LOOK
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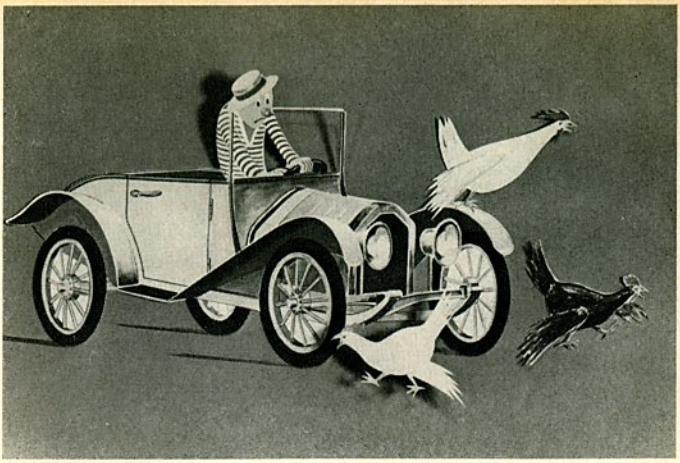
DISC BRAKES FOR TYPE 3 VEHICLES

Slide Series № 26

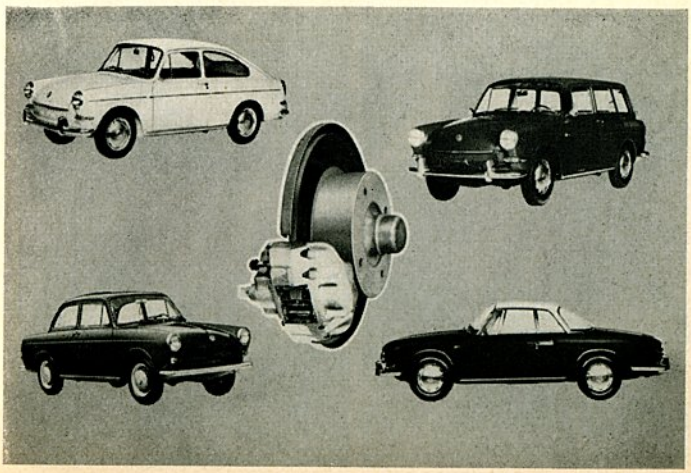


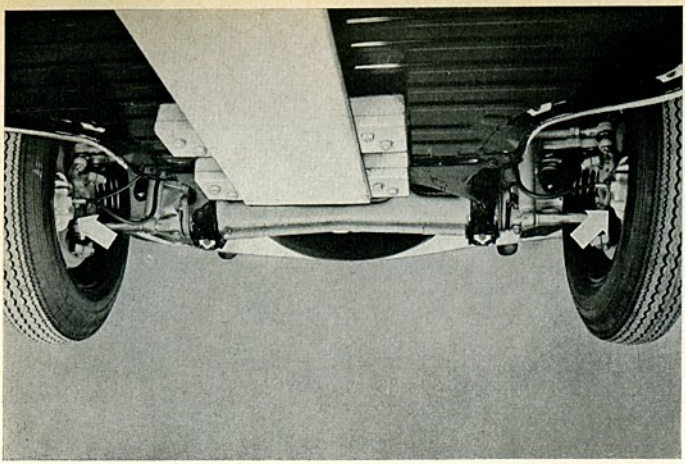
26/1 As you know, every vehicle is only as fast as its brakes are good.

Many years have passed since the model shown here was all the rage and automobiles have changed considerably in these years.

The enormous progress made in automobile design in recent years has produced faster and better vehicles and has also resulted in a steady increase in traffic density.

26/2 Present day vehicles are constantly being improved in order to keep pace with this tendency, that is why all models of the Volkswagen 1500 and 1600 are being fitted with disc brakes on the front wheels for the 1966 model year.





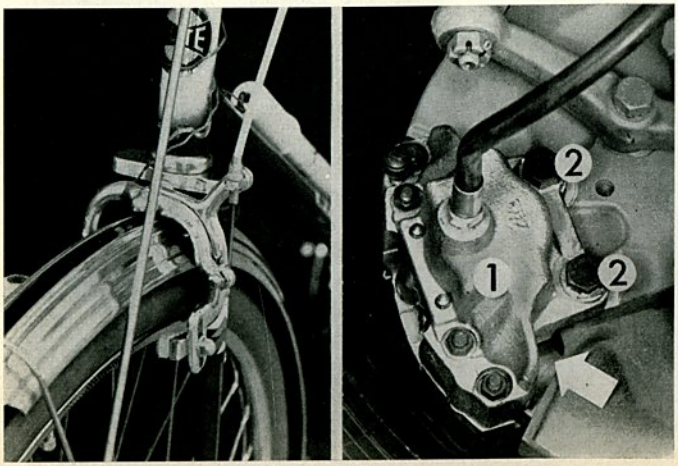
26/3 We all welcome modifications which simplify vehicle maintenance and care and thus reduce the time and effort required. The disc brakes are also another step in this direction.

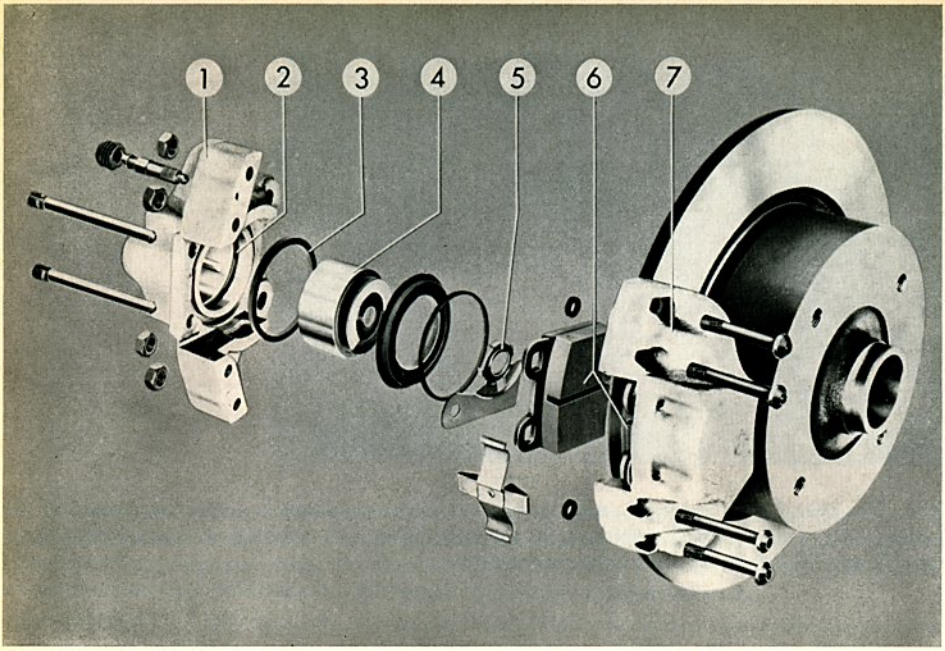
They do not need to be adjusted and the brake pads can be replaced in a few minutes when they are worn out.

However it would be wrong and dangerous to start work on the disc brakes without the proper tools and a good idea of what is required. That is why we produced this slide series which shows you the main parts of the disc brakes, how they work and how they are maintained and repaired.

26/4 The basic principle of the disc brake is familiar to us from the caliper brakes of a bicycle. Two brake blocks are pressed from both sides in to the flat flanges of the wheel rim to stop the wheel rotating. The same principle is used for the vehicle disc brakes.

The caliper (1) grips the brake disc — shown by arrow — from both sides like a pair of pliers. The caliper is secured to the steering knuckle with two screws (2).



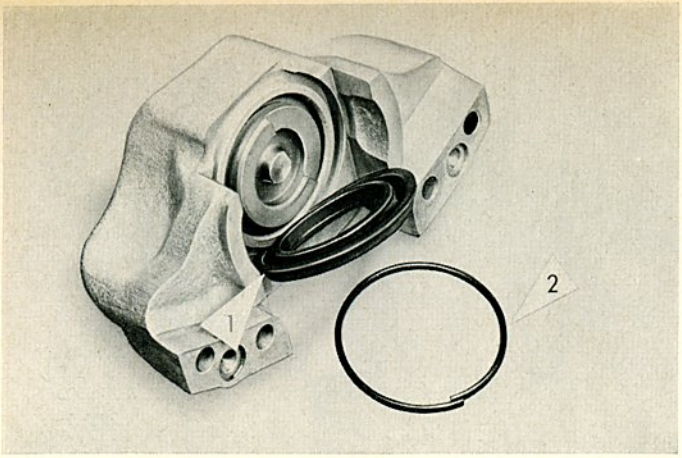


26/5 Let us look at the construction of our new brakes. The main parts are the disc and the caliper which contains the hydraulic pistons for the brake pads.

The caliper housing is in two parts: the inner part (1) and the outer part (7). These two parts are held together by four screws and form a brake cylinder. Each side houses a piston (4) and a rubber sealing ring (3). This ring is square in cross section and is let into an annular groove (2) in the cylinder to seal the piston. The ring thus prevents brake fluid from leaking out of the cylinder and stops moisture and dirt from getting in.

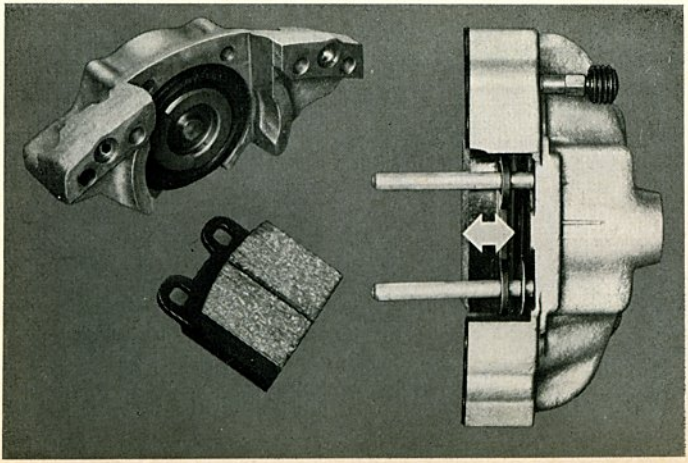
The pistons are fitted with a retainer plate (5) to prevent them from rotating when the brakes are applied. The retainer is pressed against the bottom of the piston and held by the lower brake pad retaining pin.

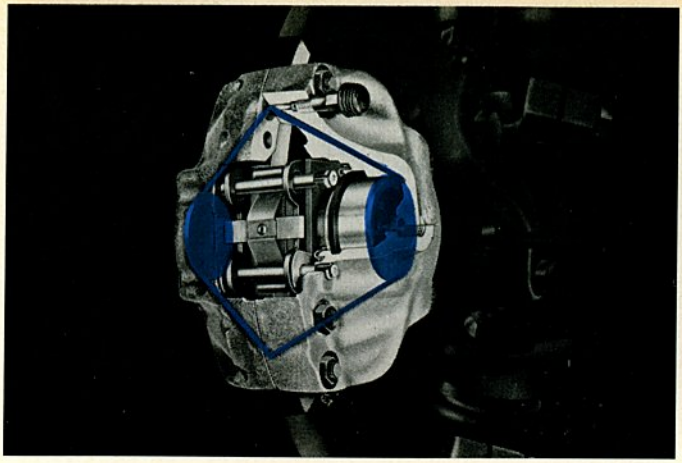
Point 6 indicates the two brake pads which slide axially in slots in the housing in front of the pistons.



26/6 The cylinder, piston and sealing ring are given additional protection from dirt and moisture by a dust seal (1) which is secured on the caliper housing by means of a spring ring (2) and fits tightly on a shoulder on the piston.

26/7 The pad carrier plates with the bonded-on pads — one has been taken out here — move axially in slots in each side of the housing and are guided by two pins above and below the double arrow.

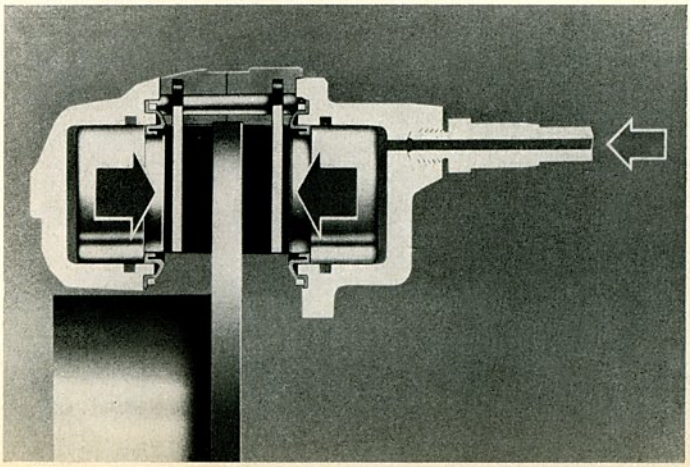


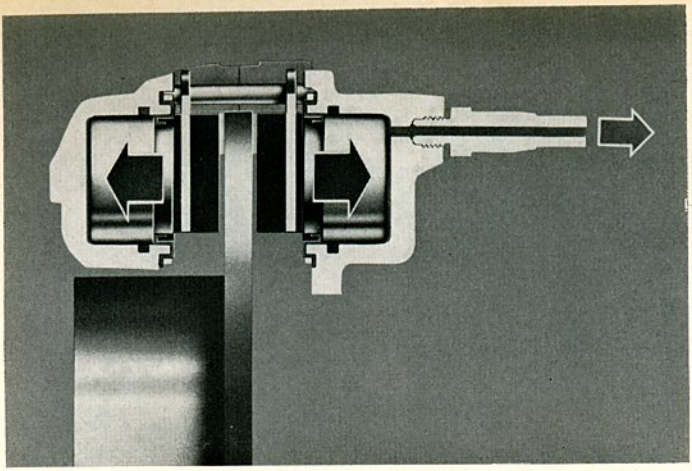


26/8 Here in blue you can see the hydraulic fluid inside the caliper. Each caliper has two threaded connections: one in line with the piston which is for the brake hose and another one at the top for the bleeder valve. The fluid enters at the space behind the piston in the inner part and passes from there via two drillings to the piston in the outer part.

That is all there is to say about the various parts and the construction of the disc brake. Now let us see how the brakes work.

26/9 When the brake pedal is depressed, the hydraulic pressure is transmitted from the master cylinder piston to the pistons in the caliper. These press the brake pads against the friction surface of the disc which is turning with the wheel. The degree of pressure at the pads and thus the braking effort depends on the force applied at the brake pedal. The pads only cover a relatively small part of the disc area at any time and the rest of the disc is exposed to the air flow caused by the movement of the vehicle and is thus cooled efficiently.

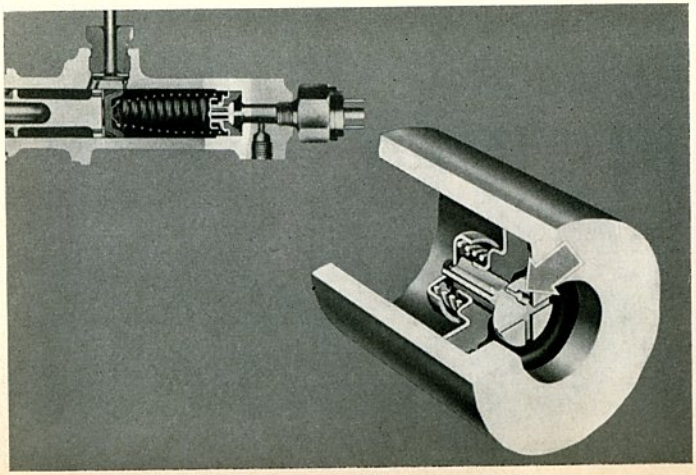


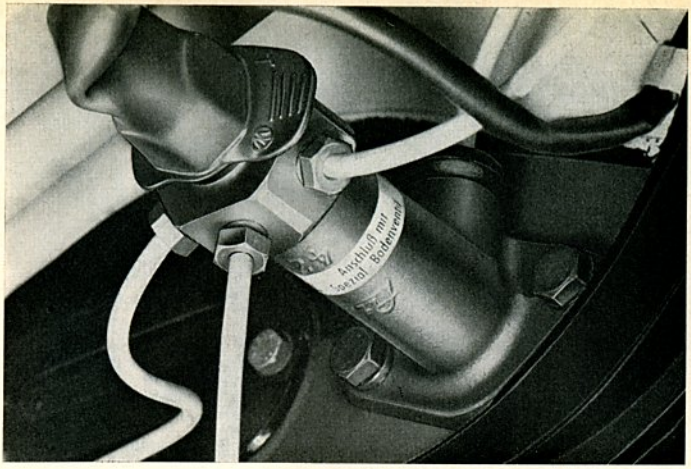


26/10 When the brake pedal is released, the hydraulic pressure is relieved, the pistons move back very slightly and the pads cease to grip the disc. Later on we shall explain in detail how this takes place.

As opposed to drum brakes where there is always a slight pressure in the lines even when the brakes are off, there is no pressure at all in the combined brake system when the brakes are not applied.

26/11 The complete reduction of pressure in the entire brake system is achieved by means of a small drilling in the special check valve. This drilling, shown here by the arrow is necessary because the relatively large pistons in the caliper could not be returned to the free position if there were the slightest residual pressure left in the system.

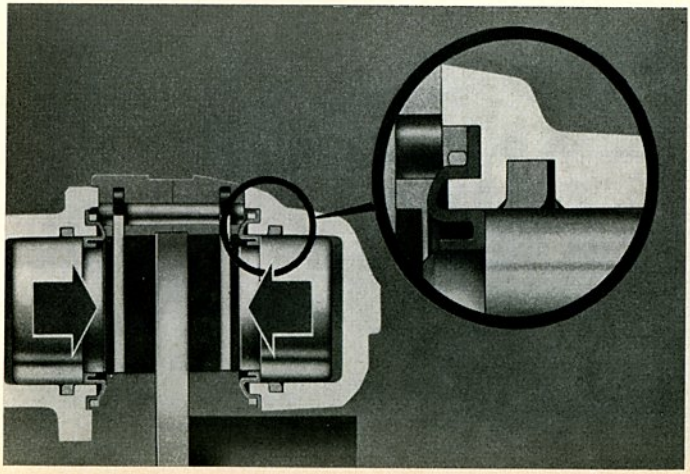


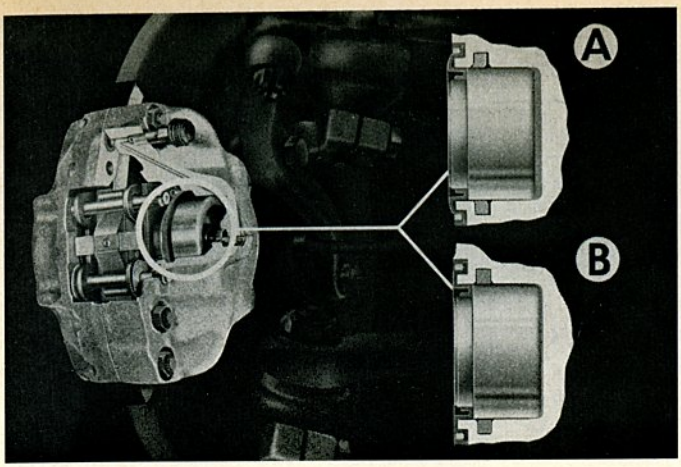


26/12 Master cylinders with the special check valve are marked with a sticker as shown there so that these cylinders can be identified easily. It is still possible, despite the special check valve, to build up pressure in the system as necessary for example, when bleeding the brakes, by pumping with the brake pedal.

26/13 We said earlier that the pistons move back slightly and release the brake pads when the pedal returns and the pressure in the lines ceases. This is achieved by means of the rubber ring in the cylinder wall and not by return springs as with the drum brakes.

In the large circle you can see how the rubber ring is deflected laterally when the brakes are applied. Let us look at this process more closely.



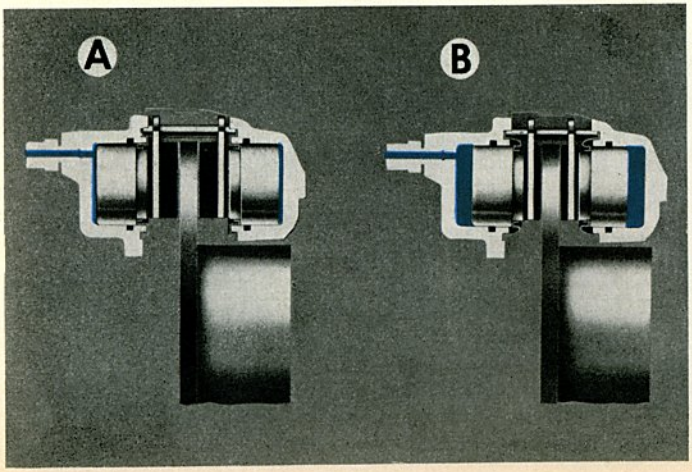


26/14 When the brakes are applied, the piston moves towards the brake pads. The rubber ring in the cylinder wall fits tightly round the piston so that it moves with the piston and is deflected. This can be seen at A. The ring remains deflected as long as the brakes are applied.

When braking ceases and the pressure drops, the rubber ring pulls the piston back by the amount the ring was deflected laterally as shown at B. The distance covered by the piston equals the clearance between disc and pad and is only a fraction of a millimeter.

This small clearance is essential in order to keep pedal play to a minimum and piston travel short. This is also dictated by the higher pressures required for the disc brakes and the larger brake cylinder diameter.

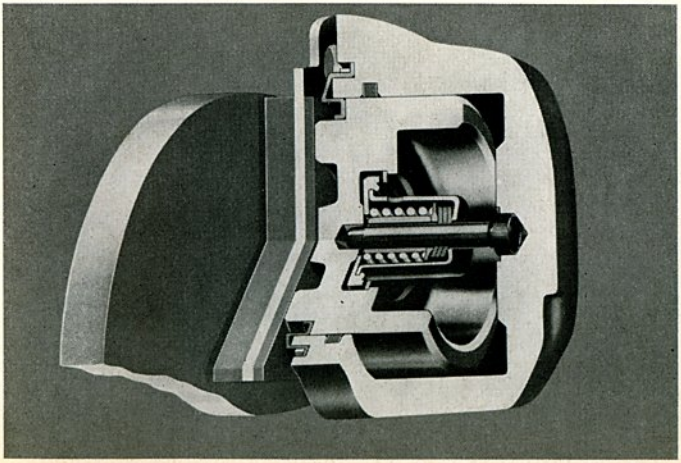
26/15 A further advantage of the disc brake is the automatic adjustment of the brake pads. This automatic adjustment is done by the piston which pushes the pad inwards as it wears. In other words, the thinner the pad is, the more the piston moves towards the disc. Picture A

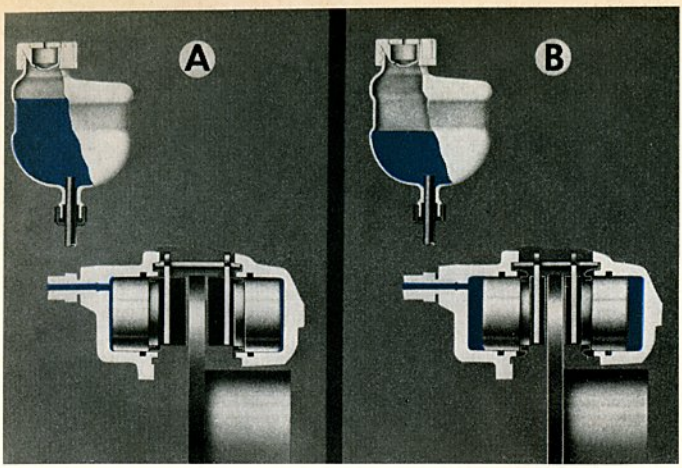


shows the pads at the normal thickness and B the worn pads which have been pushed out to keep the operating clearance to the minimum.

In picture B you can see clearly that the space behind the piston has increased as the piston has moved forward to compensate for pad wear. This increases the quantity of fluid required to fill this space, shown here in blue.

26/16 Each piston also has an automatic compensation device as you see here. This device prevents the piston from moving back into the cylinder and ensures that the pad to disc clearance remains constant. That is all there is to be said about this part which may not and cannot be repaired. When necessary, a new piston must be fitted.



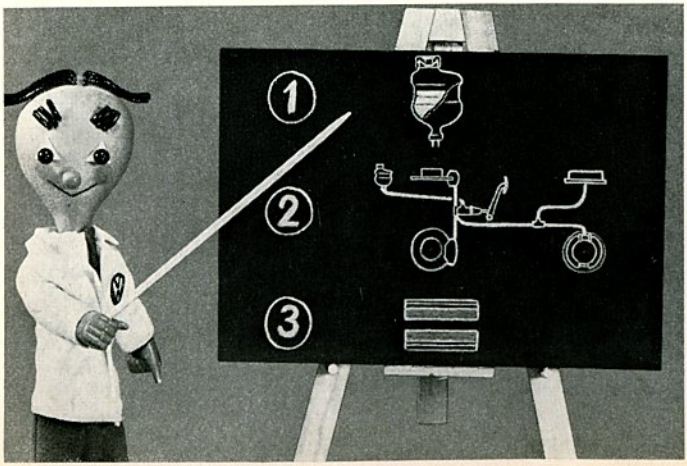


26/17 As the pads wear the fluid flows from the reservoir into the space behind the pistons which naturally means that the level of fluid in the reservoir drops slowly. Compare picture B with A in which the pads are still at full thickness.

It may be necessary to top the fluid up but, contrary to the drum brakes, a drop in fluid level is not automatically a sign that there is a leak in the system.

Now you know how the disc brakes are designed and how they work. We shall now go on to deal with maintenance and repair.

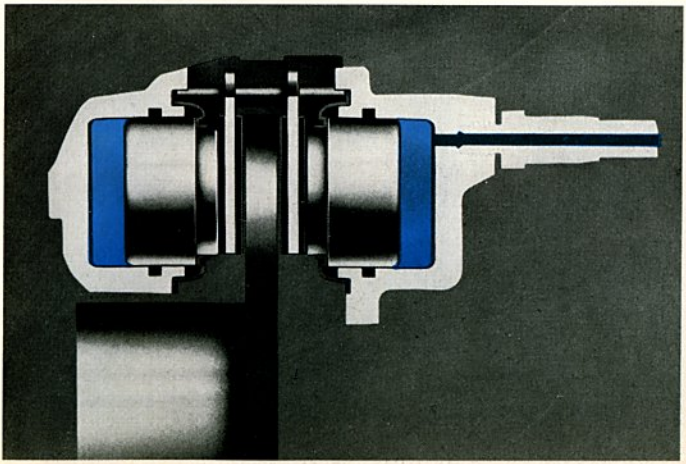
26/18 The terms care and maintenance can hardly be applied to disc brakes. The amount of maintenance required is very small and merely includes 1 — checking the fluid level, 2 — checking the lines and hoses and 3 — pad thickness.



26/19 Starting with point 1. The fluid level must be checked every 6000 miles during the maintenance service. If the level is low, top up to the correct level which is about 15—20 mm below the screw cap or roughly up to the upper edge of the securing clip.

Clean the cap thoroughly before screwing it off so that there is no possibility of dirt falling into the reservoir and affecting the operation of the brake system. It is hardly necessary to tell you this, you all know the importance of cleanliness when working on the brakes.

26/20 As we said before, a drop in fluid level in the reservoir on a vehicle with disc brakes is not necessarily a sign of leakage in the brake system, but is caused by the pads wearing and the pistons moving out in the cylinders. The fluid then fills the increased space behind the piston. In the picture, the extra fluid is shown in a slightly lighter shade.



The fact that so much extra fluid has flowed into the cylinders makes the drop in level in the reservoir quite logical and is caused by increasing pad wear. There is a direct connection between extent of wear or pad thickness and the fluid level.

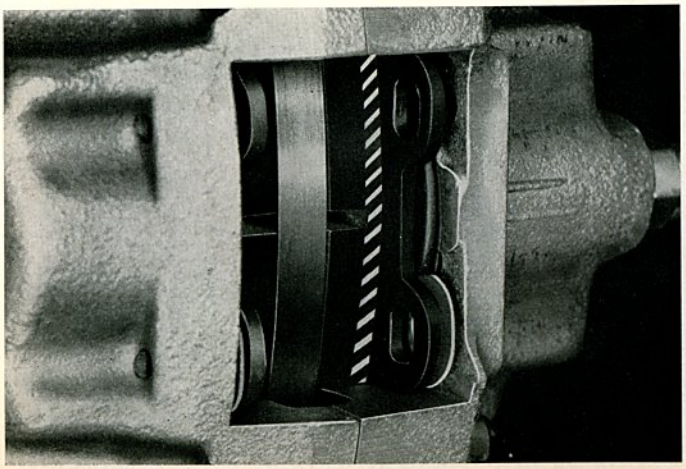
If a large drop in fluid level cannot be explained away in this manner — for example, if the pads are barely worn at all, it is justifiable to suspect that there is a leak in the system. In this case, check all lines and connections very carefully and if you find a leak, make arrangements to have it repaired by endorsing the Defect Card accordingly.

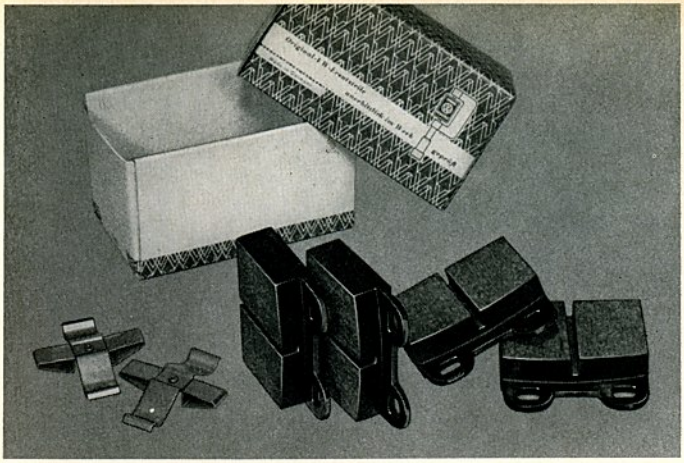
Otherwise the checking of the lines and unions for leaks and damage is a part of the maintenance service and should be done every 6000 miles.

26/21 The last maintenance task is the pad thickness check which should be carried out every 6000 miles.

After removing the wheels you can see the pads in the slots in the caliper housing. We have removed the retaining pins and the spreader spring to make it easier to see. The permissible pad thickness is shaded here. It is 2 mm (.08″). When the pads are worn down to this thickness they must be replaced.

That is all there is to be said about disc brake maintenance. Let us now see how the pads are replaced.





26/22 Please note that both sets of pads must be replaced at the same time. It not permissible to replace one pad only or both pads on one wheel only.

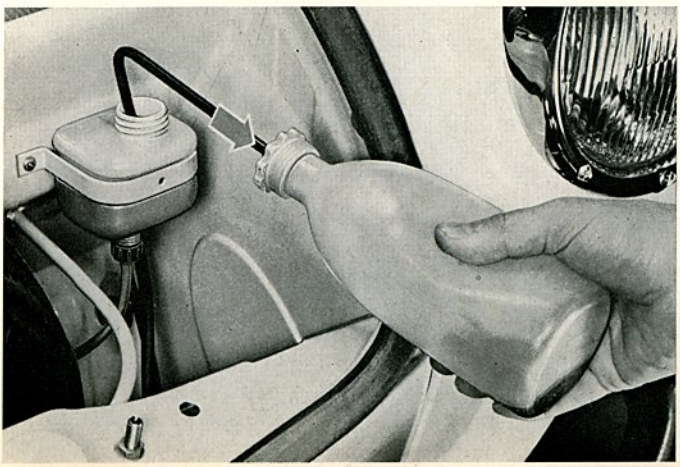
SP set — No. 421 — which contains all the parts required is available for use when replacing the pads.

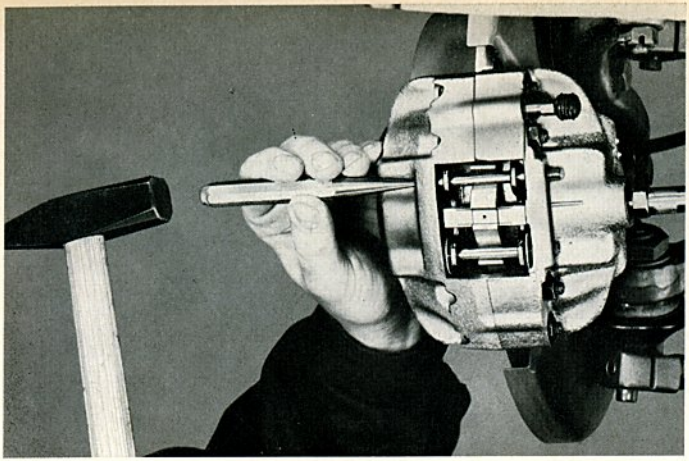
One other important point: Interchanging of pads from inner to outer position and vice versa or from right-hand to left-hand wheel is not permitted. It is advisable, therefore, to mark the pads if they are to be used again to avoid confusion.

26/23 Before removing the pads for replacement, the extra fluid used to top up the reservoir, must be drawn off to prevent it from overflowing when the pistons are pressed in again. It is best to keep a special squeeze container for this purpose to avoid contamination of the brake fluid.

Do not use the battery acid tester under any circumstances and do not forget that brake fluid will mark the paintwork if allowed to drop on to it.

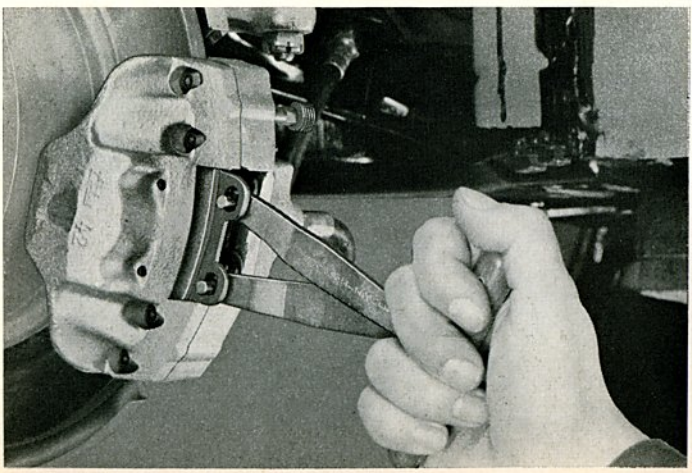
One more point: You probably know that brake fluid is poisonous so do not attempt to siphon the fluid off with a piece of rubbber pipe.

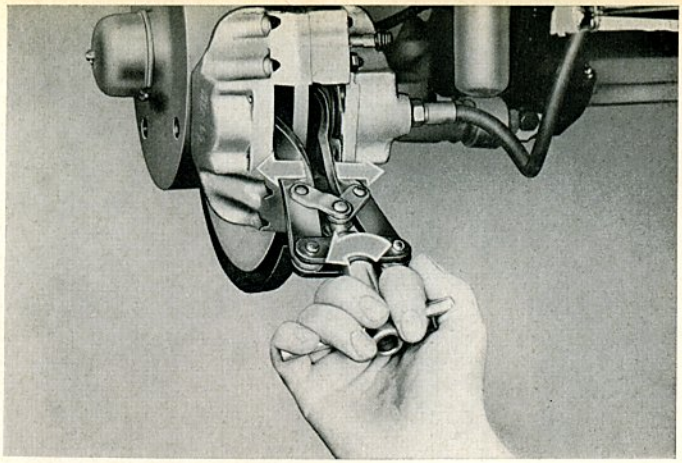




26/24 Back to pad replacement: This does not take very long. First knock the two pins out with a hammer and punch as shown here. The pins can only be knocked out from the outside as the retaining pins are held in clamp sleeves on the inside.

26/25 After removing the retaining pins and the spreader springs pull the pads out with a special puller. Do not use other tools as otherwise there is a risk of damaging the brake disc.

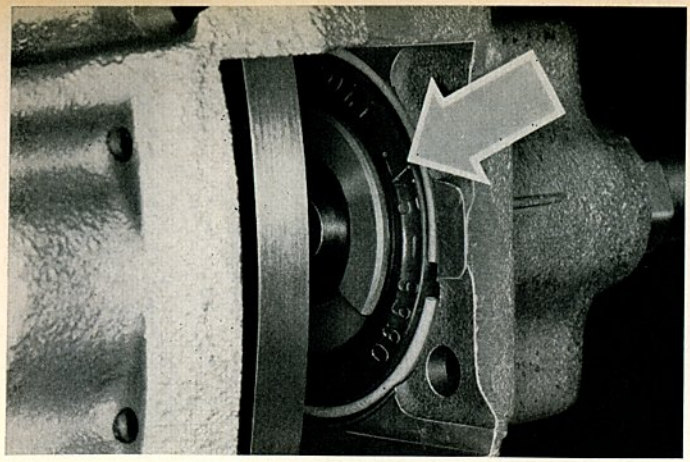




26/26 Now press the pistons back to their original positions with a special tool. This forces the fluid out of the space behind the piston back into the reservoir.

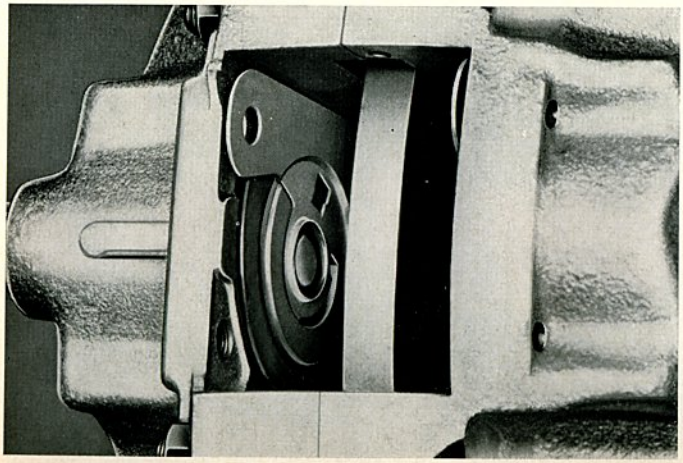
This is why you had to remove a certain amount from the reservoir before.

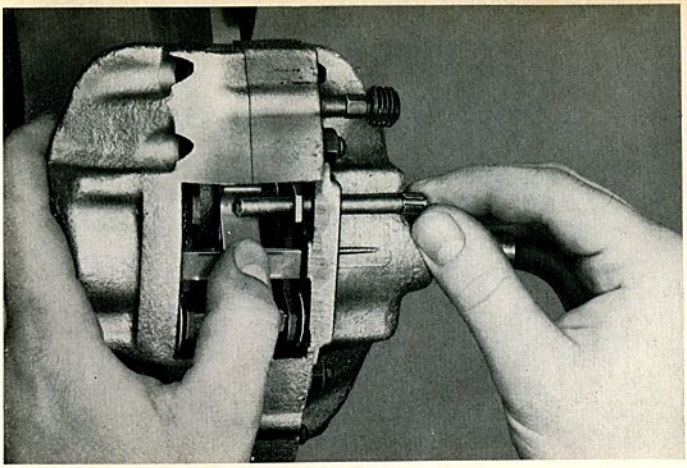
26/27 Check if the working surfaces in the caliper are dirty. If they are, clean them with methylated spirits. Do not use sharp-edged tools or mineral solvent solutions such as benzine or paint thinner. Blow the slots out with compressed air afterwards.



26/28 Then check the sealing boot and retaining ring for damage. If hardened, perished or torn, the boot should be replaced.

26/29 Before inserting the new pads, check that the piston retaining plate is located properly. If you notice that the retainer has become detached from the piston, take the retainer plate out and check the piston position with the piston gauge. We shall tell you how to do this later.

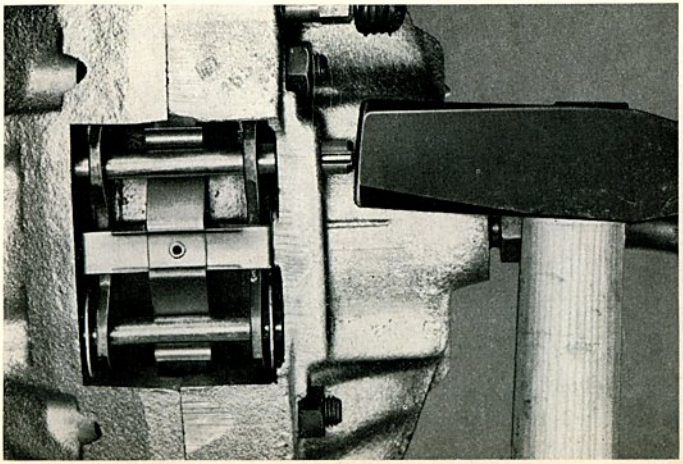


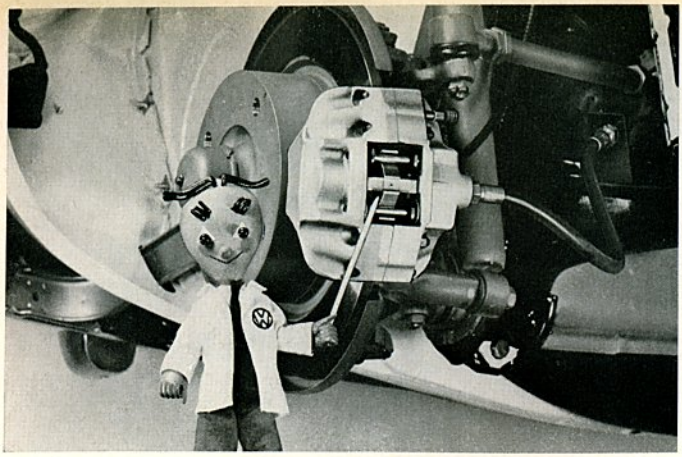


26/30 After inserting the new pads in the slots knock the lower pin in first. Now hook a new spreader spring under the lower pin and depress the free end with one finger until the second pin can be pushed in and the spring is secured under both pins.

26/31 Here you see how the spring looks when installed properly. When knocking the pins in, ensure that the clamp sleeves are located properly in the caliper housing bores again. Damaged pins should be replaced. It is best to use only a hammer to drive in the pins. If you do use a punch ensure that the diameter is not smaller than the diameter of the pin as otherwise the front shoulder of the pin can easily be sheared off by the clamp sleeve.

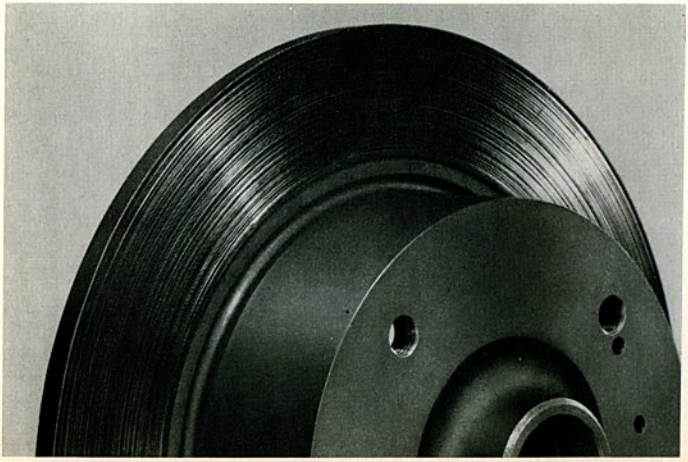
Before driving the vehicle, depress the brake pedal hard a few times so that the pistons and pads can settle down into the proper working position. Then check the fluid level in the reservoir and top up as necessary.

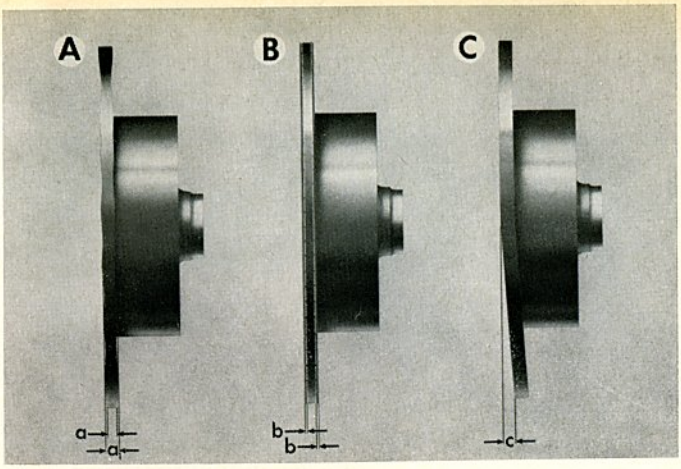




26/32 You will agree that this operation does not take long. We must draw your attention to one thing however: The surface of the new pad does not reach the degree of hardness necessary to ensure high wear resistance until after about 120 miles of normal braking, in other words, avoid severe braking during this initial period. This will have a beneficial effect on the service life of the pads.

26/33 And so to the disc itself. As the disc runs in the open with very little protection it is obvious that various signs of wear can appear in the course of time. It is therefore necessary to check the disc carefully every time new pads are fitted. A disc which is scored like this one should naturally be replaced as only a smooth disc can give the maximum braking effort.

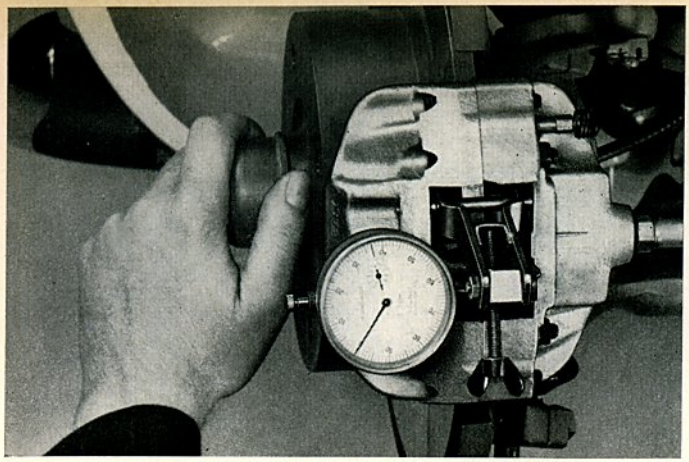




26/34 If signs of excessive wear or damage are noted on the disc, a new disc should be fitted if possible. Machining of the disc is not advisable as the maximum permissible tolerance in the disc thickness over the entire surface is only 0.02 mm (.0008″) (picture A). This means that the difference between a and a_1 — measured at various points on the disc — must not be more than .0008″.

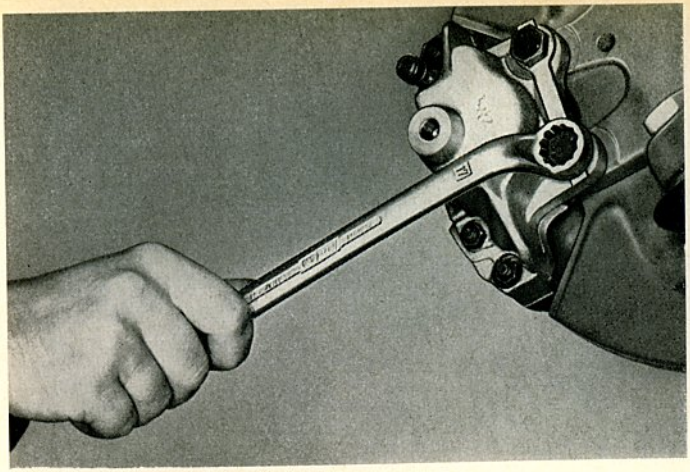
The disc surface can be reground but the same amount must always be taken off both sides of the disc. The amount which can be removed is limited to 0.5 mm (.020″) on each side and the minimum permissible disc thickness is 8.5 mm (.335″). This is shown at B where measurement b indicates the maximum permissible amount which can be taken off.

One more point to watch when checking the disc is the run-out as shown at C. This must not exceed 0.2 mm (.008″) as at c.



26/35 The run-out is checked with a dial gauge which is mounted on a special bracket so that the feeler pin contacts the disc as shown here. When you turn the disc slowly, you can read off the run-out exactly. The front wheel bearings must be adjusted properly when making this test. If the bearing play is excessive the run-out reading will not be accurate.

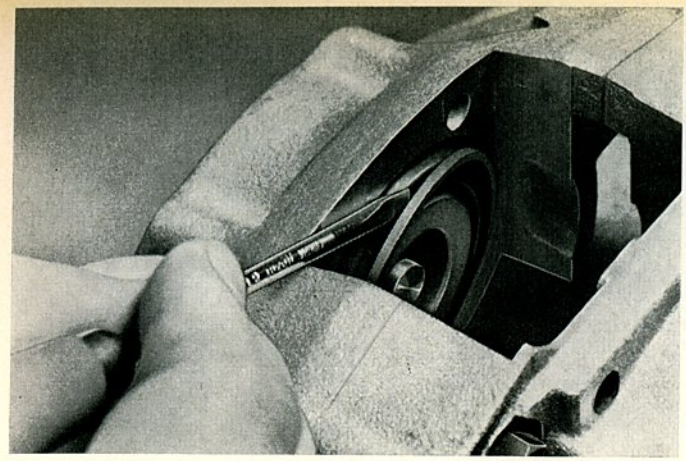
26/36 Two more points concerning care of disc brakes: When repairing the underseal or spraying on a new coating, the disc brakes must be covered up carefully. Make sure that no oil or grease gets on to the disc brakes.



26/37 We shall now deal with work on the caliper itself. As a basic rule, the caliper should only be removed when certain operations such as pressing out the pistons or replacing the sealing ring in the cylinder make this unavoidable. We should like to point out that the caliper housing must not be taken apart under any circumstances as this would damage the sealing between the two halves. All work must be carried out with the caliper assembled.

First take the wheel off. If the caliper is still hot let it cool down. Then disconnect the brake hose and remove the two screws attaching the caliper to the steering knuckle. Take the caliper off, clean it thoroughly and lay it on the work bench.

Now remove the retaining pins and pull the pads out with the special puller as already explained. You can, if you wish, pull the pads out while the caliper is still on the vehicle, this is entirely up to you.

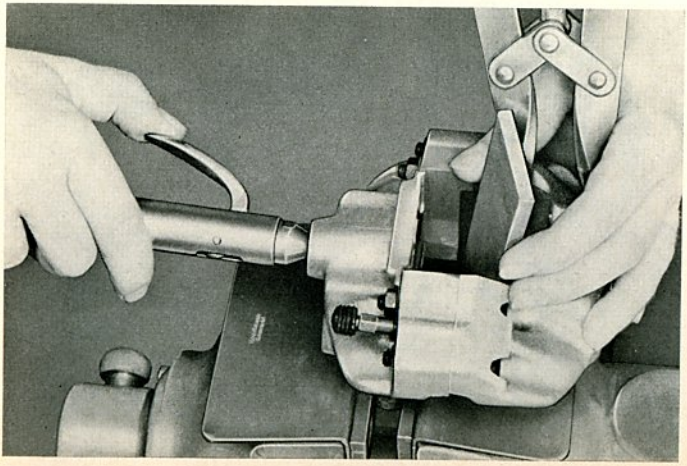


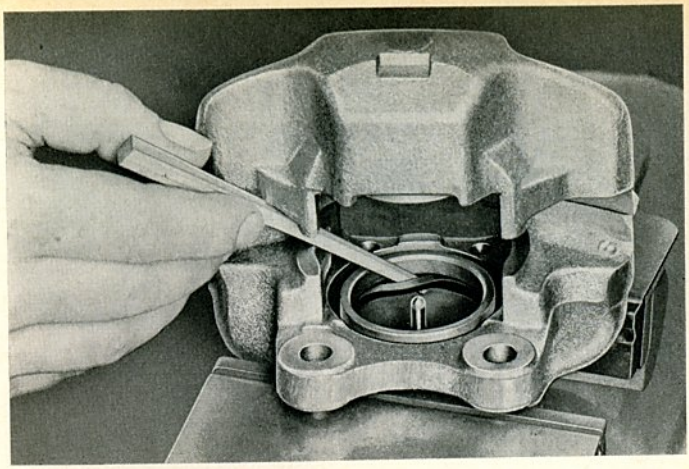
26/38 Disassemble the caliper as follows. Remove the piston retaining plates from both pistons and lift the spring rings off the rubber boots with a small screwdriver. You can now pull the boot off the shoulder in the housing.

The pistons can only be pressed out of the housing one at a time and with the aid of compressed air. This means that the second piston can only be removed when the first one has been installed again as otherwise the compressed air will escape from the housing. The pistons cannot both be removed at the same time.

26/39 For this operation you require a piece of plywood, the piston, the piston pressing tool and compressed air. Hold one piston in position with the special tool, place the piece of wood in the slot so that the piston does not strike the tool when it comes out and apply the compressed air to the hose connection.

Take care when forcing the piston out. Keep your fingers out of the way as the piston may fly out of the cylinder with considerable force.

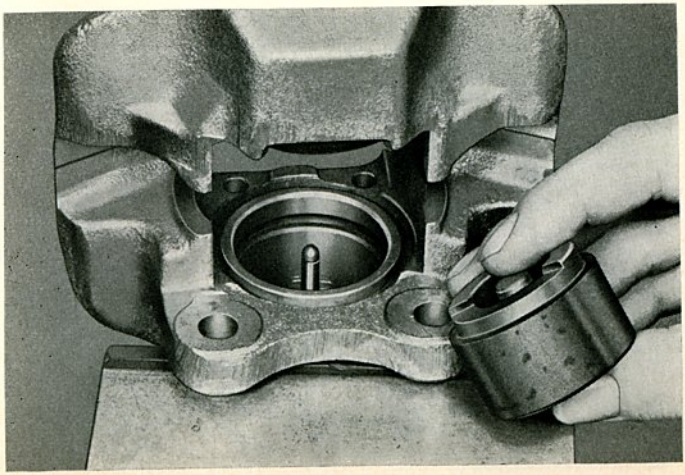


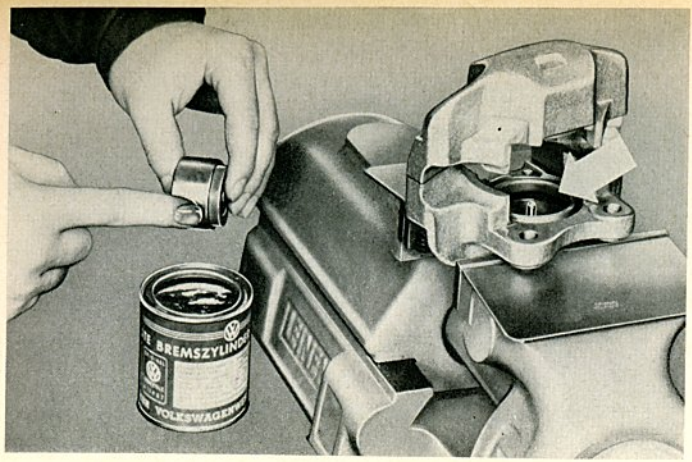


26/40 When you have taken a piston out — and your fingers are still intact — remove the rubber sealing ring with a piece of hardwood or a plastic rod.

26/41 The next step is to check the piston and cylinder. If a piston is rusty — as in this picture — or shows signs of wear a new piston should be fitted. A new caliper housing should always be fitted in if the cylinder is grooved or rusty.

The sealing rings and rubber boots with spring rings must be replaced each time the caliper is repaired. The VW Repair Kit SP 422 is avoidable to this end.

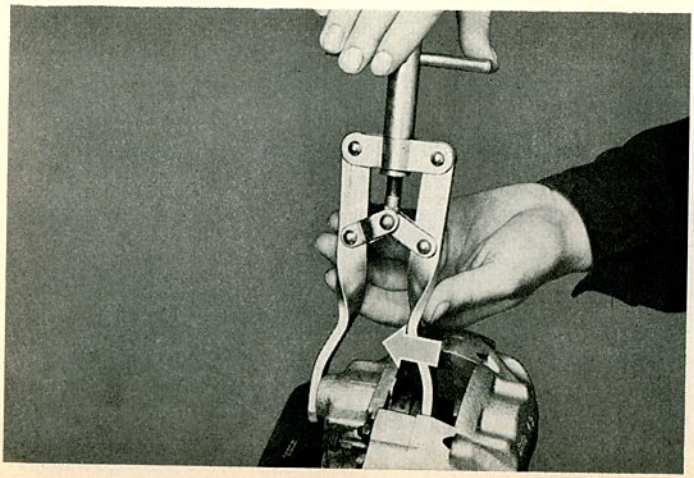


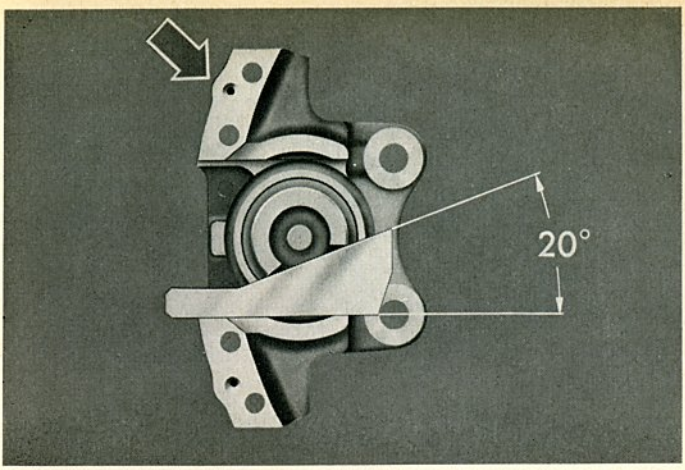


26/42 We are now ready to start assembling the parts again. First of all install a new sealing ring in the cylinder and coat cylinder, ring and piston lightly with brake cylinder paste. Then press the piston into the cylinder.

26/43 This is done by locating the piston pressing tool as shown here, with one side on the housing and the other on the piston. Then press the piston carefully into the cylinder, taking care that it does not jam.

After fitting the new rubber boot and the spring ring the same operations can be commenced on the other piston as it is now possible to build up pressure inside the housing with compressed air.

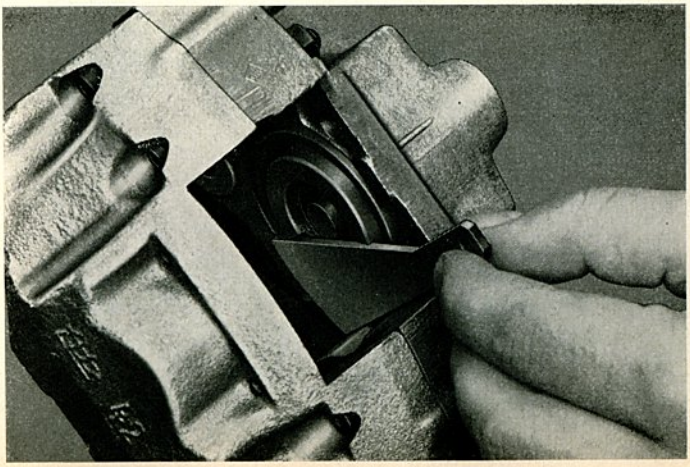


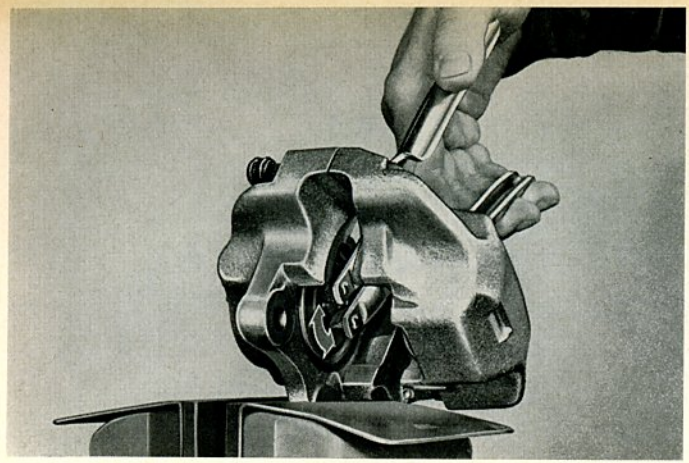


26/44 After a repair of this nature, do not fail to set the piston correctly in the cylinder. This is done with a gauge which shows whether the cut-away part on the piston is at the proper angle of 20°.

The angle of 20° is determined by the lead-in direction of the brake disc. The angular location thus created prevents the pad from wearing wedge-shaped. The proper position of the piston is established when this angle is always opposite to the bleeder valve. The arrow points to the connection for the bleeder valve.

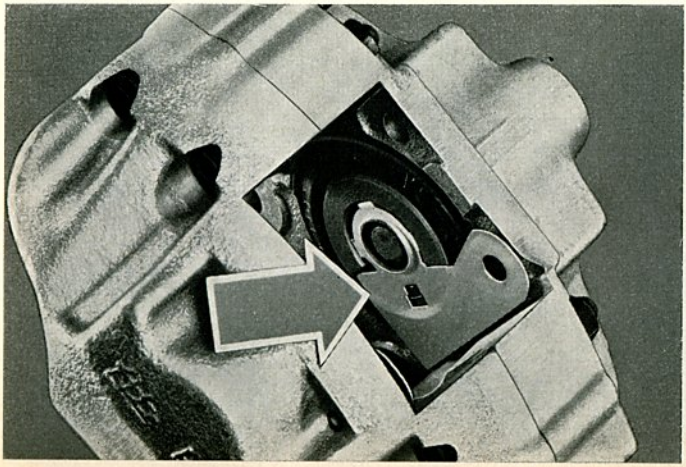
26/45 Here you see how the position of the piston is checked in the housing. The gauge must always be located in the lower guide surface in the caliper, that is, opposite to direction of rotation of disc when the vehicle is moving forwards.

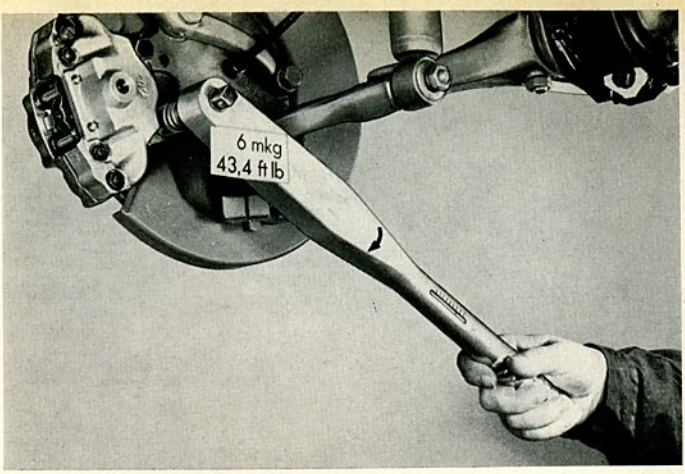




26/46 If the piston position is not correct when checked you must turn the piston. This is done with the piston turning pliers shown here. They are inserted into the piston and pressed. Due to the conical shape, the pliers jam in the piston so that it can be turned to the correct position as given by the gauge.

26/47 Then fit two new piston retaining plates as shown in this picture and fit the pads as already explained. The repaired caliper can now be fitted back on to the steering knuckle. Each caliper must be fitted to the wheel for which it is intended. To avoid confusion there is a simple rule: Note the position of the bleeder valve when fitting a caliper, the valve must always be at the top.



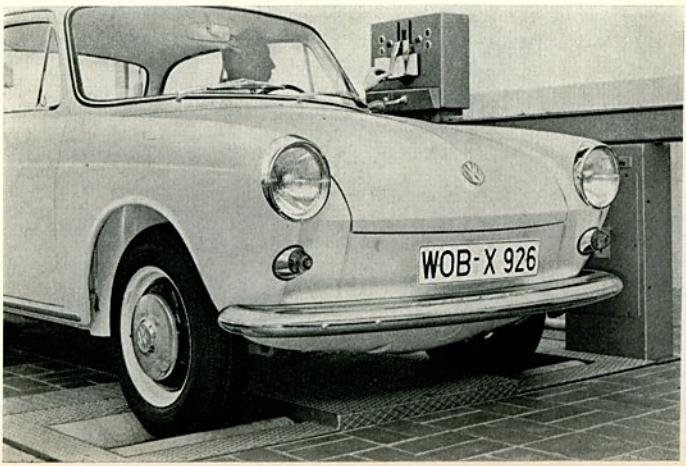


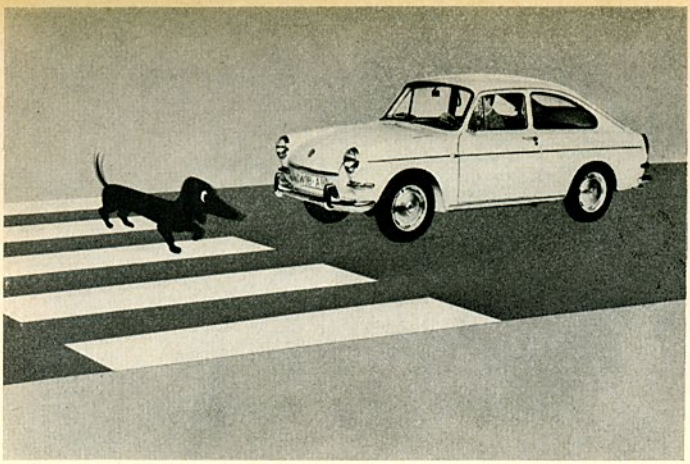
26/48 For safety reasons it is essential to always use new screws and locking plates when installing the caliper. The tightening torque for these screws is 6 mkg (43 ft. lbs). Do not forget to bend the locking plates up after tightening the screws.

26/49 This is almost the end of our slide series on disc brakes.

Always carry out a brake test after carrying out repairs to the brake system. If you have a modern brake test stand as shown here you can read off the efficiency of the brakes at each wheel.

This test will show whether you have done the job properly.





26/50 Safety first is the motto. Your skill, conscientiousness and care when working on the disc brakes are the best guarantee for the roadworthiness and reliability of the vehicles passing through your hands. Please bear this in mind — everyone will appreciate your efforts — including the dachshund.

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