so that cables are not under tension.

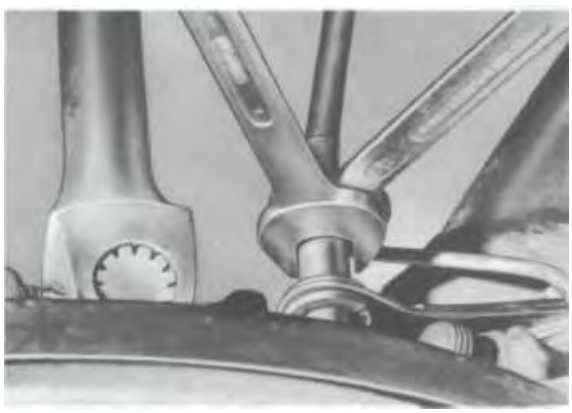


Fig. 40

4. Insert screwdriver into opening in drum of rear brake disc assembly and turn handbrake adjusting sprocket until tight, that is, so that the brake disc can no longer be turned by hand.

Fig. 41

5. Repeat the adjusting procedure on the opposite rear brake.

6. Adjust handbrake cable tension by turning nuts at the cable conduit so as to remove the cable slack.

7. Pull tunnel cover and handbrake lever boot up at the rear and check the position of the cable equalizer by looking through the two inspection holes in handbrake bracket. The equalizer must be exactly across the car's long axis when the handbrake is pulled up. If necessary, reposition the equalizer by loosening or tightening the cable conduit adjusting nuts (see Fig. 39 and 42).

Fig. 42

8. Tighten lock nuts at the conduit adjusting nuts.

9. Back off adjusting sprocket in each wheel by approx 4 - 5 teeth so that the brake disc can turn freely.

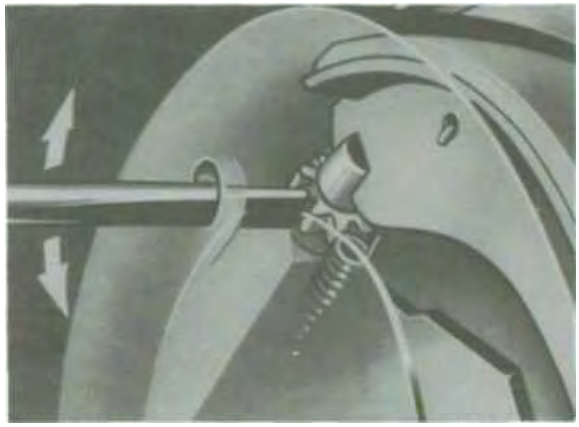


Fig. 43

10. Check handbrake clearance at the handbrake lever. The lever should have a slight clearance although the handbrake should be set when the lever is pulled up by 4 teeth of the ratchet.

CAUTION!

Repea-tedly depress the brake pedal as far as possible, before the car is driven, to force the brake pistons into proper position; thereupon check the hydraulic fluid level in the reservoir and replenish if necessary.

8Ti ADJUSTING CONTACT BLOCK OF HANDBRAKE CONTROL LAMP SWITCH

1. Pull tunnel cover and handbrake lever boot up at the rear.

2. Pull handbrake up by one tooth of the ratchet, loosen fillister screw of contact block by one to two turns and move the contact block to the instant when the control lamp lights up.

3. Tighten fillister screw of contact block and check proper functioning of the handbrake control lamp.

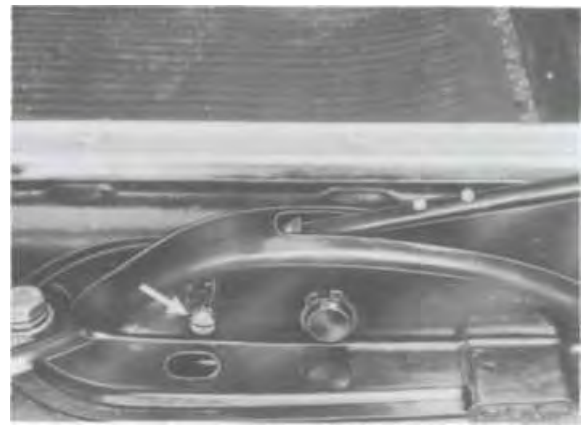


Fig. 44

9Ti CHECKING BRAKE DISC FOR LATERAL RUNOUT

Special Tools:

P 83 Piston depressor
P 86 Brake pad remover
P 87 Gauge holder (for checking lateral runout)

Front Axle

1. Remove brake pad segments (see Points 2-5, Section 3 Ti).

2. Adjust front wheel bearing clearance according to instructions (see Group S).

3. Attach gauge P 87 with retaining pins, align, arid tighten wing nut.
The gauge must be so positioned that the wing nut points down.

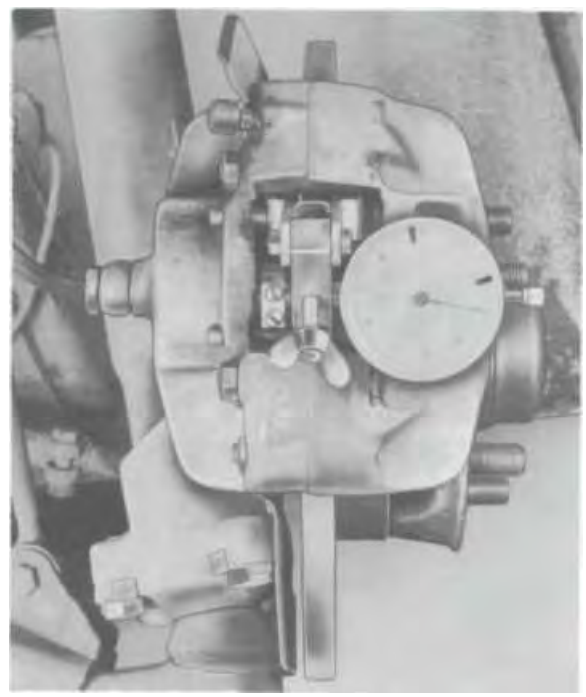


Fig. 45

4. Install dial gauge and tighten retaining screw.

5. Push feeler pin onto gauge and fasten with a slight preload. The feeler point should ride on the disc approx. 10-15 mm below the outer circumference of the disc.

6. In critical cases the lateral runout should be checked on both sides of the disc whereby the gauge should be turned around by 180°. Maximum permissible lateral runout is 0. 2 mm (.008").

7. Brake discs showing excessive lateral runout should be dressed or replaced (see page T 4, Brake Discs).

8. Install brake pad segments (see Points 10 and 11, Section 3 Ti).

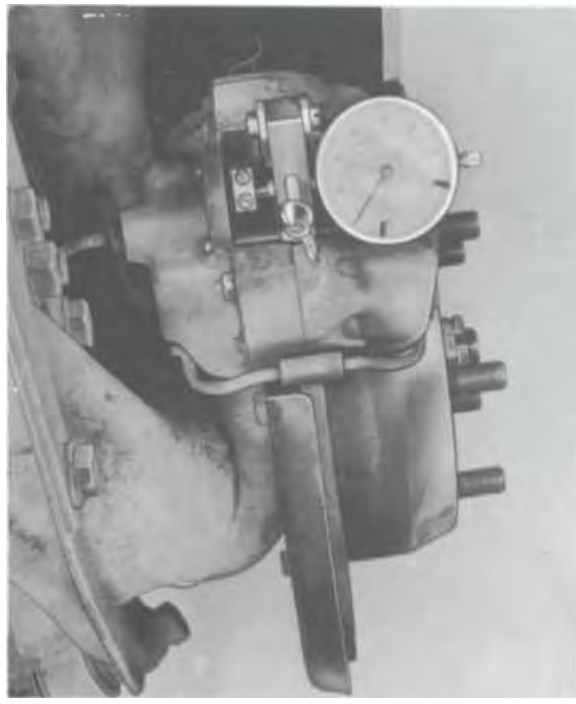


Fig. 46

2. Using wheel nuts, tighten brake disc to wheel hub. To preclude warping the disc, machined steel discs must be placed under the wheel nuts. Torque wheel nuts to 10 mkp (72. 3 Ibs/ft) in a cross pattern.

Maximum permissible lateral runout is 0.2 mm (.008").

3. Brake discs showing excessive lateral runout should be dressed or replaced (see page T 4, Brake Discs).

Rear Axle

1. Install gauge holder as outlined in Point 1. Front Axle, above.

4. Install brake pad segments (see Points 10 and 11, Section 3 Ti).

10 Ti RECONDITIONING BRAKE CALIPERS

Special Tools:

P 83 Piston depressor
P 84 Piston aligner
P 86 Brake pad remover

NOTE!

The brake calipers may be disassembled only when the O-rings between the caliper halves should develop a leak. Normally, however, such leaks occur very seldom. The rear wheel calipers and connecting lines need not be disassembled for any repair.

Removal

1. Remove caliper from car (see Points 1 to 4, Section 4 Ti, and Points 1 to 5, Section 5 Ti).

2. Loosen bleeder valve and carefully blow hydraulic fluid out of caliper (air pressure approx. 1 atm or 14 psi).

3. Mount caliper in a vice (use jaw protectors) and remove clamping ring and dust cover.

Fig. 47

4. Depress and hold down one piston with P 83 piston depressor. Place a hardwood board (approx. 1/3" thick), or something similar into the brake pad slot in caliper to protect the piston which is being removed, and force the piston out with air pressure (start with 2 atm or 29 psi, raising the pressure when necessary).

CAUTION!

Keep fingers out of the caliper slot --- 10 atm or 147 psi produce a pressure of up to 250 kp or 550 Ibs.

Fig. 48

5. Remove piston seal with a plastic pin to preclude damage to the groove.

Fig. 49

6. Clean all parts (use alcohol only).

Checking Parts

Check cylinder bore, piston, and slot surfaces for damage.

Operations involving removal of base metal from cylinder bores or pistons are not permissible.

Replace damaged parts.

Wear-and tear parts are generally to be replaced (use repair kits).

Components of the automatic pad adjustment device should not be replaced individually; if defective, always install a new piston assembly.

Installation

Note the following at reassembly:

1. To make reassembly easier, and to provide protection against corrosion, thinly coat the cylinder bore, piston, and piston seal with ATE brake cylinder paste.

2. Insert piston seal into groove in cylinder bore.

3. Using the piston aligner (P 84), position piston in cylinder so that the stepped-down piston pressure surface points towards the disc's rotational entry into the caliper. If necessary, press piston in to stop with piston depressor. Caution! Do not jam the piston.

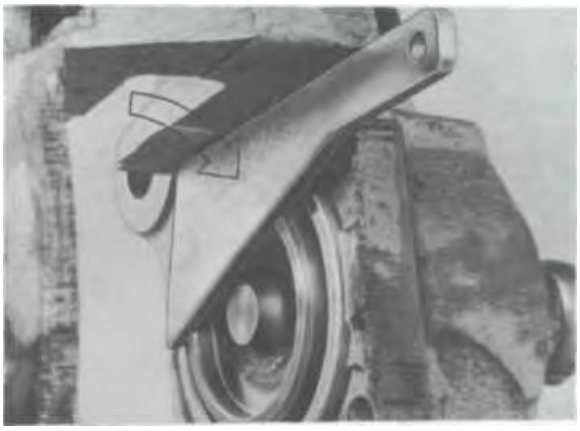


Fig. 50

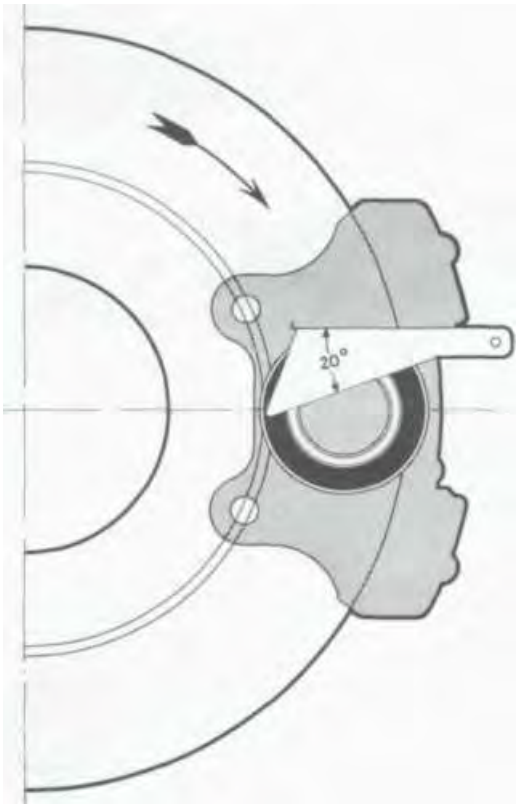


Fig. 51

With caliper installed, the piston aligner (P 84) must always rest against the upper edge of the brake pad slot.

Fig. 52

Should it become necessary to turn a piston in an installed caliper, hold the opposite piston with the P 83 piston depressor while pressing the maladjusted piston out to the point where it can be turned by hand.

4. The dust covers must be installed dry; therefore, wipe brake cylinder paste, if any, from the piston ridge.

5. Install brake caliper in car (see Points 10 to 12 in Section 4 Ti, and Points 13 to 15 in Section 5 Ti).

Disassembling and Reassembling Brake Caliper

Caution!

Disassemble the caliper only if the O-rings which seal the fluid passages between both caliper halves have become defective (leak).

Disassembly

1. Remove caliper holddown Allen Bolts.

2. Withdraw caliper cover housing.

Reassembly

Note the following at reassembly:

1. Thoroughly clean caliper housing mating surface with alcohol.

2. Install new O-rings.

3. Use new holddown A llen bolts, spring washers, and hex nuts (use only special bolts listed in the Porsche Spare Parts Catalogue, ensuring proper length).

4. With slightly tightened retaining nuts, align both caliper housing halves so that the machined surfaces within the brake pad slot are flush with each other.

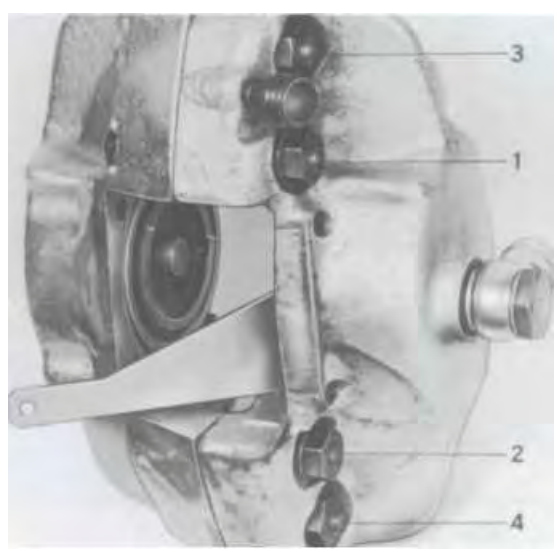


Fig. 52a

5. Torque bolts in two stages (1st stage 50 %. 2nd stage 100 % of the torque value) in sequence shown in Fig. 52a.

Torque values:

Front calipers, Allen Bolts M 8 (lo K) = 3. 4 mkp (24. C Ibs/ft).
Rear calipers, Allen bolts M 6 (12 K) = 1. 8 mkp (13. 0 Ibs/ft)

Hold brake caliper in vise through grip protectors when tightening the Allen bolts. Make certain that caliper mounting surfaces are not damaged.

BLEEDING BRAKE SYSTEM

Note:

After every service operation during which any hydraulic line had to be disconnected (except the line connecting the brake master cylinder with the fluid reservoir), the entire brake system must be bled.

It is also recommended that the system be bled when the pedal travel is abnormally long or the brakes pull to one side.

If the brake system has been fully drained for any reason, such as complete brake system overhaul, etc, it may be necessary to rebleed the system subsequent to the road test.

The pedal free travel will always remain same due to the automatic brake pad adjustment, providing that the system is properly bled; pedal travel to brake actuation is approximately 30 to 50 percent of total pedal travel.

CAUTION!

When any hydraulic connection is detached, the brake fluid will drain from the reservoir by flowing through the resupply port in the master cylinder. Such draining can, however, be prevented by slightly depressing the brake pedal with a pedal depressor, thus blocking the flow with the repositioned piston in the master cylinder.

Bleeding Brake System without the Filling and Bleeding Tank **11 Ti**

Bleeding is accomplished by two mechanics. The operation begins at the farthermost point from the master cylinder in the following order (applies to cars with left-hand drive):

1. Left rear wheel — first outer bleeder valve, then inner bleeder valve.
2. Right rear wheel — first outer bleeder valve, then inner bleeder valve.
3. Right front wheel.
4. Left front wheel.

Note:

A fully drained system is first to be filled with hydraulic fluid. Next, open bleeder valve by about 1/2 to 3/4 turn, depress brake pedal, close bleeder valve, release brake pedal. This sequence is to be repeated until hydraulic brake fluid begins to spill from the bleeder valve. Repeat the procedure with all bleeder valves, then proceed with the actual bleeding of the system.

Bleeding the System

1. Remove dust cover from bleeder valve and install bleeder hose.
2. Place free end of bleeder hose into a glass container with enough brake fluid to submerge the hose end in it.

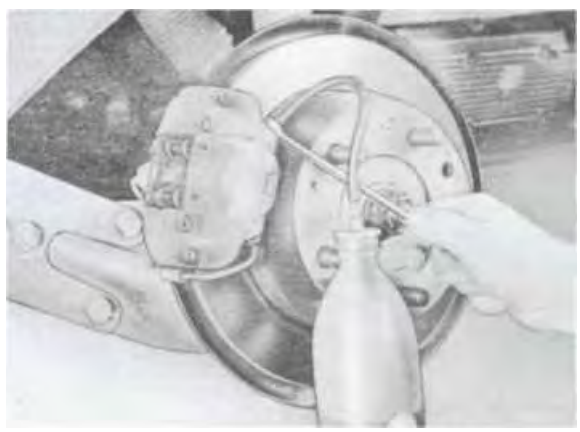


Fig. 53

3. Repeatedly depress the brake pedal in quick succession (pumping) until a slight pressure becomes evident, then hold the pedal under pressure while opening the bleeder valve by about 1/2 to 3/4 turn, and quickly depress the pedal to floor. Before releasing the pedal, always close the bleeder valve first, then allow the pedal to return slowly.

   Repeat the above procedure until no air bubbles come out through the bleeder hose submerged in the brake fluid in the container.

4. Withdraw bleeder hose from bleeder valve and replace dust cap.

5. Bleed the system at all other bleeder valves in the above stated sequence. Make sure that the brake fluid reservoir does not run dry at any time since this would allow new air to enter the system.

Caution! Brake fluid attacks the paint finish. If brake fluid should spill onto it, wash off immediately with water. Brake fluid pumped out during the bleeding operation may not be reused.

6. Check effectiveness of the bleeding operation by depressing the brake pedal.

7. Refill brake fluid reservoir. Proper level is approx. 2 cm (. 8") below the top ridge of the reservoir.

Brake fluid level in the reservoir must be checked at regular intervals and replenished if necessary. (Due to the relatively large cylinder cross-section in the brake calipers, the brake fluid level decreases much faster with continuing brake pad wear than is the case in brake system employing drum brakes).

Use only original ATE blue brake fluid (ATE Blaue Original Bremsflussigkeit).

N o t e :

Brake fluid with higher boiling point may be used for competition. Good results have been noted with "Castrol Girling Brake Fluid Amber". It should be remembered, however, that the expected improvement can be realized only if the system is refilled with fresh brake fluid prior to each competition event.

1. Fill the tank with original ATE blue brake fluid (ATE Blaue Original Bremsflussigkeit) by following the manufacturer's instructions, and pressurize with air to 2. 2 atm (32.3 psi).

2. Clean brake fluid reservoir cover and its immediate area.

3. Remove brake fluid reservoir cover and install bleeder stack (such as ATE Nr. 3. 9308-0600.2).

4. Attach quick-connector of the pressure hose to the bleeder stack and open shut-off valve.

Fig. 54

5. Attach bleeder hose of bleeder bottle to the bleeder valve located farthermost from the brake master cylinder.

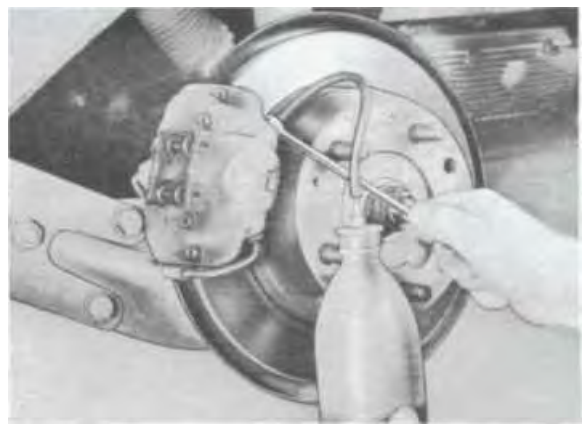


Fig. 55

Sequence of bleeding procedure (applicable to cars with left-hand drive).

1. Left rear wheel --- first the outer bleeder valve, then inner bleeder valve.

2. Right rear wheel --- first the outer bleeder valve, then the inner bleeder valve.

3. Right front wheel.

4. Left front wheel.

6. Open the bleeder valve at caliper by about 1/2 to 3/4 turn until no air bubbles come out through the bleeder hose submerged in the brake fluid.

7. Bleed the system at all other bleeder valves in the above stated sequence.

8. Close shut-off valve in pressure hose.
   C a u t i o n ! Detach the quick - connector of the pressure hose only after having opened, additionally, one of the bleeder valves to neutralize the pressure and thus prevent a spray pop-off.

9. Detach quick-connector and bleeder stack from fluid reservoir.

10. Bring brake fluid level to normal, drain a required amount if necessary. Proper fluid level is approx. 2 cm (. 8") below the top ridge of the reservoir. Make absolutely sure to let all the air out of the filling and bleeding tank (tire valve) after use.

1311 CHECKING BRAKE SYSTEM FOR LEAKS

High - pressure check:

The high-pressure check determines the absence of leaks in the entire hydraulic line system including the brake calipers.

1. Create the highest possible brake pressure by repeatedly depressing the brake pedal in succession. If the pedal appears to be soft or spongy, bleed the brake system.

2. Remove a bleeder valve from one of the rear brake calipers and attach the pressure tester in its place.
   C a u t i o n ! Do not overtighten the connecting nipple so as not to damage the sealing seat of the bleeder valve. Apply counter-force when attaching the connecting hose.

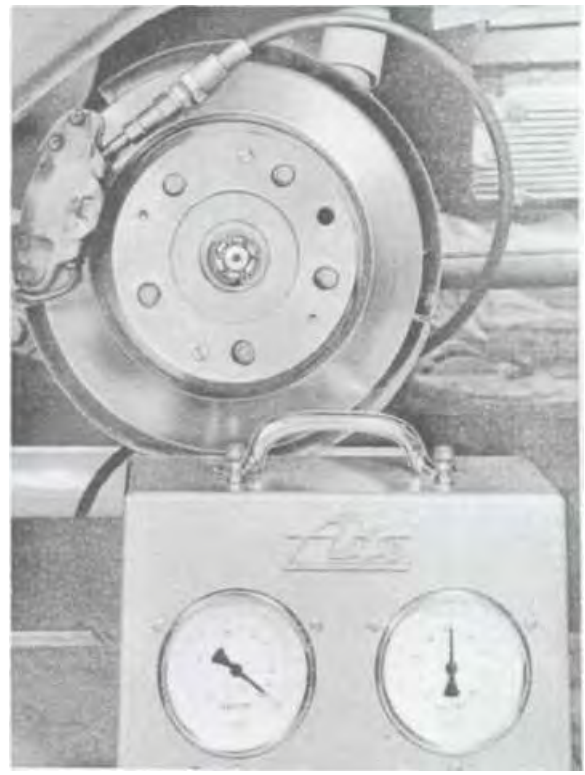


Fig. 56

3. Bleed pressure tester if necessary.

4. Create a pressure of 60 - 80 atm (880 to 1175 psi) in the brake system by using the pedal depressor. The established pressure must not drop by more than 10 % within a time period of 10 minutes.

Low-pressure check:

The low-pressure check will reveal defects in the brake system, such as leaking piston cups in the brake master cylinder, etc.

1. Adjust pedal depressor to create a hydraulic brake pressure of 4 - 6 atm (58-88 psi).

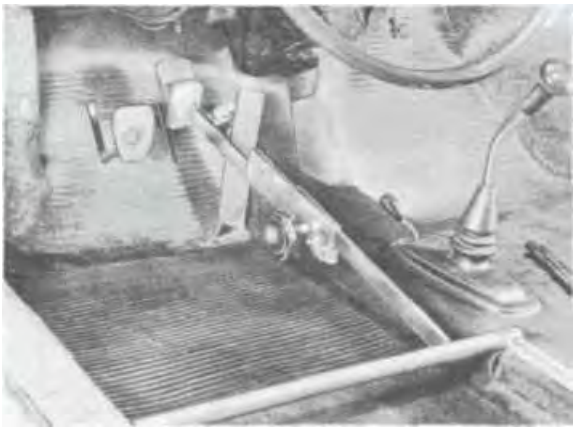


Fig. 57

The established pressure must remain constant for approx. 5 minutes.

The car and test set must be left undisturbed during the low-pressure check. Even very minimal movement of the brake pedal, brake lines, or the test hose lead to changed indication of pressure in the test set without actual leaks being present in the system.

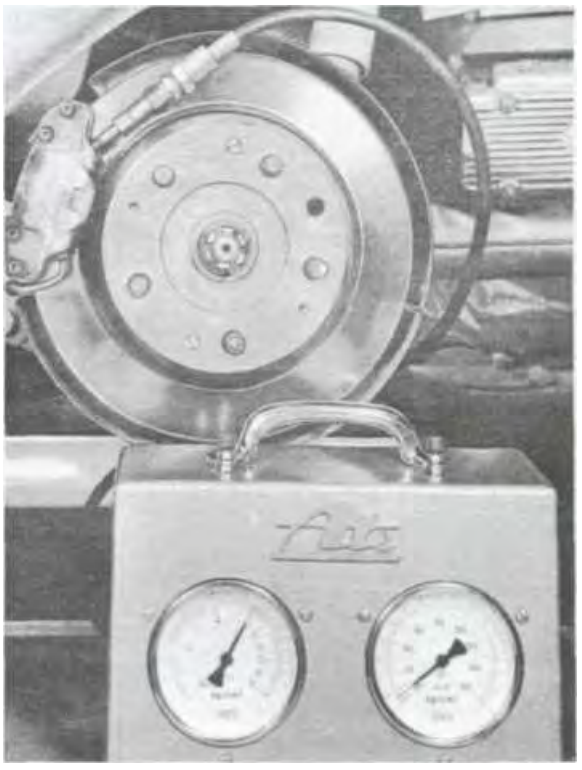


Fig. 58

Maximum brake disc thickness variation = 0. 03 mm (. 0012")

Maximum lateral runout (brake disc installed) = 0. 2 mm (. 008")

Malfunction / Remedy	Use prescribed brake pads +	Clean dirt from brake pad slots Check dust covers ++	Check 20° piston step down	Replace brake pads +++	Recondition oil-saturated brake	Replace cross-spring	Adjust wheel bearing clearance	Check disc and caliper mounting, check alignment of mating parts	Check lateral runout or thickness variation of discs	Check disc shrouds	Clean corrosion from brake cylinders	Check piston progressor (piston seal)	Repair leak in brake system	Clogged purging passage, rectify pressure condition in disc brakes	Bleed brake system
Uneven brake pad wear	X	X	X							X	X	X			
slanted brake pad wear			X	X		X	X	X		X	X	X			
Stuck brake pads		X				X									
Brake pad does not back off from disc (overheated brakes)		X				X	X			X	X	X		X	
Brake pulls to one side	X	X	X		X						X				
Brake squeaks or chatters	X	X	X			X	X	X	X						
Excessive pedal free travel	XX						X	X	X			X	X		X
Stuck pistons in calipers		X						X			X	X			
Rapid loss of brake fluid in fluid reservoir													X		
Pulsating sensation in brake pedal							X	X	X						
Poor braking effect on wet pavement										X					

\+ Use special brake pads for racing, possibly remove disc shrouds

\+ + Dress brake pads, possibly recondition brake disc surfaces

\+ ++ Overworked or overstressed brake pads may become noisy

Torque Values for Disc Brake Fasteners

	mkp	Ibs/ft
Nut, master cylinder mounting flange (M8)	2.5	18.0
Nut, bottom shield (M 16 x 1. 5)	6. 5	47.0
Bolt, bottom shield (M 10)	4,7	34.0
Nut, attaching brake disc to wheel hub (M 8)	2.3	16.6
Bolt, brake carrier (M 10)	4.7	34.0
Bolt, disc shroud (M 8)	2.5	18.0
Bolt, front wheel caliper (M 12 x 1. 5)	7.0	50.6
Bolt, rear wheel caliper (M 10)	6. 0	43.4
Bolt, brake carrier plate (M 8)	2.5	18.0
Castellated nut, on half-axle (M 20 x 1. 5)	30-35	217-253
Allen bolt, half-axle flange (M 10)	4.7	34.0
Allen bolt, front wheel caliper (M 8 - 10 K)	3.4	24.6
Allen bolt, rear wheel caliper (M 6 - 12 K)	1.8	13.0
Hollow bolt, hydraulic line banjo-connector	2.0	14.5
Wheel nuts	13.0	94.0

ATE DISC BRAKES WITH VENTILATED DISCS

General

With the introduction of Type 911 S vehicles, we have initiated the installation of disc brakes with ventilated discs. Owing to the cooling air channels, which are cast into the discs in a radial arrangement, lower brake disc operating temperatures are possible. As a result, brake pad wear has been lessened and the resistance to brake fading or formation of steam bubbles further increased.

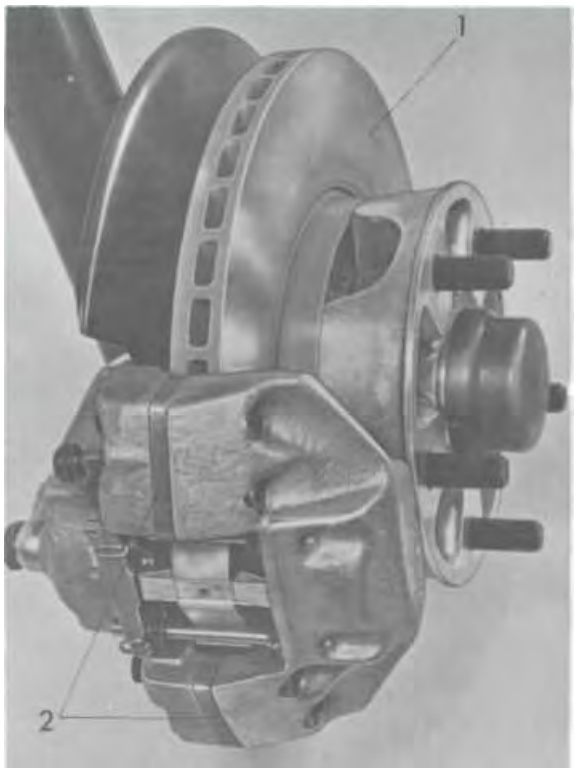


Fig. 1

1 Ventilated brake disc
2 Intermediate plate

Listed below are deviations from the ATE disc brake description shown on pages T 1 thru T 35:

Brake Discs:

a. Outside diameter : Front disc - 11.12" - 11.11" (282. 5 - 282. 2 mm)
Rear disc - 11. 26" - 11. 25" (286. 0 - 285. 7 mm)

b. Disc thickness,new : Front disc -)
Rear disc -) . 787" - . 780" (20. 0 - 19. 8 mm)

c. Surface dressing:

Recondition the brake discs only when absolutely necessary. For instance, if the disc shows grooves of a kind shown in fig. 2, no action is required, whereas if the surface has sharp ridges as shown in Fig. 3, the disc should be dressed. A dressing also is necessary when the brake disc shows excessive lateral runout or excessive thickness variations.

Fig. 2

Fig. 3

Dressing data:
Brake surface of brake disc may be dressed down to a max. of . 028" (0. 7 mm) per disc side, to a disc thickness of . 732" (18. G mm) (coarseness depth up to max. . 0002" or .006 mm).
Deviation in brake disc thickness up to max. of . 001; (0, 03 mm).
Brake disc lateral runout up to . 002" (0. 05 mm) (measured .4" or 10 mm below the brake disc outer periphery).

Caution
The brake discs may be dressed symmetrically only, that is, evenly on both sides. See arrows in Fig. 4 and 5, showing brake disc areas.

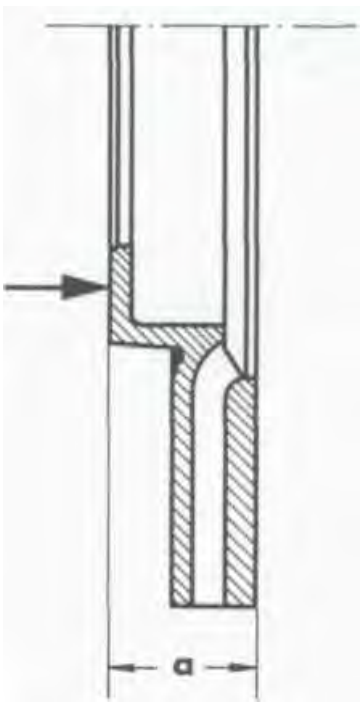


Fig. 4

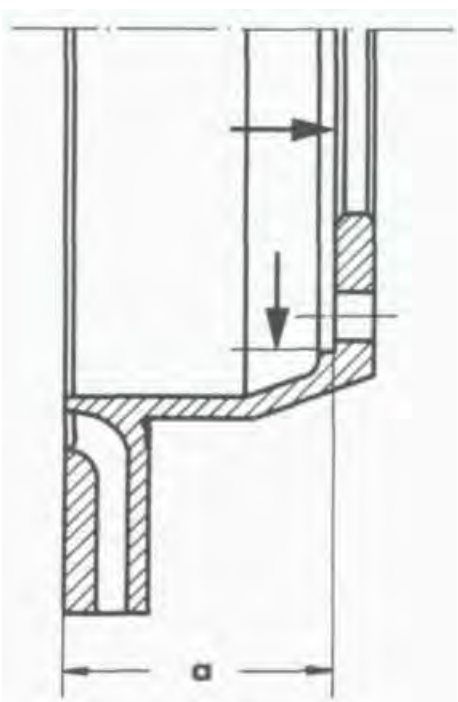


Fig. 5

Specification value "a" for determining brake disc dressing symmetry and disc thickness wear limit:

Brake Disc Type,	Location	Specification Value "a"	New-Disc Thickness
Solid disc	Front	1.378" ± .004" (35 ± 0.1 mm)	.5" - .008" (12.7 - 0.2 mm)
Solid disc	Rear	2.441" ± .004" (62 ± 01 mm) 2.451" ± .004" (62.25 ± 0.1 mm)	.394" - .008" (10. 0 -0.2 mm) .413" - .008" (10. 5 -0.2 mm)
Ventilated disc	Front	1.378" ± .004" (35 ± 0.1 mm)	.787" - .008" (20.0 - 0.2 mm)
Ventilated disc	Rear	2.559" ± .004" (65 ± 0.1 mm)	. 787 - .008" (20. 0 - 0.2 mm)
Ventilated disc from model 69 on	Rear	2.996" + .008" (76 + 0 , 2 mm)	.787 - .008" (20.0 - 0.2mm)

Wear limit in brake disc thickness is . 04" (1 mm) per disc side.

(When worn symmetrically, . 71" or 18. 0 mm)

Caution
The above dressing and wear limits apply as long as the minimum brake pad thickness of . 08" (2. 0 mm) is not disregarded since otherwise brake malfunctions could occur. (The cross-spring is provided for that purpose).

d. Unbalance:

Only balanced discs are supplied. Balancing is effected through the insertion of special clips into the disc ventilating channels (see Fig.6).

Note: Do not remove the clips.

Fig. 6

Brake Discs

Since the ventilated discs are thicker, the brake calipers have been provided with an intermediate plate .287" (7.3 mm) thick in the front wheel calipers, and .417" (10. 6 mm) thick in the rear wheel calipers. The brake caliper size remains unchanged for both, front and rear wheels. However, the diameter of the wheel brake cylinder in the rear wheel caliper now is 1.496" (38 mm).

Note

When installing rear wheel brake calipers, it is absolutely necessary to install the intermediate plate, Part Nr. 901.352.817. 00 between the brake caliper and the rear axle control arm.

The dust cap shield in the front wheel caliper has been discontinued.

All instructions and torque values pertaining to the assembly or overhaul of the brake calipers remain unchanged.

Note

Vehicles which are continually used in low speed traffic and traverse over dirty road surfaces may show an accumulation of dirt in the disc ventilating air channels to the point of plugging.
It is therefore advisable to occasionally clear the disc channels with the water hose when the car is being washed.

RECONDITIONING AND WEAR LIMITS FOR BRAKE DISCS AND PARKING BRAKE DRUMS

Brake -Disc Type	Brake Disc Location	Brake Disc Thickness (when new)	Brake Disc Minimum Thickness (when reconditioned)	Brake Disc Wear Limit (symmetrically worn)
Solid disc	Front wheel	12. 5 -12. 7 mm (0.492 - 0.500 in.)	11.5 mm (0.543 in.)	11.0 mm (0.433 in.)
Solid disc	Rear wheel	9.8 - 10.0 mm (0.386 - 0.394 in.) 10.3 - 10.5 mm (0.406 - 0.413 in.)	9.0 mm (0.354 in.) 9.5 mm (0.374 in.)	8.5 mm (0.335 in.) 9.0 mm (0.354 in.)
Vented disc	Front wheel	19.8 - 20.0 mm (0.780 - 0.787 in.)	18.6 mm (0.732 in.)	18.0 mm (0.709 in.) (1.0 mm/0.04 in. each side)
Vented disc	Rear wheel	19. 8 -20. 0mm (0.780 - 0.787 in.)	18.6 mm (0.732 in.)	18.0 mm (0.709 in.) (1.0 mm/0.04 in. each side)

Brake disc thickness tolerance	0.03 mm(0.001 in.) max.
Brake disc lateral runout	0.05 mm(0.002 in.) max.
Surface coarseness after machining	0.006 mm (0.0002 in.) max.

Parking brake:

Drum diameter (new)	180.0 - 180.2 mm (7.087 - 7.095 in.)
Drum wear limit	181.0 mm (7.126 in.) dia. max.

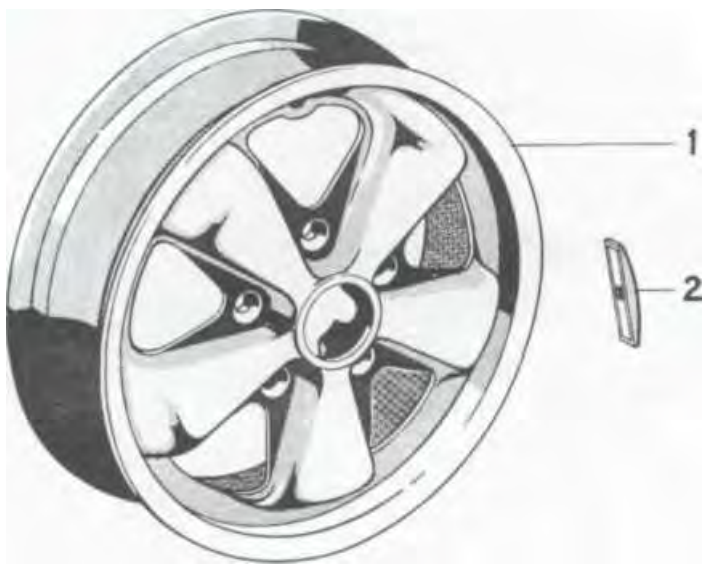
Caution:

Parking brake linings should not be allowed to wear to a thickness of less than 2.0 mm (0.08 in.).

INSTRUCTIONS FOR THE USE OF ADHESIVE BALANCING WEIGHTS IN LIGHT ALLOY WHEELS

General

The light alloy wheels may be balanced only with the use of adhesive balancing weight. Only the Porsche-supplied adhesive weights may be used; the weights are available in l0p increments from l0p to 80p (.35 oz to 2.8 oz).



1 Light alloy wheel
2 Adhesive balancing weight

Fig. 1

Manner of Application

1. Determine the exact location for weights needed; possibly attach the weights with adhesive tape until the final location is found.

2. Prepare the weight mounting area in the wheel. The contact surface must be absolutely clean and free of traces of grease.

a. New wheels; Wipe contact surface in rim with a dry cloth.

b. Used wheels: If covered with dry dust only, thoroughly clean with a dry cloth.
If the surface is contaminated with oil or grease, wash it with gasoline or solvent and wipe clean with a dry cloth.
If the wheel is covered with dirt that has dried or baked on its surface, such as after longer time in use, clean the weight contact surface in the rim with fine crocus cloth.

Note

Do not peel backing off adhesive layer until ready for use.

3. Peel the backing off the adhesive layer and press the weight firmly into place on wheel rim.

   The weight must be positioned exactly within the flat ring surface of the rim (see Fig. 2). It should not rest on the curved inner root of casting, nor protrude beyond its outer edge.

Fig. 2

   Do not use weights which are bent or which no longer match the rim curvature.

4. Dynamic and static unbalance must not exceed 10 p (.35 oz.).

5. Check that weights are firmly attached.

DUAL CIRCUIT BRAKE SYSTEM

General

Beginning with the 1968 models. Type 912, 911 (USA), 911 T, and 911 S vehicles are being equipped with the dual circuit brake system.

The main difference between the single circuit brake system and the dual circuit system is that the latter employs a tandem brake master cylinder and a twin-tank brake fluid reservoir located in the luggage compartment.

Cars destined for export to USA are additionally equipped with a brake failure indicator which is activated by the special tandem brake master cylinder; that is, the handbrake control lamp will light up if one of the two brake circuits should fail for any reason.

Mounted at the control pedal support base is a mechanical stoplight switch. The switch is actuated by a disc which is fastened to the push rod of the tandem master cylinder. The mechanical stoplight switch is adjustable.

A schematic diagram shows the layout of the dual circuit brake system.

Schematic Diagram Showing the Dual Circuit Brake System

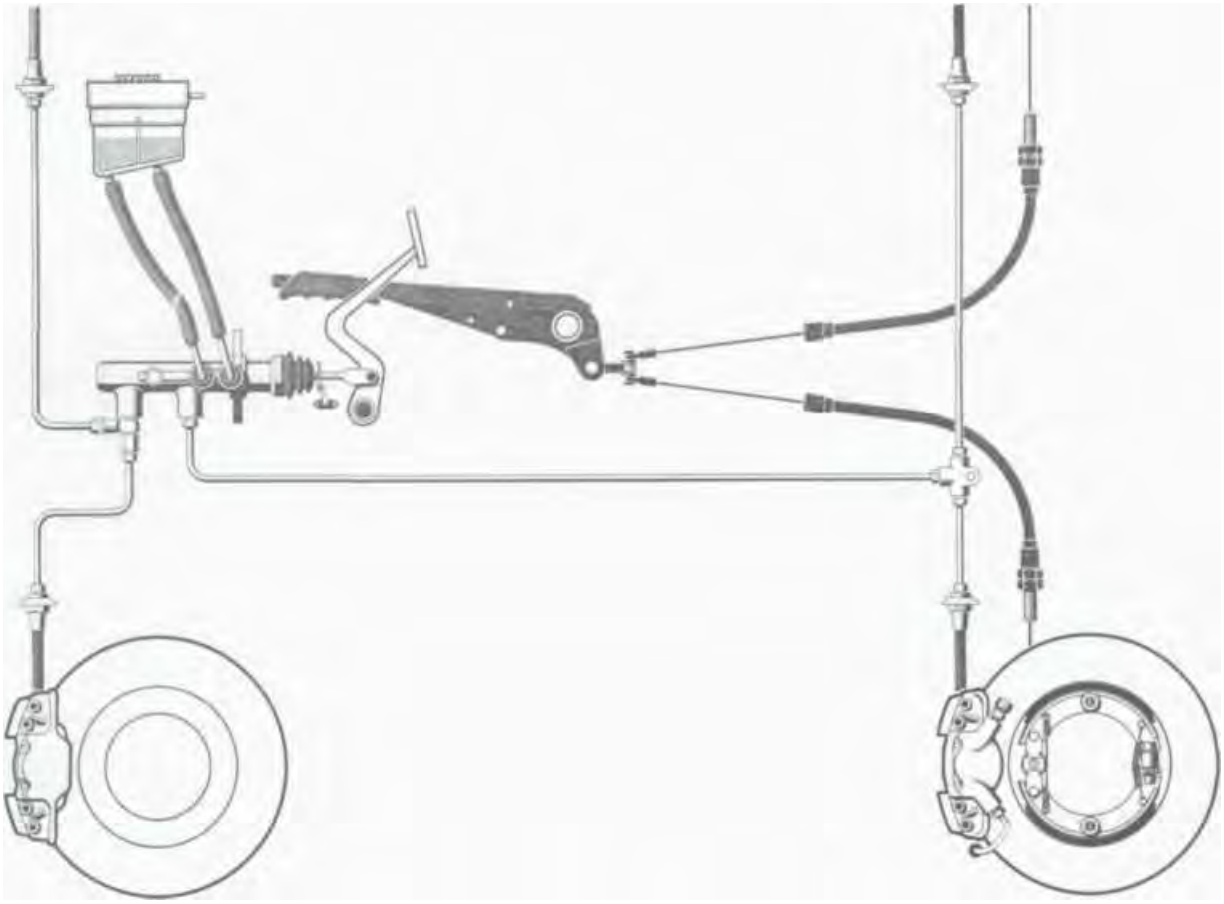


Fig. 1

Tandem Brake Master Cylinder:

Inside diameter - 19. 05 mm (3/4")

European version - without failure warning system

USA version - with failure warning system

Brake Data:

Type 912 and 911 T vehicles (except Sportomatic) are equipped with solid brake discs, and wheel brake cylinders of 48 mm diameter front and 35 mm diameter rear.

Type 911 T-Sportomatic, 911 L, and 911 S vehicles are equipped with ventilated brake discs, and wheel brake cylinders of 48 mm diameter front and 38 mm diameter rear.

Work Procedures

Bleeding the Brake System:
The bleeding procedure is same as that in the single circuit system, bleeding the rear brake circuit first and front circuit last. When using a filling and bleeding pressure equipment, detach the overflow hose from the brake fluid reservoir and plug the pipe connection.

Checking Brake System for Leaks:
Follow same test procedure as that for single-circuit systems.

Work procedures differing from those applicable to the single circuit system are described below.

Removal

1. Raise car.

2. Pull throttle pedal back and out of the connecting pushrod, detach and remove left front floor covering.

3. Remove floor board retaining hex nut and withdraw floor board.

Fig. 2

4. Pull dust boot off brake master cylinder.

5. Drain brake fluid from both tanks in the reservoir.

6. Remove front axle undershield.

Fig. 3

7. Detach brake lines from brake master cylinder. (In USA-type vehicles also detach wires from circuit failure sender.)

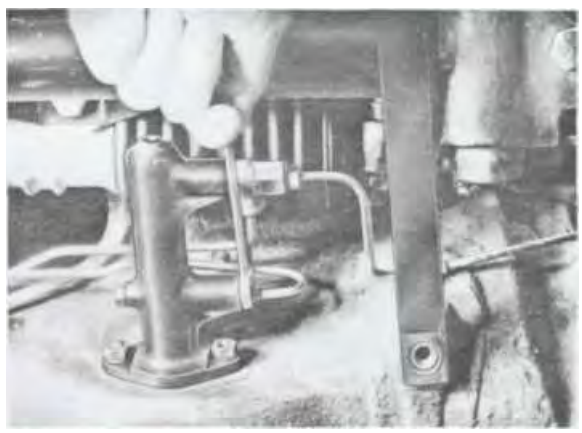


Fig. 4

8. Remove hex nuts (SW 13) from flange of brake master cylinder.

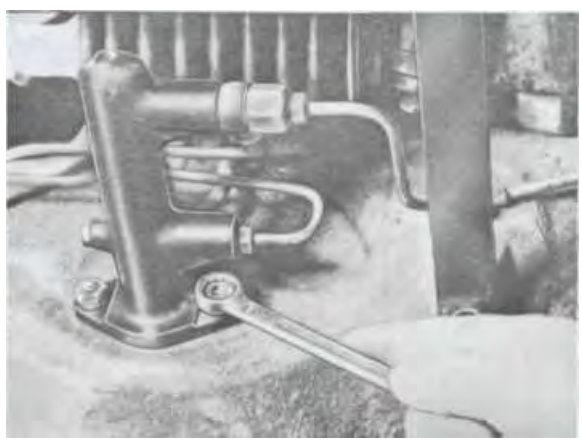


Fig. 5

9. Detach brake fluid reservoir connecting lines from master cylinder and remove it.

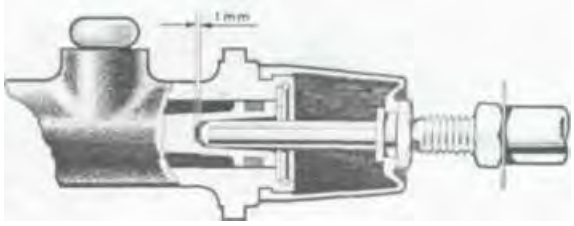


Fig. 7

Installation

Note the following points during installation:

1. When installing the brake master cylinder, properly position the piston push rod at the same time. Also, seal the flange with sealing putty to prevent entry of water into the car's interior.

2. Place new spring washers under the retaining hex nuts and torque to 2. 5 mkp (18 lb-ft).

3. Provide a clearance of approx. 1 mm (. 04") between piston push rod and piston in master cylinder. (Loosen lock nut on piston rod and turn rod as required.)

Fig. 6

4. Refill system with fresh brake fluid.

5. Bleed brake system.

6. Torque undershield retaining M10 hex bolts to 4. 7 mkp (34 lb-ft), and M8 to 2. 5 (18 lb-ft).

7. Check the brake circuit failure warning system (see page ST 14).
(Applies only to USA-type cars.)

Exploded View of Tandem Brake Master Cylinder (for USA)

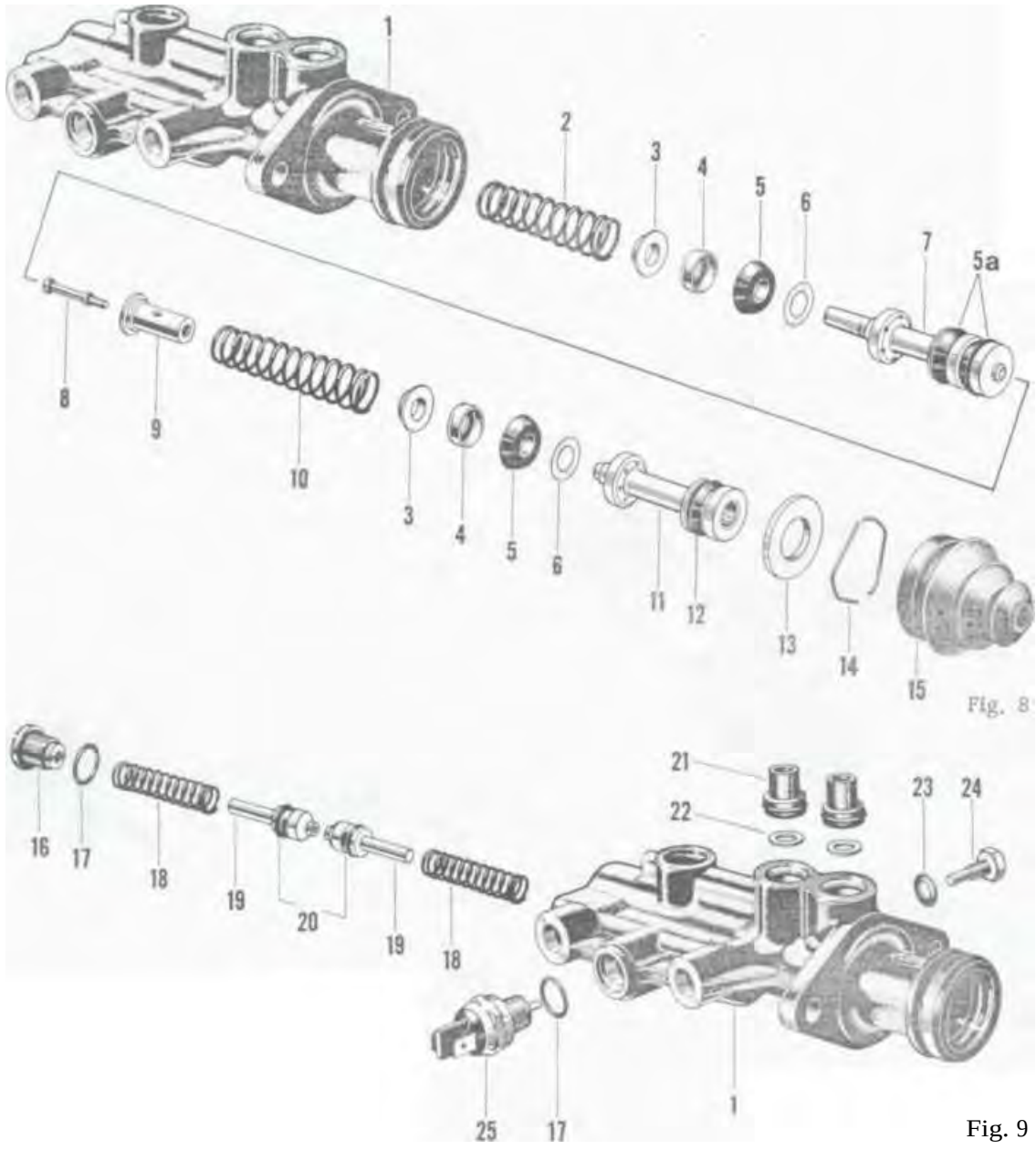


Fig. 8

Fig. 9

1 Housing
2 Secondary piston return spring
3 Spring seat
4 Supporting washer
5 Primary cup
5a At 19.05 dia. - primary collar or separating collar 3. 3301-1923.2; or at 20. 64 dia. separating collar 3.3301 -2022.1
6 Filler disc
7 Secondary piston
8 Stroke limiting bolt
9 Travel stop
10 Primary piston return spring
11 Primary piston
12 Secondary cup
13 Stop plate
14 Lock ring
15 Dust boot
16 Bolt
17 O-ring
18 Spring
19 Piston
20 Piston cup
21 Grommet
22 Washer
23 Gasket
24 Stop bolt
25 Circuit failure sender

Disassembly

1. Fasten master cylinder in a vise with light force (use jaw covers).

2. Withdraw lock ring with a small screwdriver.

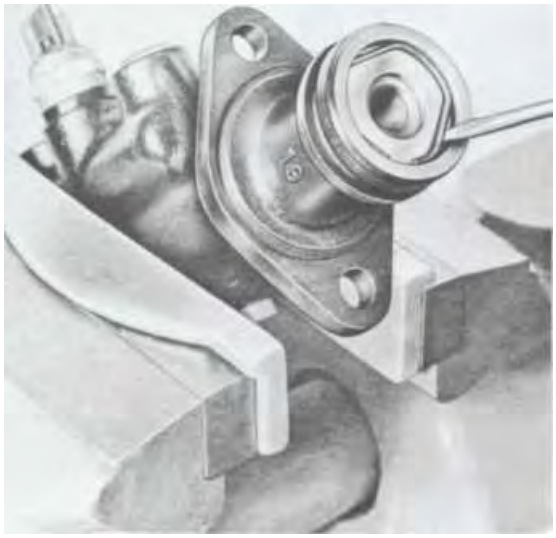


Fig. 10

3. Remove stop plate together with the complete primary piston with installed spring, cups, etc.

4. Remove stroke limiting bolt of secondary piston and blow the piston out with compressed air (approx. 1 atm or 14 psi pressure). (Cover appropriate holes in housing.)

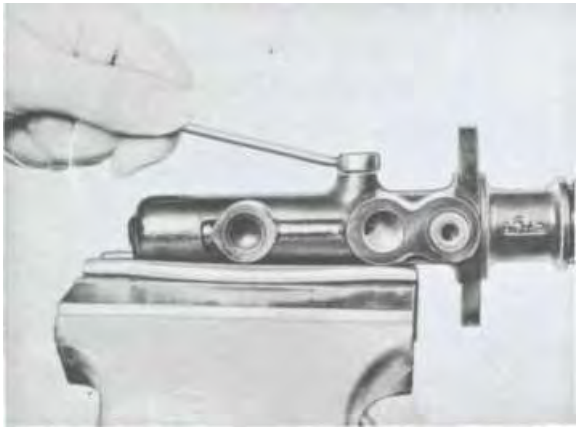


Fig. 11

5. Remove spring, spring seat, and supporting washer.

6. Gently hold primary piston in a vise and remove the stroke limiting bolt; during this operation, slightly compress the spring so that the stop bolt threads in the piston will not be damaged.

Fig. 12

7. Remove stop sleeve, stop bolt, spring, spring seat, and supporting washer from the primary piston.

8. (Applicable only to USA-type cars equipped with the brake circuit failure warning sender:) Remove warning sender, and cap screw, blow out plungers and springs with compressed air (approx. 1 atm or 14 psi).

Reassembly:

Note the following points during reassembly:

1. Clean all parts in alcohol. Dry the housing and clear compensating ports with compressed air.

2. Check parts for wear. Replace the master cylinder when the cylinder surface should show damage due to scoring or rust, or have other deficiencies.

3. Thinly coat the cylinder walls, piston running surface, and cups with ATE brake cylinder paste.

4. Assemble in sequence shown in the exploded view.

5. Insert secondary piston into master cylinder housing, together with filler disc, primary cup, supporting washer, spring seat, and spring (large coil of spring must face housing bottom).

6. Using a non-metallic tool, push secondary piston into the housing until clearing the hole for the hex stop bolt, then screw the stop bolt in together with washer.

   Tightening torque is 1. 0 to 1. 2 mkp (7. 2 to 8. 7 lb-ft).

   Note: Recheck proper seating of stop screw. The screw must be in position ahead of the secondary piston; the piston must move freely to the housing bottom.

7. Push filler disc, primary cup, and supporting washer onto the primary piston, then fasten spring, spring seat, and stop sleeve to the primary piston with the stroke limiting bolt.

8. Make sure that the lock ring is well seated.

9. When replacing piston cups, make sure that these are installed in proper positions (see exploded view).

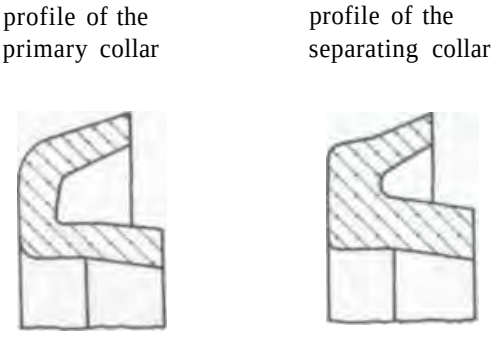


Fig. 12a

10. (Points 10 thru 12 apply only to USA-type vehicles equipped with the circuit failure warning system.)
    Coat warning system plungers with ATE brake cylinder paste and install in housing together with springs. See exploded view for assembly sequence.

11. Use new O-ring in cap screw. Torque cap screw to 1. 5 mkp (11 lb-ft).

12. Use new O-ring in circuit failure sender. Torque sender to 1. 5 mkp (11 lb-ft).

TESTING CIRCUIT FAILURE WARNING SYSTEM IN DUAL CIRCUIT BRAKE

(USA-type vehicles only)

General

The circuit failure warning system in dual circuit brake, required by law in USA, must be tested after every 10, 000 km (6, 000 miles). In addition, the warning system must be tested whenever any repairs are made in the hydraulic brake system.

Testing

1. Switch ignition on. The handbrake control lamp must light up when the handbrake is set (this is the bulb test).

2. Depress brake pedal to brake actuation point.

3. A second mechanic simulates the failure of a brake circuit by loosening the bleeder valve in a wheel brake cylinder.

4. Depress the brake pedal to brake actuation point in the other brake circuit. The handbrake control lamp must light up.

5. Tighten bleeder valve and release brake pedal.

6. Repeat steps 2 thru 5, this time by loosening the appropriate bleeder valve to simulate the failure of the other brake circuit.

If the lamp should not light up in the course of one of the above tests, check the circuit failure sender in the brake master cylinder, replacing the sender if necessary.

Removal

1. Pull throttle pedal back and out of the connecting pushrod, detach and remove left front floor covering.

2. Remove floor board retaining hex nut and withdraw floor board.

Fig. 13

3. Remove stop light switch retaining screws, detach cable connections, and withdraw switch.

Fig. 14

Installation

Note the following during installation:

Adjust stop light switch (see page ST 16).

ADJUSTING STOP LIGHT SWITCH

1. Pull throttle pedal back and out of the connecting pushrod, detach and remove left floor covering.

2. Remove floor board retaining hex nut and withdraw floor board.

Fig. 15

3. Place a 4 mm (. 157") thick piece of steel between the brake pedal and its travel return stop. (This is equivalent to a pedal travel of approx. 21 mm, or .827", measured from the pedal pad center.)

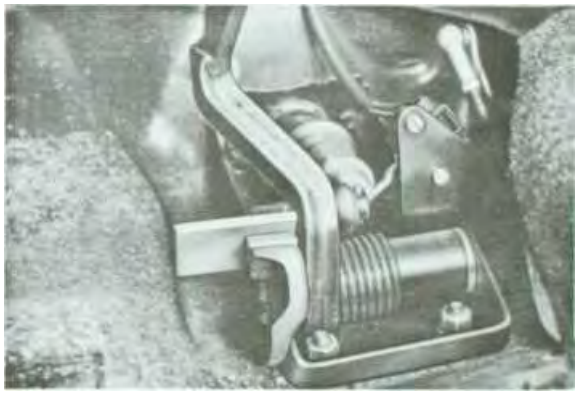


Fig. 16

4. Loosen the adjusting screw lock nut (SW 7) in the stop light switch and turn the adjusting screw to the point where the stoplights will have gone on.

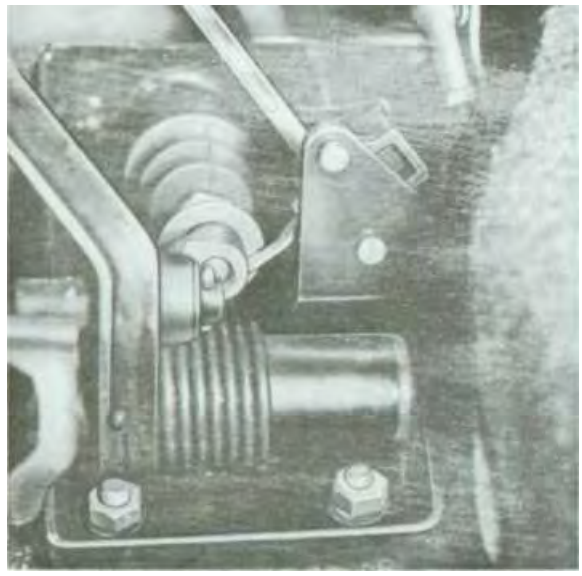


Fig. 17

Fig. 18

5. Tighten lock nut in adjusting screw and check stop lights for proper functioning.

REMOVING AND INSTALLING HANDBRAKE SUPPORT HOUSING

Removal

1. Remove tunnel cover and handbrake lever dust boot.

2. Remove knob from heater control lever.

3. Remove retaining hex bolts from handbrake support housing.

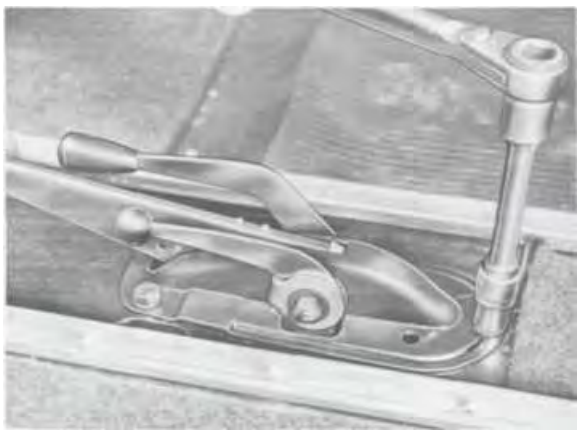


Fig. 19

4. Remove self-locking hex nut which secures heater control lever. Withdraw cup spring, pressure disc, friction disc, and heater control lever.

Fig. 20

5. Lift handbrake support housing a little, unsnap an pull out cable equalizer retaining stud.

Fig. 21

6. Pull out handbrake control lamp wire from switch assembly and remove handbrake support housing.

Installation

Note the following points during installation:

1. Reinsert cable connector into handbrake control lamp switch.

2. Insert heater control lever into the handbrake support housing, install and secure cable equalizer stud.
   Note: Check handbrake cables for proper seating.

3. Torque handbrake support housing bolts to 2.5 mkp (18 lb-ft).

4. Install friction disc, heater control lever, second friction disc, pressure disc, cup spring, and self-locking hex nut. Tighten the self-locking hex nut so that the lever does not slip back when the heater is fully on. On the other hand, the lever should not be too tight.

5. Check adjustment of heater control flaps (see page SE 30).

6. Check adjustment of hand throttle control (see page SE 31).

7. Check handbrake adjustment (see page T 22).

DISASSEMBLING AND REASSEMBLING HANDBRAKE SUPPORT HOUSING

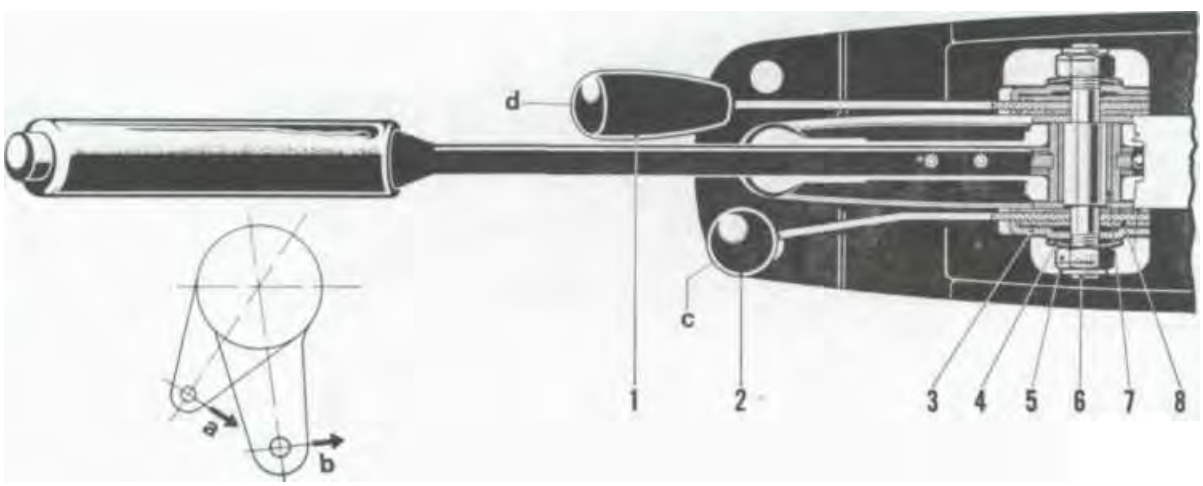


Fig. 22

1 Heater control lever
2 Hand throttle lever
3 Pressure disc
4 Cup spring
5 Self-locking hex nut
6 Pivot shaft
7 Spacer sleeve
8 Friction disc

a Limiting friction of heater lever clutch is 10 kp (22 Ibs)
b Limiting friction of hand throttle clutch is 6 kp (13 Ibs)
c Hand throttle lever knob is pressed on (avoid damaging the knob)
d Heater lever knob is screwd on

Disassembly

1. Remove lock ring which secures hand throttle drag link, withdraw washer and drag link.

2. Remove self-locking nut which secures heater control lever. Take off cup spring, pressure disc, lever, and second friction disc.

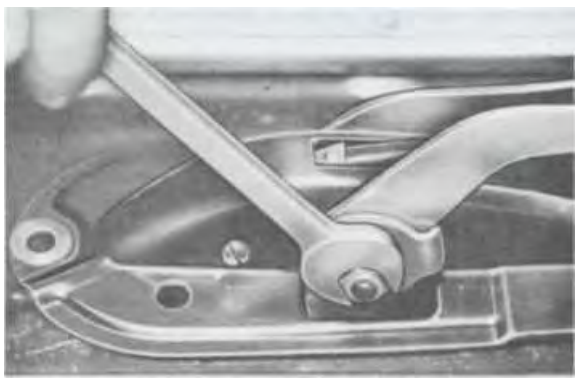


Fig. 23

3, Remove self-locking nut which secures hand throttle lever. Remove cup spring, pressure disc, friction disc, lever, and second friction disc.

4. Pull out pivot shaft.

5. Remove fillister screw which secures control switch and withdraw it.

6. Push handbrake lever slightly back out of the support housing and remove ratchet plate.

7. Grind off rivet head in stud of ratchet pawl, drive the stud out, and remove pawl.

8. If the handbrake lever is to be removed, first remove the hand grip which is glued on; this will permit withdrawal of the control button with rod. ring, and spring as well.

Reassembly

Note the following points at reassembly:

1. Handbrake lever grip must be glued on. (Use Lechler KC 110 S or Uhu-Plus cement, or equivalent adhesive.)
   Note: Make sure that no glue enters the space between the grip and button when the grip is being pushed on.

2. Insert ratchet plate, pawl, and pivot shaft, greasing these slightly with multipurpose Lithium grease.

3. Install friction discs dry and make sure that their mating surfaces also are dry and free of grease.

4. Tighten the self-locking hex nuts so that the stud ends are about flush with the nuts and the limiting friction of heater lever clutch is 10 kp (22 Ibs), and that of the hand throttle clutch is 6 kp (13 Ibs). (See Fig. 22.)

   This adjustment can also be made with the handbrake support housing in place:

   Tighten the self-locking nuts to the point where the lever does not move back when the heater is turned fully on and, on the other hand, the lever is not too difficult to move.

REMOVING AND INSTALLING HANDBRAKE CABLES

Removal

1. Raise car and remove rear wheels.

2. Remove handbrake support housing (see page ST 17).

3. Detach cables from cable equalizer.

4. Remove hydraulic brake line from rear wheel brake caliper. (Keep brake fluid from draining out of the fluid reservoir by slightly depressing the brake pedal with a depressor).

5. Remove caliper retaining screws and withdraw caliper.

6. Remove countersunk bolts from brake disc, withdraw disc together with spacer ring.

7. Remove cotter pin, castellated nut, and disc, then pull handbrake cable out towards the car's center.

8. Pull other end of cable out of the conduit tube in center tunnel.

Installation

Note the following points during installation:

1. Coat the cable with multipurpose Lithium grease while feeding the cable into the conduit tube.

2. Place one washer between spacer sleeve and brake expander, and one under the castellated nut. Turn the nut until a crown slot clears the cotter pin hole, then secure with a new cotter pin.
   Note: Check brake expander for proper seating.

3. Torque the caliper retaining bolts in rear to 6 mkp (43 lb-ft), use new spring washers.

4. Install handbrake support housing (see page ST 17).

5. Bleed the brake system (see page T 29 and T 31).

6. Adjust handbrake (see page T 22).

BRAKE MODIFICATIONS FOR '69 MODELS

Type 912, 912-USA, and 911 T (except Sportomatic)

Technical Data

Effective brake disc diameter, front 235 mm (9. 252"); rear 244 mm (9. 606") - formerly 243 mm (9.567")
Brake pad area, per wheel (service brake), front 52. 5 cm^2 (8.14 sq. in.); rear 52. 5 cm^2 (8.14 sq. in.)
- formerly 40. 0 cm^2 (6. 20 sq.in.) -
Total effective brake area (service brake) 210 cm^2 (32. 55 sq. in.) - formerly 185 cm^2 (28. 67 sq. in.) -
Total effective brake area (parking brake) 170 cm^2 (26. 35 sq. in.) - formerly 210 cm^2 (32. 55 sq. in.) -
Handbrake drum diameter 180 mm (7. 087")
Brake lining width 25 mm (. 984") - formerly 30 mm (1.181") -
Brake master cylinder diameter 19. 05 mm (. 750"); 18/13 stroke
Wheel brake cylinder diameter, front 48 mm (1. 890"); rear 38 mm (1.496") - formerly 35 mm (1.378") •

Front Wheel Brakes

Solid-disc brakes.

Main Changes:
Grey-cast fixed caliper "M" with extended bleeder valve for use with 14" wheels.

Rear Wheel Brakes

Solid-disc brakes.

MainChanges:
Grey-cast fixed caliper "M" (formerly grey-cast fixed caliper "L" with connecting line).
Brake disc with wider handbrake pot for use with the new wheel mounting and larger brake caliper.
Brake disc outside diameter 290 mm (1.417"), formerly 285 mm (1. 220").
Handbrake lining width 25 mm (. 984"), formerly 30 mm (1.181").
Handbrake cables, spacer tube, handbrake cable bracket, disc shroud, and brake lines modified for use with the new rear wheel mounting.

Summary of standard wheels and tires:

Up to 68 Model

Perforated disc wheels (steel or light alloy): 4 1/2 J x 15

Tires: 165 HR 15 (Types 912 and 911), 165 VR 15 (Type 911 S)

68 Model

Perforated disc wheels (steel or light alloy): 5 1/2 J x 15

Tires: 165 HR 15 (Types 912, 911 T and 911 L), 165 VR 15 (Type 911 S)

From 69 Model on

Vehicle types: 912. 912 USA and 911 T

Standard equipment:
Perforated disc wheels (steel):
51/2 J x15

Tires: 165 HR 15

Special option:
Perforated disc wheels (light alloy):
51/2 Jxl4 and 6Jxl5

Tires: 185 HR 14 and 185/70 VR 15

Type 911 E

Standard equipment:
Perforated disc wheels (light alloy): 6 J x 15 - for USA and Sportomatic 51/2Jxl4

Tires: 185/70 VR 15 and 185 HR 14

Type 911 S

Standard equipment:
Perforated disc wheels (light alloy): 6 J x 15

Tires: 185/70 VR 15

Perforated disc wheels (steel or light alloy) - checking

Measuring points for checking vertical and lateral runout on inside of rim, see Fig. 1.
Distance "a" = 8 mm (0. 315")

Max. permitted vertical and lateral runout at steel rims 1. 25 mm (0. 049")

Max. permitted lateral runout at light alloy rims 0.8 mm (0.0315")

Max. permitted vertical runout at light alloy rims 1.0 mm (0.0394")

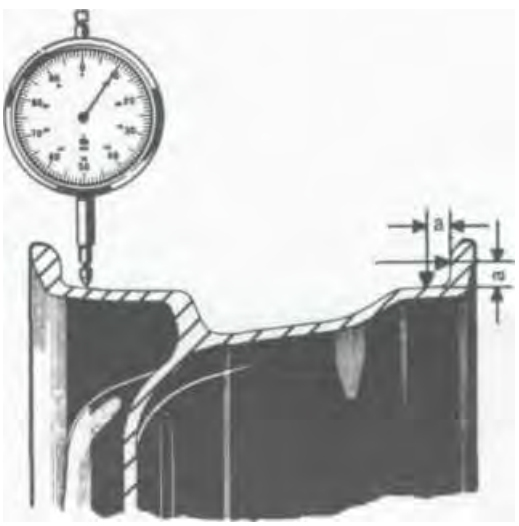


Fig. 1

Warning:
Distorted rims must not be straightened.

Wheel changing

When changing wheels, note the following points:

1. Coat the domed ends of the wheel nuts with an Mo s2 paste, for example Molykote G Rapid or LM 348. This is important for aluminum wheel nuts.

2. Make sure that the domed ends of the wheel nuts locate properly in the recesses in the perforated disc wheels.

3. Tighten the wheel nuts in an X pattern to 13 mkp (94 lb/ft).

Balancing wheels

The max. permitted dynamic and static out of balance force is 10 g (. 353 oz.).

Warning:
On 5 1/2 J x 14 light alloy perforated disc wheels the balance weights should be secured by adhesive on the outside of the rim only. On the inside of the rim weights should be secured with spring clips (as used for steel disc wheels), since the larger weights of the type secured by adhesive could make contact with the fixed calipers of the disc brakes.

TIRES

Tire dimensions (approximate)

Tire designation	165 HR 15 or 165 VR 15 (rim size 5 1/2 J x 15)	185/70 VR 15 (rim size 6 J x 15)	185 HR 14 (rim size 5 1/2 Jx14)
Outside diameter	650 mm	650 mm	650 mm
Nominal tire width	177 mm	196 mm	188 mm
Effective static radius	295 mm	295 mm	295 mm
Effective dynamic radius	314 mm	314 mm	314 mm

Tire pressure:

The values shown are nominal and apply to cold tires.

Size 165 HR 15 or 185/70 VR 15, and
size 165 SR 15 or 185/70 SR 15 snow treads with or without studs:

2. 0 atm (29 psi) front, 2.4 atm (35 psi) rear

Note

If the car is to be parked for a long period of time without being placed on blocks, the tires should be inflated to 4 atu (59 psi) to prevent formation of flat spots.

Tire mounting hints:

To prevent damage to light alloy wheels, mount or dismount tires over the inner side of the rim. Use leather or similar material as a base cover on the tire mounting machine to prevent scratching the outer side of the rim.

As of March 24, 1971, a new light alloy wheel, 6 J x 15, Part # 911.561.020.00, has a changed rim configuration. On these wheels, the tires must be mounted or removed over the outer side only (easier to accomplish).

Note

Coat tire beads with tire mounting solution when installing or removing tires.

Tubes

For safety reasons, tubes should be installed only once. When mounting new tires, always use new tubes. Use tubes of same size and make as the tire.

Caution

Do not use repaired tubes.

TYPE 911 WHEELBASE AND TRACK DATA

Model	Wheelbase	Front	Track Rear with solid brake disc	Rear with vented brake disc	Rim Size
65-66	2211 mm (87.05 in.)	1337 mm (52.64 in.) 1367 mm (53.82 in.) 1379 mm (54.29 in.)	1317 mm (51.85 in.) 1331 mm (52.40 in.) 1343 mm (52.87 in.)		4 1/2 J x 15 5 1/2 J x 15 6 Jx 15
67	2211 mm (87.05 in.)	1353 mm (53.27 in.) 1367 mm (53.82 in.) 1379 mm (54.29 in.)	1321 mm (52.01 in.) 1335 mm (52.56 in.) 1347 mm (53.03 in.)	1325 mm (52.17 in.) 1339 mm (52.72 in.) 1351 mm (53.19 in.)	4 1/2 J x 15 5 1/2 J x 15 6 J x 15
68	2211 mm (87.05 in.)	1367 mm (53.82 in.) 1379 mm (54.29 in.)	1335 mm (52.56 in.) 1347 mm (53.03 in.)	1339 mm (52.72 in.) 1351 mm (53.19 in.)	5 1/2 J x 15 6 J x 15
69	2268 mm (89.29 in.)	1362 mm (53.62 in.) 1374 mm (54.09 in.) 1364 mm (53.70 in.)	1343 mm (52.87 in.) 1355 mm (53.35 in.) 1345 mm (52.95 in.)	1343 mm (52.87 in.) 1355 mm (53.35 in.) 1345 mm (52.95 in.)	5 1/2 J x 15 6 J x 15 5 1/2 J x 14
70-71	2268 mm (89.29 in.)	1362 mm (53.62 in.) 1374 mm (54.09 in.) 1364 mm (53.70 in.)		1343 mm (52.87 in.) 1355 mm (53.35 in.) 1345 mm (52.95 in.)	5 1/2 J x 15 6 J x 15 5 1/2 J x 14