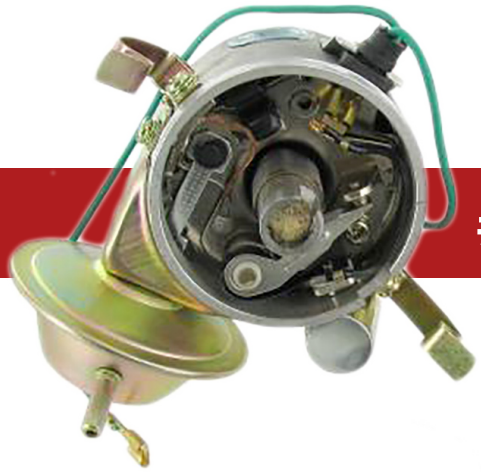
Paruzzi Magazine

Technical Publication for the classic Volkswagen

12



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Types of drum brakes

Almost all classic Volkswagens have drum brakes installed on the rear wheels and the front wheels. VW installed disc brakes in the front on some models such as the type 3, type 4, the 1300S, 1302 and 1303 and the Bay Window Bus initially as an option and later as factory default. You could of course convert any drum brake to disc brake if you really want to.

The drum brake system in our VW's is based on the "**Bendix**" concept. Other designs were developed and installed by other automobile manufacturers along the years such as the **Lockheed construction** or the **Girling construction**. We show the Lockheed construction on page 5, on the following pages we show the Girling and Bendix setups.

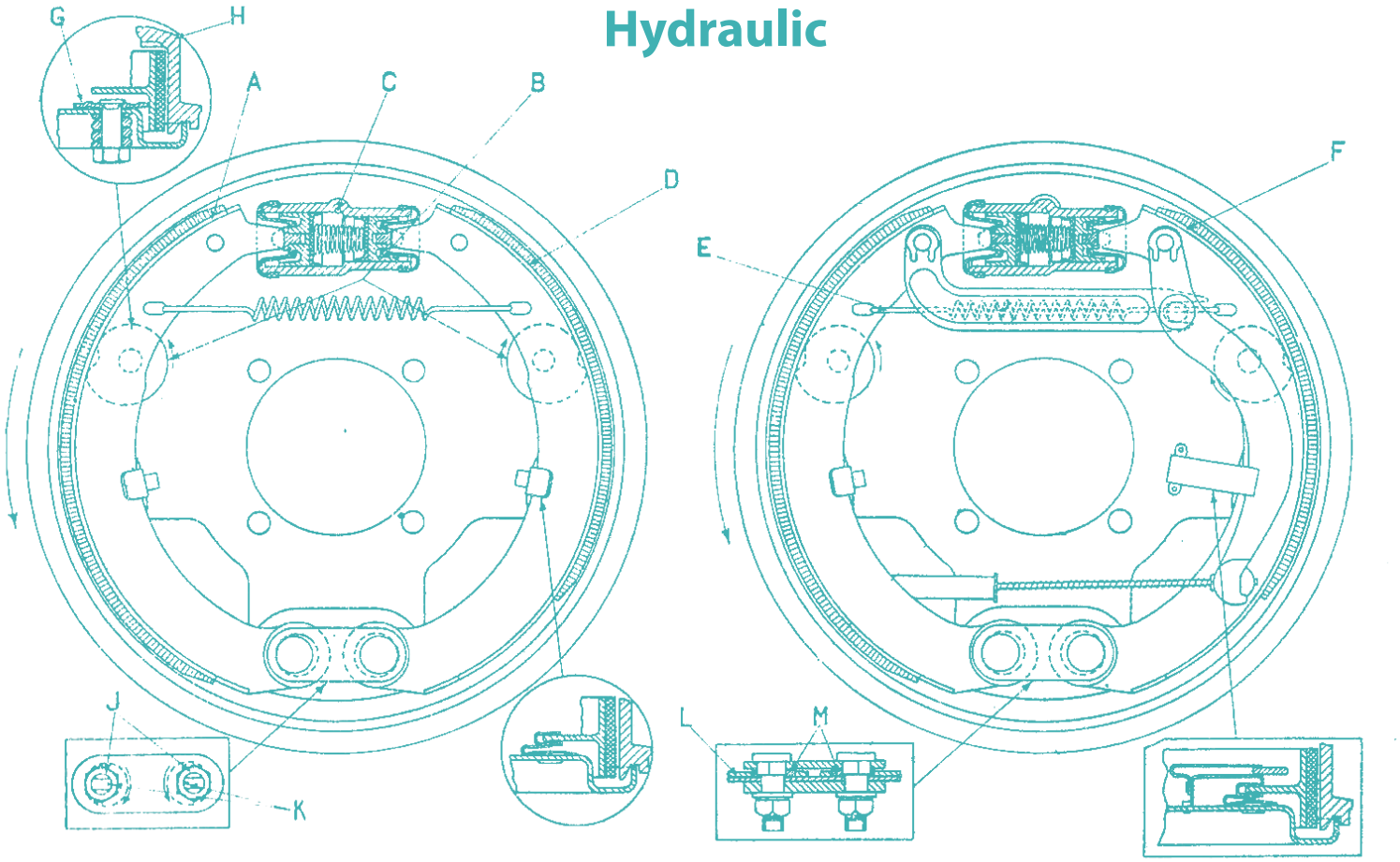
As said earlier, the Bendix design is used on our classic Volkswagen. If you are also interested in other classic car brands you will work on different drum brake designs. Bendix and Girling are today also car part brands, so it is possible that you find Girling branded brakes based on the Bendix principle on your VW.

The main difference between all these drum brake concepts is the way the anchors are installed, how the brake shoes hinge and how they are being adjusted. Drum brakes with two brake shoes have a primary shoe or leading shoe and a secondary shoe or trailing shoe as you can see on the drawing on the next page. The lining of the brake shoes has a very high friction coefficient to allow for a maximum brake capacity.

Lockheed front wheel

Lockheed rear wheel

Hydraulic

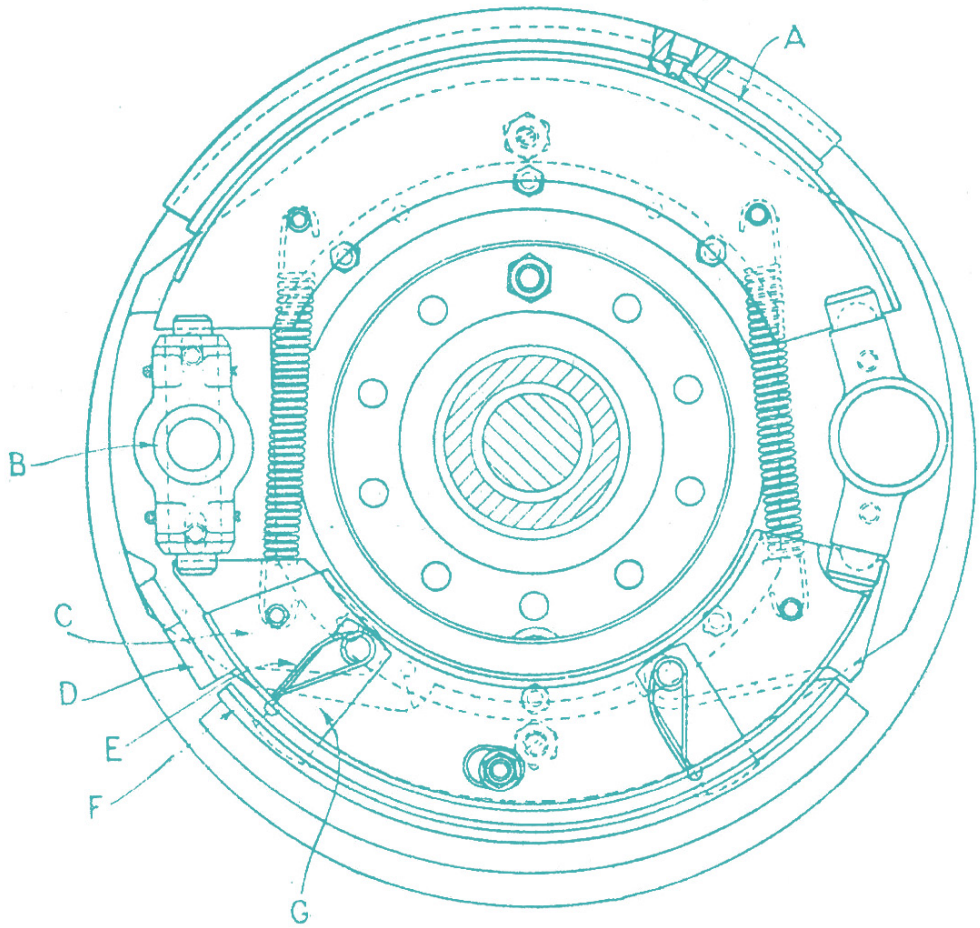


- **A** Leading shoe (primary shoe)
- **B** Excenter to distribute shoe play
- **C** Wheel cylinder breather
- **D** Trailing shoe (secondary shoe)
- **E** Retracting spring
- **F** Hand brake control
- **G** Excenter detailed
- **H** Drum detailed
- **J** Excenter anchor bolts
- **K** Hold down spring
- **L** Anchoring
- **M** Excenter plates for anchor bolts

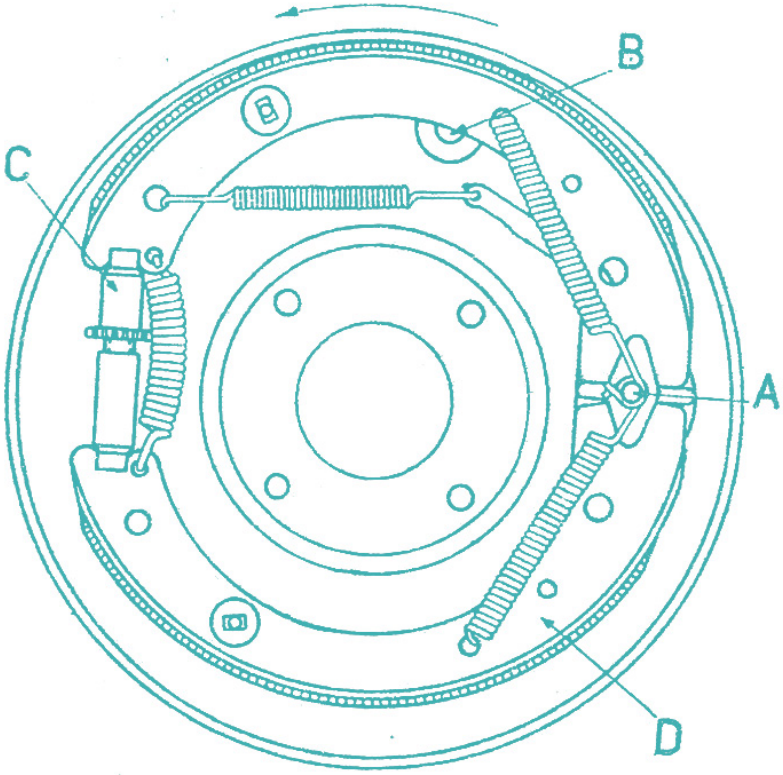
Girling hydraulic

The construction of the Girling drum brake with hydraulic wheel cylinder (B) is shown on this drawing. All drum brakes discussed here can be adapted to operate with cables (mechanical) or with hydraulics (with master cylinder and wheel/slave cylinders). This drawing is from a rear wheel hydraulic drum brake with mechanical hand brake.

- **A** Leading shoe
- **B** Adjusting mechanism/wheel cylinder
- **C** Support
- **D** Stopping plate
- **E** Springs
- **F** Trailing shoe
- **G** Strips



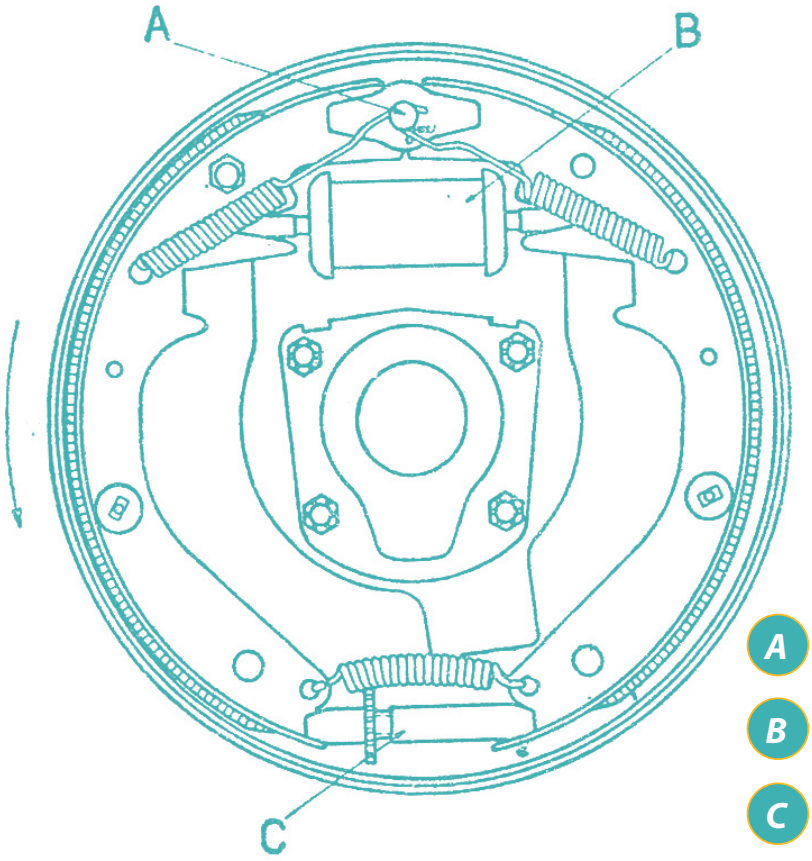
Bendix mechanical



- **A** Anchor
- **B** Adjustment excenter
- **C** Shaft with left and right thread
- **D** Trailing shoe

The Bendix construction was originally designed to be cable operated as shown on the drawing at the top of this page (mechanical), it was adapted later on to be operated by an hydraulic system as shown on the bottom of this page. There is only one fixed anchor point in this design (A), one of the brake shoes (leading shoe) will be pushed against the drum when the pivot rotates, this will force the other brake shoe (trailing shoe) to move towards the drum.

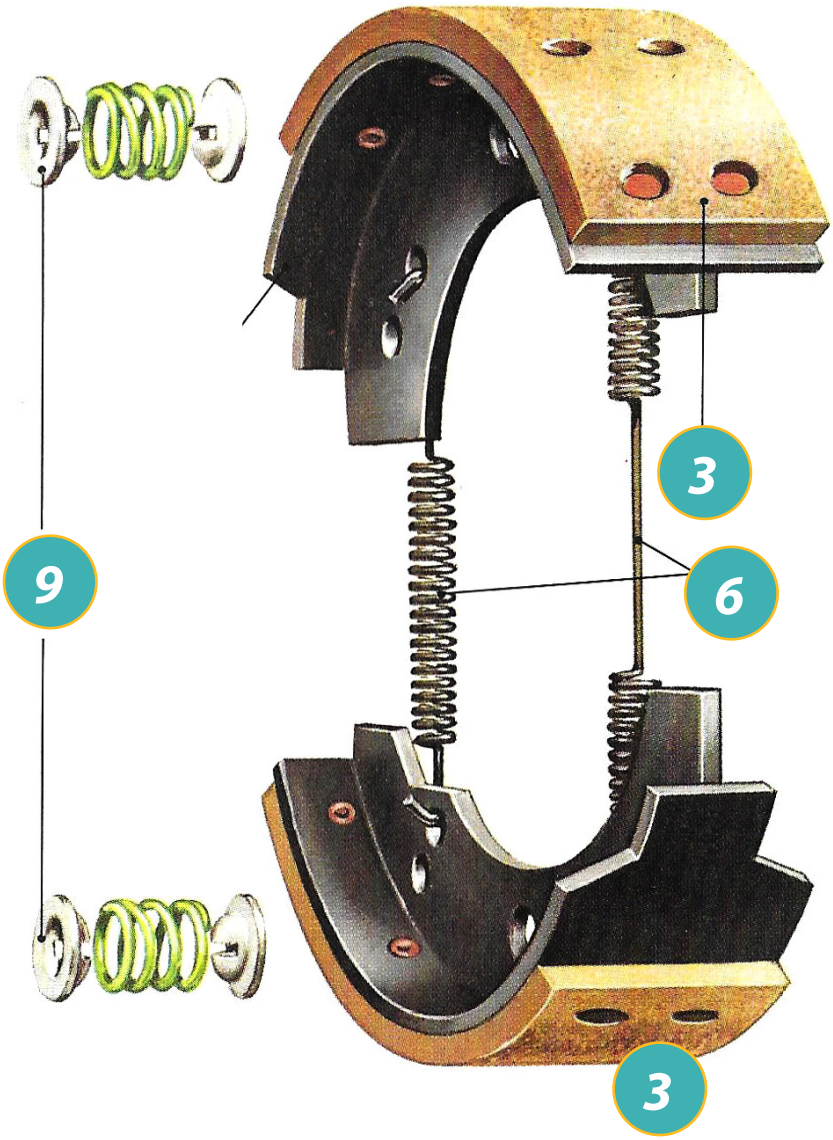
Bendix hydraulic



- **A** Anchor
- **B** Wheel cylinder
- **C** Adjusting bolt with left and right thread

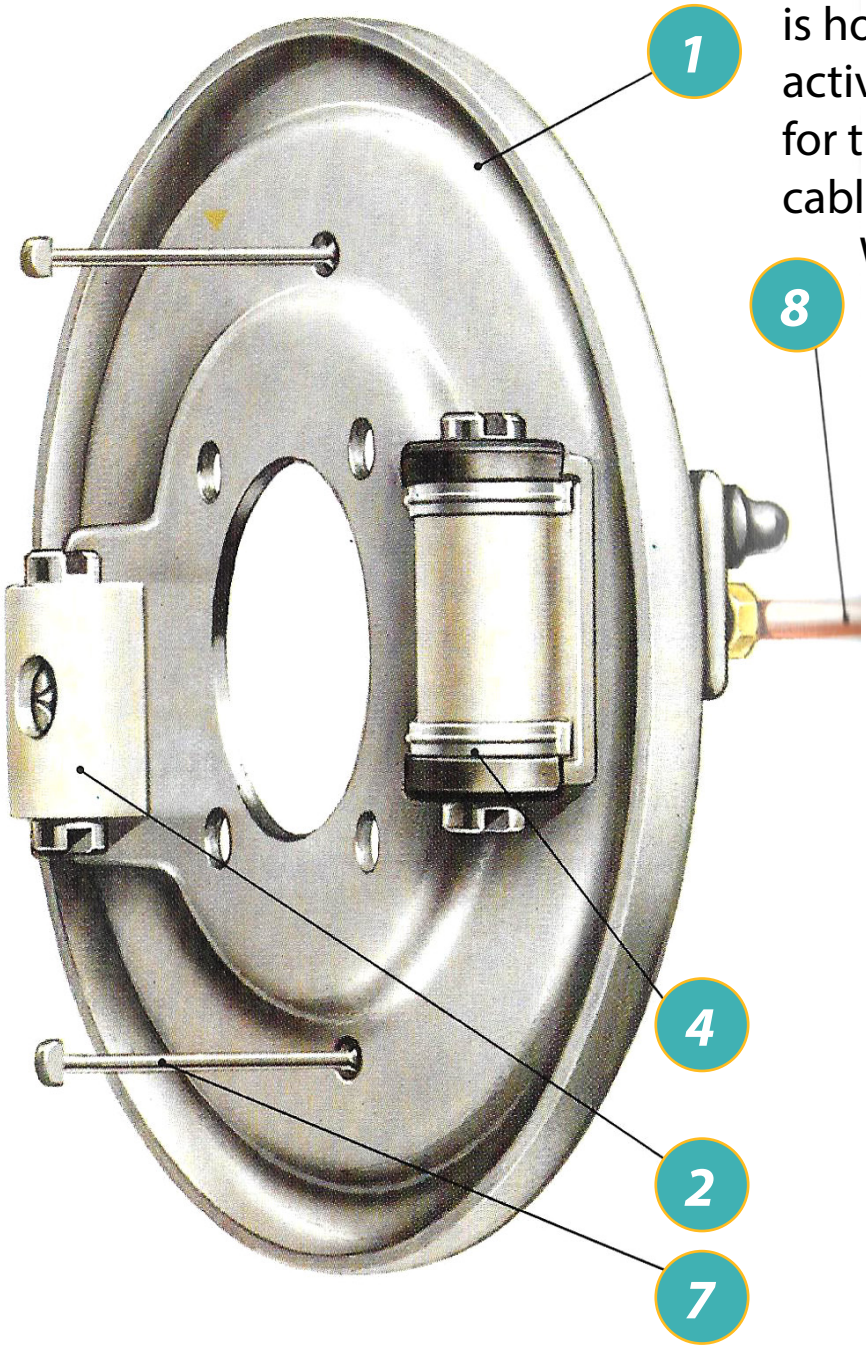
#34 Brakes

This is a technical drawing I found in an old school book, this is not for a VW but a very generic representation of a drum brake assembly. A drum brake consists of a backing plate (1) with an anchor (2) that will operate as an hinge for the two brake shoes (3) and a wheel cylinder (4) (only for the hydraulic drum brake) that will operated by pressing the brake pedal. The drum (5) and the backing plate protect all the parts against dirt and water.



drum brakes

When you push the brake pedal, the master cylinder will build up hydraulic pressure and force the wheel cylinder to expand, this will push the brake shoes against the drum, the retracting springs (6) (or return springs) will force the brake shoes to return to their initial position when releasing the brake pedal. We explained in edition 05 how the hydraulic brake system works. There is no difference when it comes to the principal between hydraulic and mechanical operated drum brakes, the difference is how the brake shoes will be activated, by a wheel cylinder for the hydraulic drums or with cables for the mechanical drums. We will show on the following pages how brake drums installed in your VW work.



1. **Backing plate or support plate**
2. **Shoe adjusting bolt**
3. **Brake shoes**
4. **Wheel cylinder**
5. **Brake drum**
6. **Retracting springs**
7. **Brake shoe hold down pins**
8. **Brake line (hydraulic)**
9. **Brake shoe hold down springs and retainers**

The Volkswagen drum brakes

hydraulic drum brakes

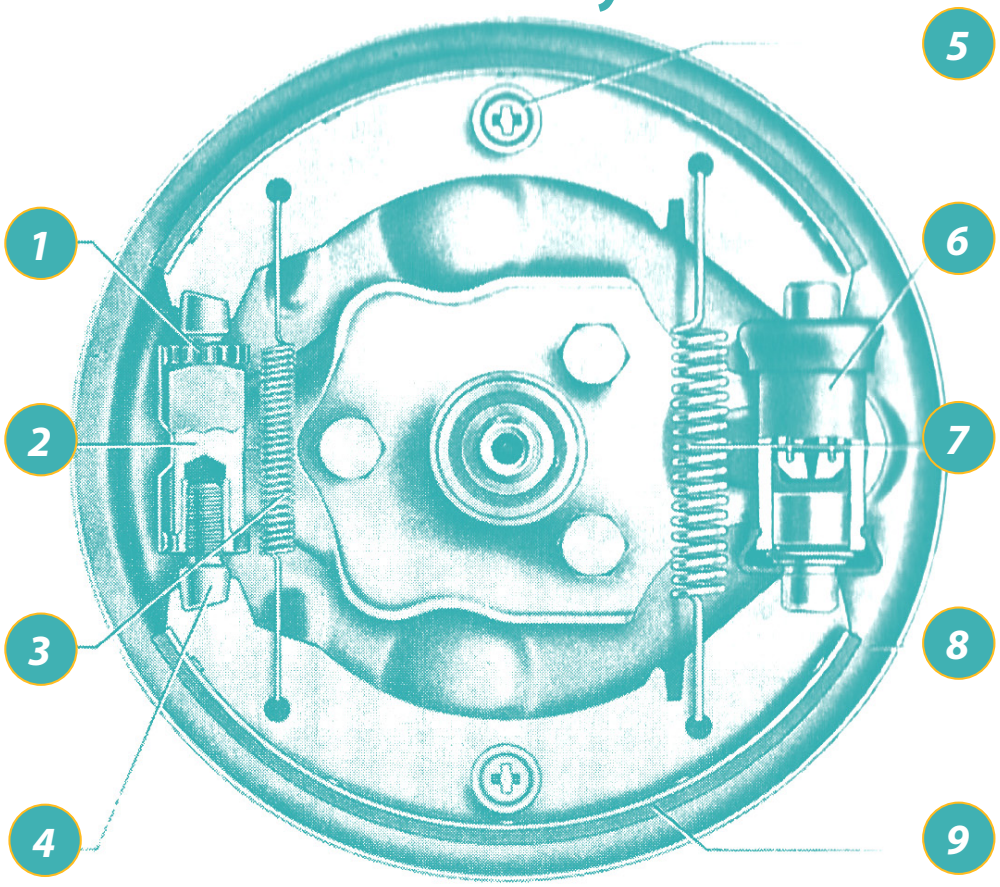
1	K	Adjusting nut
2	L	Anchor block
3		Front return spring
4	F	Adjusting screw
5	D	Guide springs with cup and pin
6	A	Wheel cylinder
7		Rear return spring
8	G	Backing plate
9	B	Brake shoe with lining
	C	Upper return spring
	E	Lower return spring
	H	Hand brake connecting link
	I	Hand brake lever
	J	Hand brake cable

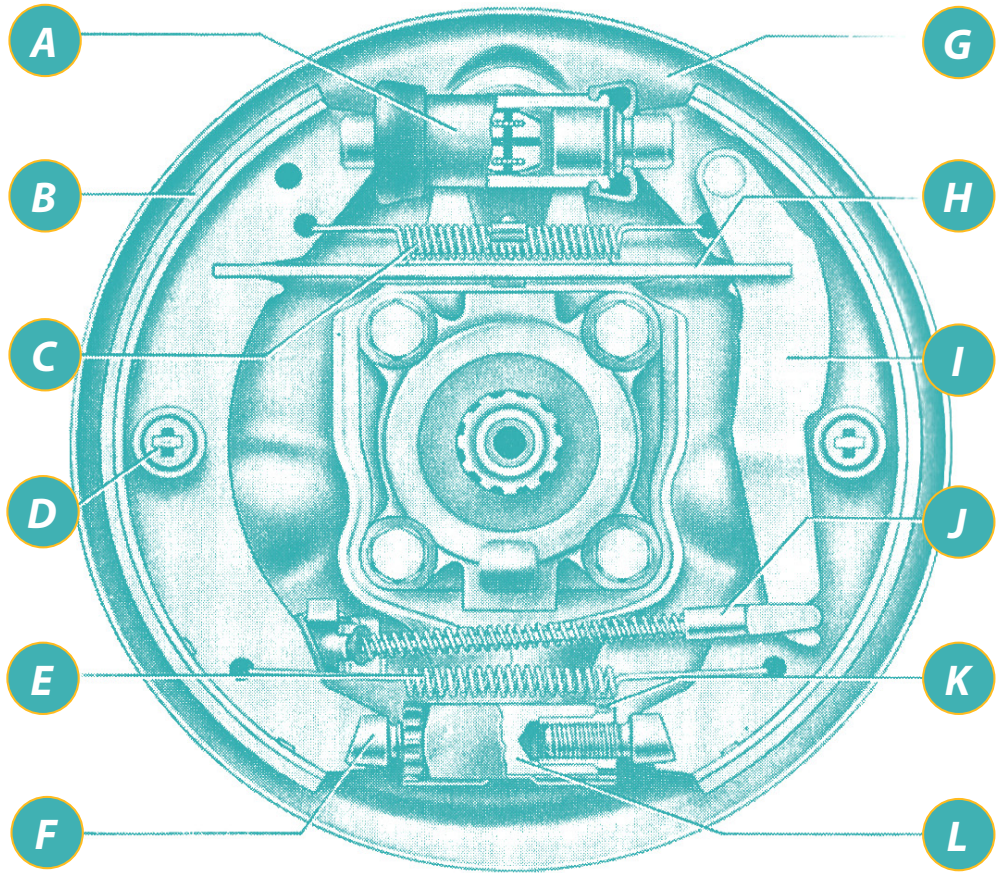
These drawings are from hydraulic drum brakes on a 1967 Volkswagen Beetle, we will use them as an example to name all parts. Most classic Volkswagen drum brakes are similar to these models. On top is the front brake, at the bottom is the rear drum brake. Both are based on the Bendix construction as we discussed on the previous pages.

The main difference between the front and rear drum brakes is the position of the brake shoes, the reason is because forces are distributed differently on the front and the rear wheels when pushing the brake pedal. You will also recognise the rear brake because of the extra mechanical control with cable and push rod (circles H, I and J). This simple setup makes it possible to operate the rear brakes with the hand brake lever (parking brake) independently from the brake pedal.

drum brakes

front brake hydraulic





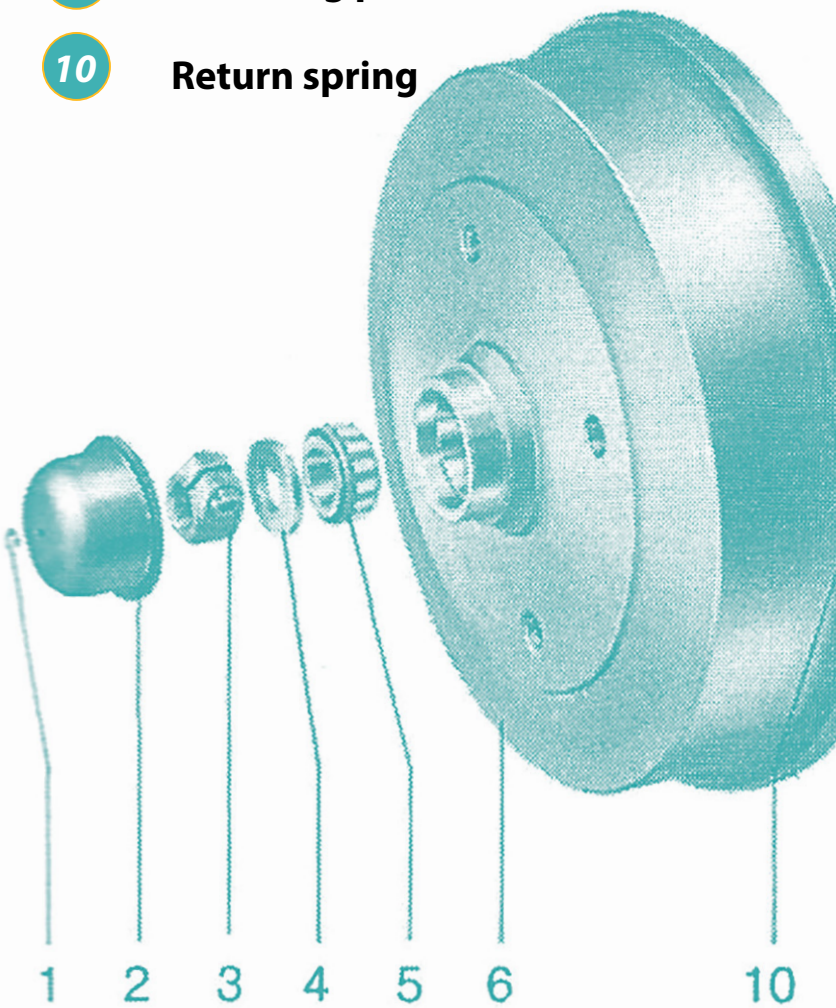
rear brake hydraulic

#34 Brakes

We show now a drum brake assembly on a late 1960 VW Beetle. This is the front brake of course, there are no hand brake components as you can see. The backing plate is installed on the front wheel spindle. On the rear drum brake, the backing plate will be installed on the rear wheel shaft.

The brake drum has two brake shoes that are installed on the backing plate (21), the latter is fixed to the spindle (front wheel) or the wheel shaft (rear wheel), it will not rotate with the wheel. The drum protects all brake parts, it is attached to the wheel, so it will rotate with the wheel. When you push the brake pedal, the brake shoes are pushed to the outside towards the drum. The friction between the drum and the brake shoes lining will slow down the rotation of the wheel.

1. **C-washer for speedo cable**
2. **Dust cap**
3. **Clamp nut**
4. **Thrust washer**
5. **Wheel bearing**
6. **Brake drum**
7. **Spring plate**
8. **Spring**
9. **Retaining pin**
10. **Return spring**



drum brakes

11 Return spring

12 Brake shoe

13 Adjusting screw

14 Adjusting nut

15 Bolt

16 Lock washer

17 Wheel brake cylinder

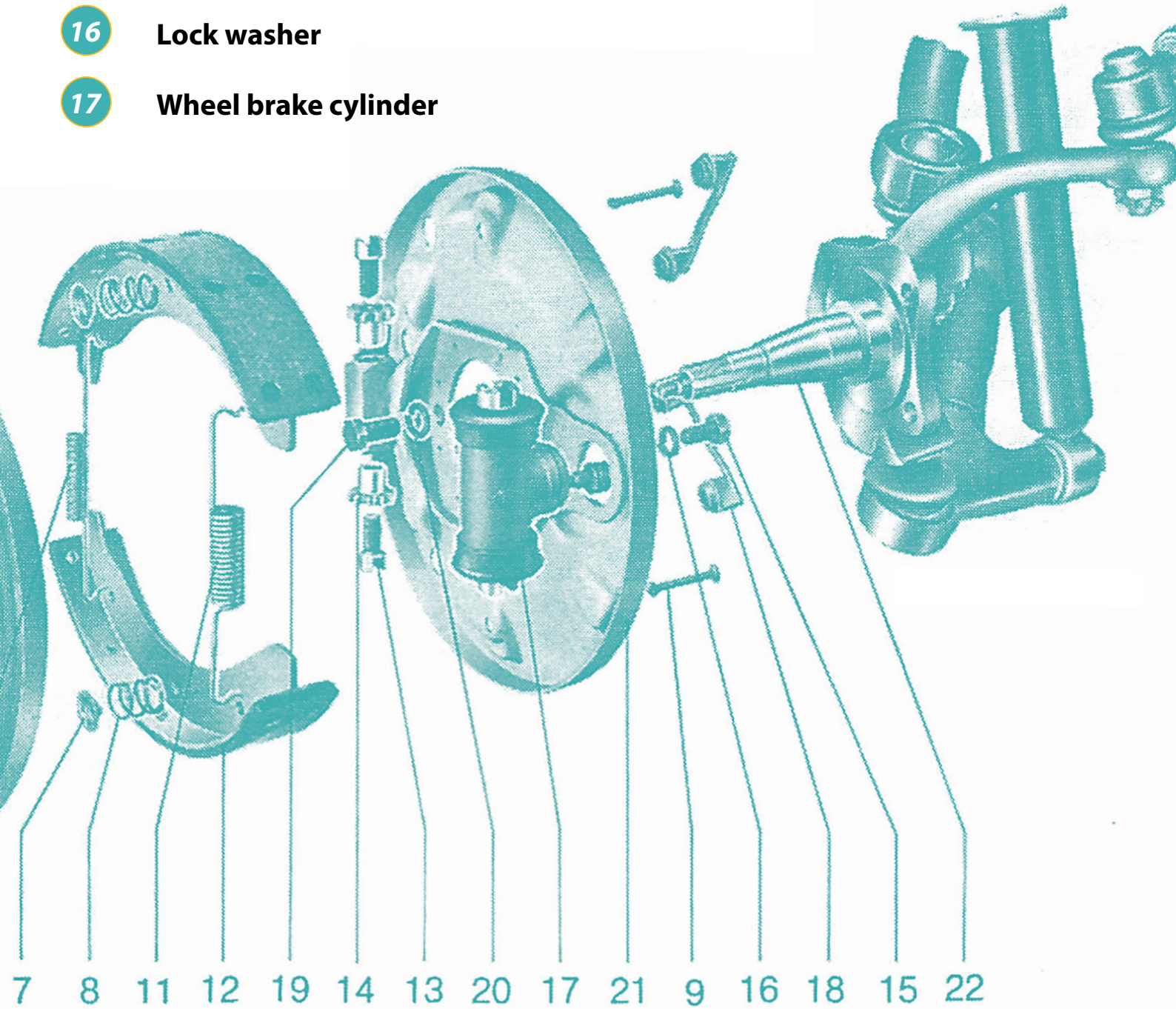
18 Sealing plugs

19 Bolt

20 Lock washer

21 Backing plate

22 Steering nuckle/spindle



#34 Brakes

You understand that both the drum and the brake shoes should be absolutely free of oil, grease or water.

There is an inspection hole in de brake drum or in the backing plate to allow you to check if the brake shoes are still fine (refer to page 17). You will adjust the brakes through that same hole.

1. **Drum brake mounting hardware**
2. **Brake shoes**
3. **Adjusting nuts**
4. **Adjusting bolts**

We show now all the parts you will need to rebuild your drum brakes on your classic Volkswagen, these parts are available in our webstore.

1

drum brakes

2

3

4

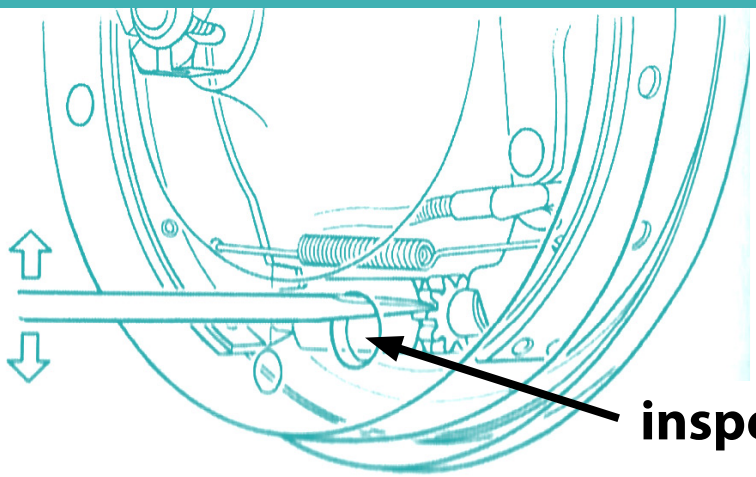
#34 Brakes

- 5 **Hand brake connecting link**
- 6 **Wheel cylindre**
- 7 **Backing plate**
- 8 **Brake drums**

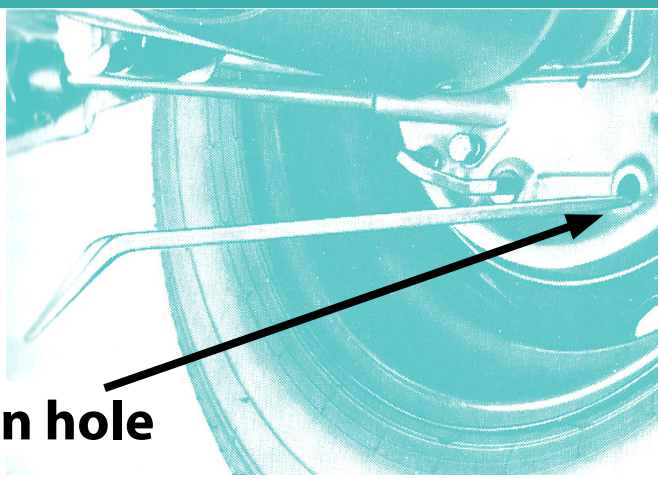
inspection hole

inspection hole

drum brakes



inspection hole

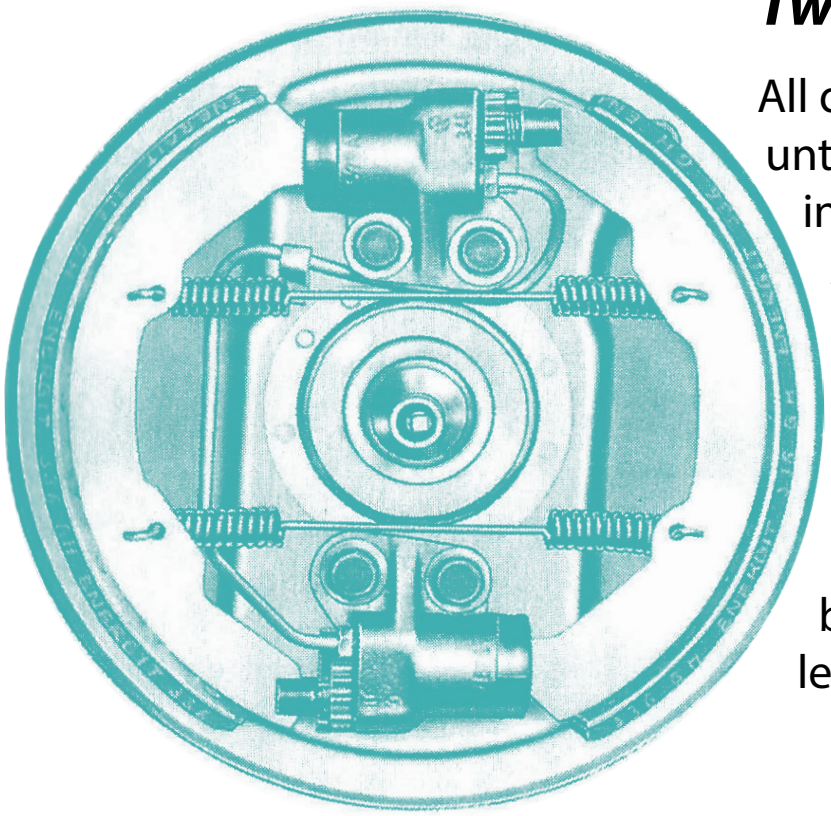


early VW models

Above two drum brakes showing the inspection hole, this inspection hole is located in the drum on early VW models, in the backing plate on the late models (picture top right).

late VW models

We will explain in a next edition how to remove and install the drum brakes on your VW and how to adjust the brake shoes.



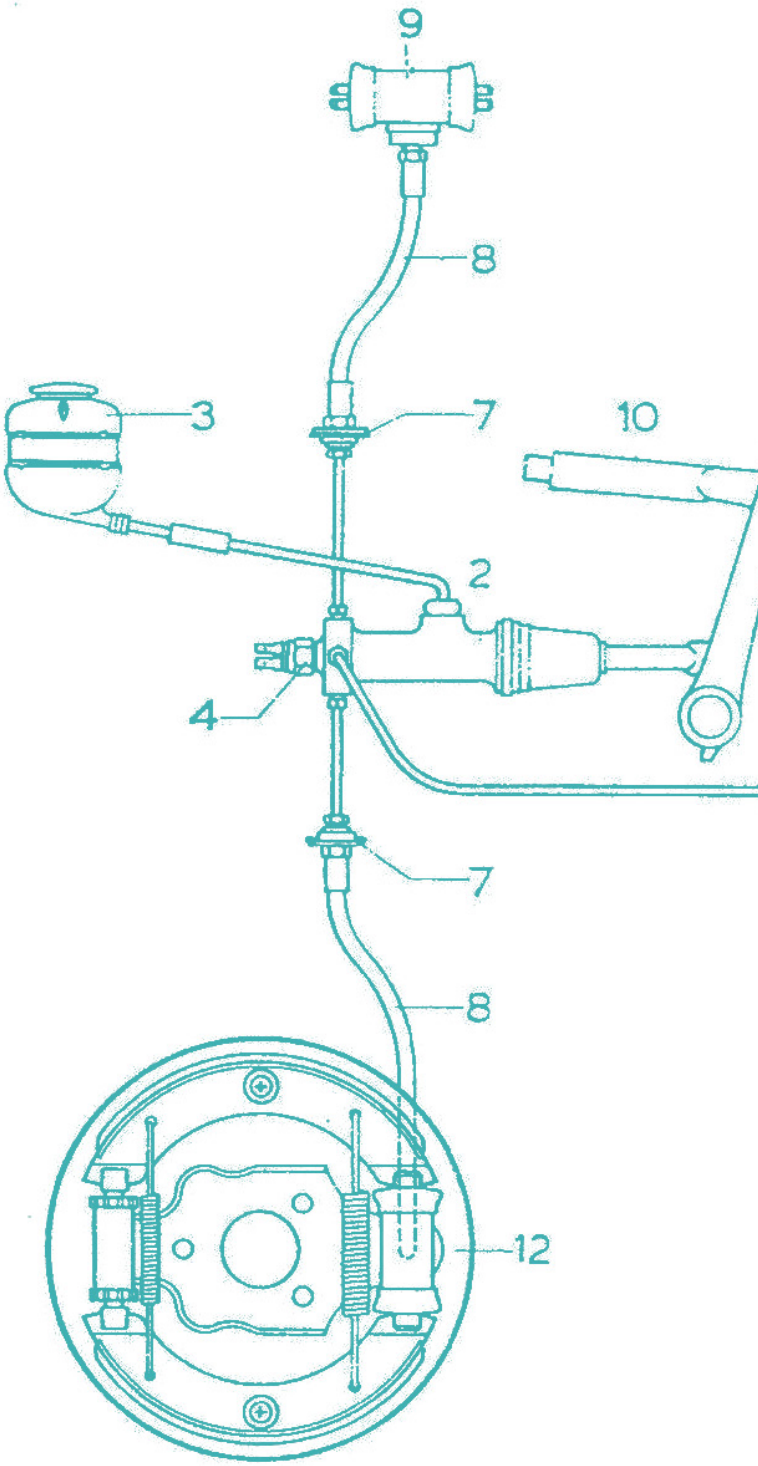
Two wheel cylinders

All drum brakes we discussed until now had one wheel cylinder to activate the brake shoes. Some classic VW's such as the Split Bus and the Bay Window T2a until 1970 have two wheel cylinders installed in the front drum brake. We show this type of brake on the picture on the left hand side.

hydraulic drum brakes

When pushing the brake pedal, an hydraulic pressure is generated in the master cylinder (2), the pressure in the brake fluid is distributed equally over all brake lines following Pascal's law.

The pistons in the wheel cylinders (9) will push the brake shoes against the drum.

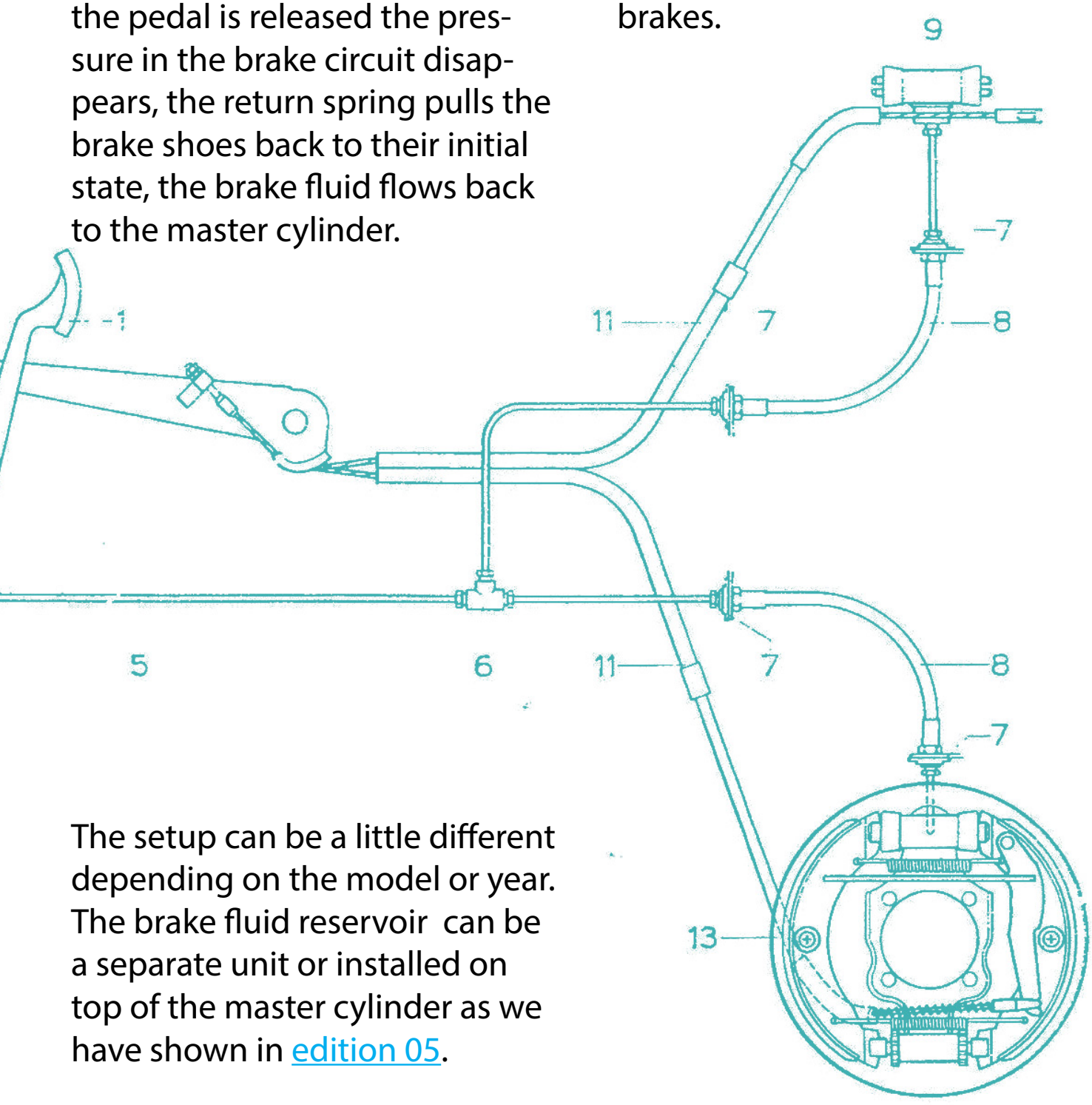


1. **Brake pedal**
2. **Master cylinder**
3. **Fluid reservoir**
4. **Stop light switch**
5. **Metal brake line**
6. **Three-way connection**
7. **Brake hose bracket**
8. **Brake hose**
9. **Wheel cylinder**
10. **Hand brake lever**
11. **Cable and conduit tube**
12. **Front wheel brake**
13. **Rear wheel brake**

drum brakes

The more pressure on the brake pedal the harder the brake shoes will push against the drum. Once the pedal is released the pressure in the brake circuit disappears, the return spring pulls the brake shoes back to their initial state, the brake fluid flows back to the master cylinder.

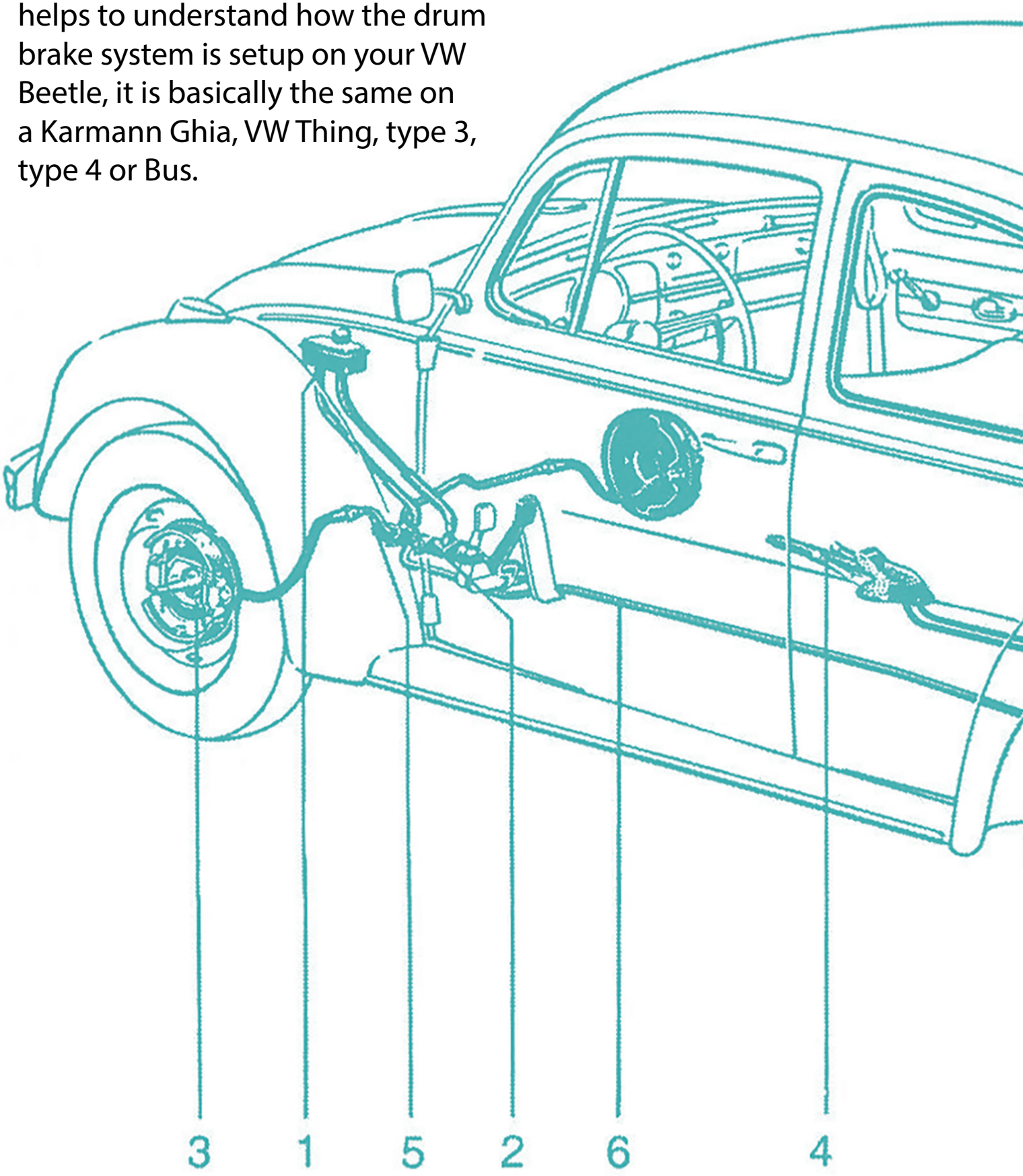
The hand brake (10) is using cables working independently of the hydraulic circuit of the main brakes.



The setup can be a little different depending on the model or year. The brake fluid reservoir can be a separate unit or installed on top of the master cylinder as we have shown in edition 05.

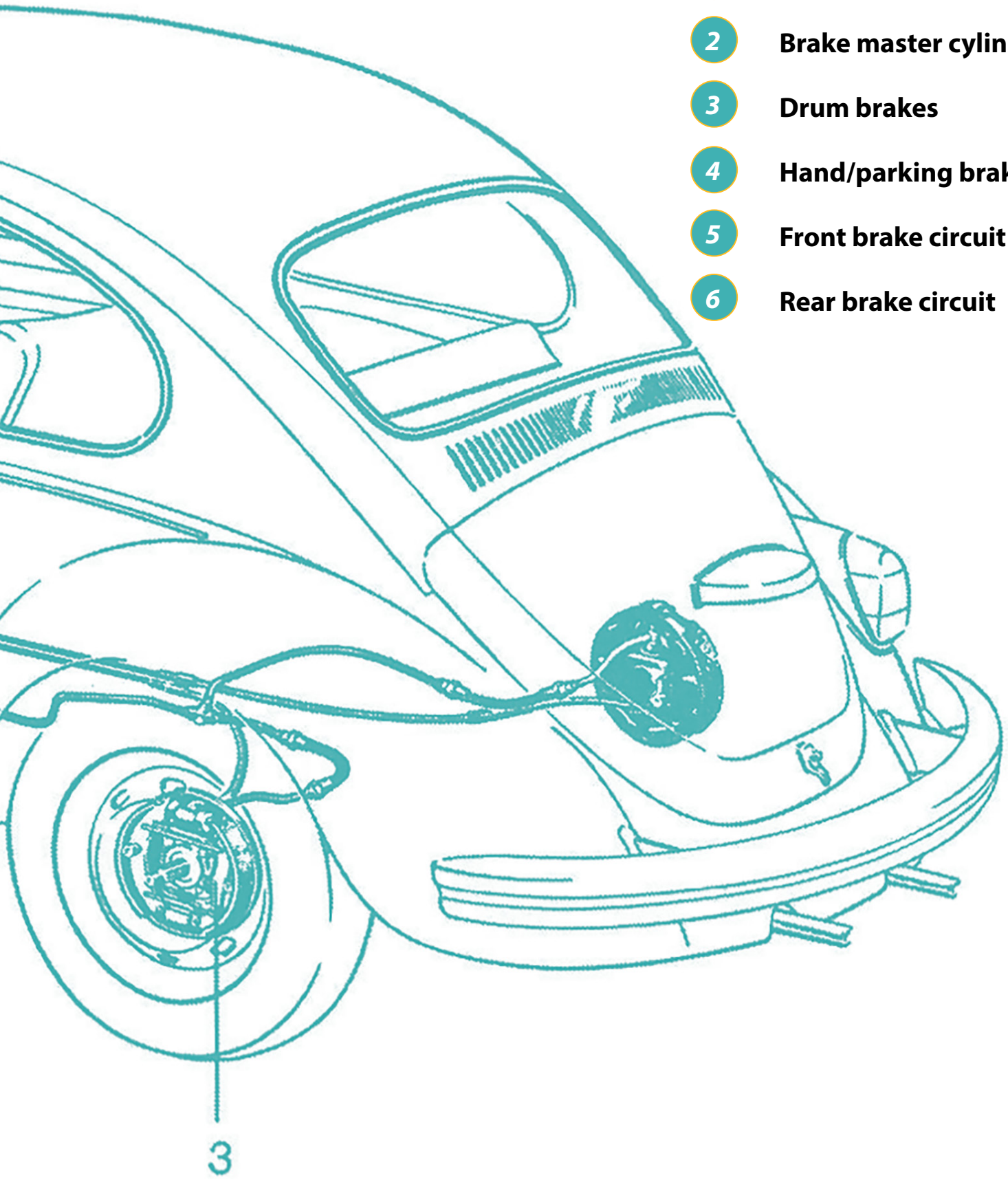
#34 Brakes

I have added this drawing, I think it helps to understand how the drum brake system is setup on your VW Beetle, it is basically the same on a Karmann Ghia, VW Thing, type 3, type 4 or Bus.



drum brakes

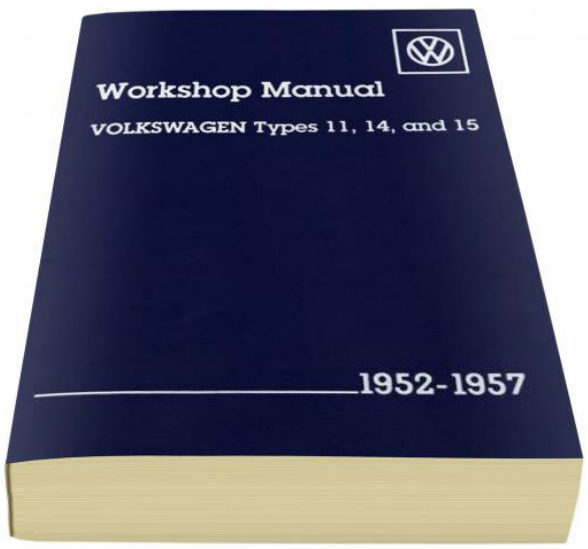
1. Brake fluid reservoir
2. Brake master cylinder
3. Drum brakes
4. Hand/parking brake
5. Front brake circuit
6. Rear brake circuit



#34 Brakes

mechanical drum brakes

1. **Backing plate**
2. **Brake shoe**
3. **Brake cable**
4. **Brake shoe lever**
5. **Expander**
6. **Cable adjusting sleeve**
7. **Return spring**
8. **Leaf spring**
9. **Adjuster cone**
10. **Adjuster screw**



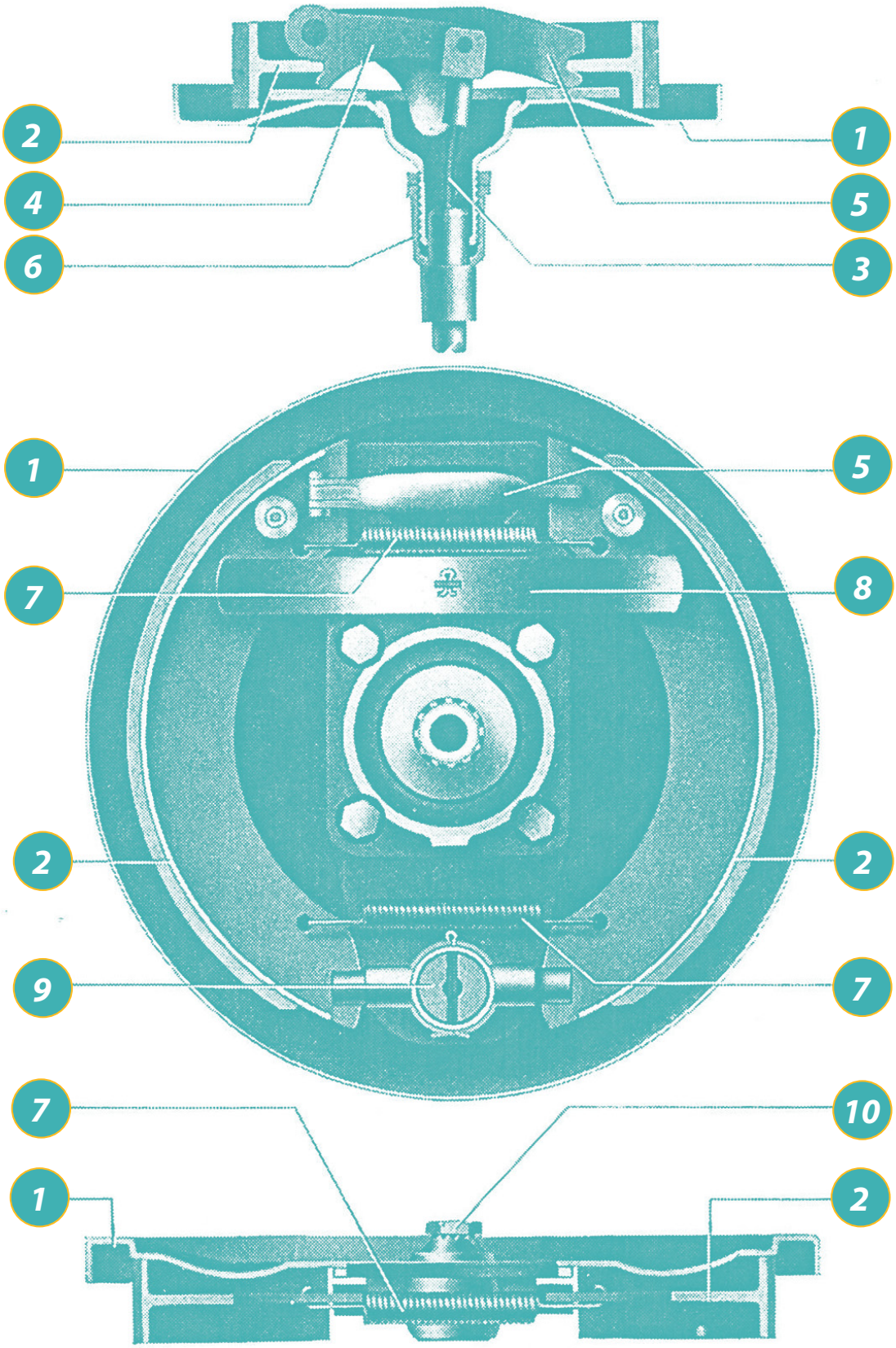
You will find these older mechanical drum brakes operated by cables on the very early fifties Beetles and Karmann Ghia's. If you're lucky you'll see them on a Vintage VW Show.

Here is a drawing of a cable operated brake sourced from an old Volkswagen Official Service Manual. We have the complete series published by Bentley Publishing available in our webstore for you to order. These books list all technical specifications and explain how to repair or diagnose your classic Volkswagen.

The construction of a mechanical drum brake is much simpler than the hydraulic drum brake, but it is much more difficult to adjust properly though. You will need some experience to achieve the same braking force on both front and rear wheels. The drawing on the next page is one of a rear mechanical drum brake. We show how the cables are connect on the next page.

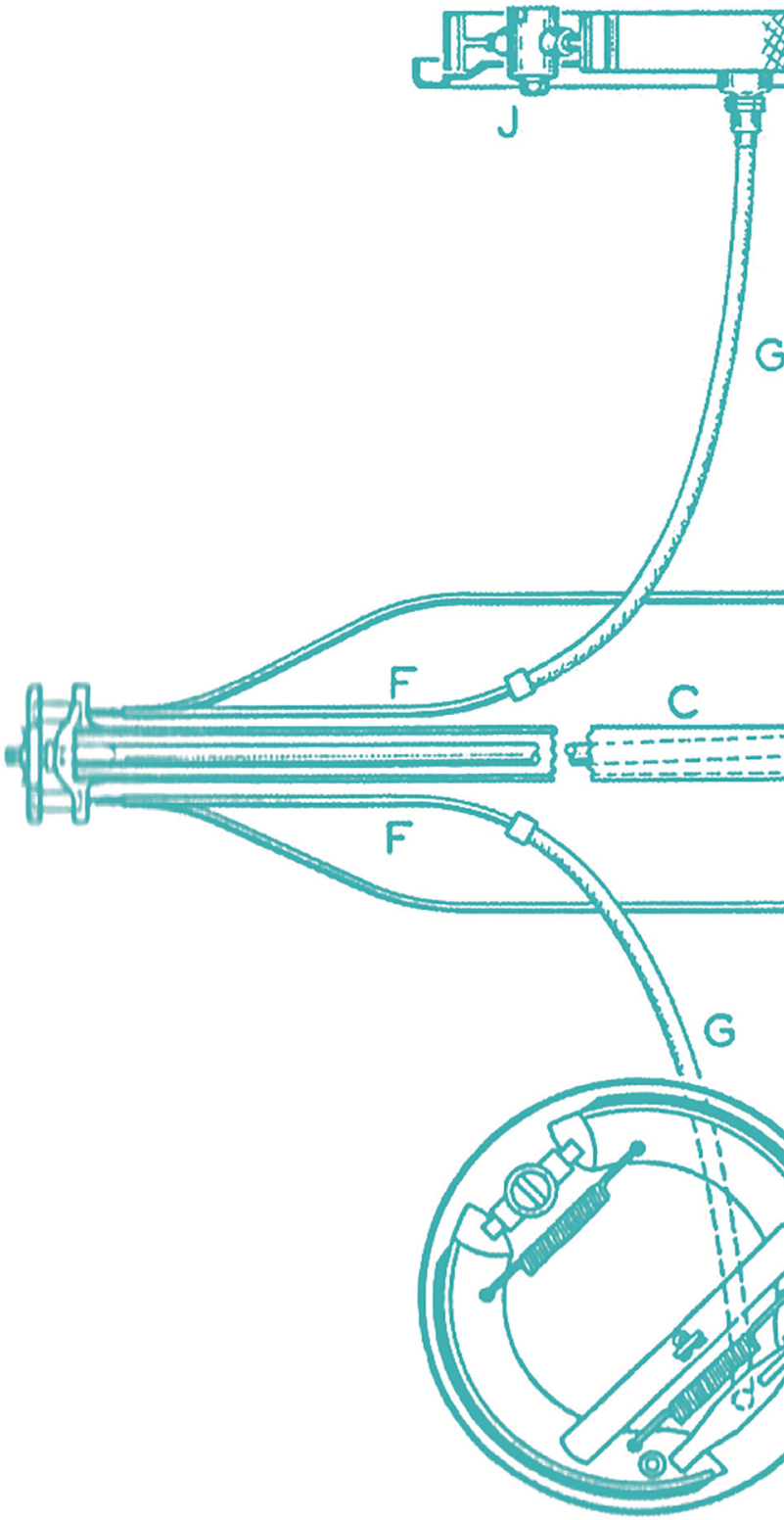
drum brakes

rear brake mechanical



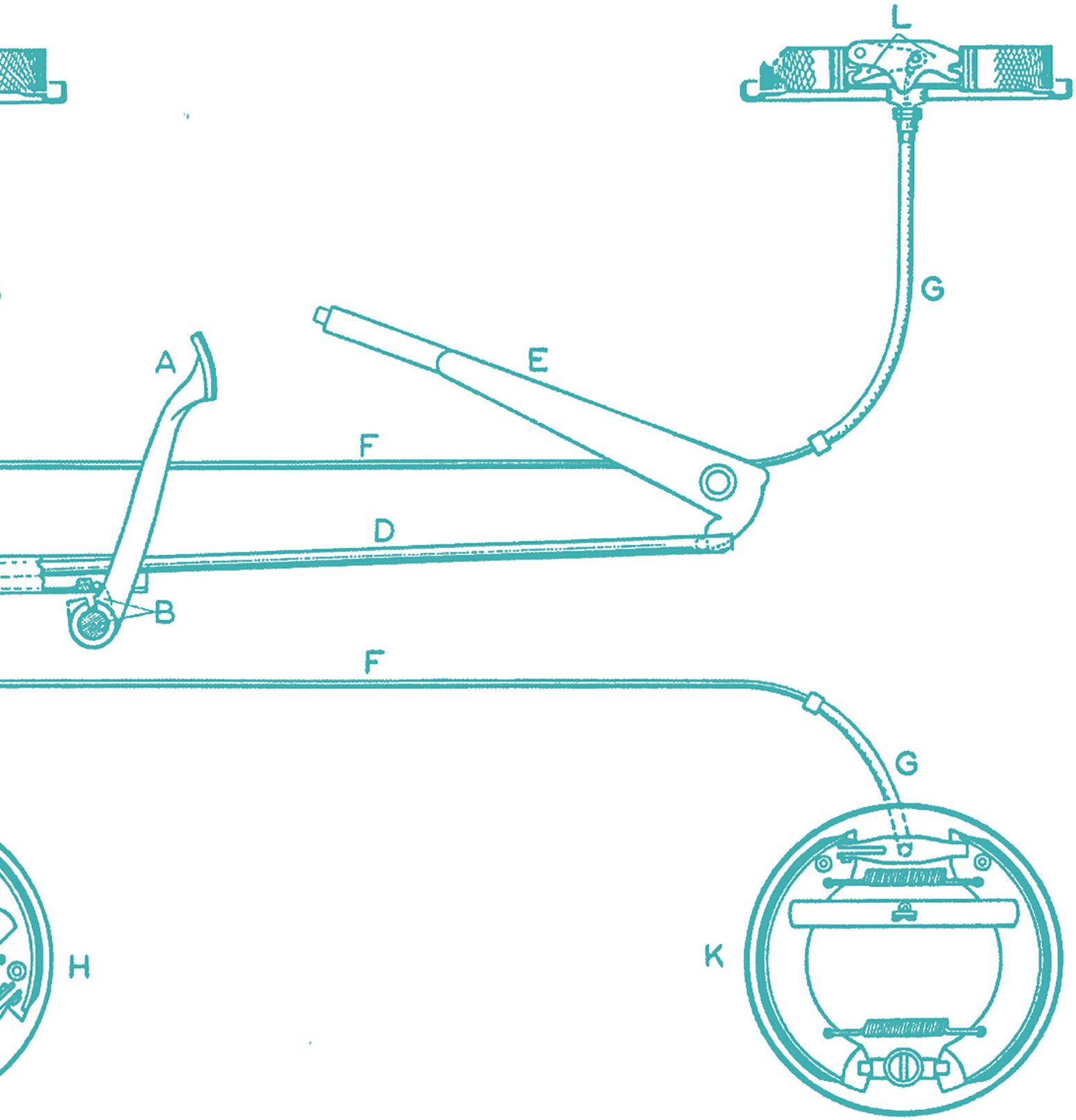
cable operated brakes

In this setup there is no brake fluid, no wheel cylinder or master cylinder. The hand brake (or parking brake) and the front and rear brakes are cable operated using push bars. Only four cables are used to activate the brakes, two for the front wheels and two for the rear wheels.



- **A** Brake pedal
- **B** Brake pedal shaft
- **C** Floor brake push bar
- **D** Hand brake push bar
- **E** Hand brake lever
- **F** Brake cable conduit tube
- **G** Flexible metal tube
- **H** Front wheel brake
- **J** Wheel brake cylinder
- **K** Rear wheel brake
- **L** Brake shoe expanding device

drum brakes

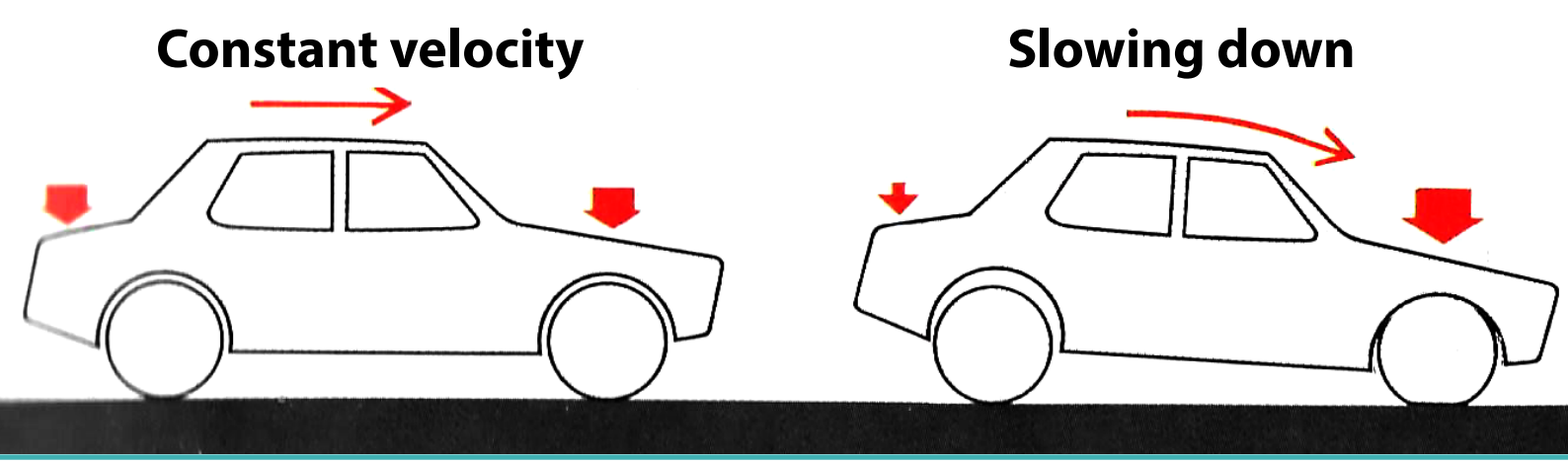


Drum brakes versus disc brakes

Disc brakes offer a much better performance, that is why they are used on the front wheels on early classic Volkswagens. The front of the car will experience large forces when slowing down, disc brakes are designed to develop more braking power than drum brakes, that is why cars with high performance engines have disc brake conversions in the front. We show an example of such a drum to disc conversion kit on the next page, they are available with 4-holes or 5-holes drums. Installing a brake conversion kit is technically not required for a factory VW engine, but it offers more comfort and safety though.

The hand brake is operated by cables as explained earlier, they have to be independent of the main brakes wheel cylinders. The design of the drum brake makes it much more easy to combine both the hand brake and the main brake in one assembly than with disc brakes. That is why you will still find many cars today, mainly models in the lower budget class, with drum brakes on the rear wheels.

Drum brakes keep most of the friction material within the drum, the wheels don't get dirty as fast as with disc brakes.



drum brakes

The drum brake is designed to keep rain, snow, ice or dirt outside of the drum to avoid that the friction between the brake shoes and the drum would be altered. Overheating of the brake shoes and drum can reduce the braking power, if this situation persists for too long the friction material will be irrevocably damaged. Losing braking force after heavy usage like in the mountains is known as brake fading.

Overheating will cause a temporary change of the friction specifications of the brake shoes, the braking force will go down and the brakes will not work as they should. The drum brakes should work better again after cooling down. If the temperature was too high for too much time the surface of the brake shoe material will show a glassy layer, replacing the brake shoes with new one will be necessary.

Front brakes conversion kit Beetle, Karmann Ghia or VW Thing/type 181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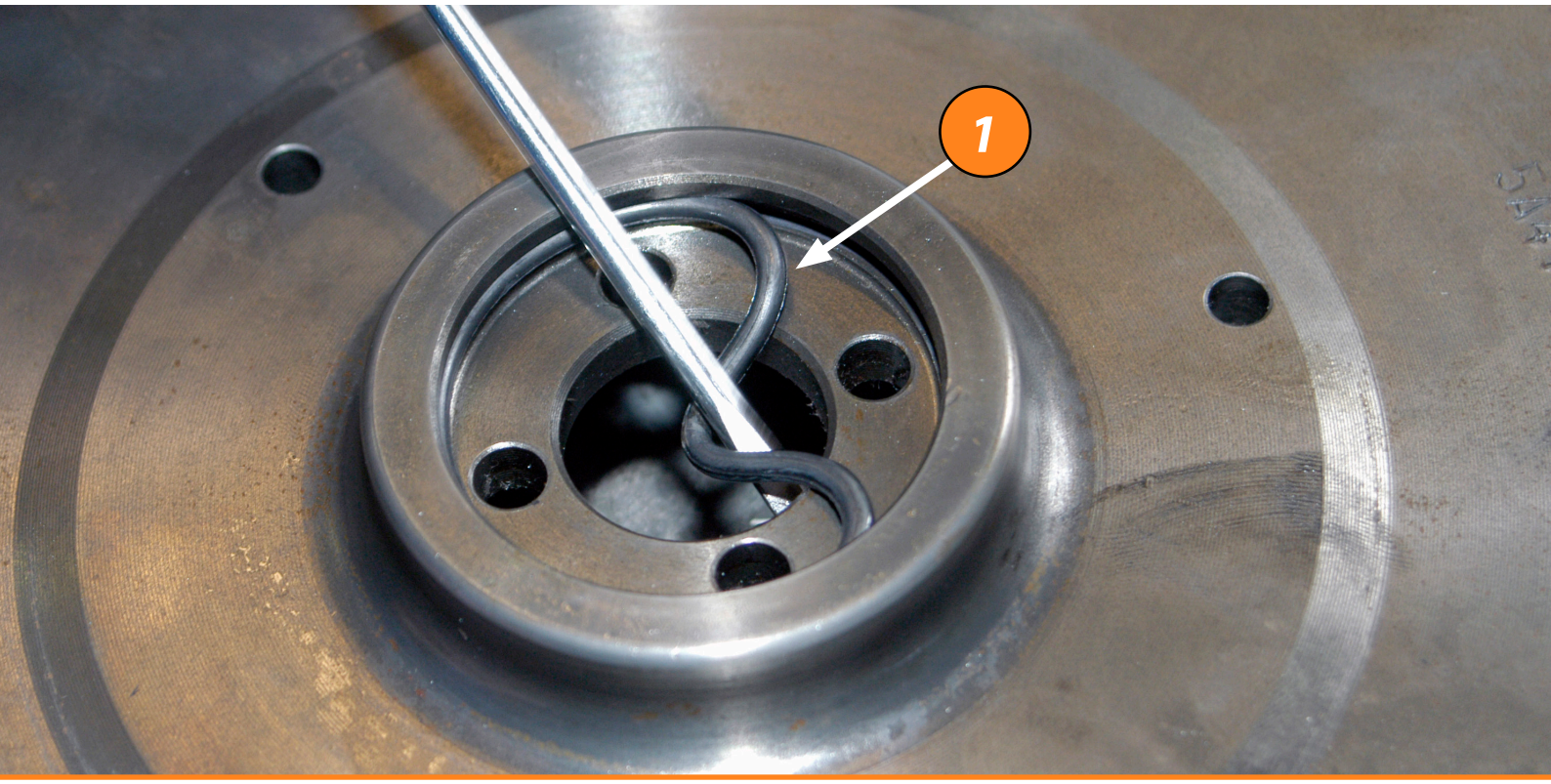
Oil seal types

You need to seal all rotating mechanical parts to avoid oil or grease to leak. Seals are used on parts such as crankshafts, transmission parts, steering rods and many more. Our classic VW uses two types of oil seal, the static oil seal and the dynamic oil seal (the latter is also known as the lip seal).

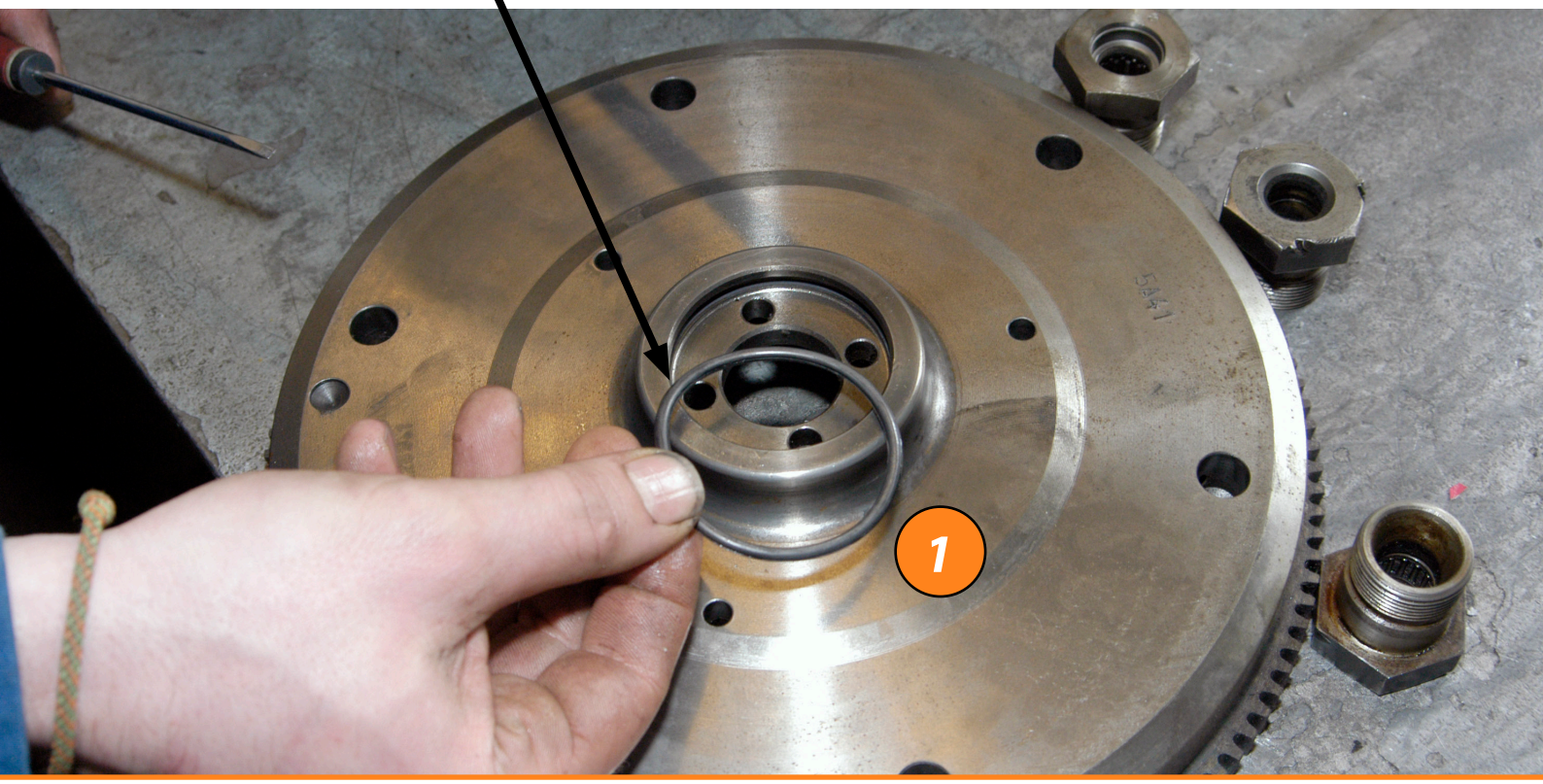
Static oil seals are used to seal two mechanical parts when there is no movement between sealing surfaces. An O-ring is an example of a static oil seal, it is used to seal an oil filter on the engine case. Most type 1 engine have an O-ring (1) on the back of the flywheel as shown on the picture below. Early type 1 engines (6 volts models) used a paper gasket instead.



oil seals

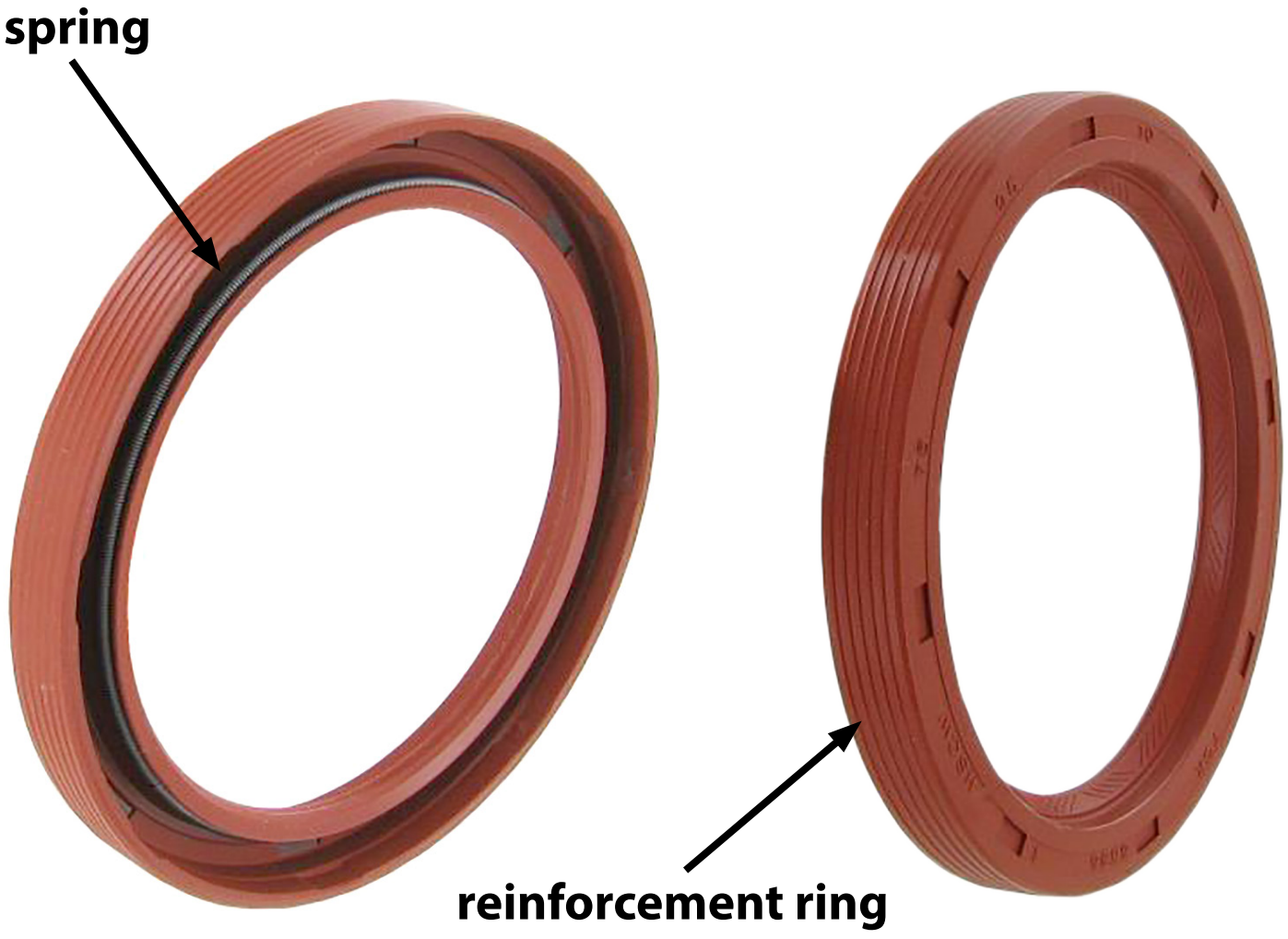
O-rings are also installed between the cylinder and cylinder head on a type 1 1200 engine, between the rocker shaft and the cylinder head (2) and between crankcase halves.

O-rings may not be reused, they tend to deform and lose their strength after some time in the hot engine. Removing them will damage them for sure. The sealing faces are not always matching the O-ring shape, so the seal will deform once installed, it is therefore impossible to reuse old O-rings because you'll never be able to install it the same way as before.



Dynamic oil seals, also called lip seals or radial seals, are used to seal joins between rotating and stationary machine components. They are used in the gear box, transmission and gear box and the flywheel in our classic VW's. Dynamic seals are more complex than static seals, they can have one or two lips for a higher sealing capacity, depending on the application.

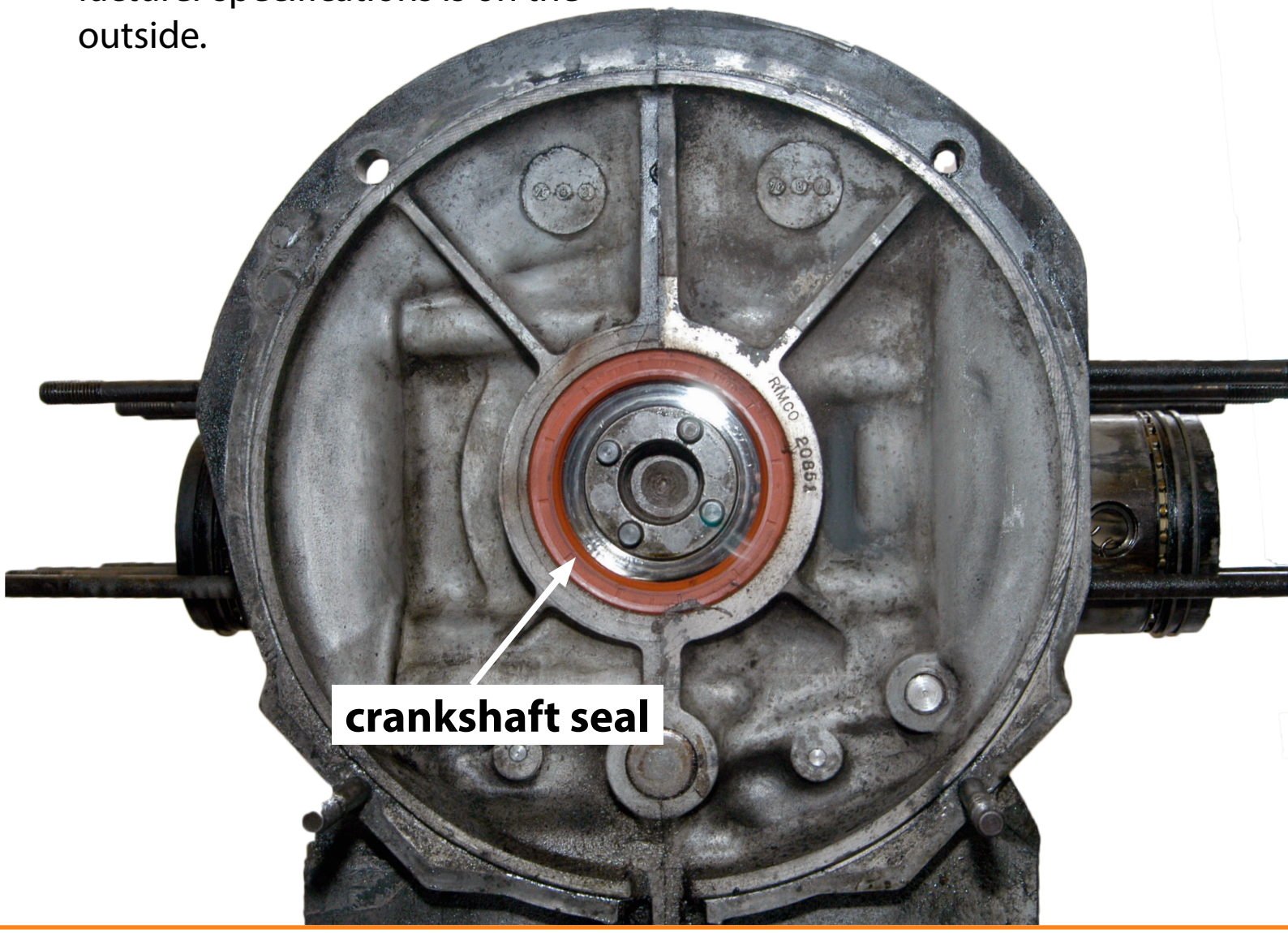
A lip seal consists of a cylindrical outer covering of sheet steel, or an elastomer with the right interference fit to seal statically against the shaft, and a sprung main sealing lip that has contact with the shaft. The spring inside the lip seal (not always present) will keep the lip against the rotating part. Most lip seals also have a reinforcement ring which make the installation easier.



oil seals

Below is the crankshaft (lip) seal installed in a type 1 engine. We show the flywheel side of the engine, the flywheel is removed. Read edition 11 for more information about this topic, we will show how to replace this crankshaft seal in a next edition of this series. The open side of the lip seal (with visible spring) is the oil side, the side with the manufacturer specifications is on the outside.

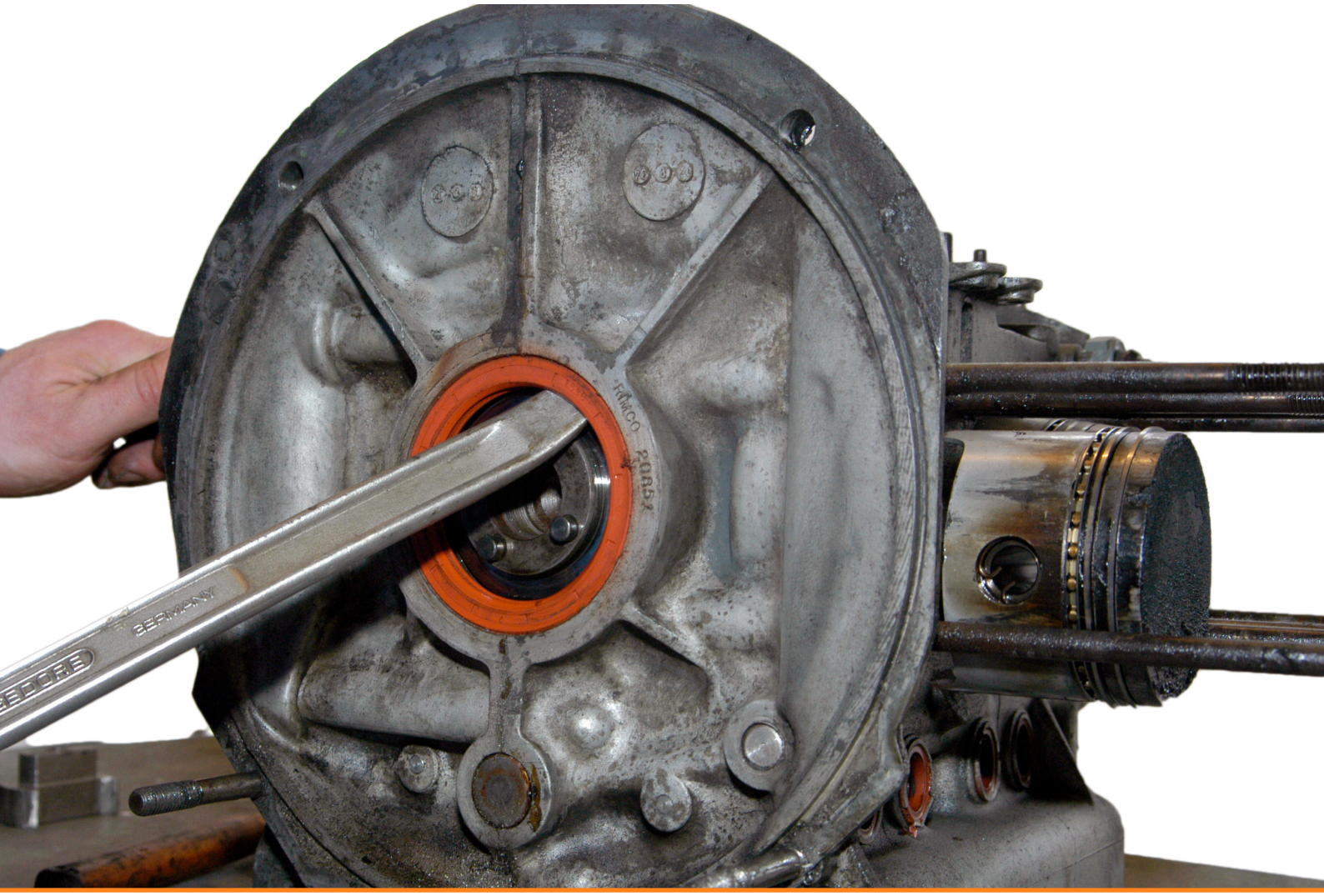
The seal stops oil to escape from the engine and it will also protect the engine against dirt and water from the outside. Lip seals exist for both clockwise and counterclockwise rotating shafts, make sure you order the correct seal for your application, the Paruzzi webstore will tell you all about the seals you need for your Volkswagen.



Oil seal removal

You shouldn't reuse installed oil seals, this is the case for both static and dynamic oil seals. So you may damage them during removal, but you need to be very careful not to damage the metal sealing surfaces using sharp metal tools! Oil seals will seal better the smoother the sealing surfaces are.

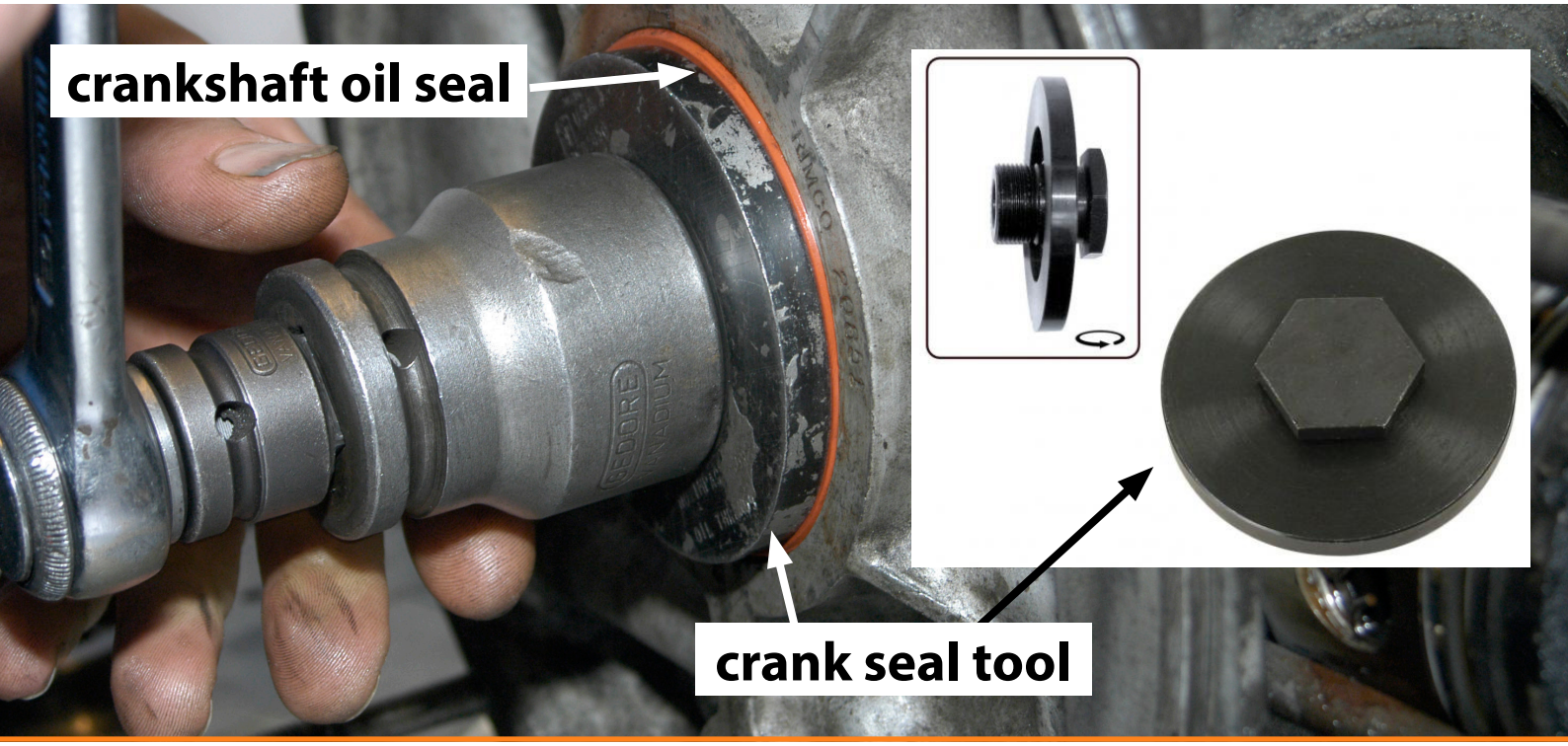
Stressed or distorted shafts will vibrate and leak because the oil seal is not able to keep the oil inside, even if the oil seal is new and properly installed. You may use a tyre lever as shown on the picture below to remove the crankcase oil seal, or a screwdriver, as long as you don't scratch the metal sealing surfaces.



Oil seal install

You can use more professional tools than a tyre lever or a screwdriver of course as shown below. If the oil seal is hard to remove, drill some holes in the seal and secure some screws in the plastic housing, pull the screws firmly and the oil-seal should come out without using sharp tools.

To install new oil seals **you will need** specific tools. Special designed tools will allow to install the lip seal without damaging the inside (the lip), and without damaging the reinforcement ring or plastic (elastomer) housing. You will find a tool depending on the seal you need to install, below we show the crankshaft seal installation tool available in our webstore. We will discuss how to install this crankshaft seal in a next edition of this series.

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Introduction

We explained in edition 10 how the distributor and the ignition circuit works. For the ignition to work properly you need to adjust a series of settings such as the points gap or Dwell angle and the ignition advance. You also need to make sure that the advance mechanism works as it should, we explained this in the previous edition of this series.

We said this already a few times in this magazine, but we repeat this procedure in case you didn't read the previous editions yet. You always need to adjust the valves first (edition 05), then check out the electrical circuits (edition 02), then test the ignition coil (edition 08) and the advance mechanism (edition 11), if all these checks are done, you are ready to adjust the ignition.

We will explain in this article how to adjust the points gap, also known as the Dwell angle adjustment (refer to edition 10). We will not only set the gap but we will also replace the old ignition points with new ones.

If you just bought a classic Volkswagen and you didn't receive the maintenance history of that car, replacing the ignition points is not a bad idea.

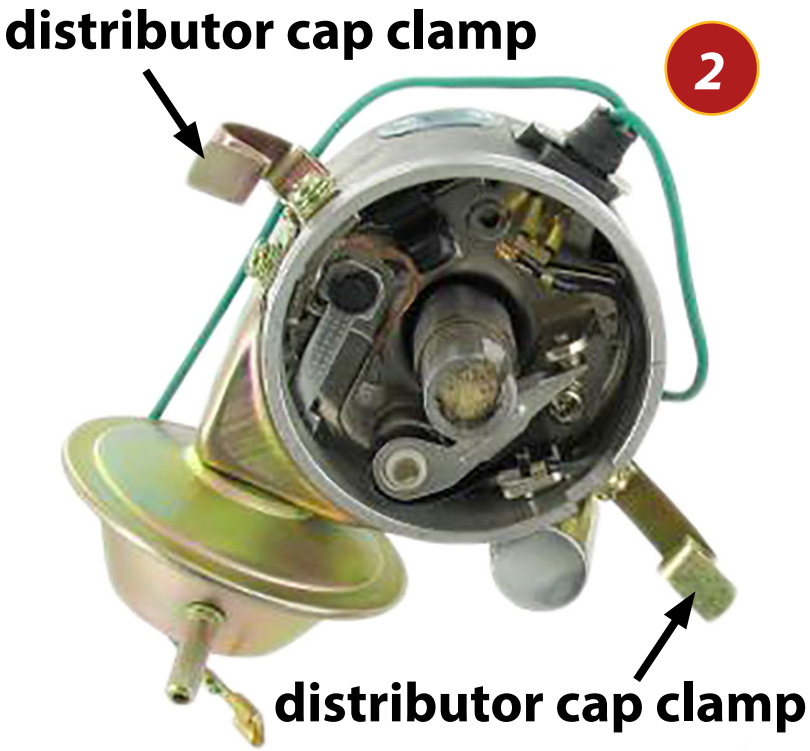
Removing the ignition points

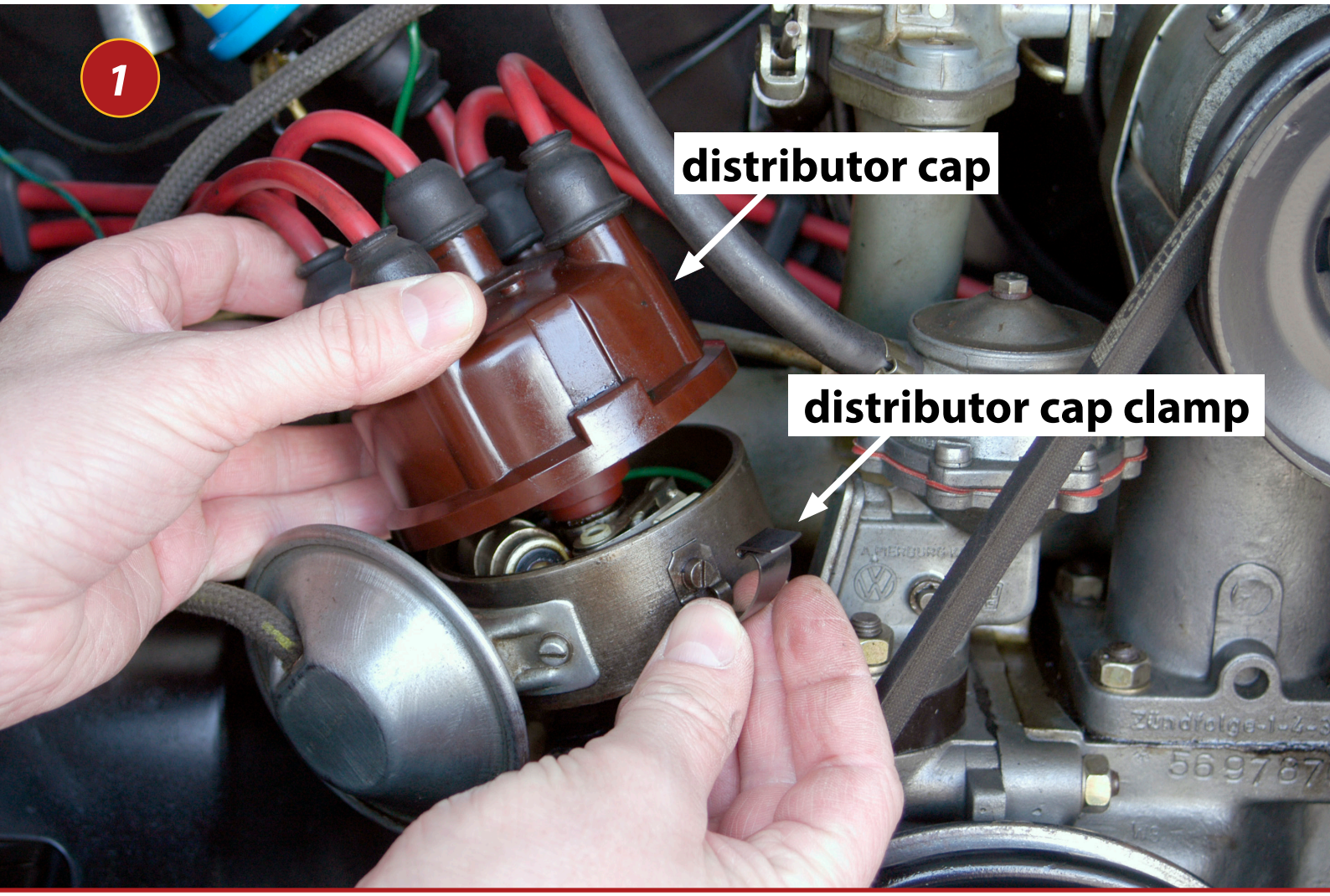
You will need to set the points gap once the new ignition points have been installed. We will explain how professionals do that, step by step.

First, turn the ignition key of your VW off. We advise to disconnect the battery by loosing the clamp of the negative battery terminal (see picture below).

The low voltage terminal of the ignition coil is not fused as we explained on page 17 of edition 02. Disconnecting the battery is an extra precaution in case you accidently turn the ignition key on, this will avoid a short circuit in the ignition circuit while you remove and install the ignition points. Make sure the negative battery clamp is protected, I use a plastic bag, but that's just me.

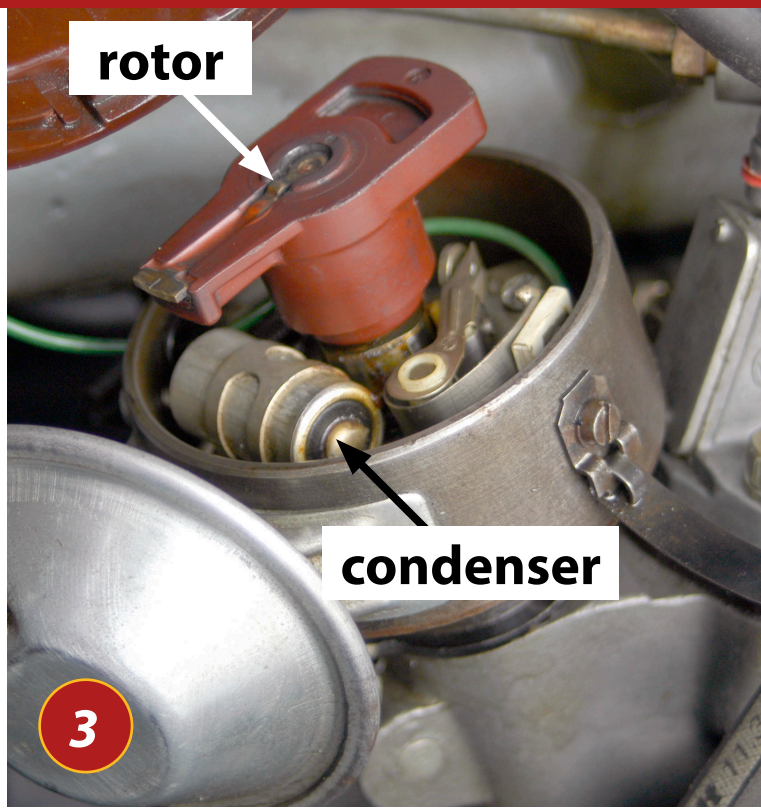
Unlock the distributor cap by removing the metal spring clamps on both sides. (picture 1 and 2). You may leave the spark plug cables (high tension cables) in place. Try to store the cap with cables safely behind the distributor. The plastic cover is missing on this distributor as you can see on the picture, read edition 10 on page 10 to see how this cover looks like.

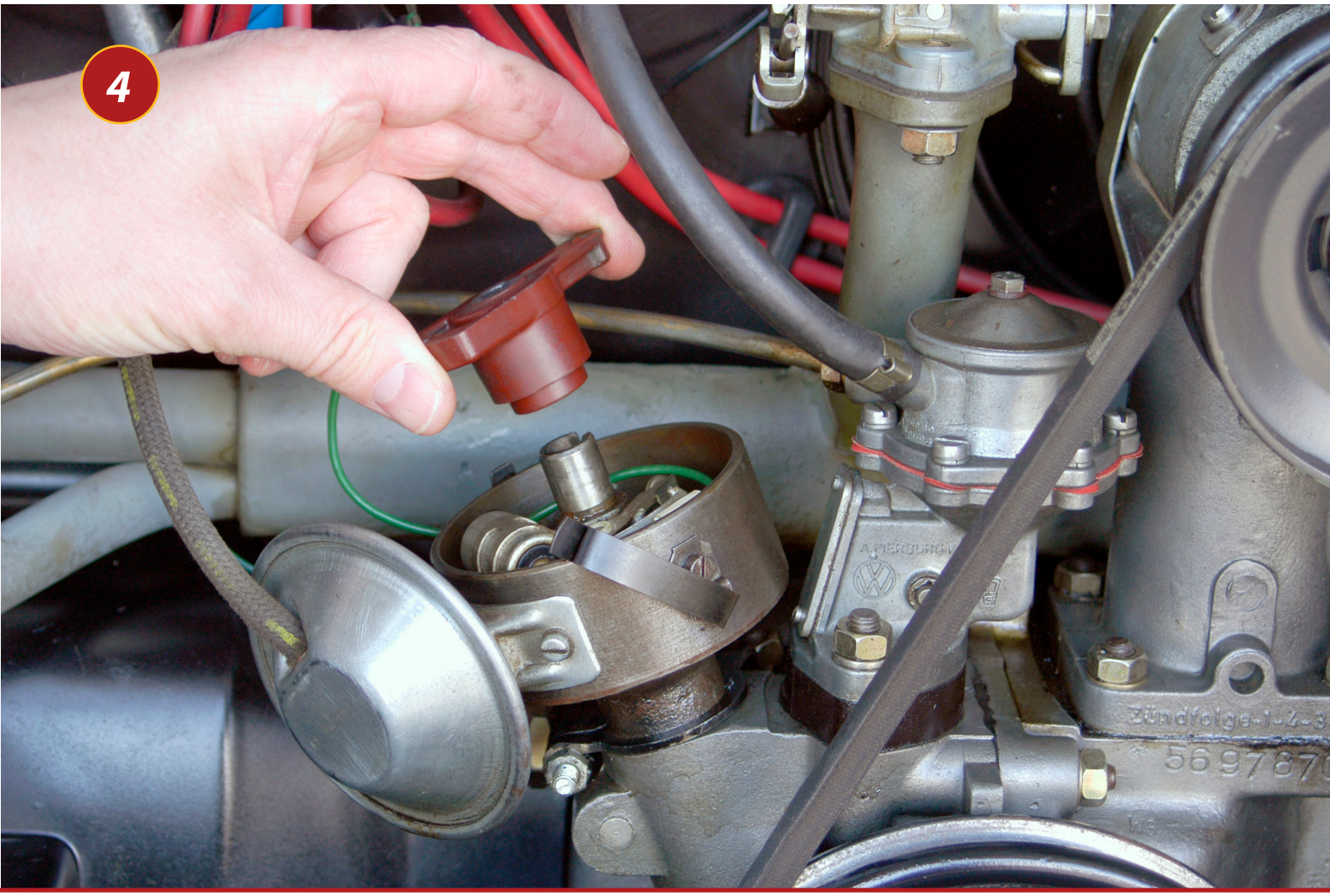




replacing ignition points

Once the distributor cap is removed you will see the rotor and the ignition points (picture 3). The condenser is installed in the distributor housing on this engine, other engines will have the condenser installed outside the distributor housing (refer to edition 10). Remove the rotor now by pulling it upwards firmly (picture 4), watch out not to hurt yourself, the rotor can be hard to pull from the distributor shaft.



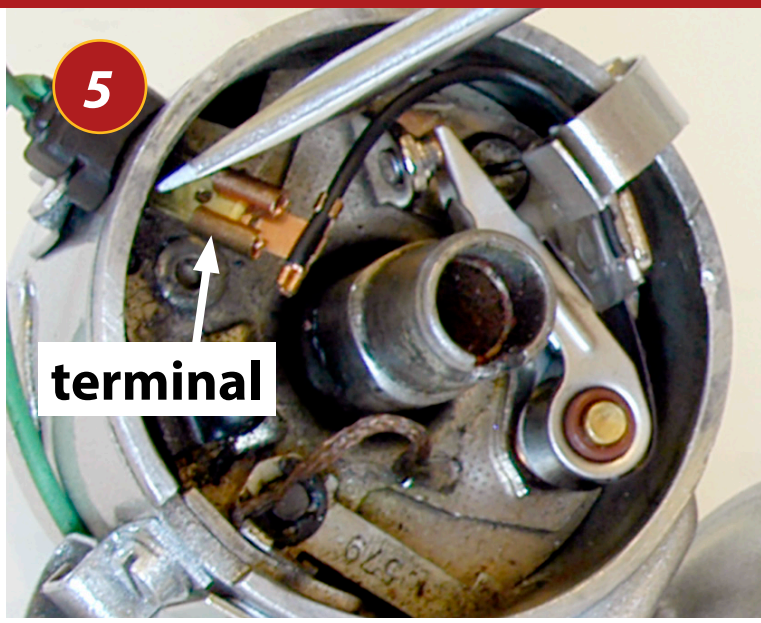


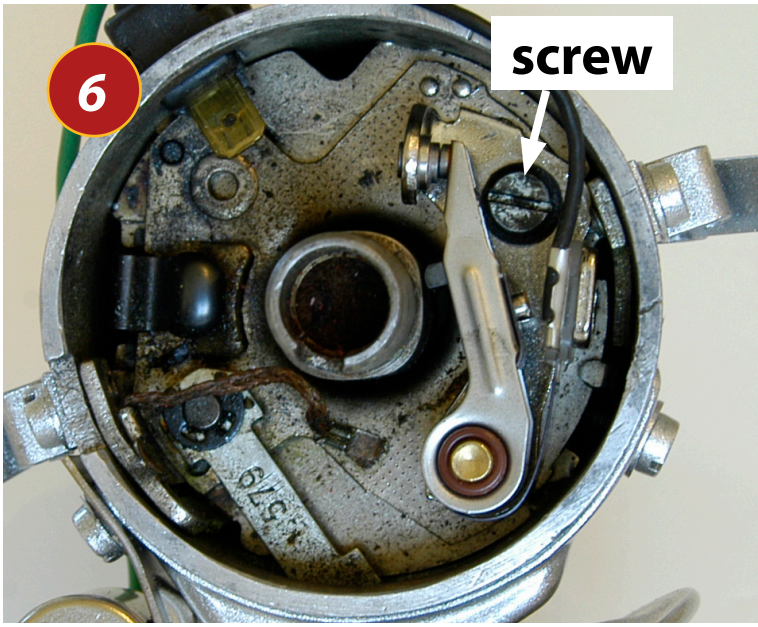
You are ready now to replace the ignition points. Make sure to disconnect all electrical power in your engine!

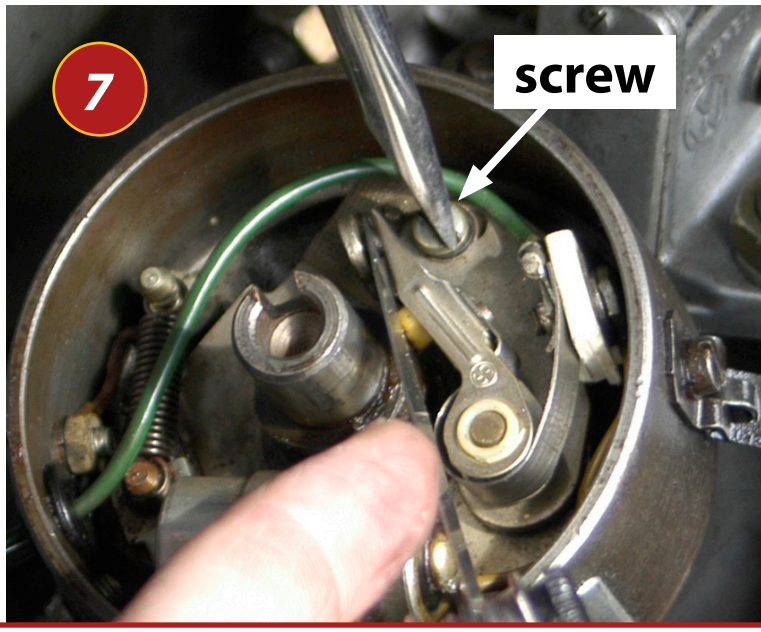
First, remove the electrical terminal in the distributor housing (picture 5). This terminal can be hard to remove sometimes, so I use a screwdriver to avoid hurting myself or damaging distributor parts.

Once the terminal comes loose, loosen the screw that holds down the ignition points (picture 6), use a screwdriver that matches the head of the screw to avoid damage, this is the screw that is used to adjust the points gap, so it better stay in good shape. Use a screwdriver with a magnetic head so you don't lose the screw.

Once the screw loosen, you are ready to remove the points from the distributor housing.







Ignition points types

You will need to have new points available in your workshop, or order new ones. Make sure you order the correct models, there are a lot of different ignition points available. The chassis number (VIN) or engine serial number of your VW are not always a good reference for ordering new points.

Type 1 engine:
1200 1974 (D 1 307 619) and later
1300 8.1968 and later
1500 1967 (L 0 019 430) and later
1500 1967 (H 0 879 927 + 5 077 366) and later
1600

Type 3 motoren:
1500 t/m 7.1964
1600 engine code U
1600 1967 (T 0 463 430) and later
Type 4 engines
Water boxer engines (WBX)

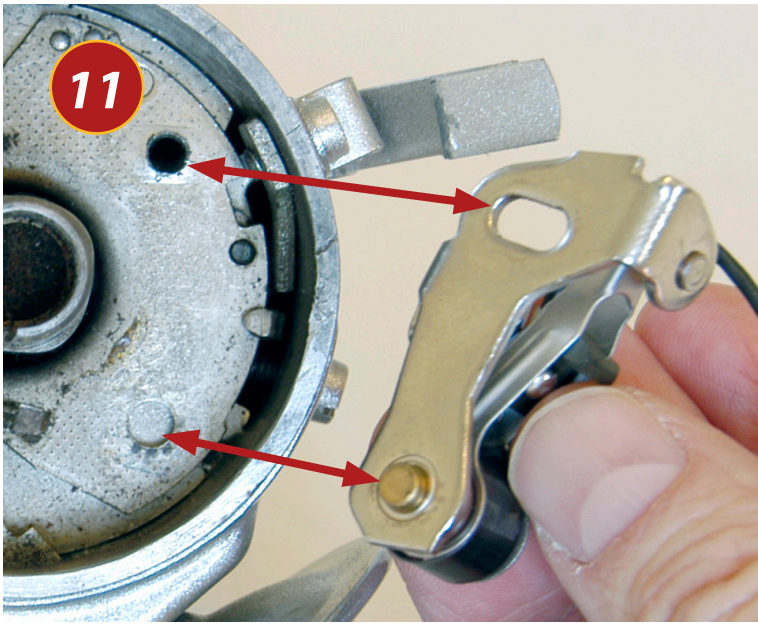
Type 1 engine *30 hp until 7.1960*
Type 3 engine *1500 8.1963 until 7.1964*

We advise to compare the installed points with the available ones in our webstore, this is the only way to be sure you have the matching parts for your distributor. The early models come in two separate parts as shown on the picture 8, the late models come as one part (picture 9).

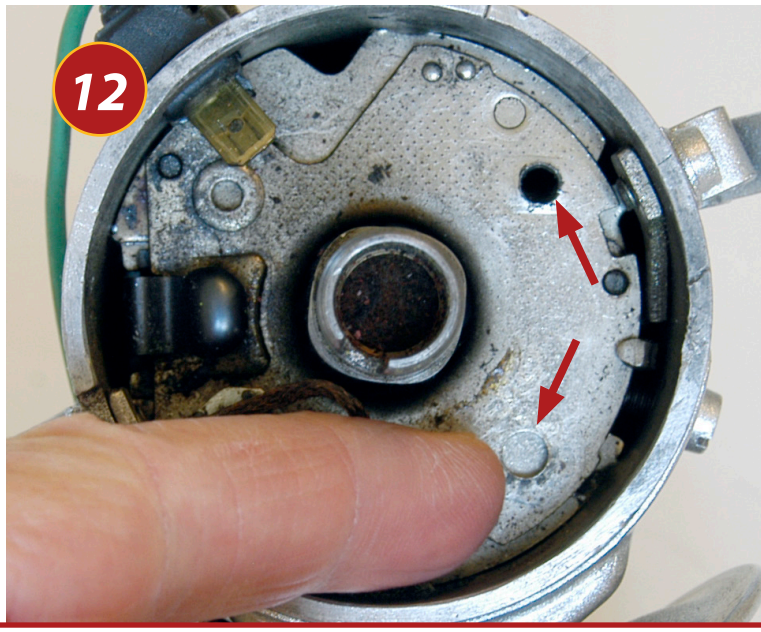
Installing the ignition points

We will show now how to replace the ignition points on a type 1 engine (AB 1300 dual port). The procedure is quite similar on other type 1 and type 3 engines.

Clean the surface of the contacts (picture 10), makes sure they are not greasy.



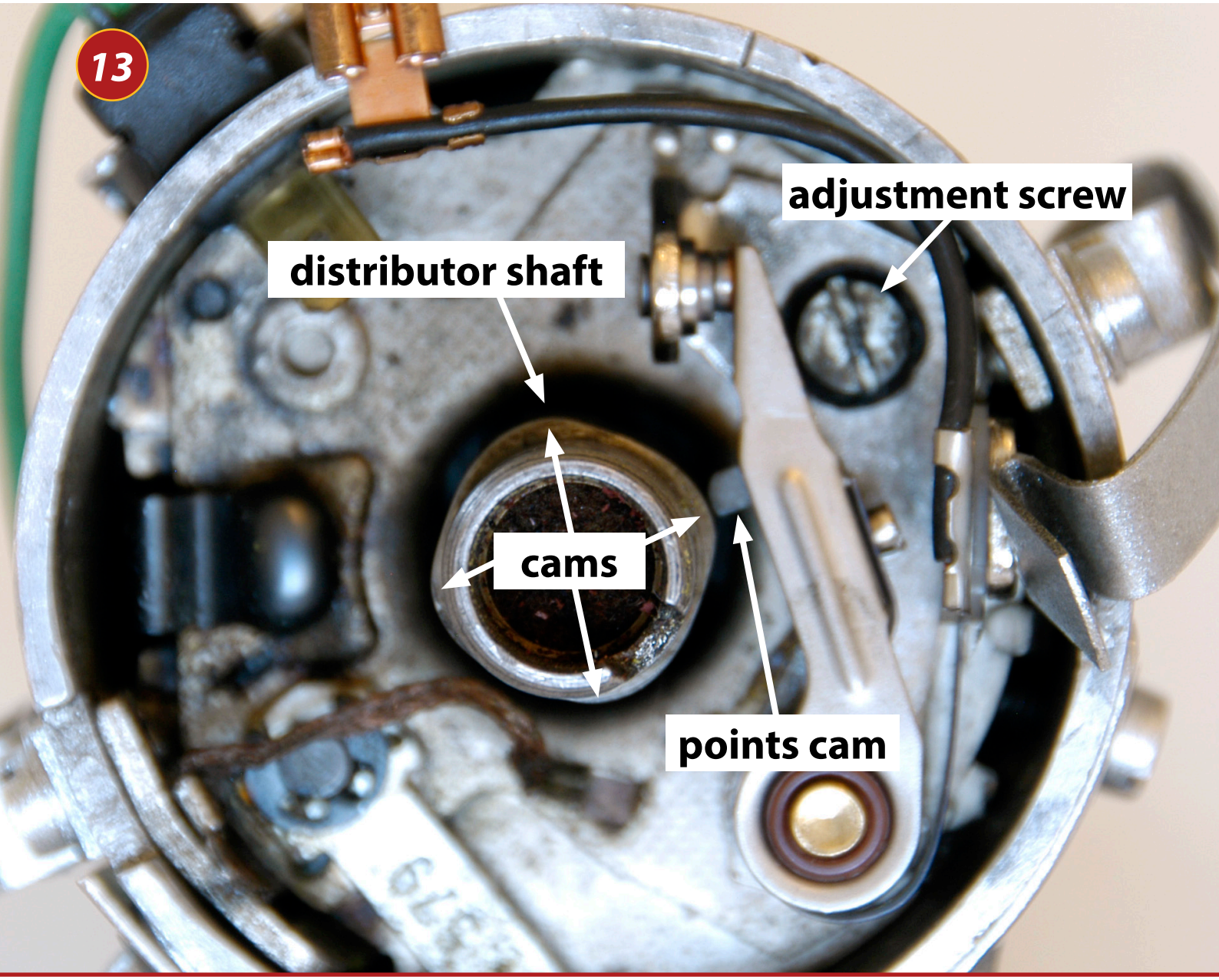
The bottom of the ignition points chassis has a pin that matches a hole in the distributor base plate (or moving plate) (picture 11 and 12). The hole is for the adjustment screw, it is bigger than the screw diameter to allow the points chassis to move to adjust the points gap. Position the ignition points correctly in the distributor and secure them with the adjustment screw (picture 13), don't tighten the screw yet, you will do that soon once the points gap is set correctly.



replacing ignition points

If the screw head is damaged, replace the screw, because it will be used to set the points gap. Don't reconnect the electrical terminal yet, this could make the adjustment more difficult than necessary by create some pressure on the points chassis.

Position the distributor shaft so that one of the cams is in line with the cam on the ignition points (refer to the picture below), this will push one of the point as far as possible away from the shaft. To rotate the distributor shaft, rotate the pulley as we explained in edition 06.



Setting points gap (Dwell angle) - static

A static adjustment means that you will adjust with the engine turned off compared to a dynamic adjustment done with the engine running.

The points gap should be 0,40 mm to adjust the ignition correctly. Make sure that one of the distributor shaft cams is lined up with the ignition points cam as shown on picture 13. You will need a 0,40 mm feeler gauge, we show one below on picture 14.

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feeler gauge 0,40 mm

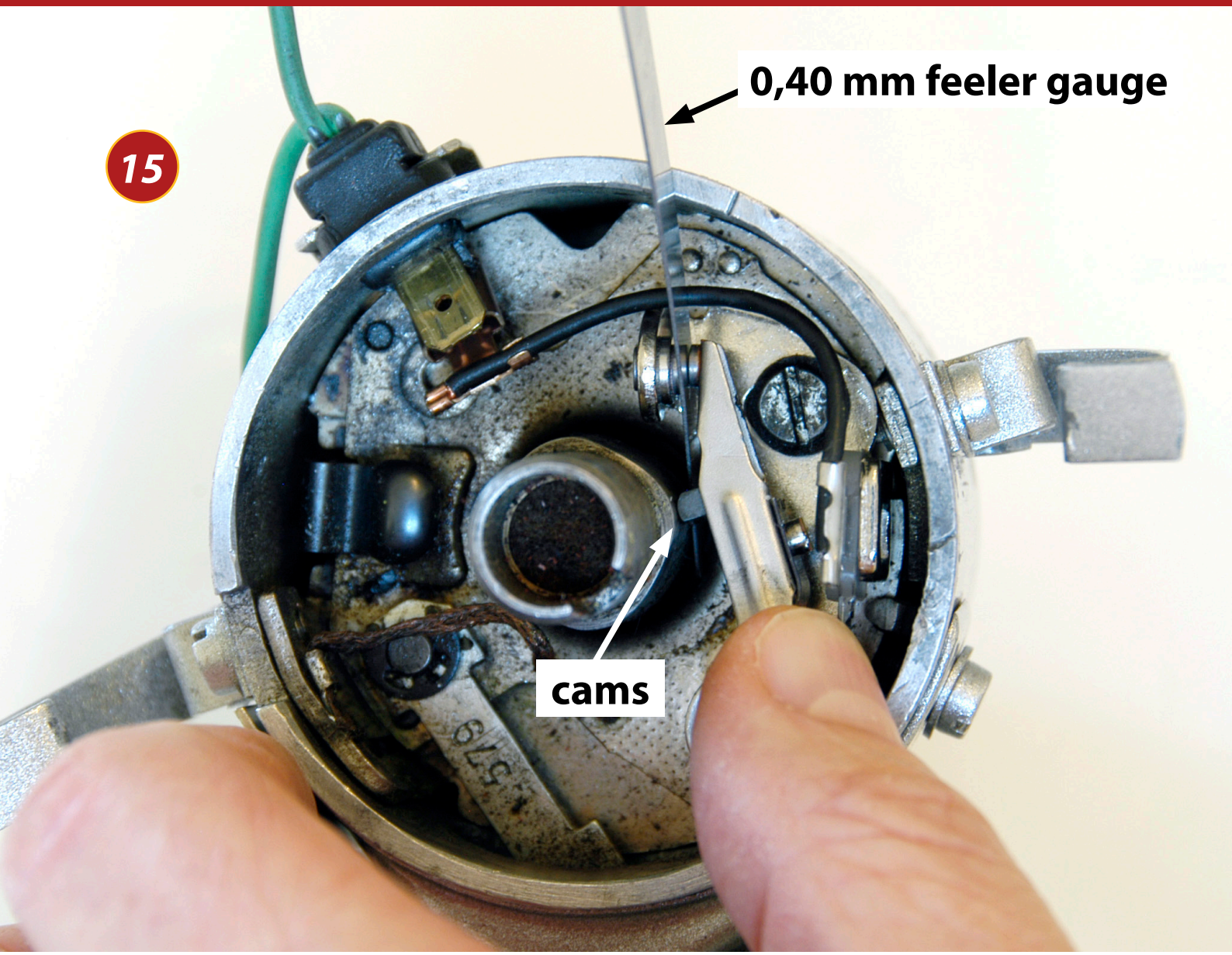
Rotate the pulley to align both cams as explained in edition 06 on page 31. The ignition points screw is not tighten yet. Slide the 0,40 mm feeler gauge between the two points (picture 15). Make sure both points are pushed against the distributor shaft while inserting the feeler gauge, then secure the adjustment screw and remove the feeler gauge.

Watch out! The feeler gauge should be aligned with the points while adjusting.

The points gap (or Dwell angle) should be set correctly now.

I can assure you that if this is the first time you adjust the points gap, you will have to retry a few times before you get the technique right. If your distributor has the ignition points made of two separate parts it is even more difficult (refer to page 43) to adjust.

replacing ignition points



You should watch the ignition points while your are tightening the adjusting screw, they tend to move, so the final gap is not 0,40 mm anymore once the screw is secured. What I usually do is rotate the distributor shaft with 90° (one quarter turn), you need to rotate the pulley one full cycle (360°) to achive this (clockwise or counterclockwise, this is not important right now). The next distributor shaft cam is now aligned with the points cam. Measure the points gap again by sliding the 0,40 mm feeler gauge between the points, you should be able to slide the feeler gauge without too much friction.

If there is no friction or you are able to slide a 0,50 mm feeler gauge between the points then you need to adjust the points gap again as explained starting page 46.

The adjustment should be very precise if you use new ignition points, the points surface is then be perfectly flat. A small deviation from the 0,40 mm is allowed. If you rotate the pulley (and the distributor shaft) and you measure more or less 0,40 mm, then you are good to go.

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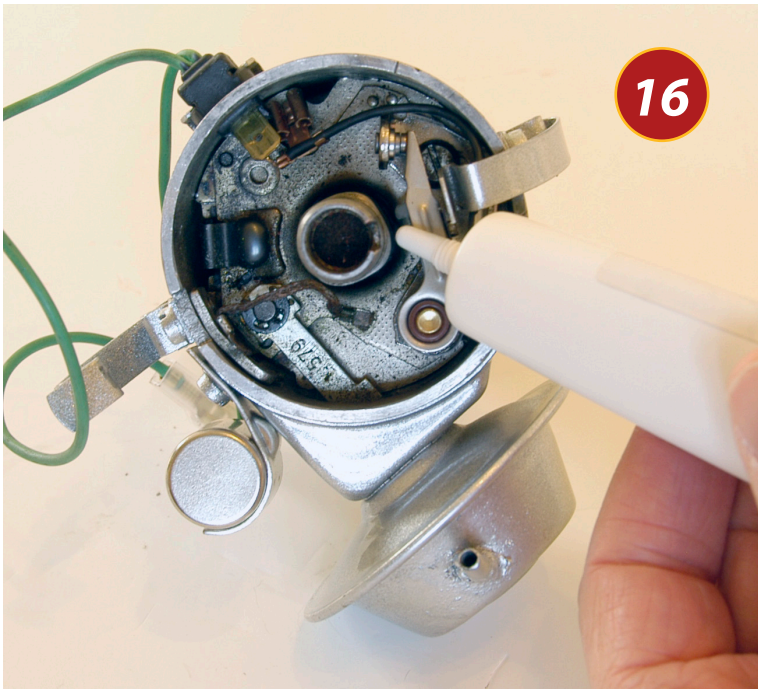

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Apply a very small amount of special distributor cam lubricant on the distributor shaft and the ignition points cam (picture 16). Special grease for that purpose is available (picture 17), it is very important that this grease is not splashing around on the points while the shaft is rotating. So, this lubricant needs to be very thick and resistant to high temperature. Don't apply grease or oil on the ignition contacts! Also apply a little bit of lubricant on the ignition points hinge.

replacing ignition points

Some new contacts come with a small amount of special lubricant, not all do though. Never use this lubricant in abundance!

Clean all the electrical contacts such as the ones on the rotor, the distributor cap and the points. Connect the electrical terminal and install the plastic cap. The latter was not present on our engine on page 40, but make sure it is installed to protect the ignition parts.

Install the rotor by pushing it onto the distributor shaft. The rotor has a small cam inside that fits onto the opening in the distributor shaft as shown on the picture below (picture 20).

Install the distributor cap, remark the small notch (picture 21) in the cap that fits on the distributor housing. Secure the cap with the two metal clamps. Connect the battery negative terminal clamp and you are ready to start your engine.

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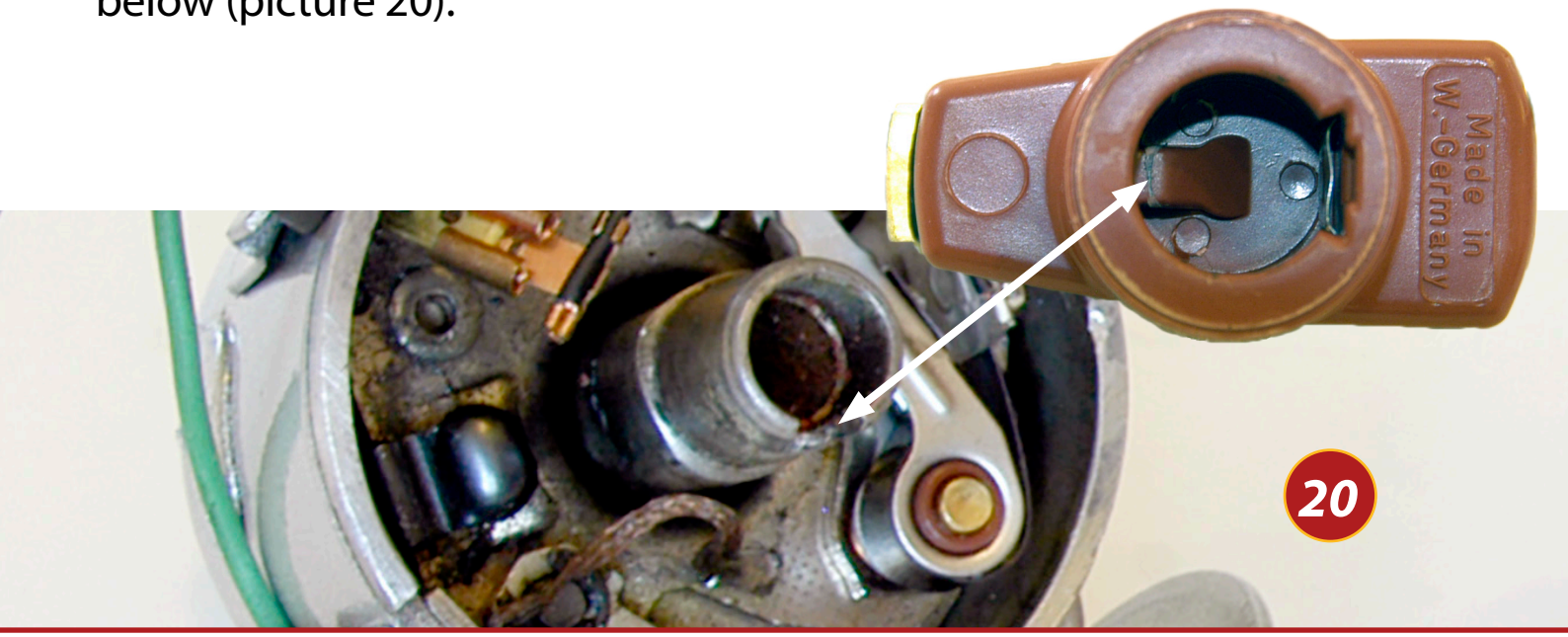
Conclusion

You have replaced the ignition points and set the points gap at 0,40 mm. This adjustment sets the Dwell angle to 50° as prescribed by the manufacturer.



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