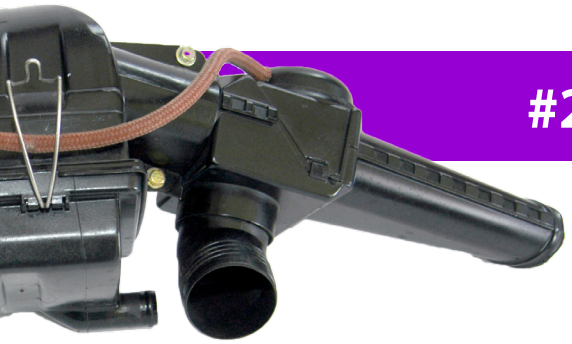
# Paruzzi Magazine

*Technical Publication for the classic Volkswagen*

10









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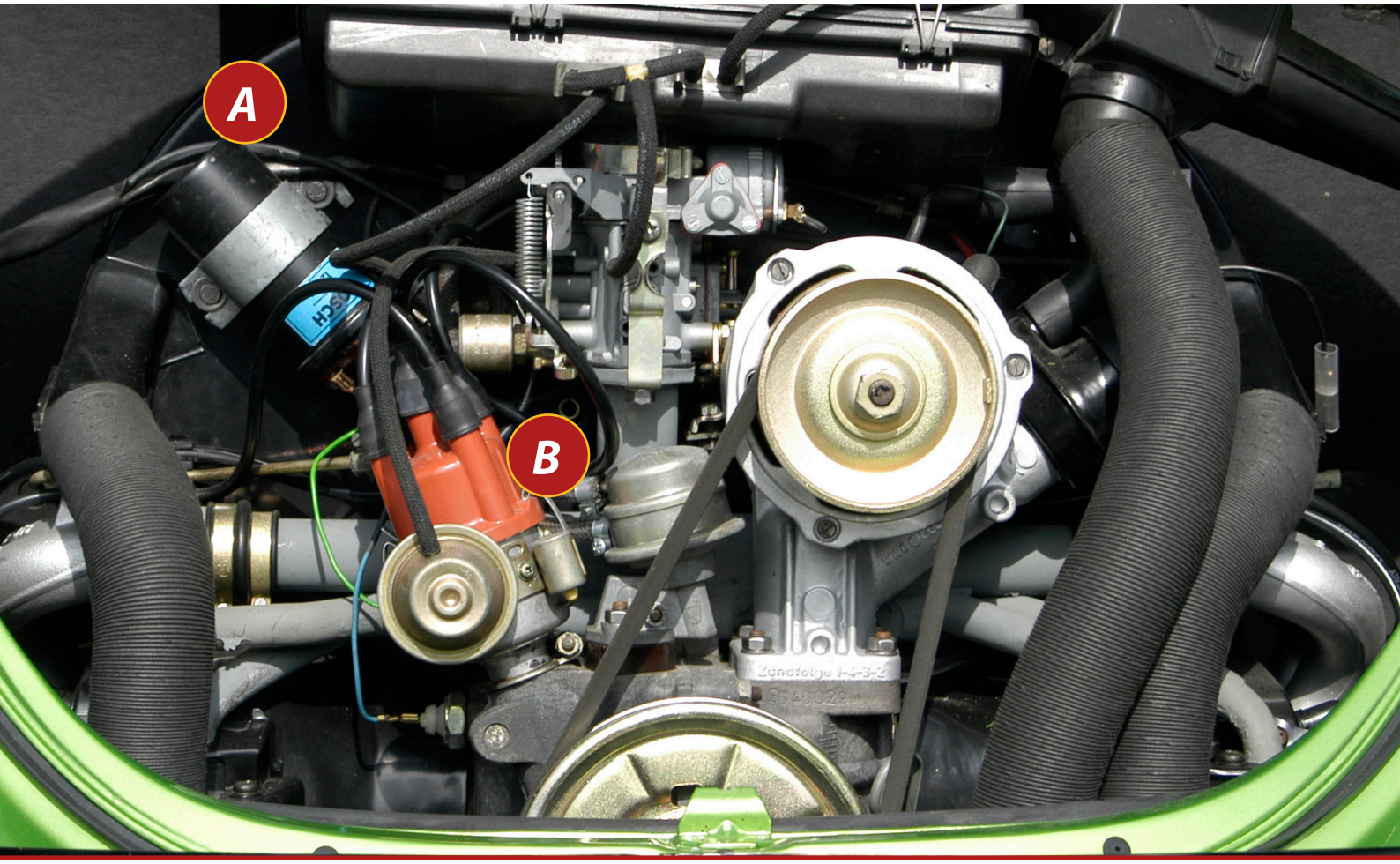
## Ignition circuit parts

The goal eventually is for you to be able to fine tune the ignition of your classic Volkswagen I can image. You need first to learn some theory about how the ignition circuit works before you change the settings. Once you understand the basic concept, it will be so much easier to diagnose ignition issues.

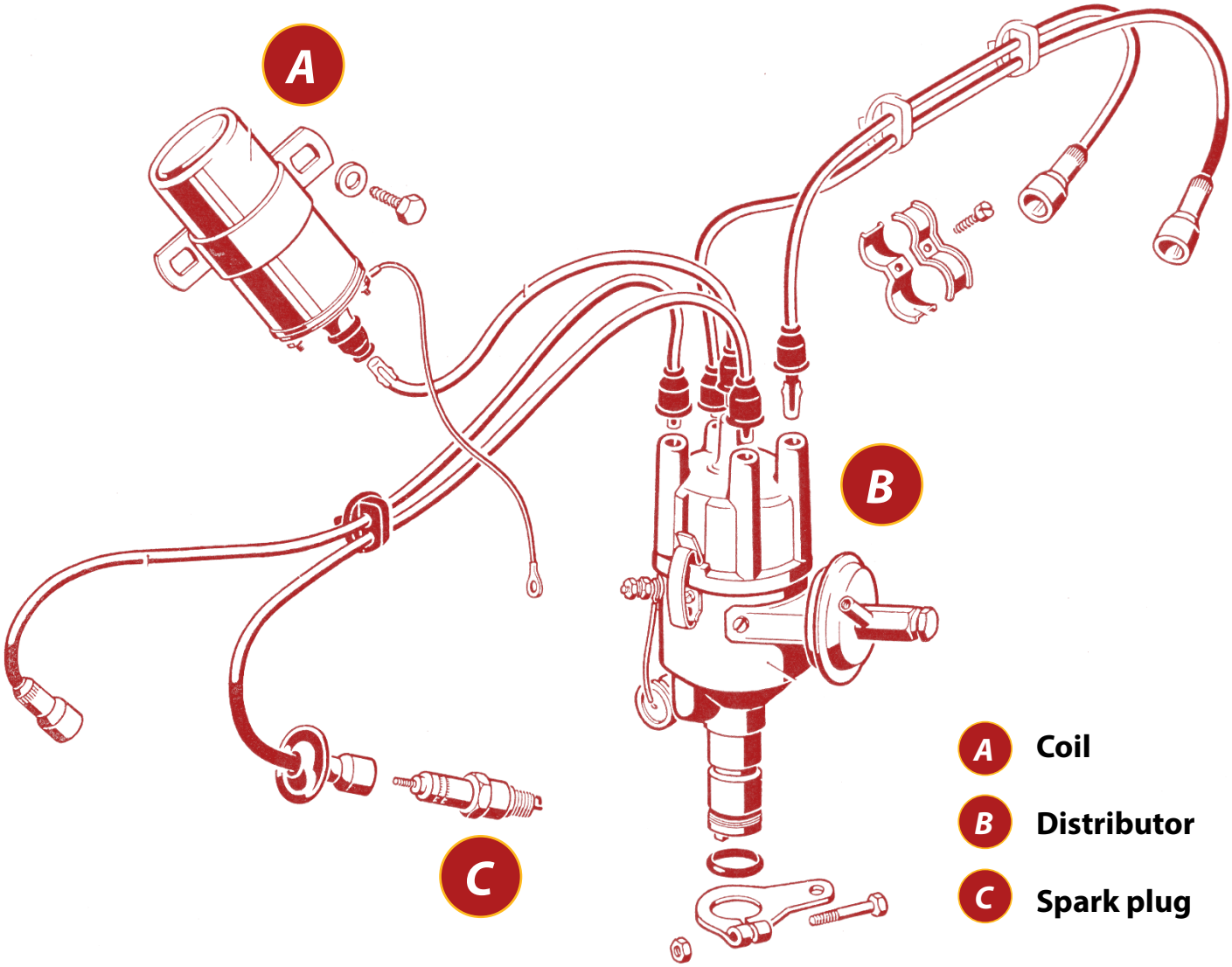
We explained the concept of the otto engine in edition 06 and how important it is to understand what the top dead center (TDC) is, if you didn't read edition 06 already or you need freshen up your knowledge.



# the distributor

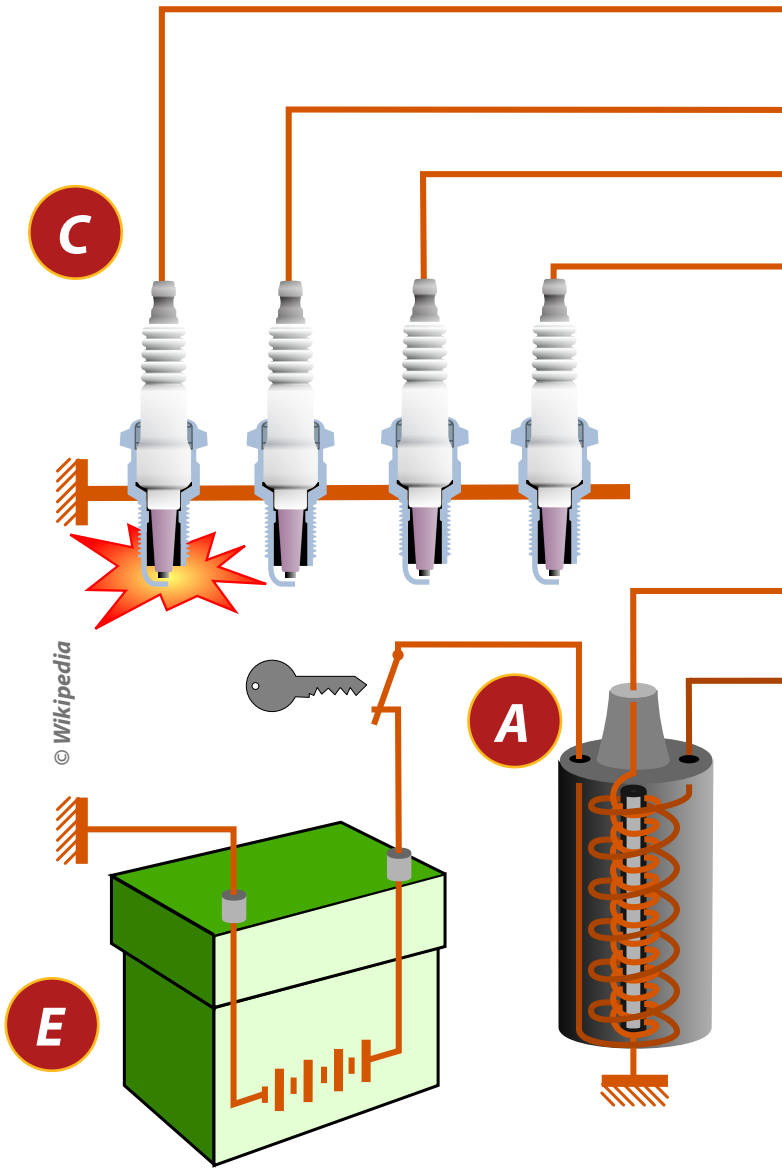
You need a strong spark to ignite the air-fuel mixture in a petrol engine. This strong spark will be developed between the spark plug electrodes once a high voltage is delivered. It is the coil that will generate the high voltage. We explained in edition 08 how the coil works and how to diagnose the low voltage and the high voltage circuit.

We will show which parts you need to build the ignition circuit of your classic Volkswagen. We show below all the parts of the ignition circuit, on this page is a very nice technical drawing and on the previous page the same parts in a VW 1303S with 1600 type 1 engine, you can't see the spark plugs on the picture though.



**1.** It all starts with the **battery** (shown as E on the artwork on this page) that will deliver the electrical voltage, 12 or 6 volt depending on the VW model or built year. The battery is not really a part of the ignition circuit tough, but it is a very important actor. If the battery is not delivering enough voltage (and current) the ignition circuit will malfunction. We explained how to diagnose the battery in edition 01 of this technical series.

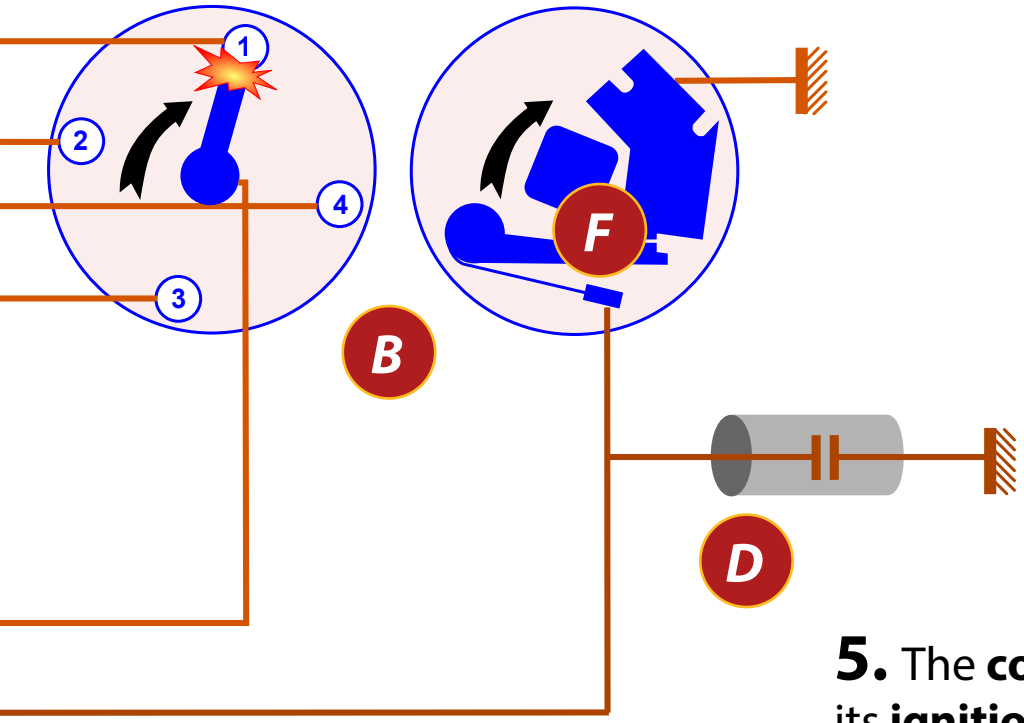
**2.** The dynamo (direct current) or alternator (alternating current) are also very important actors as is the voltage rectifier in the alternator that will transform the alternating current into direct current and the voltage regulator. You will never see the dynamo or alternator shown in the ignition circuit, but if they are not functioning properly, the ignition circuit will fail. So, make sure this part of the electrical circuit works fine.




**3.** The **coil** (A) is converting the low voltage (6 volt or 12 volt) delivered by the battery to a high voltage that is needed to generate the spark in the spark plug.

**4.** The high voltage will generate a spark between the **spark plugs** (C) electrodes.

# the distributor




- **A** Coil
- **B** Distributor
- **C** Spark plug
- **D** Condenser
- **E** Battery
- **F** Ignition points

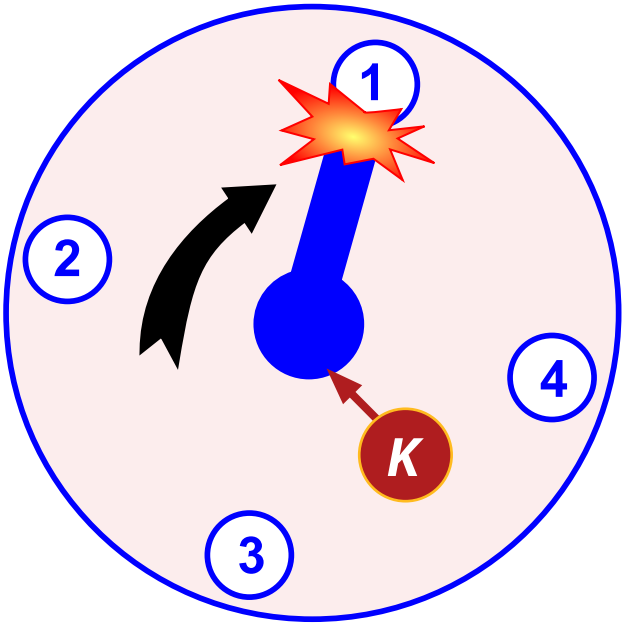
Do we have all parts necessary to build the ignition circuit for our classic Volkswagen so that the air-fuel mixture can be ignited?

We still miss two crucial parts to make it all happen. If we believe the theory about induction we explained in edition 08 you need to interrupt the low voltage in the primary winding of the coil to induce a high voltage (more than 1000 times 6 or 12 volt) in the secondary winding. How do we achieve that?

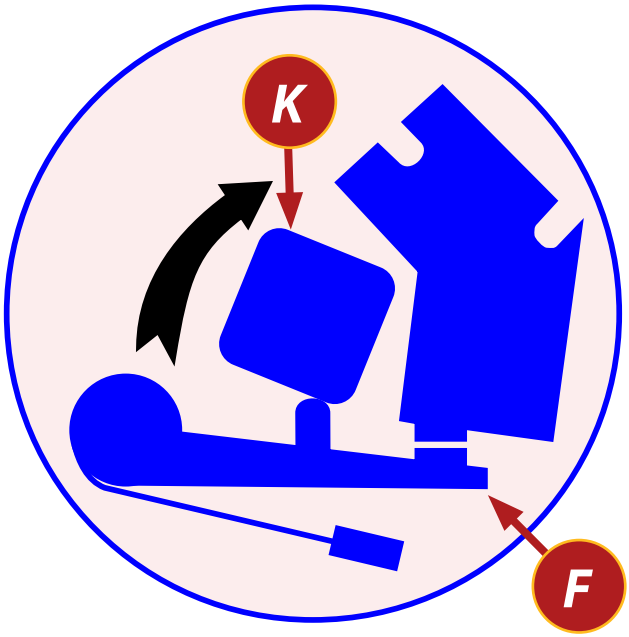
**5.** The **contact breaker** (F) with its **ignition points** will take care of just that. The contact breaker will interrupt the low voltage in the primary winding at the right moment to generate a high voltage between the spark plug electrodes. The correct timing is just before the top dead center (TDC).

**6.** We still have one last challenge, there are four cylinders in our air-cooled, now, how does the high voltage get to each of the four cylinders? The **distributor** (B and F, we explain this drawing on page 8) takes care of that, the distributor will connect each spark plug with the high voltage at the right time.

## high voltage

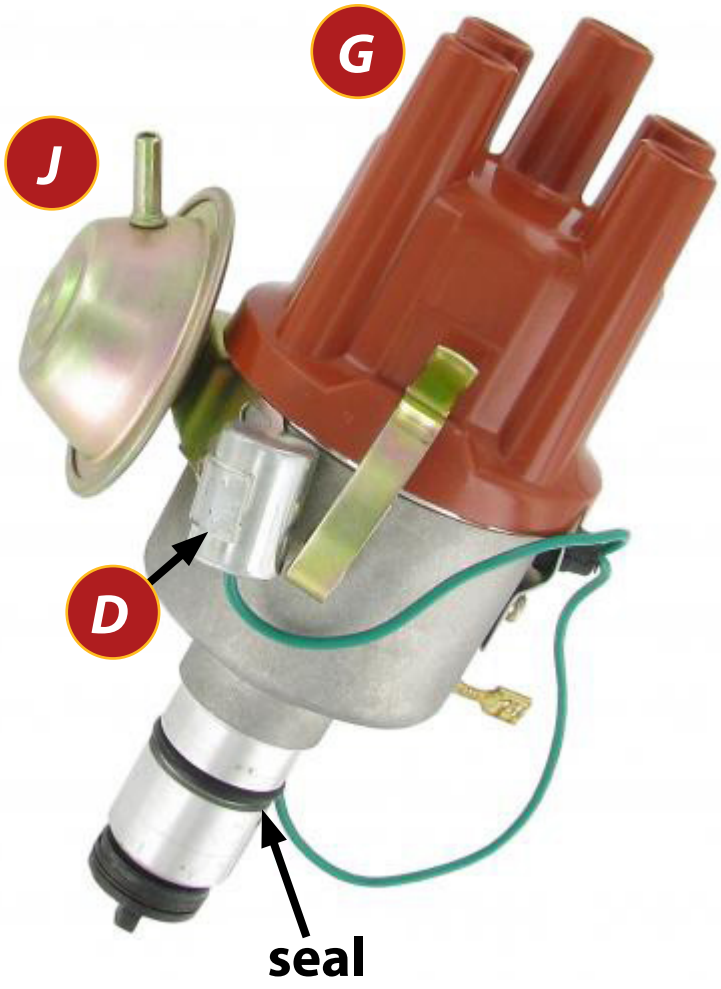



## low voltage




The drawings on page 6 an 7 and above show very well how the distributor works, it needs some explanation though. It is indeed a little strange to show one distributor as two circles, but it makes sense.

The circle on the right hand side shows the low voltage part of the distributor, it contains the contact breaker (F) with ignition points, the distributor shaft (K) and cams. The circle on the left hand side is the high voltage part and includes the rotor and the distributor cap.



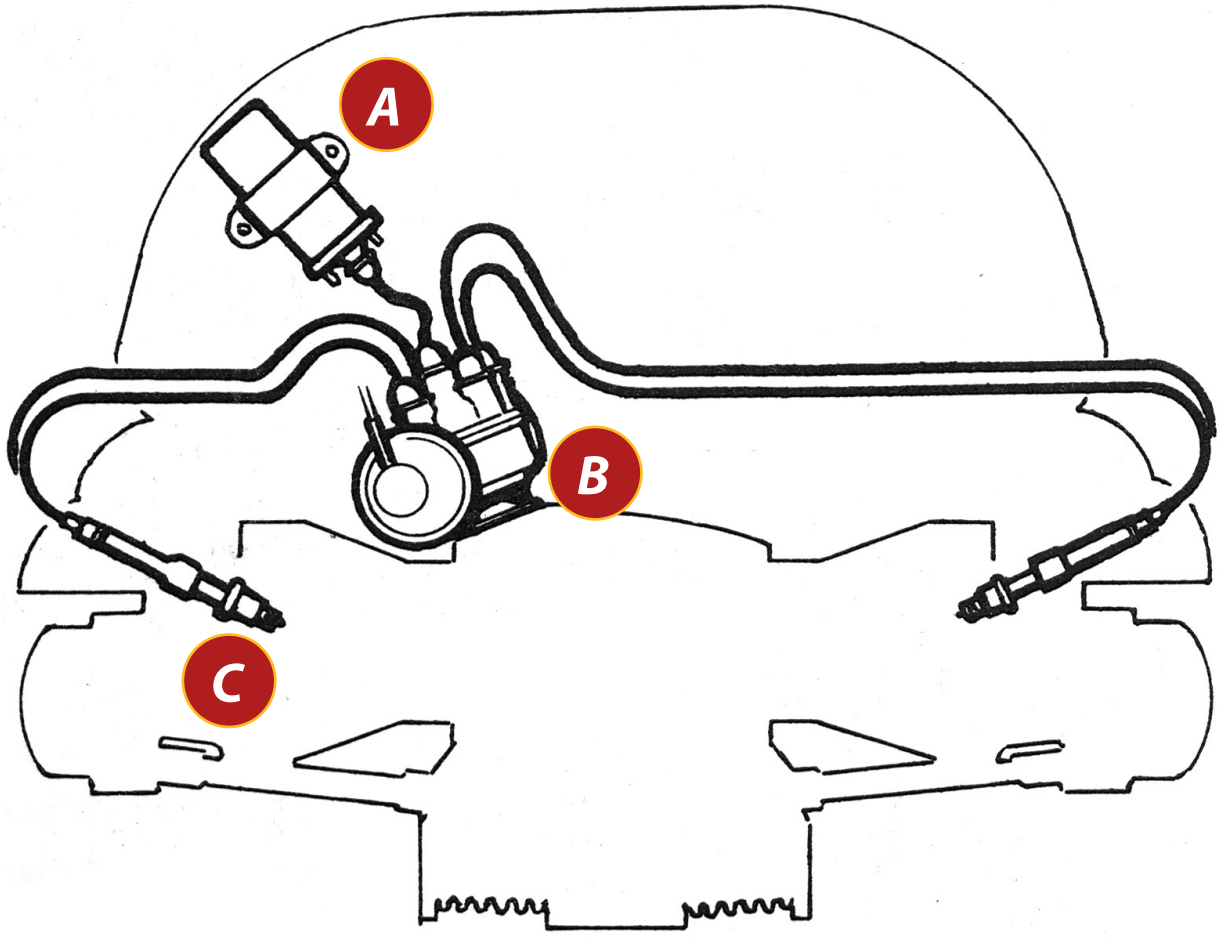
# the distributor

**7.** Well, we are almost there. We still miss one important piece of the puzzle, the **condenser** (D on page 8). Why do you need this small piece of electronic? When the contact breaker opens, a high voltage is generated in the secondary winding of the coil (about 10.000 V) as explained earlier, but also in the primary winding (about 500 V), at that very moment the condenser will protect the ignition points against the voltage peak. The condenser will dampen the effect of the high voltage so that the ignition points last longer. The second important function of the condenser is to create the 500V (see edition 18).

**A** **Coil**

**B** **Distributor**

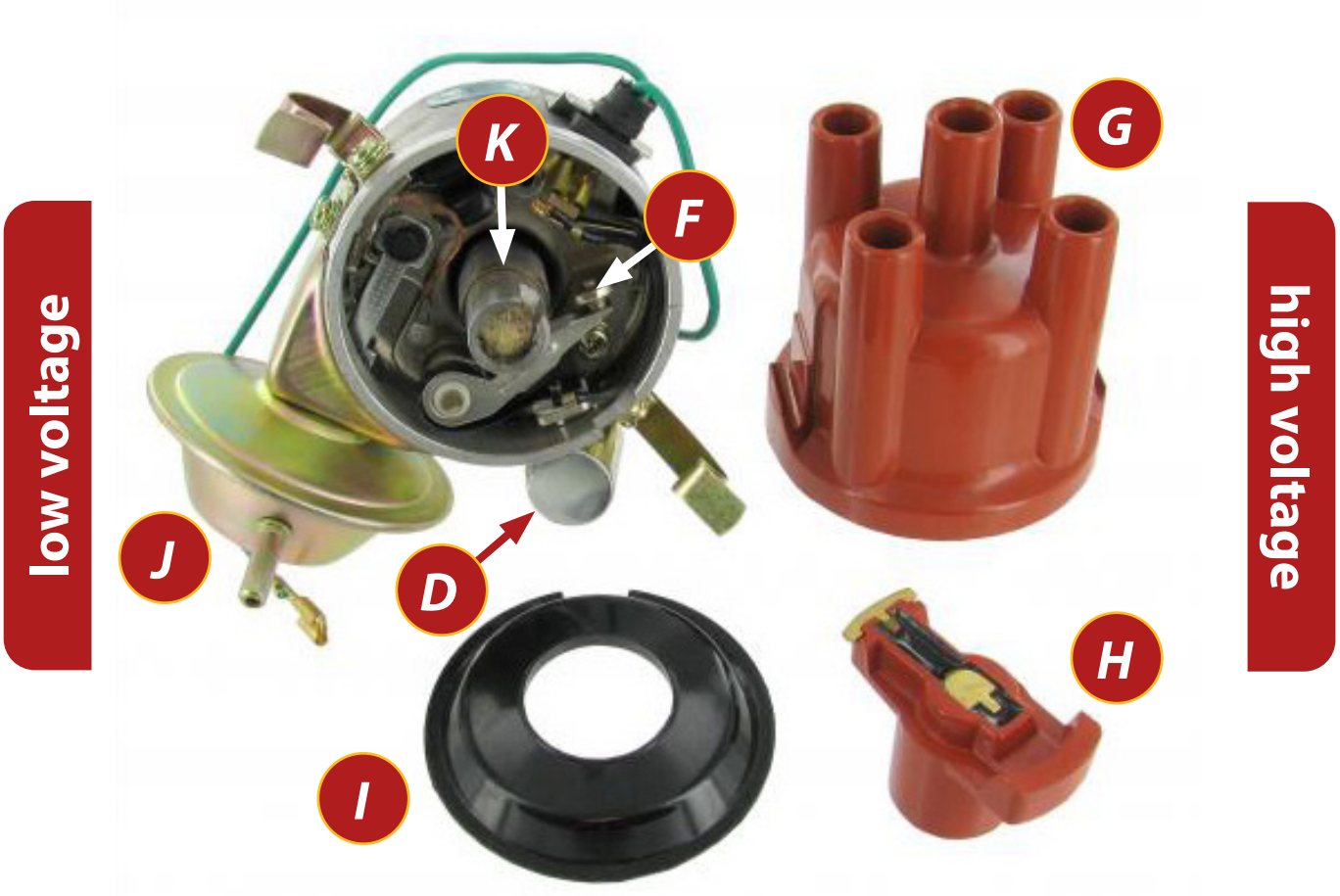
**C** **Spark plug**



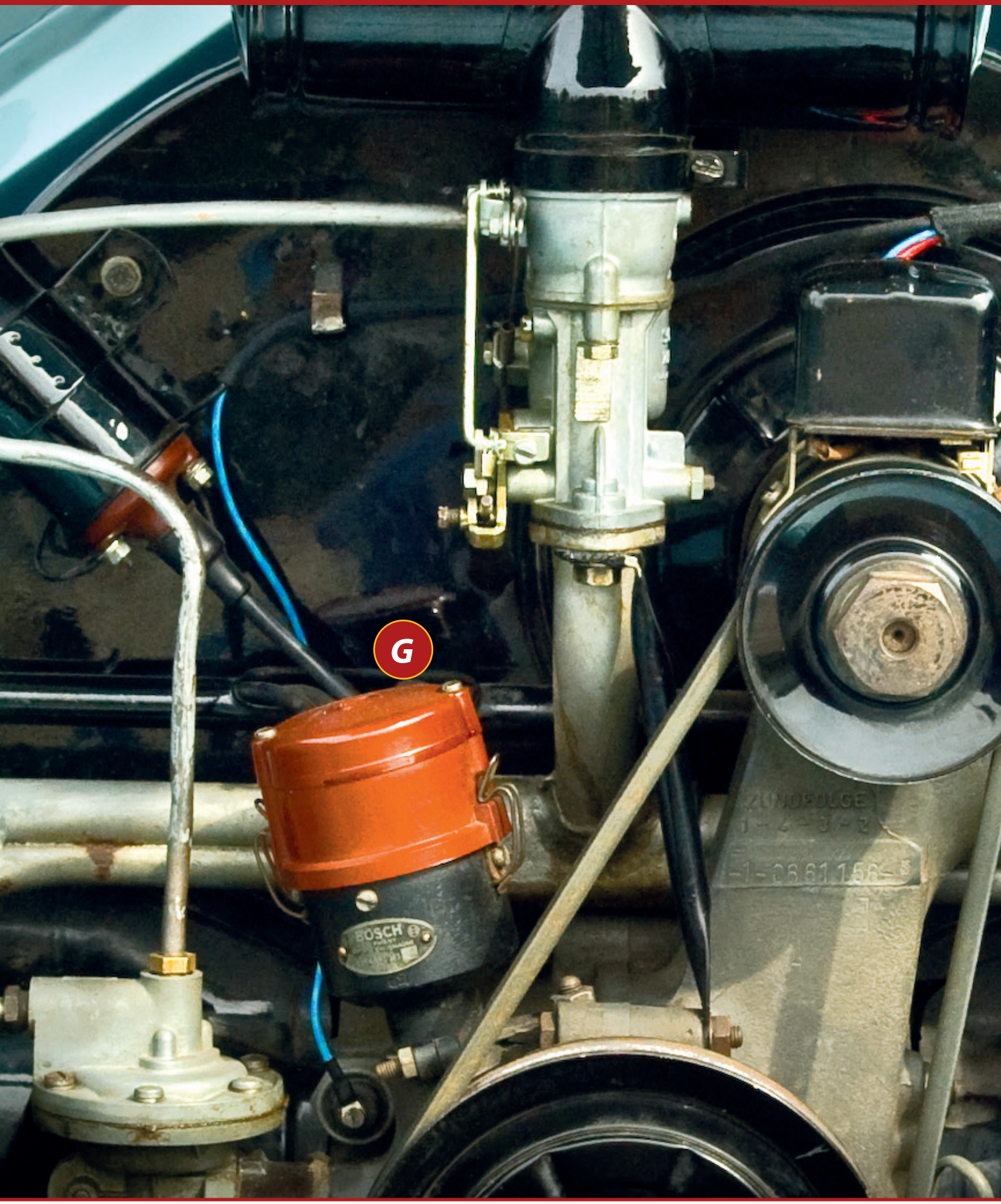
We show a distributor below, watch out, Volkswagen used different types of distributors over the years since the inception of the first VW Beetle in 1949. The 25 hp type 1 engine distributor on page 11 is very different from the one below.

- **A** Coil
- **B** Distributor
- **C** Spark plug
- **D** Condenser
- **E** Battery
- **F** Ignition points
- **G** Distributor cap
- **H** Rotor
- **I** Cover
- **J** Advance
- **K** Shaft/cam

The condenser can be built in or installed on the outside of the distributor depending on the model. We show a distributor with vacuum advance (J) below, another advance technique is the mechanical advance (picture on the right). More about ignition timing advance later.



# the distributor

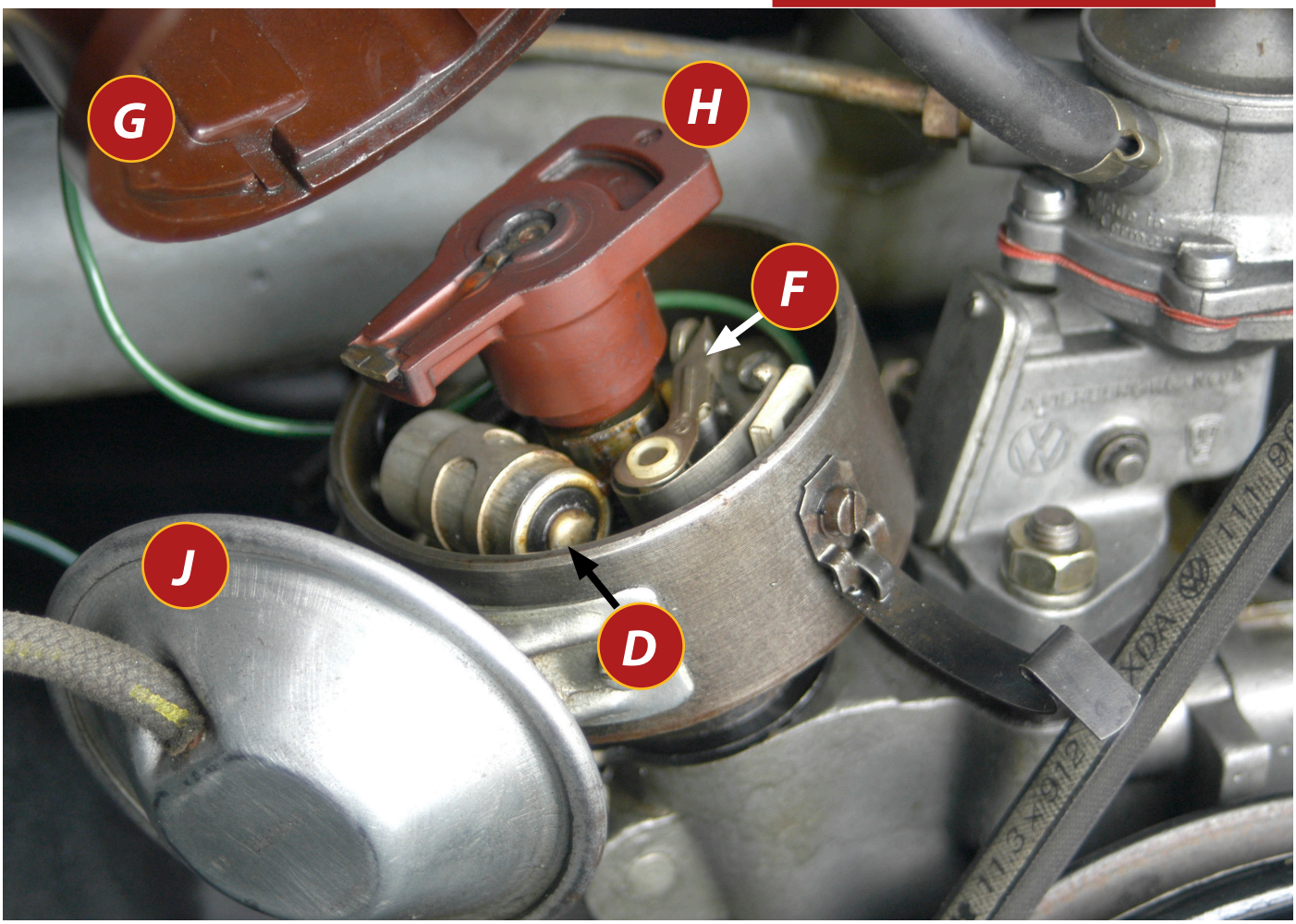


We show the same ignition parts below in a 1200 Beetle engine, this one has a built in condenser.

You can also see the high voltage contacts (G) inside the distributor cap on page 13. The center contact is connected with the rotor and the secondary winding of the coil.

The four contacts on the edge of the distributor cap are connected to the high voltage cables and the rotor (H). While the rotor spins around it will deliver a high voltage to each spark plug, in turn. The drawing on the right page shows the blue high voltage conductors on the rotor (H), it connects with the central connector and the spark plug cables.

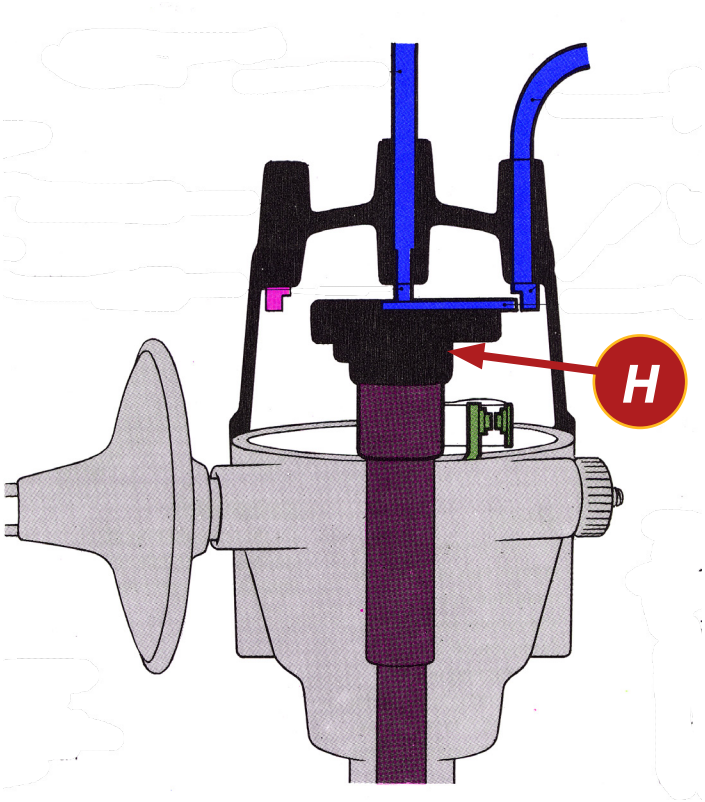
**low voltage**



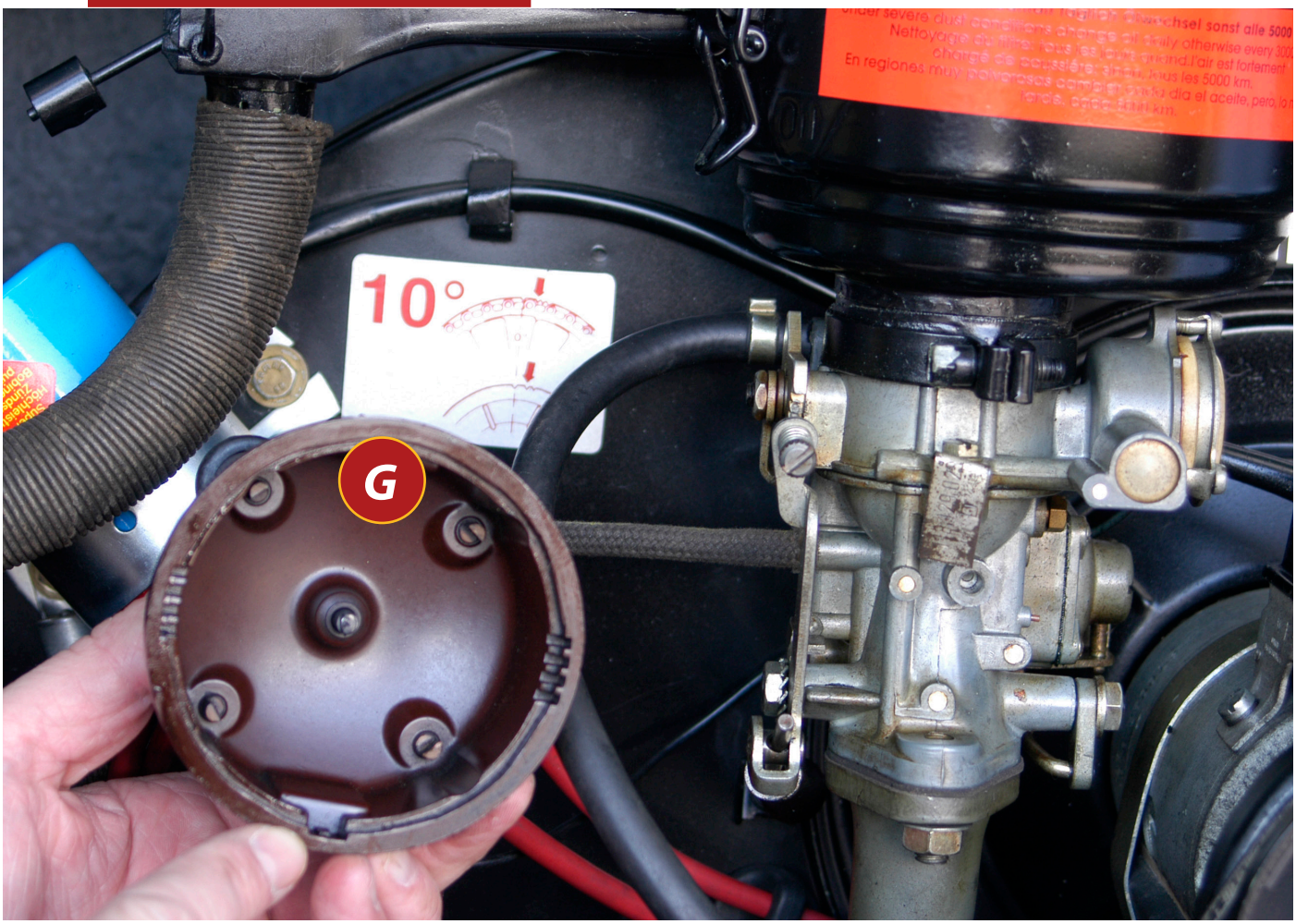
# the distributor

We'll discuss every part separately in this issue, we will explain how to fine tune and diagnose all ignition parts in the following issues of this technical series.

We talked about all ignition parts now, time to explain how the distributor is mounted and how the ignition circuit works.

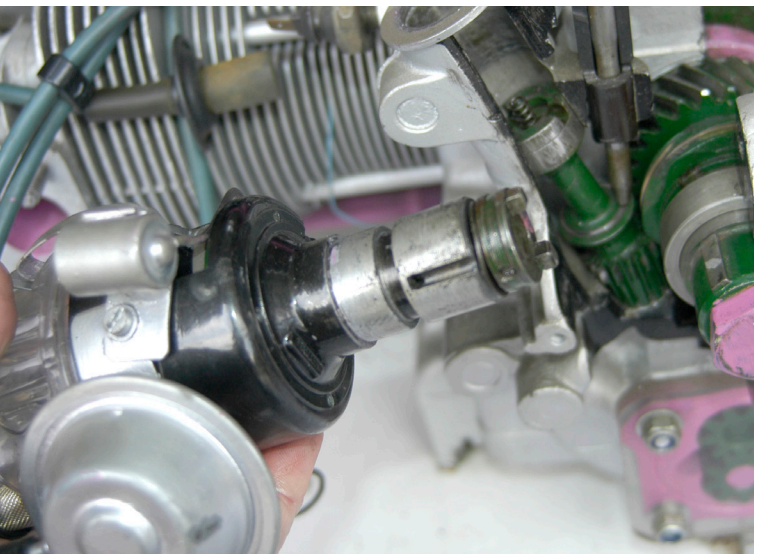


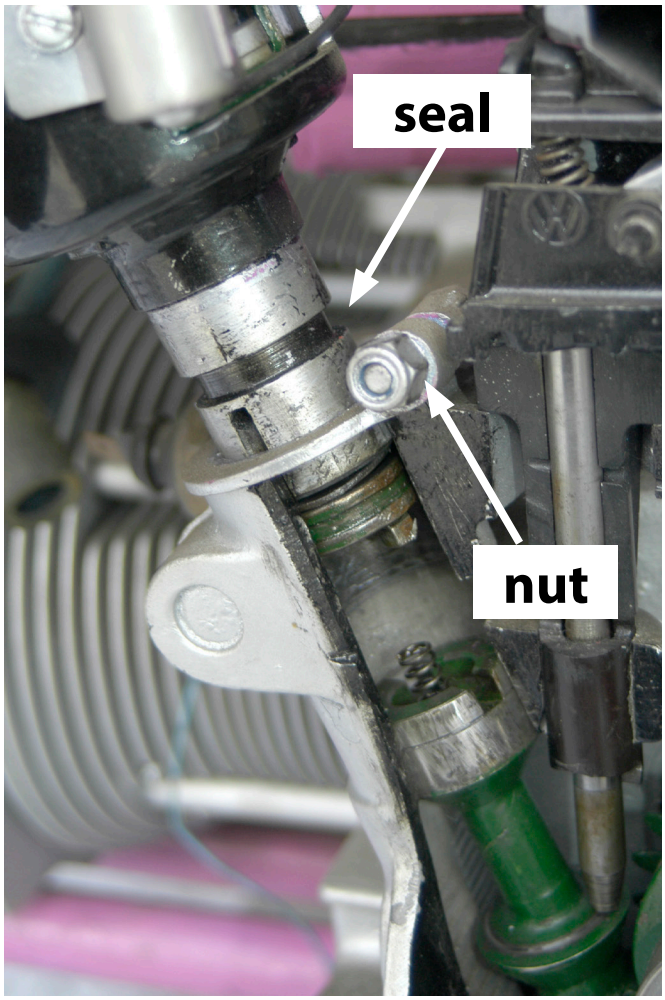

## high voltage



## Assembling

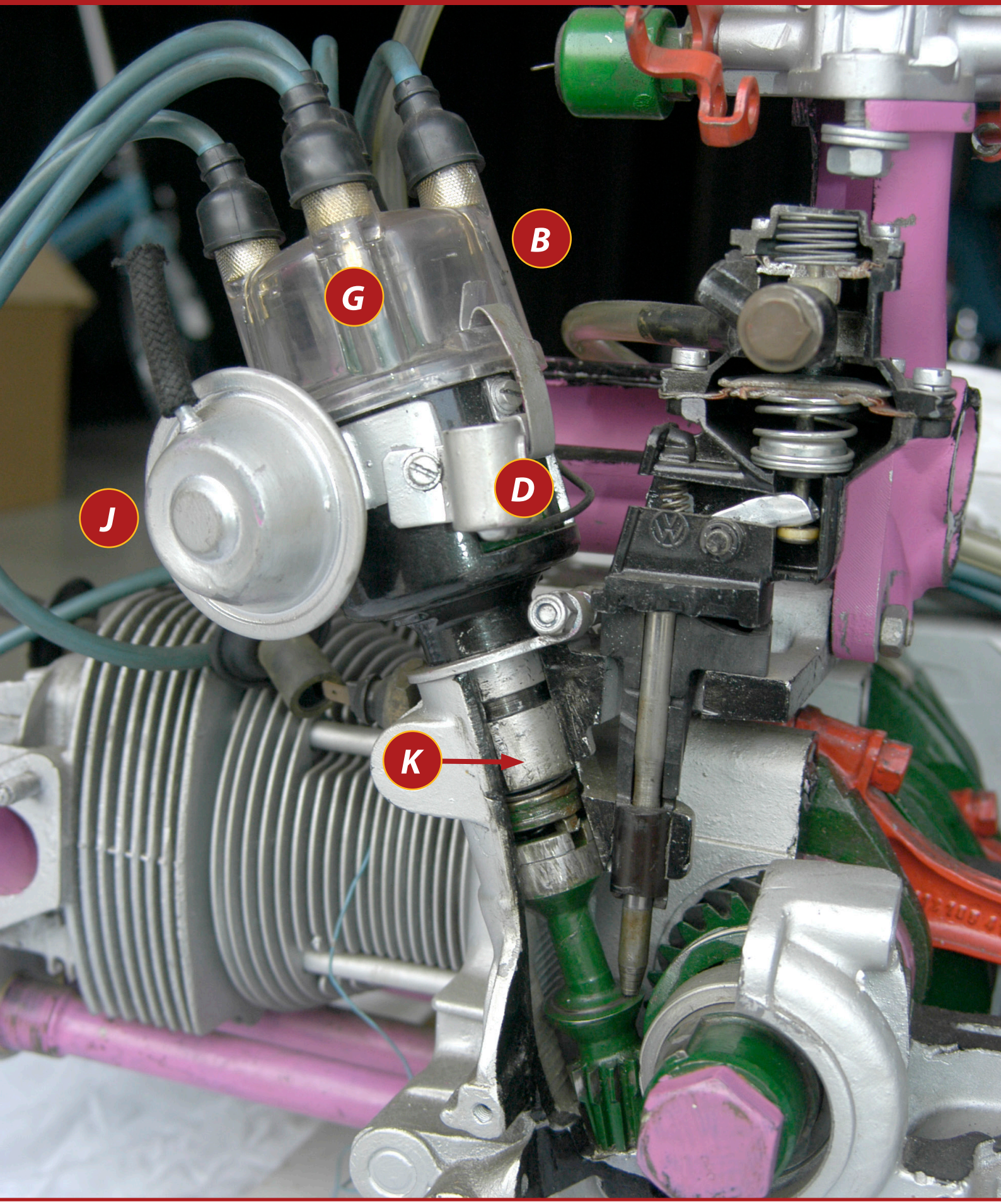
How does the distributor fit into the engine? The high voltage sent to the spark plugs should be timed perfectly, it has to be in sync with the rotation of the engine (read crankshaft). The only way to achieve this is to mechanically connect the distributor shaft with the rotating crankshaft. And that is what you see on the picture on the right. The distributor shaft (K on the picture) connects onto another shaft with gears (the same shaft that drives the fuel pump), these gears are physically connected to the crankshaft.






The pictures show an engine that has been cut open for a school project long ago. Of course a great thing to have to show parts you normally never see. Remark that the seal is not shown on the picture, but it is there on page 8. It is very easy to remove the distributor by loosening the nut shown in the picture above, you will need to set the ignition advance when reinstalling the distributor though.

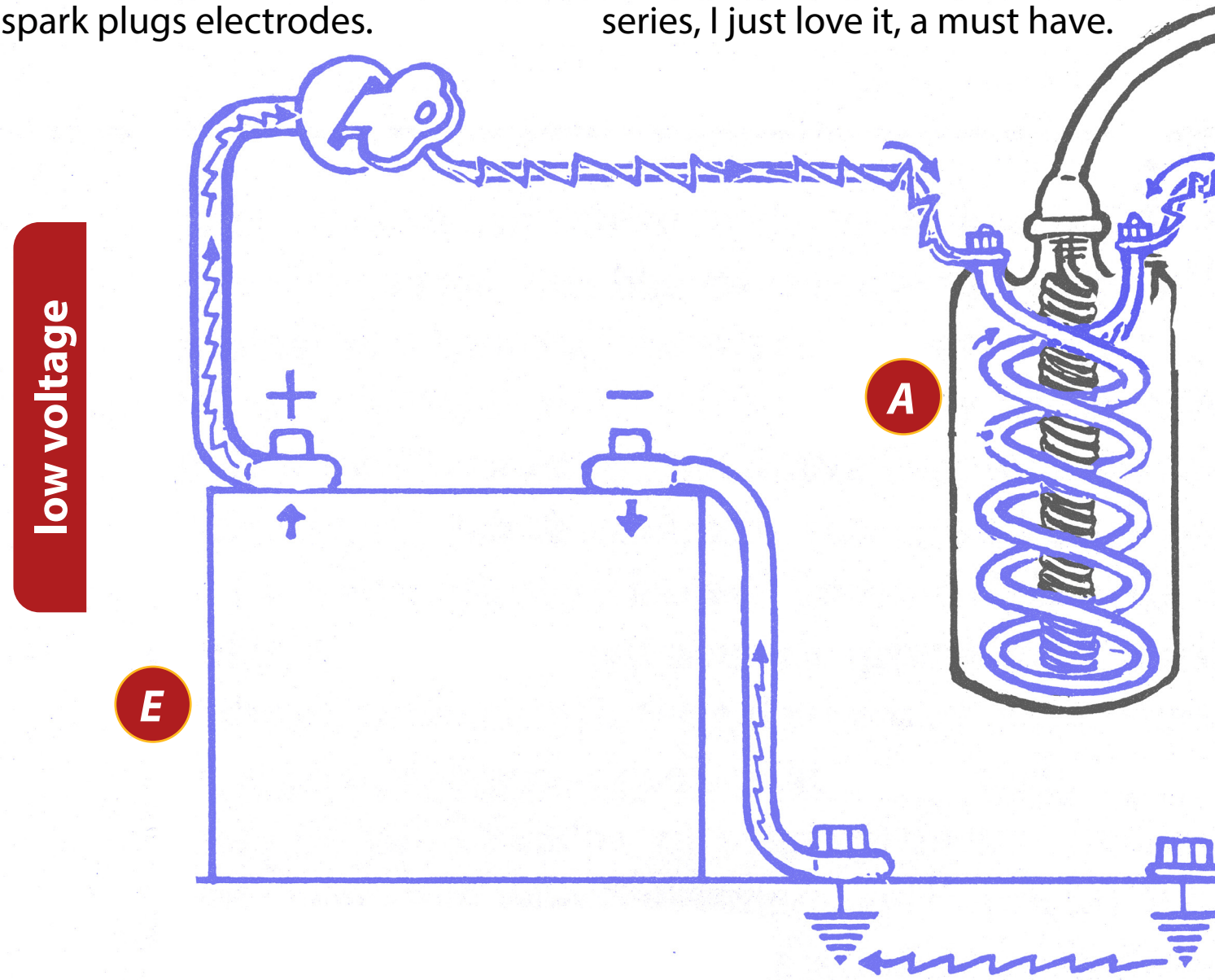
# the distributor



## How it works

We have listed all parts needed to build the ignition circuit and explained how the distributor fits into the engine, it is time to unveil the magic these ignition parts create. The final output will be these sparks between the spark plugs electrodes.

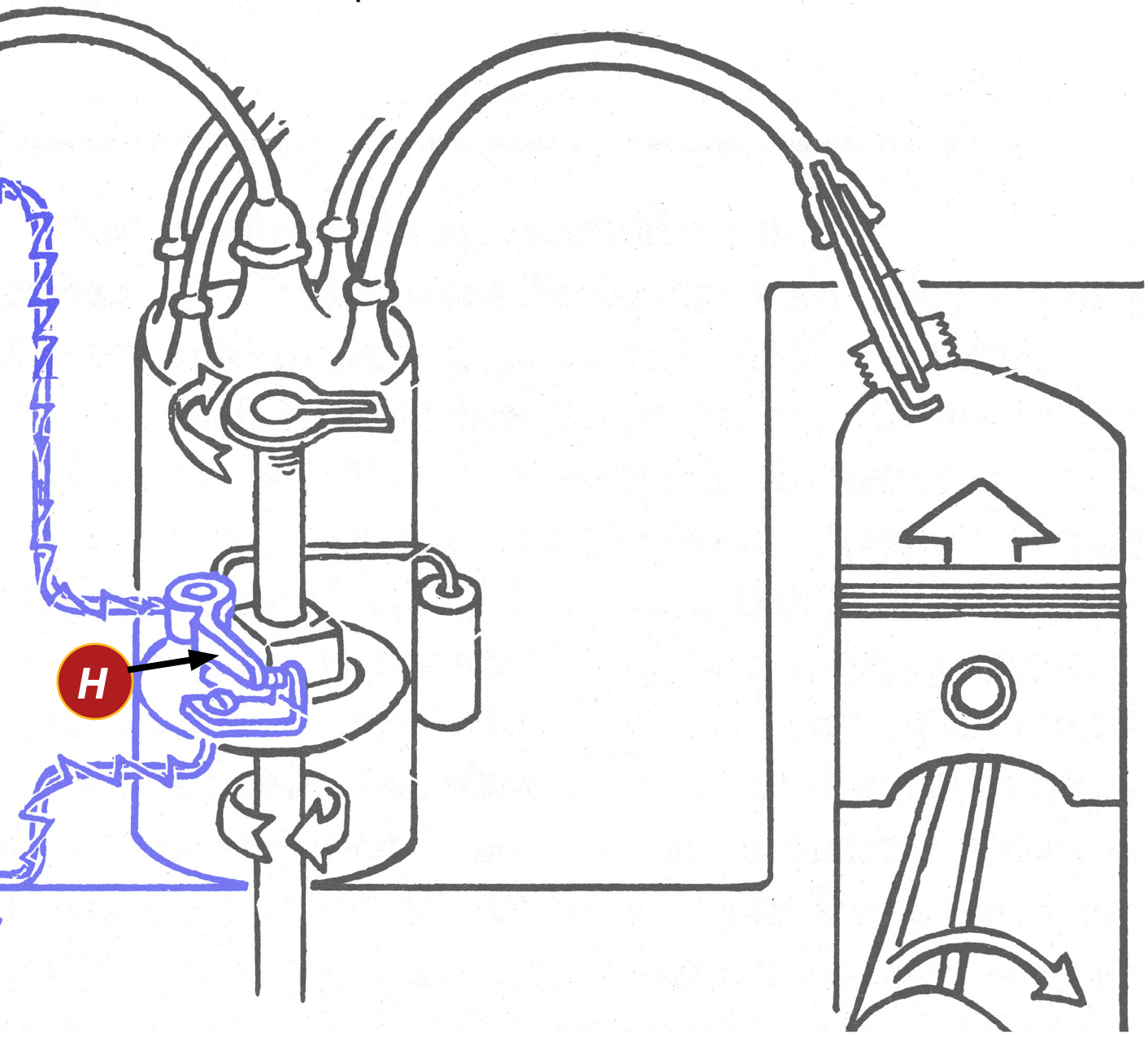
We start with the low voltage part of the ignition circuit. We show below this great drawing from the excellent book from Muir, How to keep your Volkswagen alive, we talked about this book in previous editions of this series, I just love it, a must have.



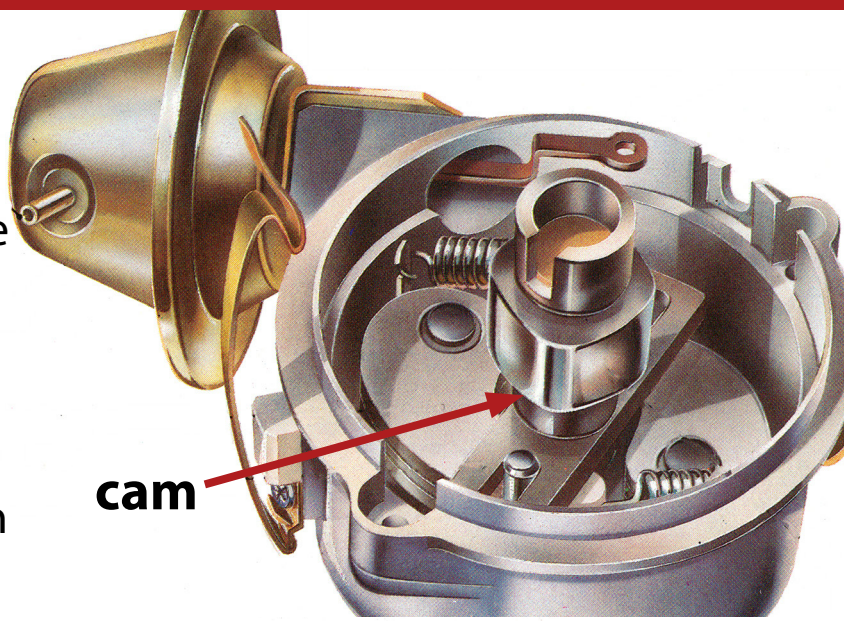
# the distributor

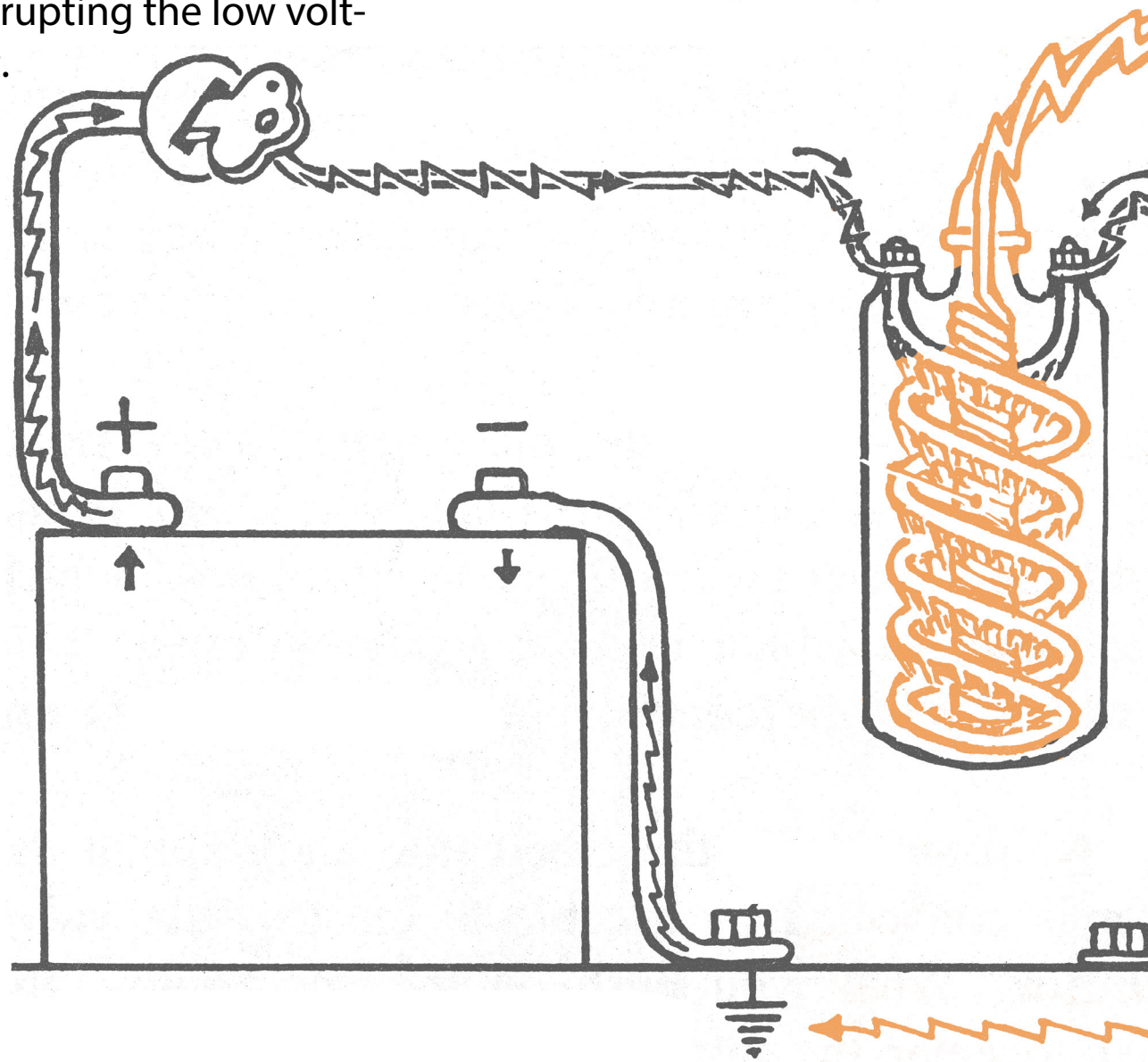
The low voltage circuit is painted in blue to make it easier to understand how it works. The coil is connected to the low voltage (6 V or 12 V) delivered by the battery (E) once the ignition key is turn to the ON position.

An electrical current will flow through the primary winding of the coil (A) and then through the closed contact breaker (H) to finally reach the chassis of the car (negative or electrical mass).



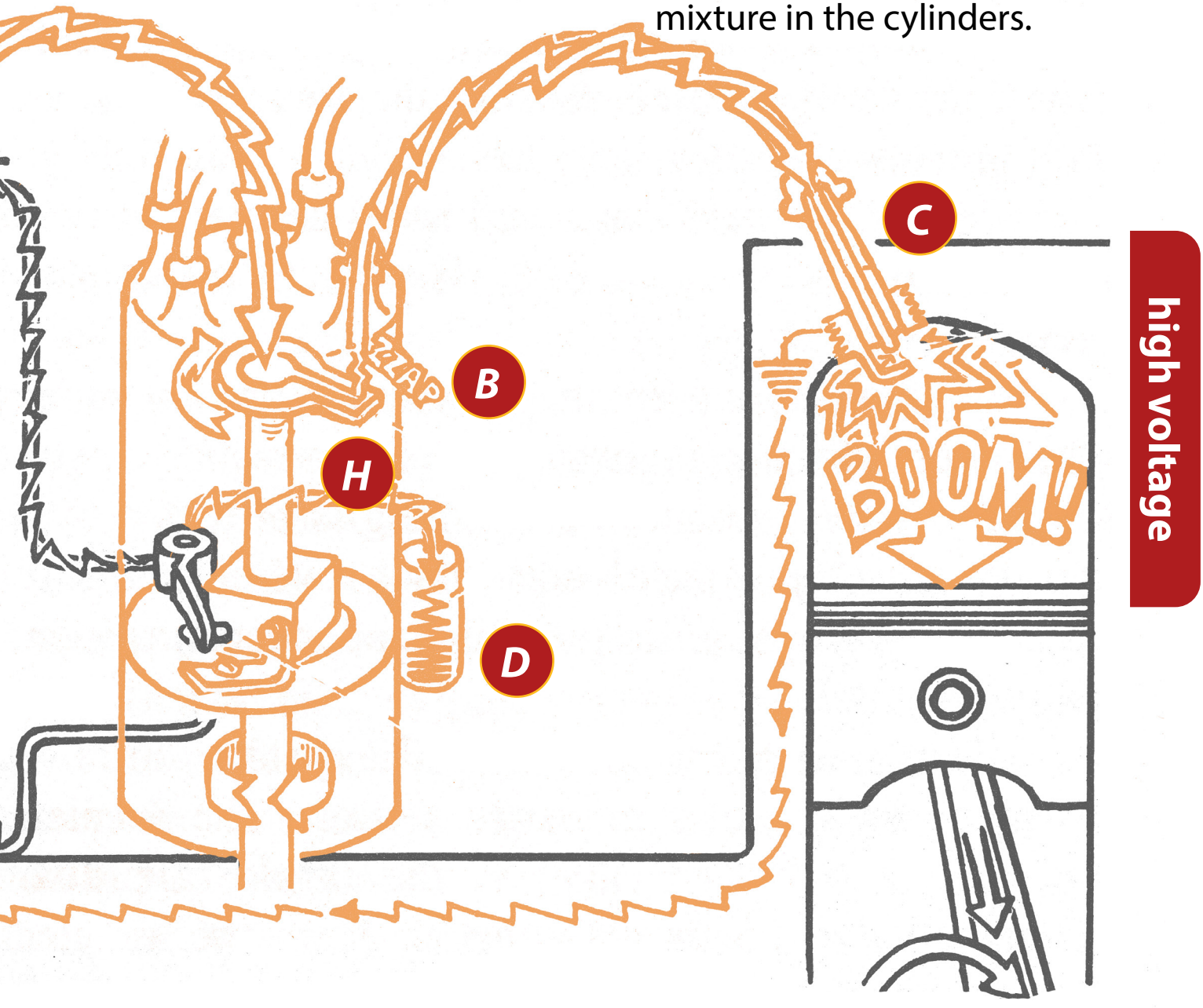
Once the engine is running the crankshaft rotates and the distributor shaft spins around at the same paste. The contact breaker will open and close on the same rhythm, the four cams on the distributor shaft are pushing the contact breaker lever resulting in the ignition points to open and close interrupting the low voltage circuit.



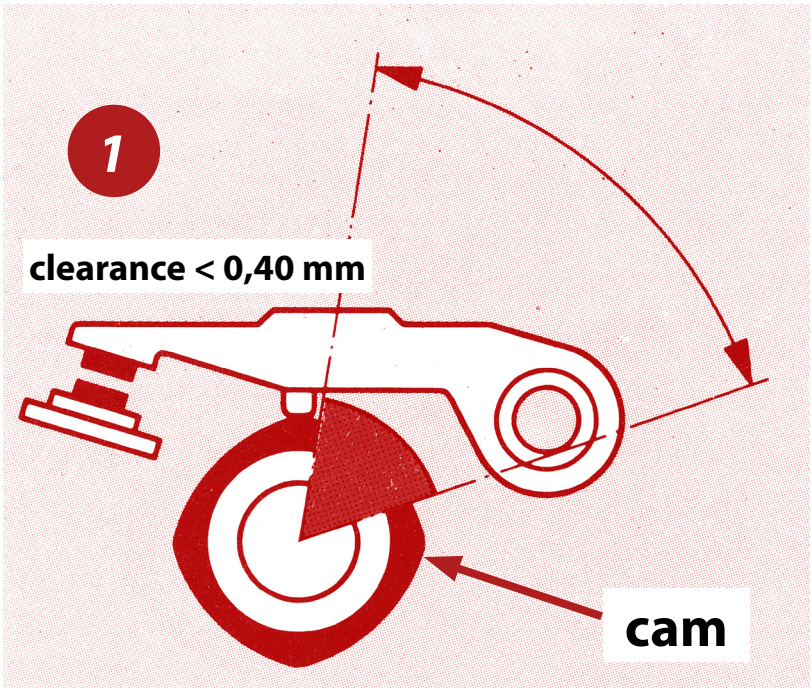
# the distributor

The interruption of the low voltage circuit will interrupt the current in the primary winding of the coil resulting in an induction of a high voltage in the secondary winding as explained earlier. This is shown in the drawing below. The induced high voltage will find its way to the high voltage cable of the coil (central cable) which is connected to the rotor. The rotor spins around and connects the high voltage to the spark plug cables, one by one, at the same speed as the engine. The high voltage will generate a spark between the spark plug electrodes to ignite the air-fuel mixture in the cylinders.



## Dwell angle

We explained that the contact breaker will open and close on the same rhythm as the engine. The next question is: how long should you keep the ignition points open? How long the points are open will depend on the maximum ignition points opening (gap) you have set, this should be 0,40 mm for most air-cooled VW engines.




### 1 *Not enough clearance Dwell angle too big*

The rotor rotates 360° within a full four-stroke engine cycle. The contact breaker will open and close four times within one cycle. If the ignition points are not open long enough (maximum points opening is smaller than 0,40 mm as shown on drawing 1) the spark will not be strong enough. The points are closing too fast, the high voltage to the spark plugs will be interrupted too soon.

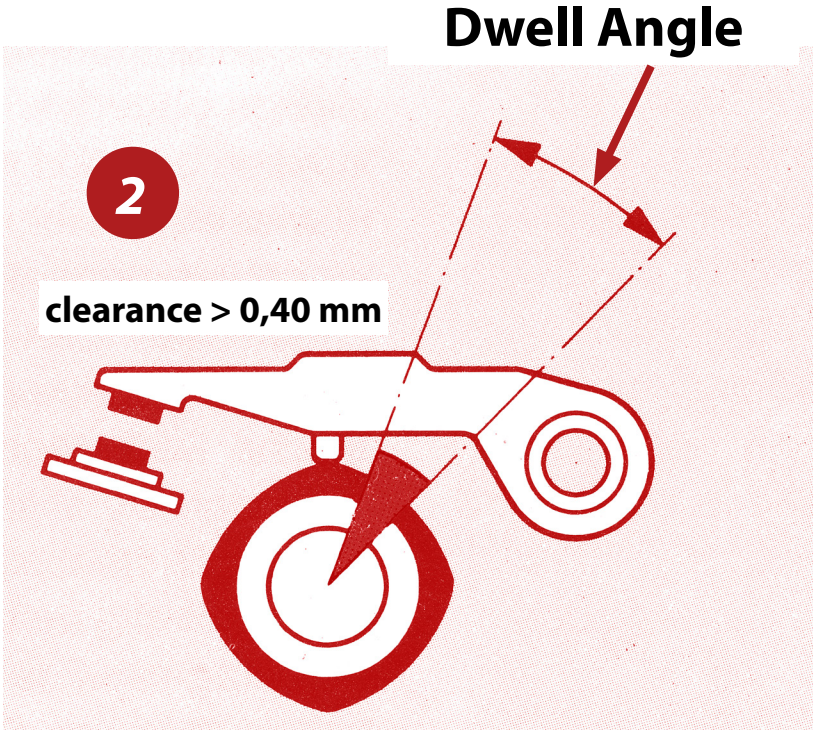
### 2 *Too much clearance Dwell angle too small*

If the contact breaker stays open too long (maximum points opening is greater than 0,40 mm as shown on drawing 2) the spark will also not be strong enough as in the first scenario. The points are not closed long enough, the high voltage build-up in the primary winding will be interrupted too soon.
The result for both scenarios is a weak spark resulting in a bad performing engine.

## *Dwell angle or Dwell percentage?*

We will explain how to set the Dwell angle in a future edition of this technical series, when we discuss the dynamic ignition tuning.

Sometimes you will see a Dwell percentage mentioned in technical handbooks or on your strobe lamp, this is a little confusing, so we need to explain what the difference is between Dwell angle and Dwell percentage. The Dwell percentage is influenced by the number of cylinders in your engine. For us, air-cooled VW enthusiasts, it is quite simple, it is always four cylinders. The rotor will rotate 360° in one cycle, so this is 90° per cylinder. If the maximum ignition point opening (clearance) is 0,40 mm then you have a Dwell angle of 50° (refer to the VW workshop manual). How much Dwell percentage is this?




The ignition points will be open during 50° out of 90°:

Dwell % = 100 x (50°/90°) = 56%

If you set the ignition breaker gap with a light bulb (static) you will use a 0,40 mm feeler gauge. If you set the ignition breaker with a strobe lamp (dynamic) then you will set the Dwell angle to 50° or you will use the Dwell percentage value of 56%. A deviation of +/- 4° or 8% is allowed. The Dwell angle will have an influence on the ignition advance, so you need to set the ignition breaker points clearance first.

## Ignition timing - advance

The ignition should take place just **before** the piston reaches the top end of the cylinder during the compression stroke. The reason for this advance in timing is that the air-fuel mixture needs some time to combust. The end of the second stroke is also known as the TDC (top dead center). Read all about the TDC in edition 06 of this series, we explain how a four-stroke engine works.

The exact moment when the spark has to be generated is measured in the number of degrees the crankshaft has still to rotate before it reaches the TDC. If the ignition advance is 7,5° at idle for example this means that the ignition will happen 7,5° crankshaft rotation before reaching the TDC when the engine runs abut 700 to 800 rpm. Workshop manuals will mention 7,5° before TDC.

When the engine runs faster than idle, the pistons move faster from left to right in a boxer engine. The air-fuel mixture still needs the same amount of time to fully ignite though. So, the ignition should start earlier the faster the engine is running.

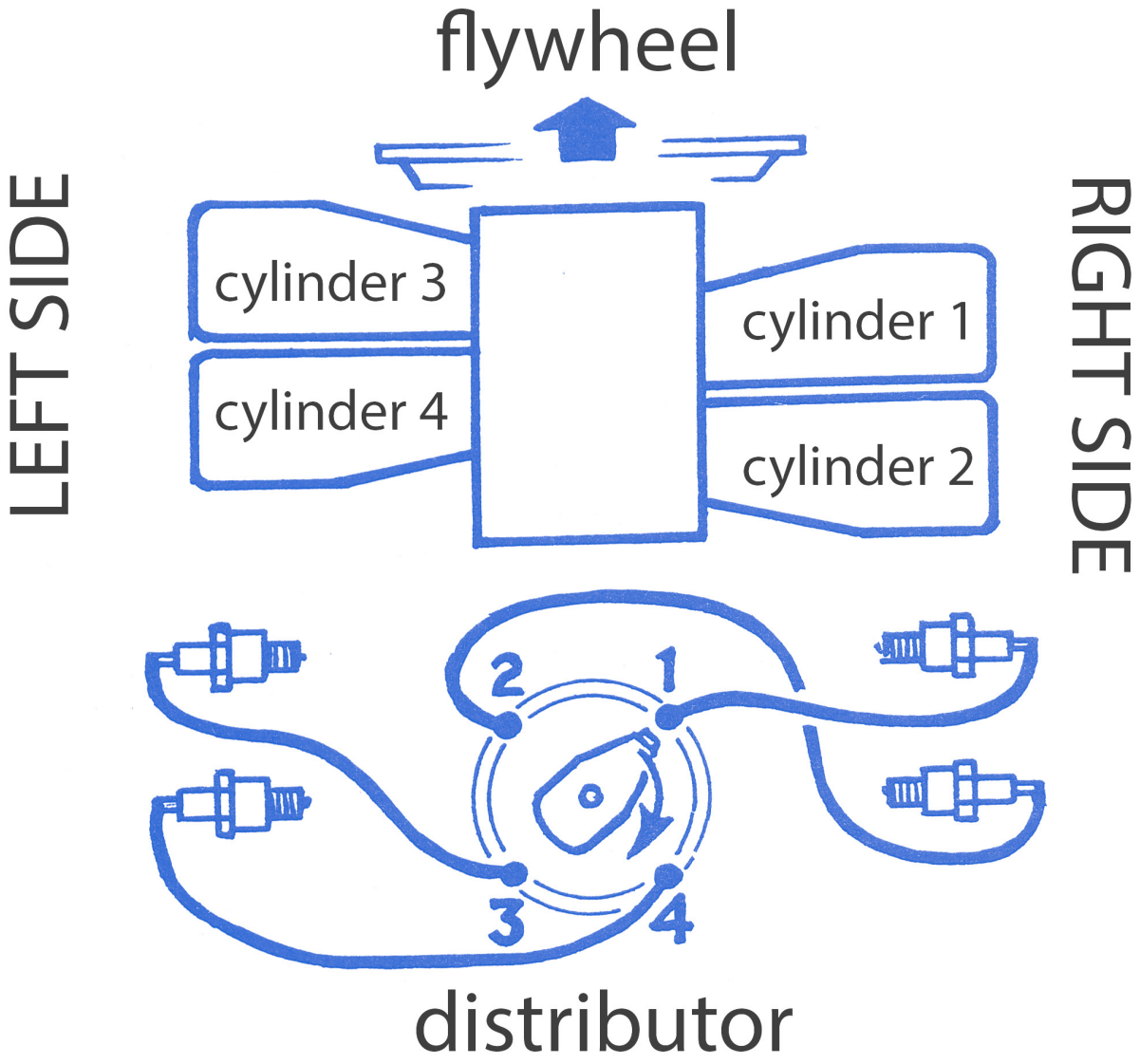
The **progressive change** in ignition timing depending on the rpm is done automatically by the distributor advance system. This advance system will make sure that the ignition always happens at the right moment in the range from idle to maximum rpm. The faster the engine runs the earlier the ignition points will open to induce the high voltage in the secondary winding. You don't have to worry about that while driving, but you will need to set the base advance at idle or at a predefined rpm depending on the engine type.



# the distributor

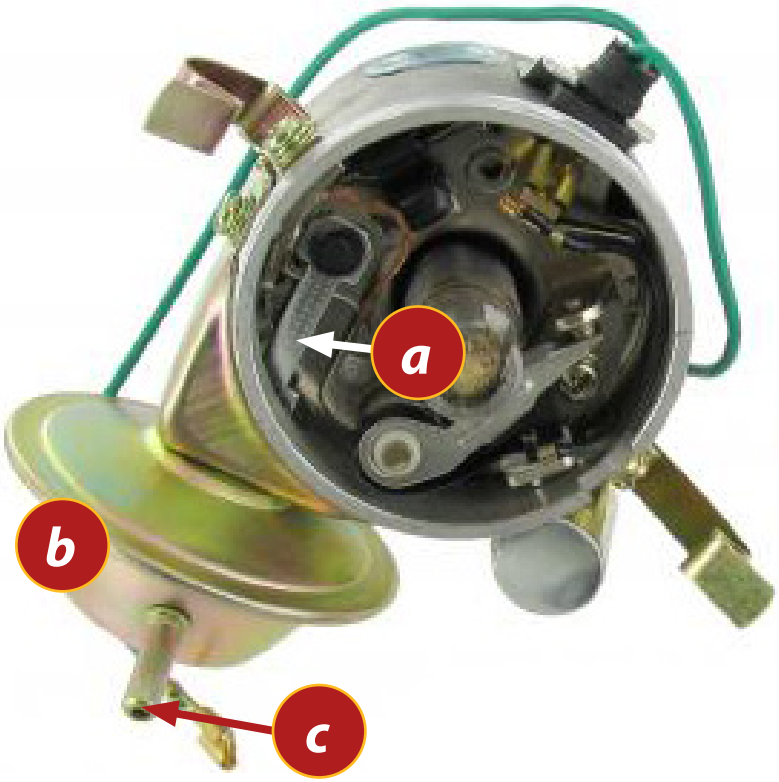
We will explain how to set the ignition advance both statically and dynamically in a future edition of this series. We will first explain how the automatic advance system works. We explained in edition 06 that the ignition sequence is cylinder 1, then cylinder 4, 3 and 2.

You understand now that the objective of the ignition advance system is to change the ignition moment for each cylinder depending on the rpm of the engine. Their are two types, the vacuum and the mechanical advance system. Now, let's see how this advance system works.



## *Vacuum advance*

A first type of advance is the vacuum advance. The vacuum advance (b) is visible on the outside of the distributor, a tube (c) connects to the carburetor. The vacuum developed in the cylinder (the pistons create a vacuum in the cylinders, this vacuum travels to the inlet manifold and to the carburetor) will activate the membrane of the vacuum advance system which is connected to a tie rod (a) that will rotate a metal plate within the distributor.




We show the inside of a distributor with vacuum advance on the picture below and the drawing on the right. When the tie rod (a) moves towards the vacuum system because of the decompression (vacuum) in the carburetor, the metal plate inside the distributor rotates and the contact breaker position will move relative to the cams on the distributor shaft. And that is what we want to achieve, the faster the engine runs, the more vacuum in the carburetor, the sooner the contact breaker will open. So, the faster the engine the earlier the spark will be generated, so the air-fuel mixture has more time to combust, and that is what we wanted.

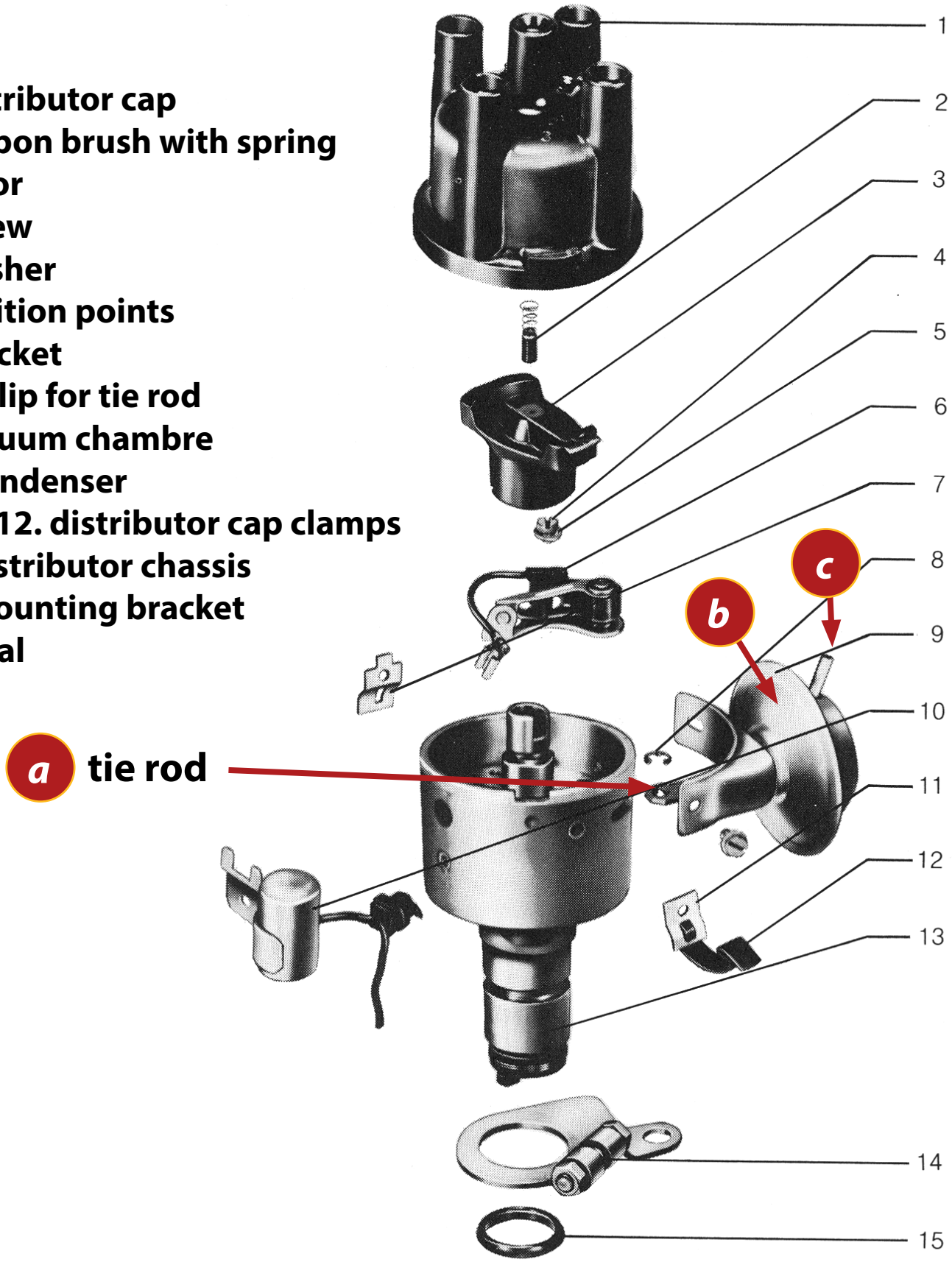
**a** **tie rod**

**b** **vacuum system**

**c** **hose to carburetor**

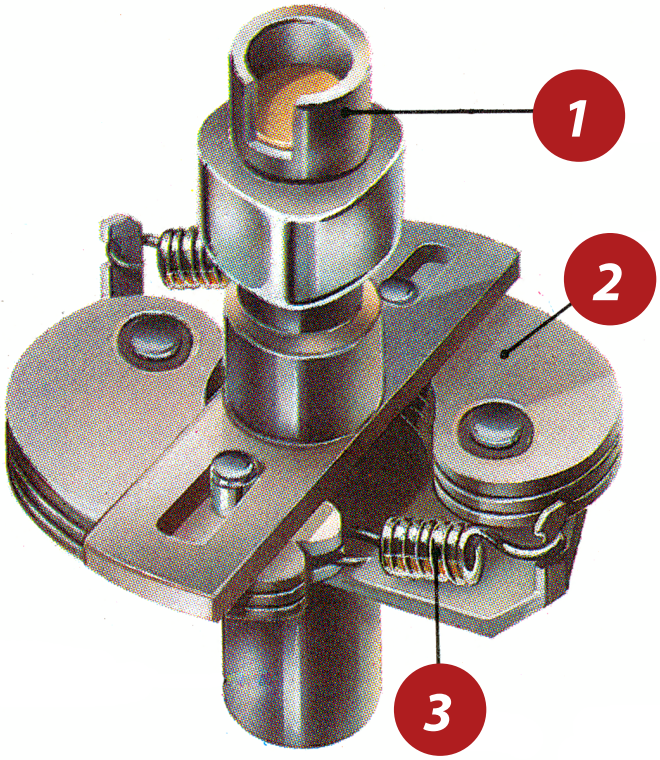
# the distributor

1. distributor cap
2. carbon brush with spring
3. rotor
4. screw
5. washer
6. ignition points
7. bracket
8. circlip for tie rod
9. vacuum chambre
10. condenser
11. & 12. distributor cap clamps
13. distributor chassis
14. mounting bracket
15. seal



## *Mechanical advance*

Mechanical advance or centrifugal advance uses the principle of centrifugal force or inertia. The distributor shaft consists of two parts, a top part and a bottom part. Both are connected together but they can move independently from each another. The bottom part is connected to the engine crankshaft, the top part includes the distributor shaft with the cams to activate the contact breaker. The faster the engine runs, the more the weights (2) will tends to move outwards.

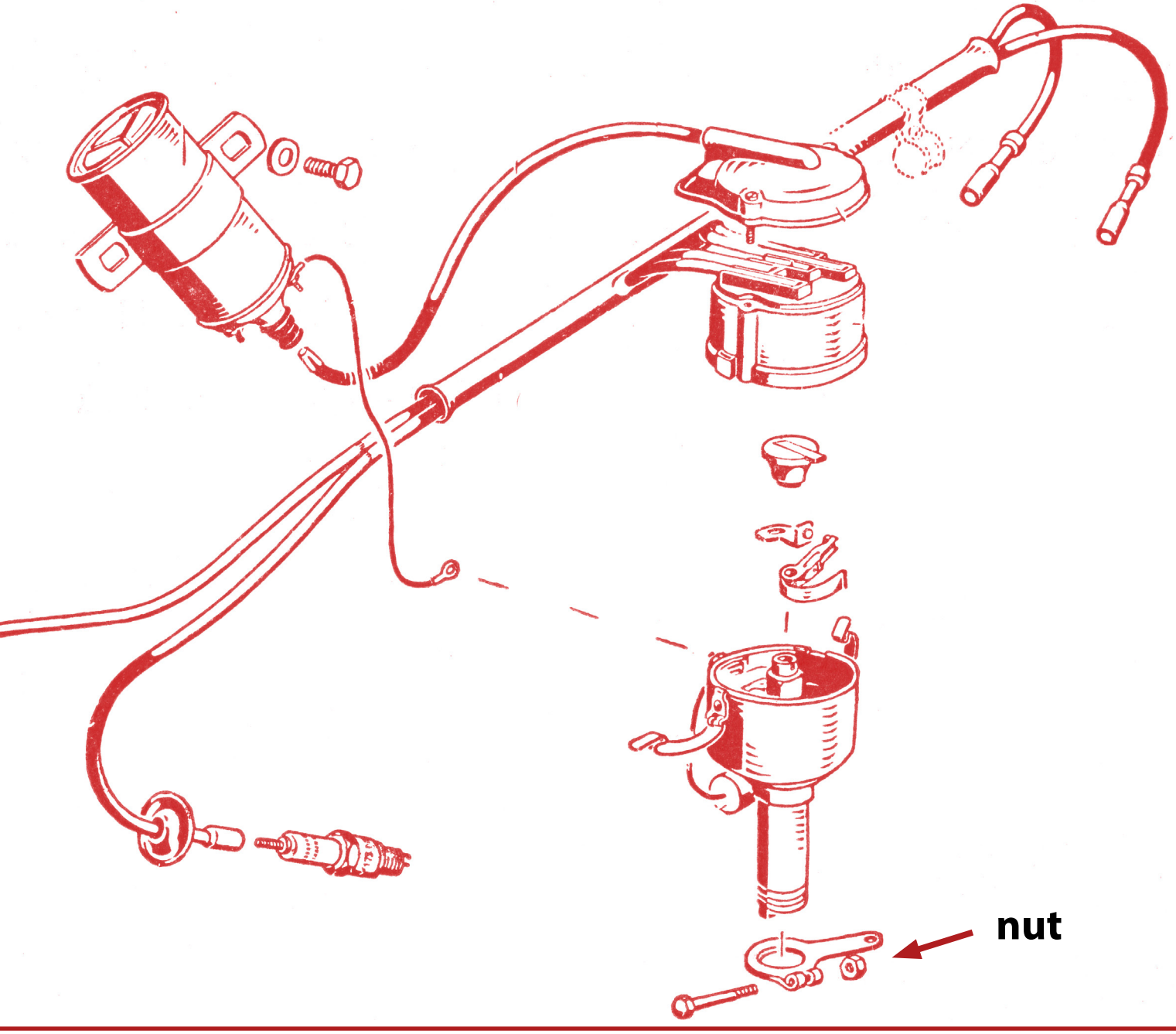



We show a drawing of a mechanical advance system on the bottom left. You see the distributor shaft (1) (the rotor is installed on top of it as shown on the drawing on the right), under the shaft are the mechanical advance weights (2) secured with springs (3). The size and shape of these weights and the characteristics of the springs will define the advance curve of the distributor. The stronger the springs the less advance, so it is very important that the mechanical advance parts installed match your engine specs. The drawing on page 27 is from a 1949 Beetle, there is no vacuum advance system on this model, the mechanical advance parts are built-in. To set the advance you need rotate the distributor, but first you have to loosen the nut from the mounting bracket (refer also to part number 14 on page 25). We'll discuss this in detail in a future edition.

## Conclusion

I think we have enough information now to start with the tuning of the ignition of our classic VW.

It is a long story, so we will take the time to explain this to you in detail. We will explain how to set the Dwell angle, how to set the advance, how to measure the condenser and much more...

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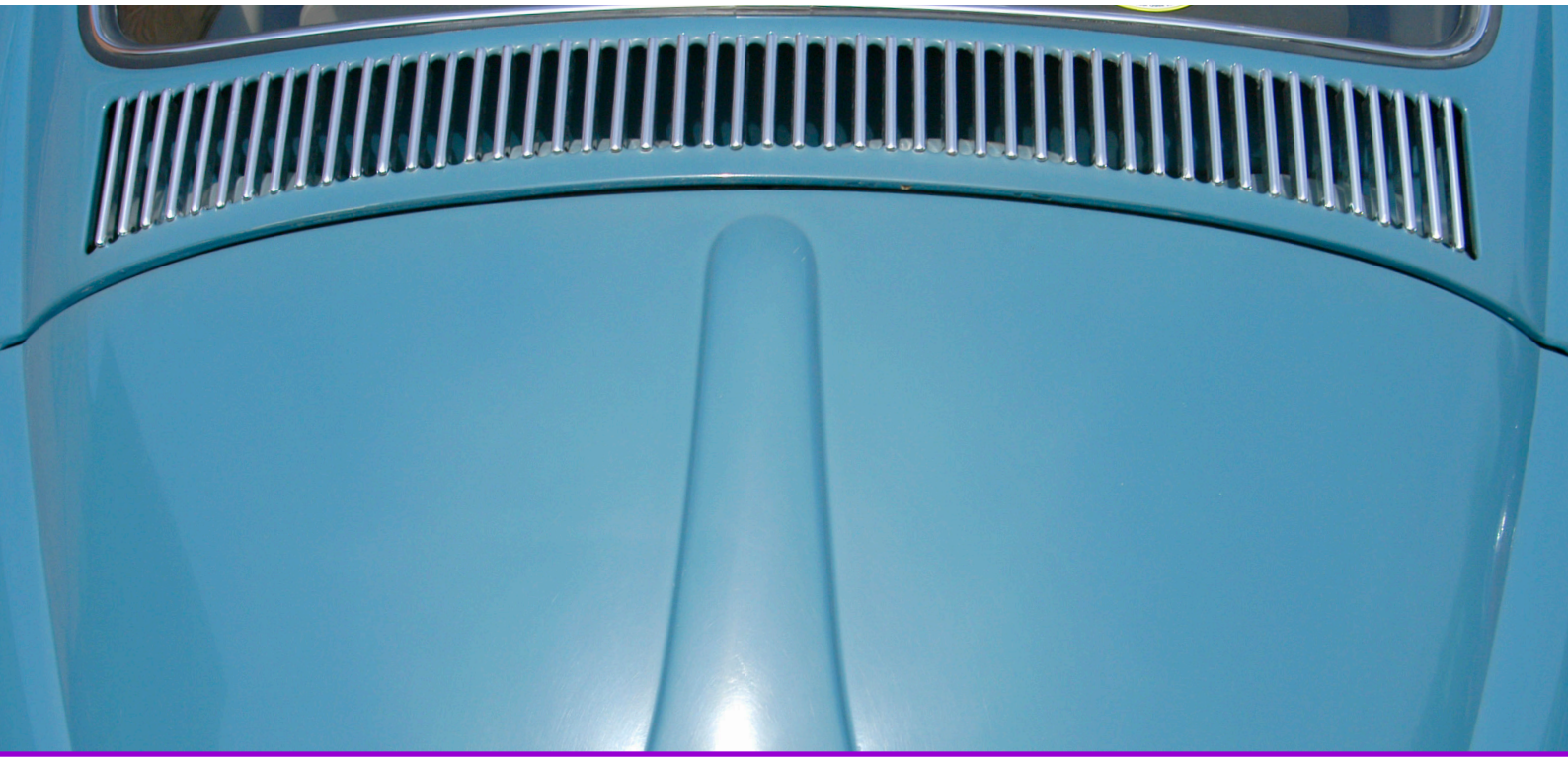
# #29 Carburetor

## Fuel mixture

The air cleaner is something you take for granted, you don't pay too much attention to. It is a very important part of the fuel system tough, it is comparable with lungs for us humans.

The role of the carburetor is to mix petrol with air to create an air-fuel mixture that is ready to combust in the cylinders. Pure petrol is not usable, you need to add oxygen to make it the ideal for our combustion engine.

An air-cooled engine needs a mixture of fifteen kilogram air for every kilogram petrol. Air is not very heavy as you know, fifteen kilogram air is about 10.000 liter. The relation between air and petrol is one liter petrol for 10.000 liter air, unbelievable. If you drive a VW Beetle, or any other car based on the otto engine, from Amsterdam to Brussels, you will use about 20 liter petrol but roughly 250.000 liter air!





# air cleaner preheating

The 1955 Karmann Ghia workshop manual tells us that the engine uses 1369 liter air per kilometer in fourth gear. You also need a large volume of air to cool down the air-cooled engine of course, but this is a completely different story.

So, we need to make sure that our engine (read carburetor) can suck enough air to generate the air-fuel mixture. The incoming air should also have the correct temperature, otherwise the mixture will not be ideal.

The ambient air enters the engine compartment through the air grille on the back of the car (pictures below) in the engine lid or above the lid. The VW Bus and type 3 Squareback and Fastback have air grilles on the side. Make sure these grilles are clean and not obstructed by any object or dirt because they are crucial for the engine. The standard air grilles have been designed to feed the engine that was installed in the car at the factory, so if you change the engine, you will need to review the air grilles.

# #29 Carburetor

## Air temperature

The ambient air coming into the air cleaner will have the ambient temperature. If the weather is hot, the air will be warm which is ideal to mix with petrol. If it is winter and the outside temperature is very low then the air will not mix well with petrol.

The above is a contradiction with the air you need to cool the engine, the colder the air the better in this case.

So, you need a system that heats the ambient air before it enters in the carburetor when the weather is cold. If it is warm outside this system shouldn't influence the incoming air temperature.

A system doing just this is installed in almost all our air-cooled Volkswagens, except the very old ones.

Don't confuse the air cleaner preheating with the inlet manifold preheating we discussed earlier in edition 03. The air cleaner preheating is necessary to improve the air-fuel mixture when it is cold outside, it will also help to reduce the choke usage. Preheating of the inlet manifold as discussed in edition 03 is necessary to avoid that the air-fuel mixture flowing from the carburetor to the cylinders through the inlet manifold freezes.

If the air cleaner preheating is failing you will experience difficulties to crank up the engine, the engine will not run well and will not perform as it should.

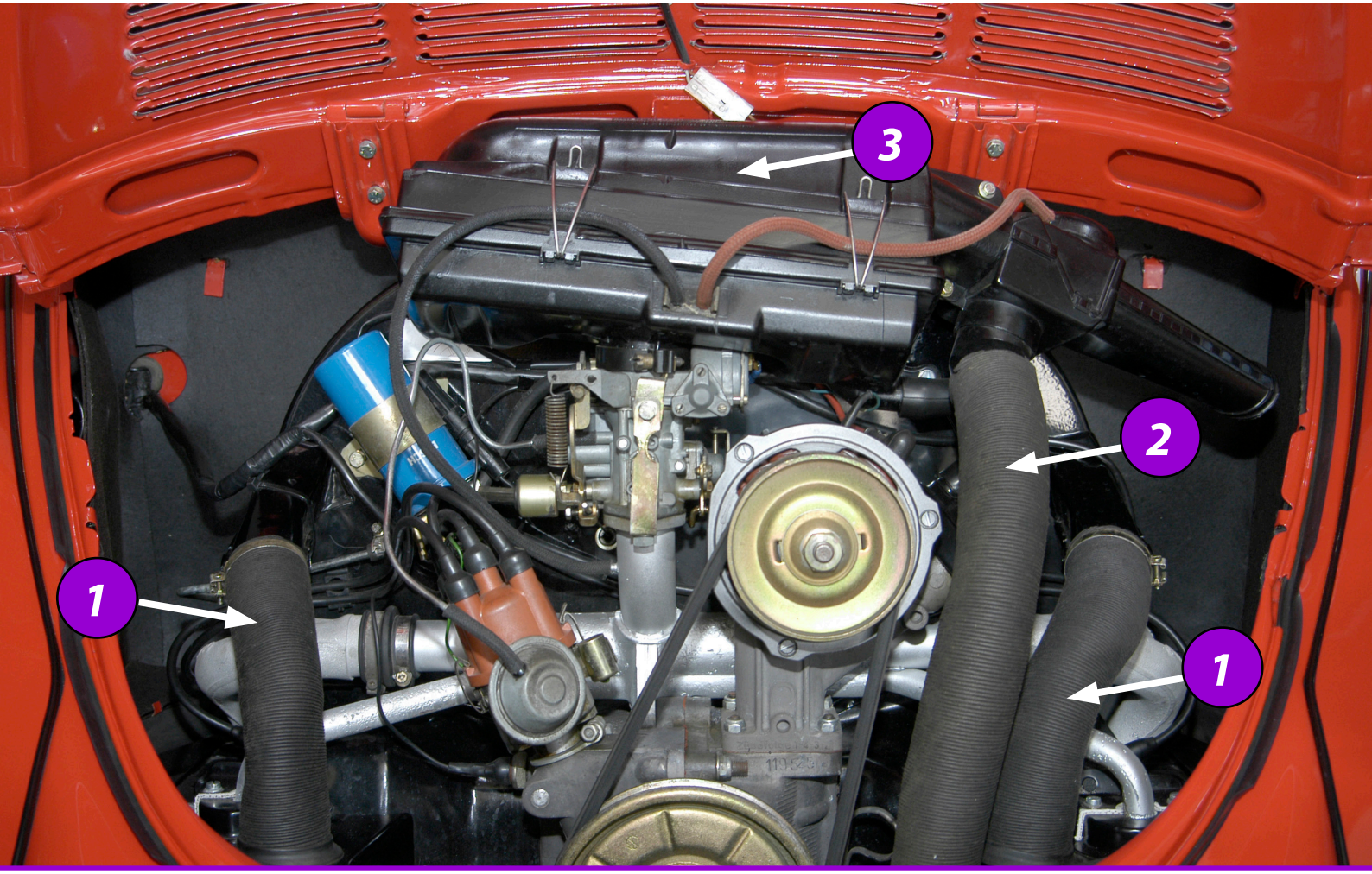
If your engine doesn't run well and you suspect the carburetor, first check out the air cleaner preheating. This can save you a great amount of time and precious money.



# air cleaner preheating

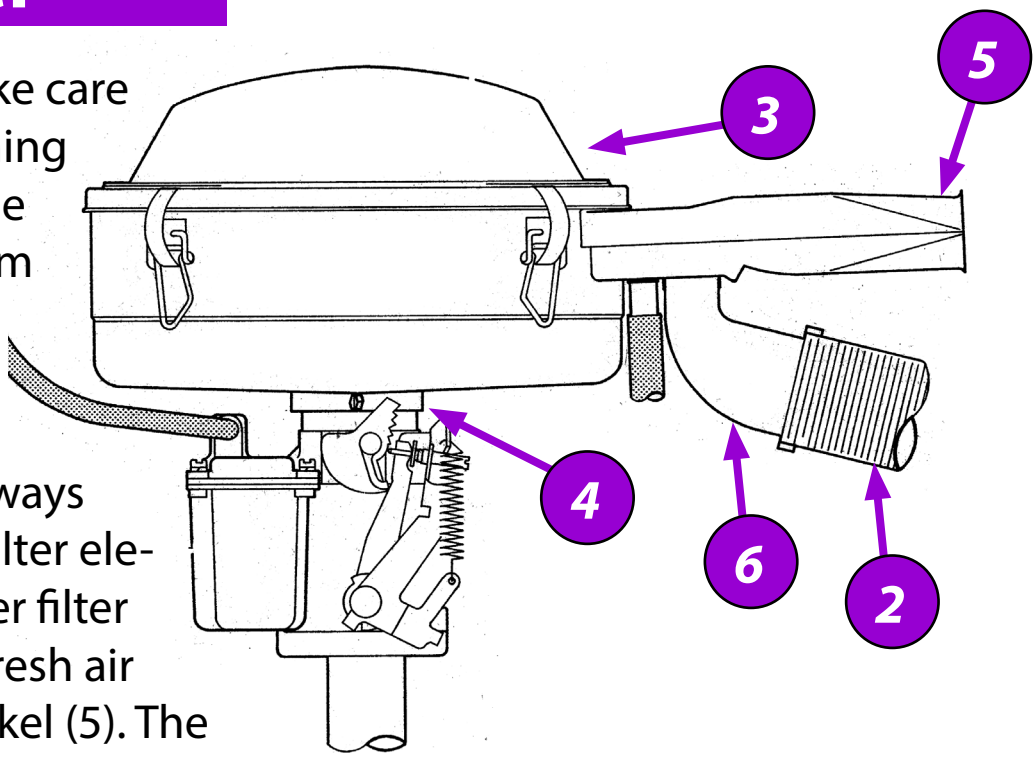
Although there are different types of air cleaner preheating systems out there, they all use the same principal; mixing cold ambient air with warm air to achieve the ideal carburetor air temperature. We show below a 1600 type 1 engine in a 1303 Beetle, both (short) hoses on the left and right hand side (1) are used to transport fresh air from the ventilator shroud to the heat exchangers, the long hose (2) brings warm air from the engine to the air cleaner (3).

The air temperature regulation in the air cleaner is achieved using different techniques, that is what we will discuss next.



# #29 Carburetor

## Oil bath filter




The air cleaner will take care of cleaning the incoming air and dampening the sound that the vacuum generates.

The air cleaner assembly or body (3) always has some kind of air filter element, it can be a paper filter or oil bath filter. The fresh air will enter via the snorkel (5). The air cleaner base (4) is connected to the carburetor. The hot air duct (6) for the preheating of the air cleaner connects to a paper hose (2), it is the same hose that we showed on page 33.

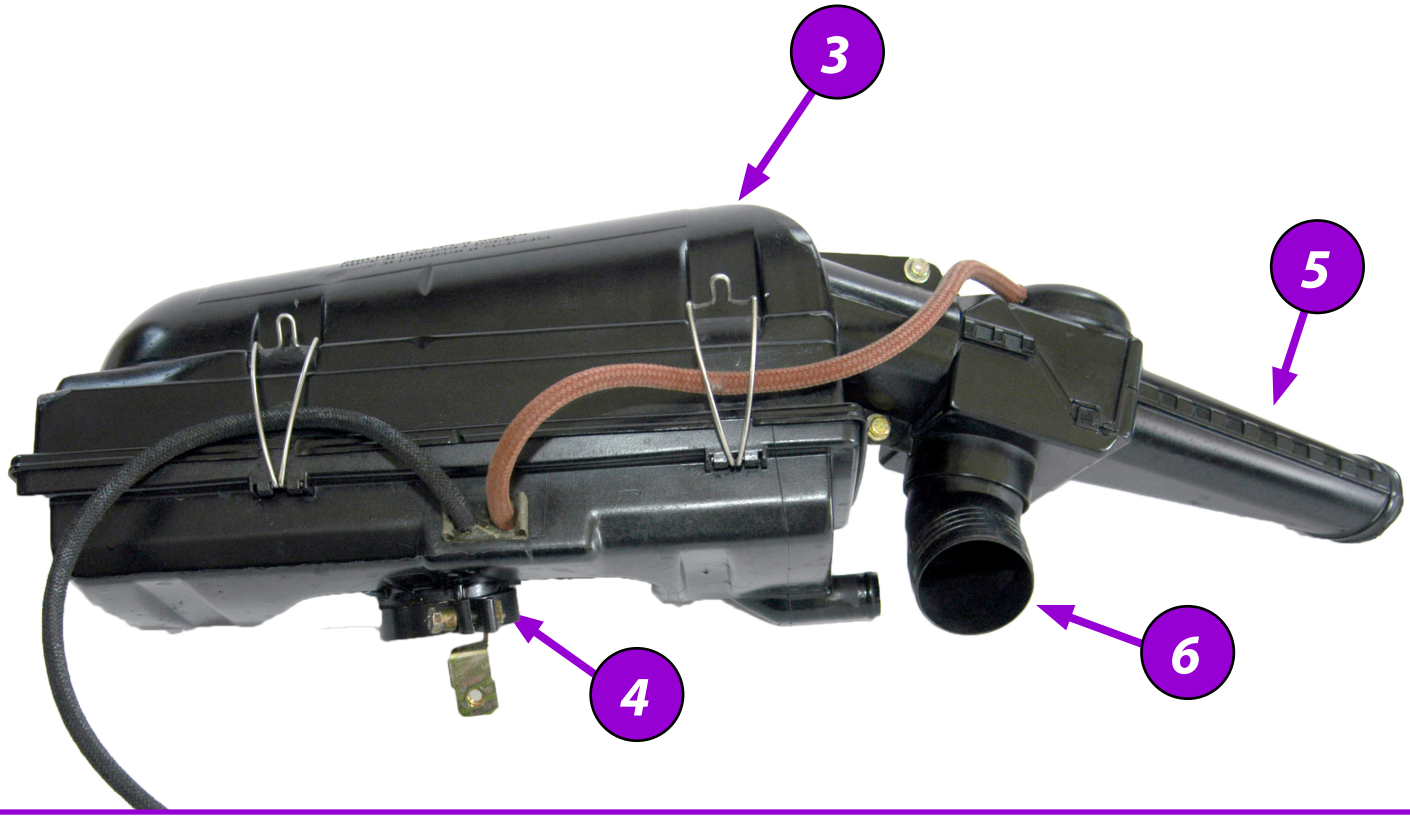

The older VW types use a oil bath filtering system as shown on the drawing above and the picture on the right hand side.
An oil bath is a very good air cleaning method but the younger model air cleaners with (dry) paper filter system (refer to page 35) are easier to maintain.

## Paper filter

The younger VW models use an air cleaner system with a paper filter element as explained on page 34. This filter element is made of pleated paper which is a very good filtering material. The small holes in the paper filter will let air pass through but the small dust particles in the air will be stopped. The paper filter can be used for as long as 20.000 km when driving under normal conditions.

There are different controlling systems used to regulate the air temperature of the air cleaner preheating system. Which system was used depends on the type of engine, the older engines used a counterweight while the younger engines used a thermostat.

We will explain now how both systems operate.



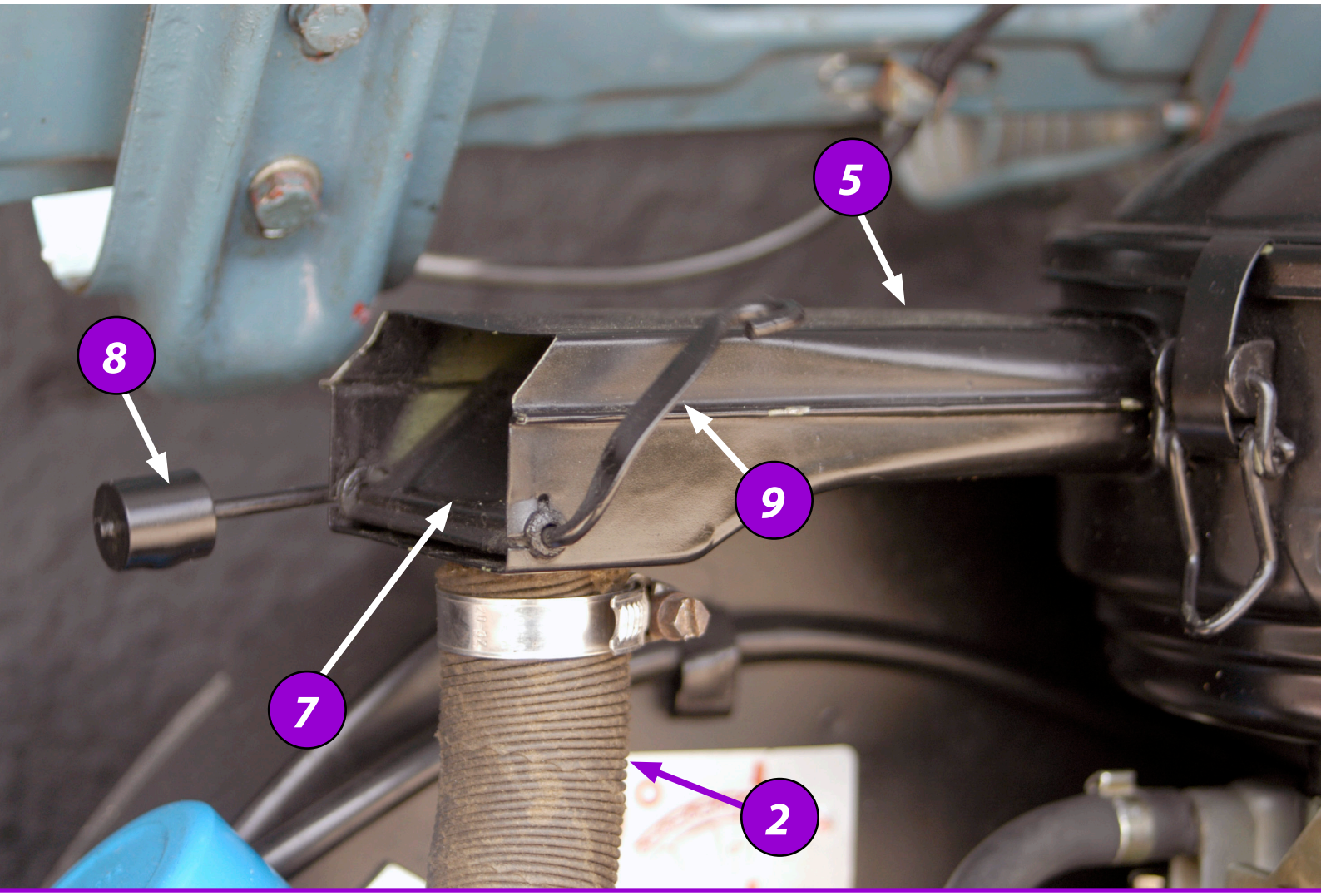
# #29 Carburetor

## Counterweight

A valve or flap (7) with counter-weight (8) is installed in the air cleaner air inlet (5). This valve can be forced into open position in the summer (summer mode) by fixing the arm (9) to the air inlet. This valve will freely move in the winter (winter mode) to allow an automatic regulation of the preheated air.

## *Winter mode*

When it is cold outside, the valve (7) will move depending on the amount of vacuum in the car-buretor. At idle, the valve will close the air inlet (picture A), only warm air will flow into the air cleaner, this warm air (heated by the exhaust) flows through the paper hose connected to the snorkel.

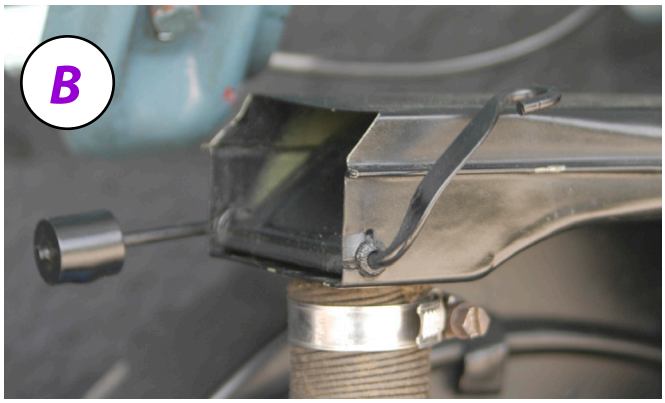


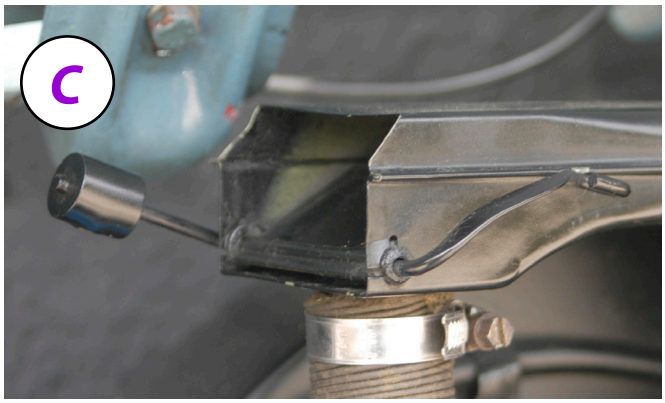
The hot air will mix much better with fuel then cold air. Using hot air will also avoids carburetor icing,  this condition can affect any carburetor under certain atmospheric conditions.

Once the engine runs faster (higher rpm) the air flow in the air cleaner caused by the vacuum in the carburetor will be higher, this vacuum is strong enough to open the air inlet valve (read to lift the counterweight) as shown on picture B. A mixture of fresh ambient air and preheated air will flow through the air cleaner. At high rpm the vacuum will be at its peak and the valve will fully open, only fresh air will flow into the air cleaner, the preheated air will be blocked. The valve (7) should be in winter mode when the outside temperature is lower than 15° C. If the temperature is higher you need to set the valve in summer mode.

## *Summer mode*

The summer mode is achieved by securing the valve so that it can't move freely anymore as shown on picture C, this is a manual procedure. Only ambient air will flow through the air cleaner.

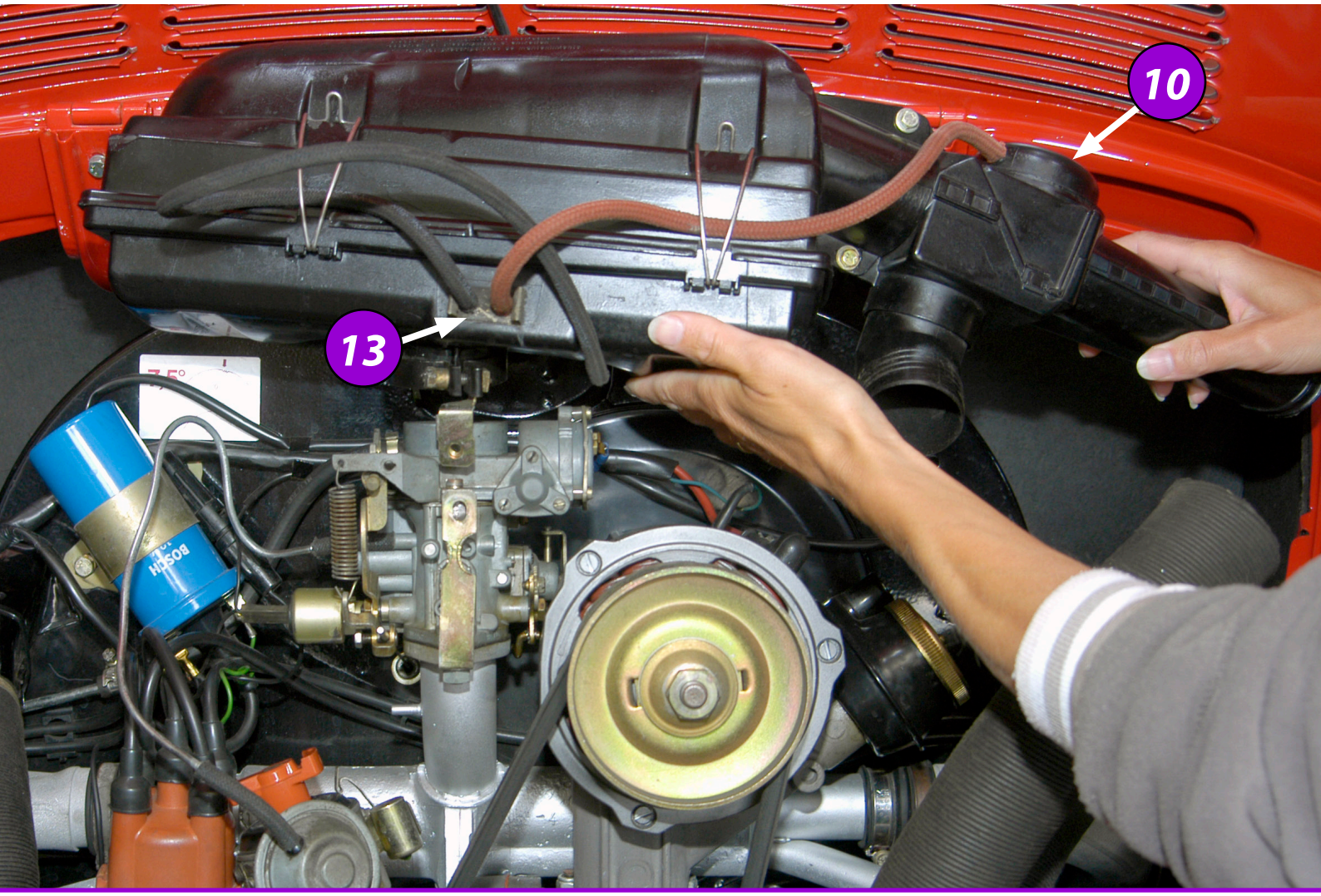



# #29 Carburetor

## Thermostat

The system with counterweight we just described used on older engines doesn't allow very fine tuning as you can imagine. Owners also tend to forget to set the winter or summer mode, wouldn't you? The climate in our regions (Western Europe) is changing every day, so the counterweight system is very labor intensive.

The modern thermostat preheating regulations system is less visible than the counterweight one. Which is an advantage, but many of us tend to forget that it's there. So it is never maintained and in most cases already broken for some years and creating headaches (read unexplainable engine problems).



# air cleaner preheating

The younger VW models have this thermostat regulated preheating system installed in the air cleaner assembly. You need to check on a regular basis if the preheating still works.

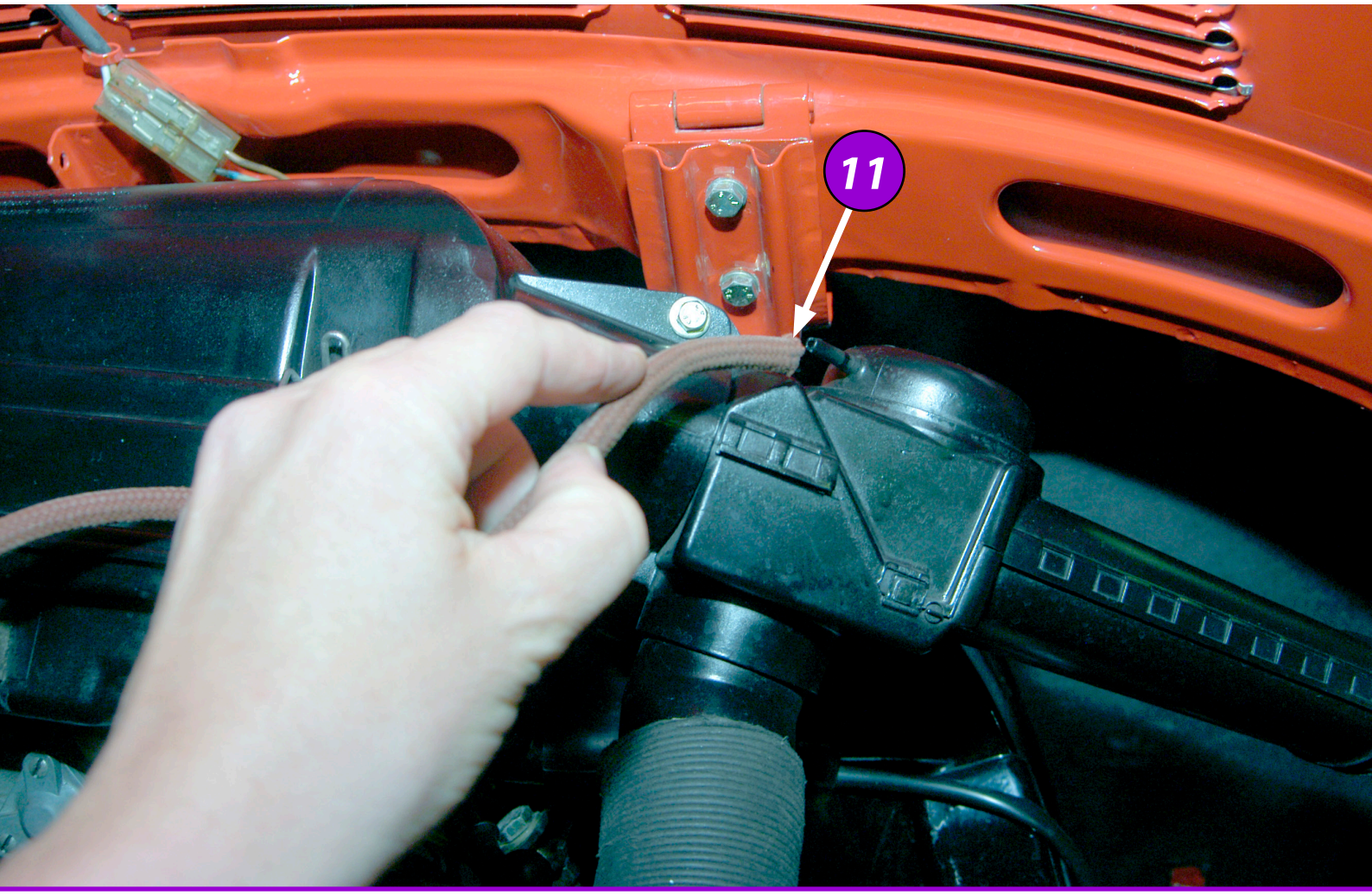
The construction can be very different depending of the engine type, but the basic principles are the same. We show the built-in thermostat (13) on the picture on page 38.

Cold and warm air are mixed using a valve, basically the same idea as with the counterweight air cleaner. The exact relation between cold air and warm air is now regulated by a thermostat. The valve in the air inlet is controlled by a vacuum diaphragm motor (10). This diaphragm will be activated by the vacuum in the carburetor.

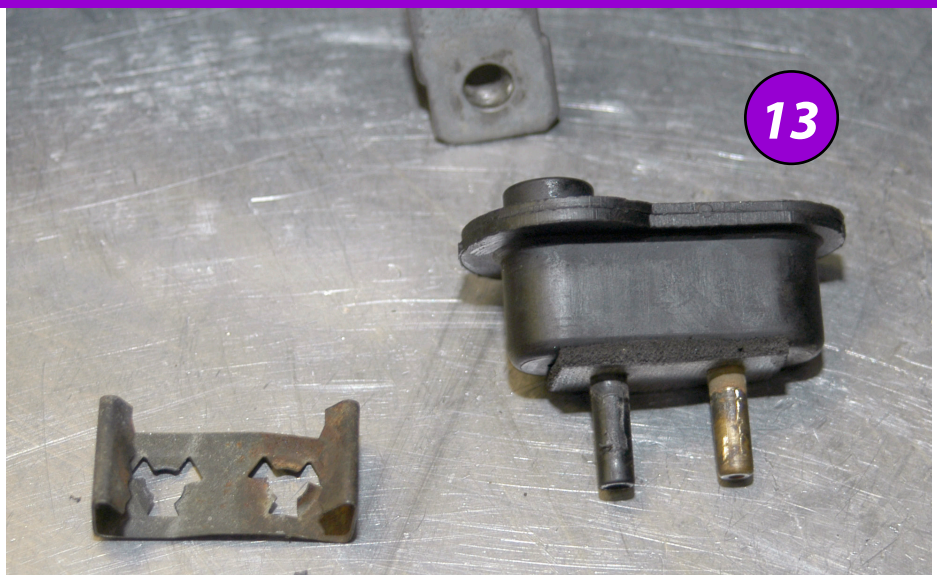
# #29 Carburetor

The thermostat is built into the air cleaner assembly as shown on page 38, we also show the thermostat (13) on the picture on page 41. This thermostat will activate the diaphragm as soon as the preheated air reaches 45°C. This will cause the vacuum to disappear, the diaphragm opens the air inlet fully to allow only fresh air to come in.

It is very easy to check if the pre-heating system still works. Crank up the **cold** engine. Remove the vacuum hose (11) connected to the air inlet (the hose connected to the diaphragm), you will hear the valve opening. Connect the hose (11) again and you should here the valve again. If the valve is not moving then the vacuum diaphragm motor is broken, or the valve broken or the thermo-stat is failing.

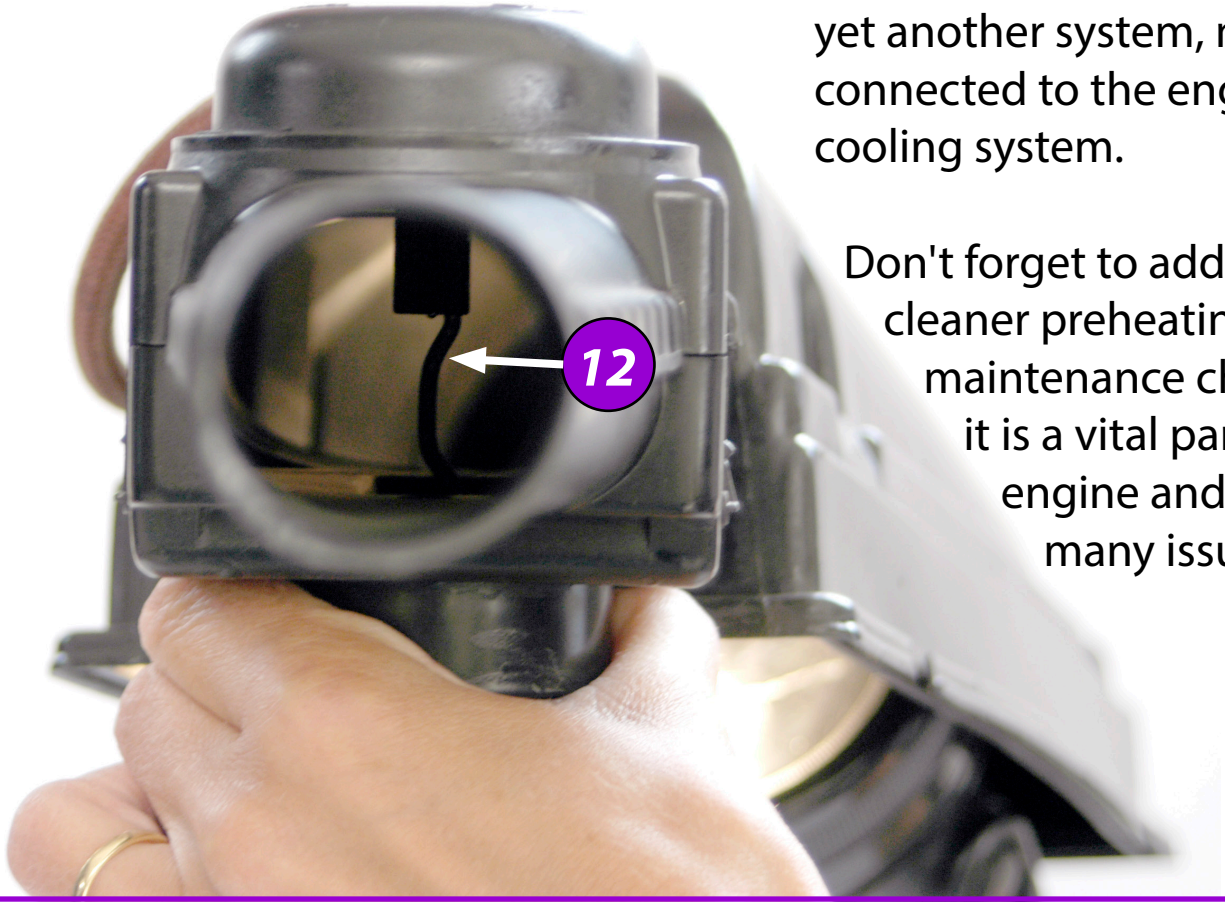


# air cleaner preheating




*We show the thermostat (13) once it is removed from the air cleaner assembly. It is not an easy job, we'll show how to do that in a future edition of this series. Unfortunately new thermostats are not available at this moment.*

You can also check, when the snorkel is removed, if the valve is moving (12). Watch out, don't try to move the valve by hand as you would do with the counter-weight system, you could end up damaging the diaphragm.




This thermostat preheating system was also installed on oil bath air cleaners in the seventies. The basic principle is the same as we just described.

Some oil bath air cleaners use yet another system, metal cables connected to the engine air-cooling system.

Don't forget to add the air cleaner preheating to your maintenance check list, it is a vital part of your engine and can cause many issues.


FR-42-54
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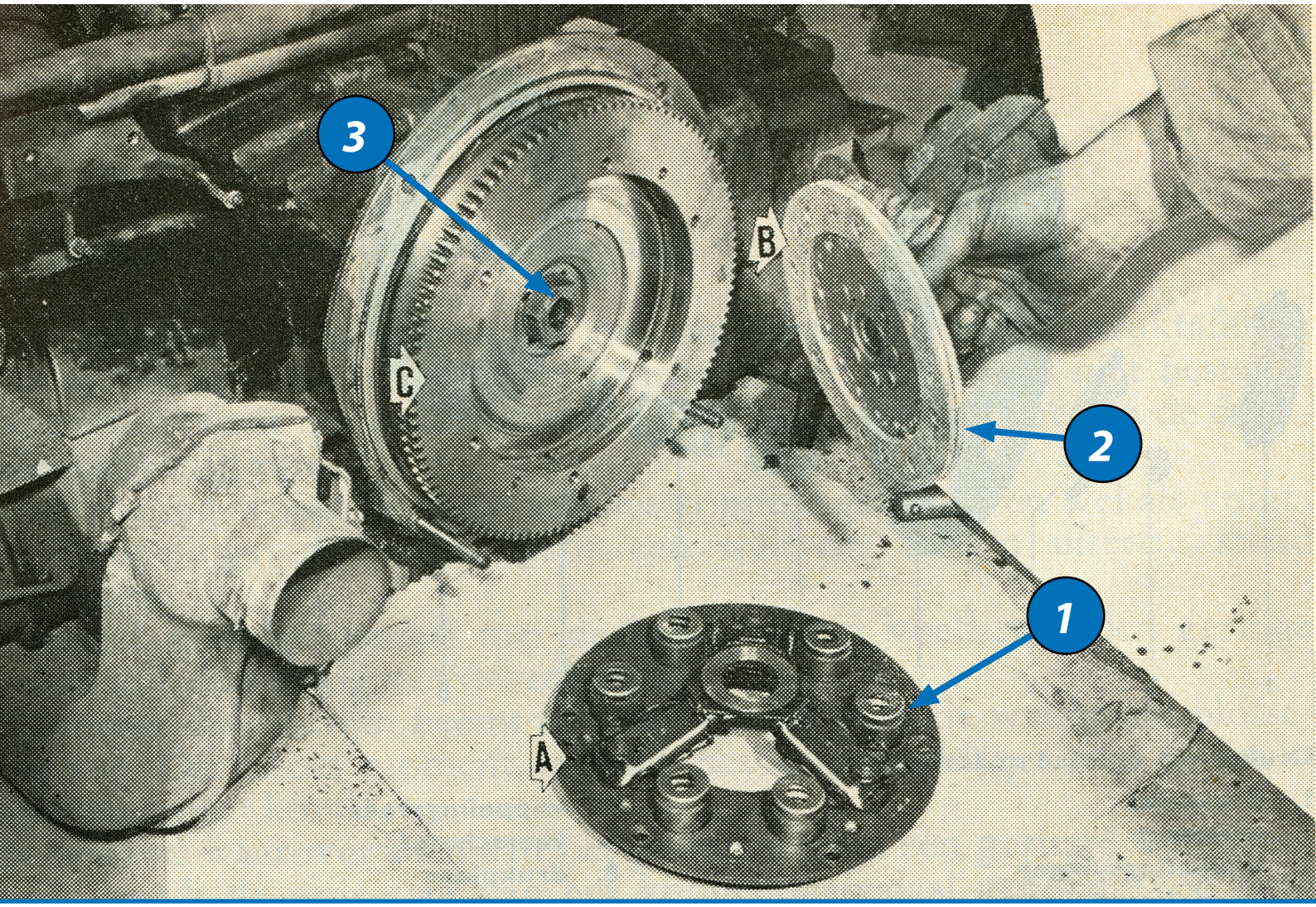
## Introduction

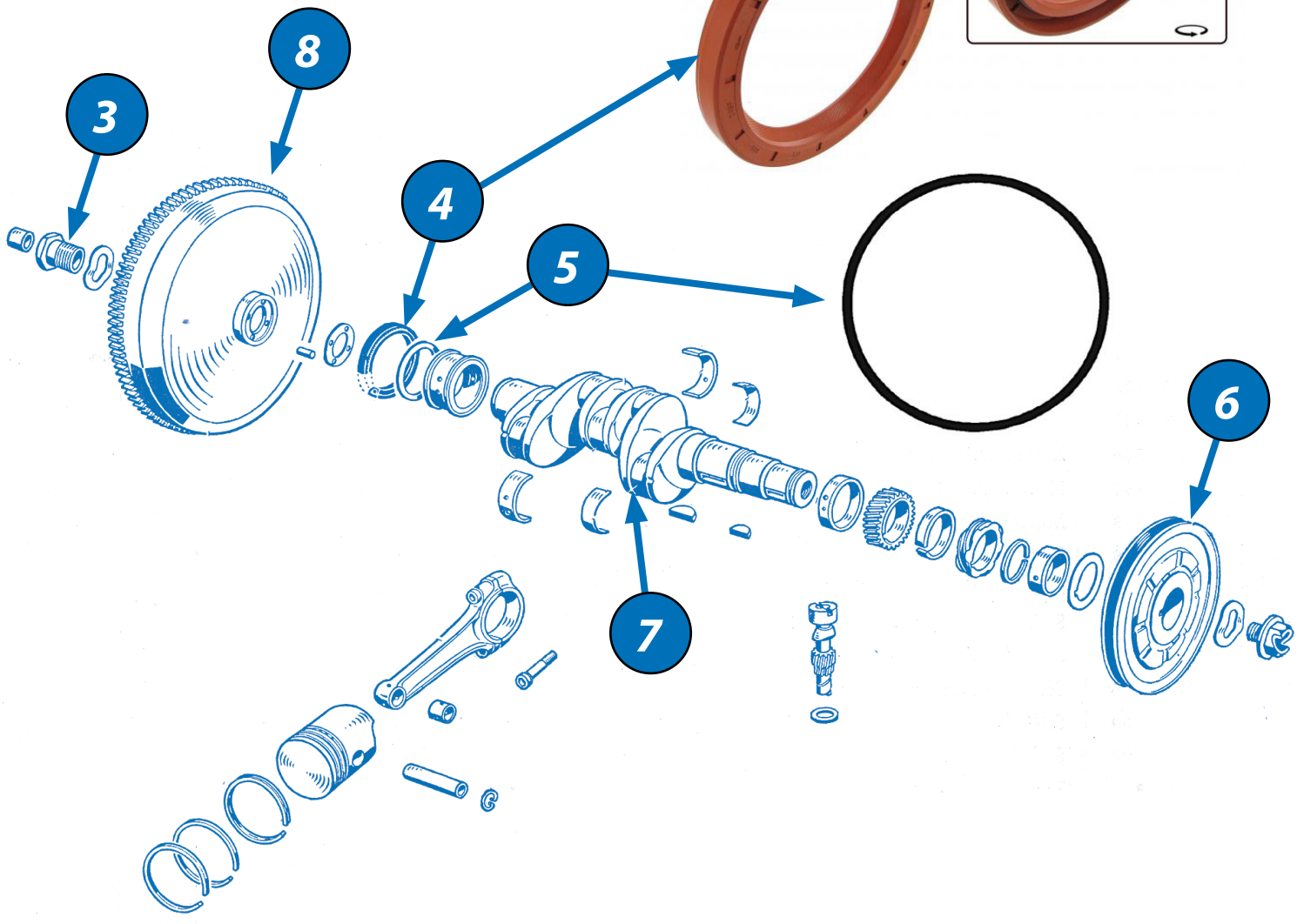
We explained in edition 09 how to replace the clutch disc, the pressure plate and the clutch release bearing. You can read that again on page 43 in edition 09 if you want. If the surface behind the clutch disc, more exactly the surface near the flywheel, shows grease residues there is a chance that the flywheel bearing (or also called crank seal flywheel side) needs replacement. We show a picture below sourced from an old Volkswagen workshop manual, it explains very well how the flywheel bolt (3) becomes visible after removing the pressure plate (1) and the clutch disc (2). The flywheel bearing is hidden behind this bolt.



# crankshaft axial clearance

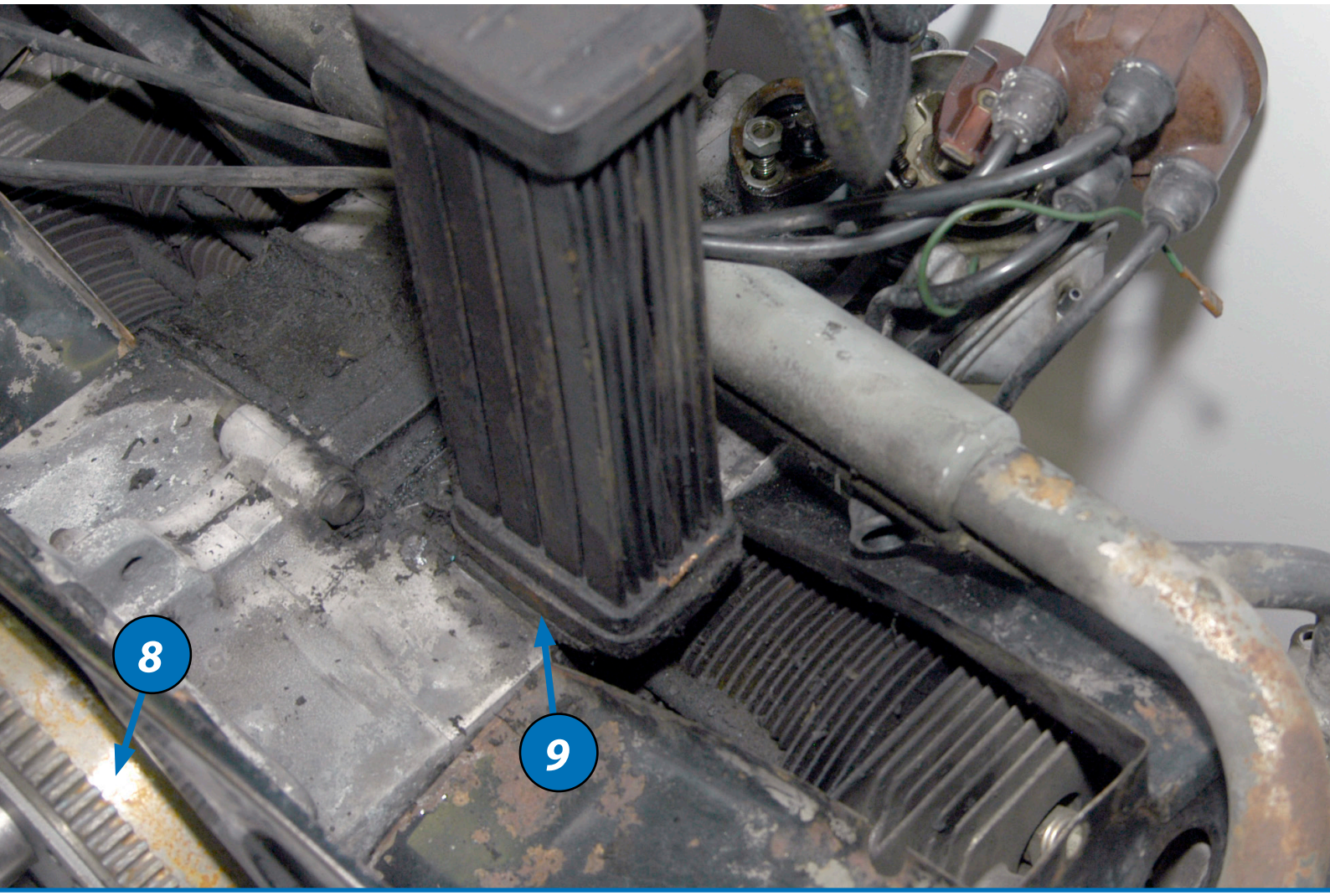
We show below a drawing of a crankshaft (7) with the flywheel (8) and the crankshaft pulley (6). On the left hand side on this drawing is the flywheel bolt (3) and behind this bolt is the flywheel bearing (4) with the O-ring (5). This O-ring is not used on the older engine types, a paper gasket is used instead.

You understand that if the flywheel bearing or the O-ring (or paper gasket) are damaged there will be engine oil dripping all around the flywheel and clutch area.



# #30 Engine

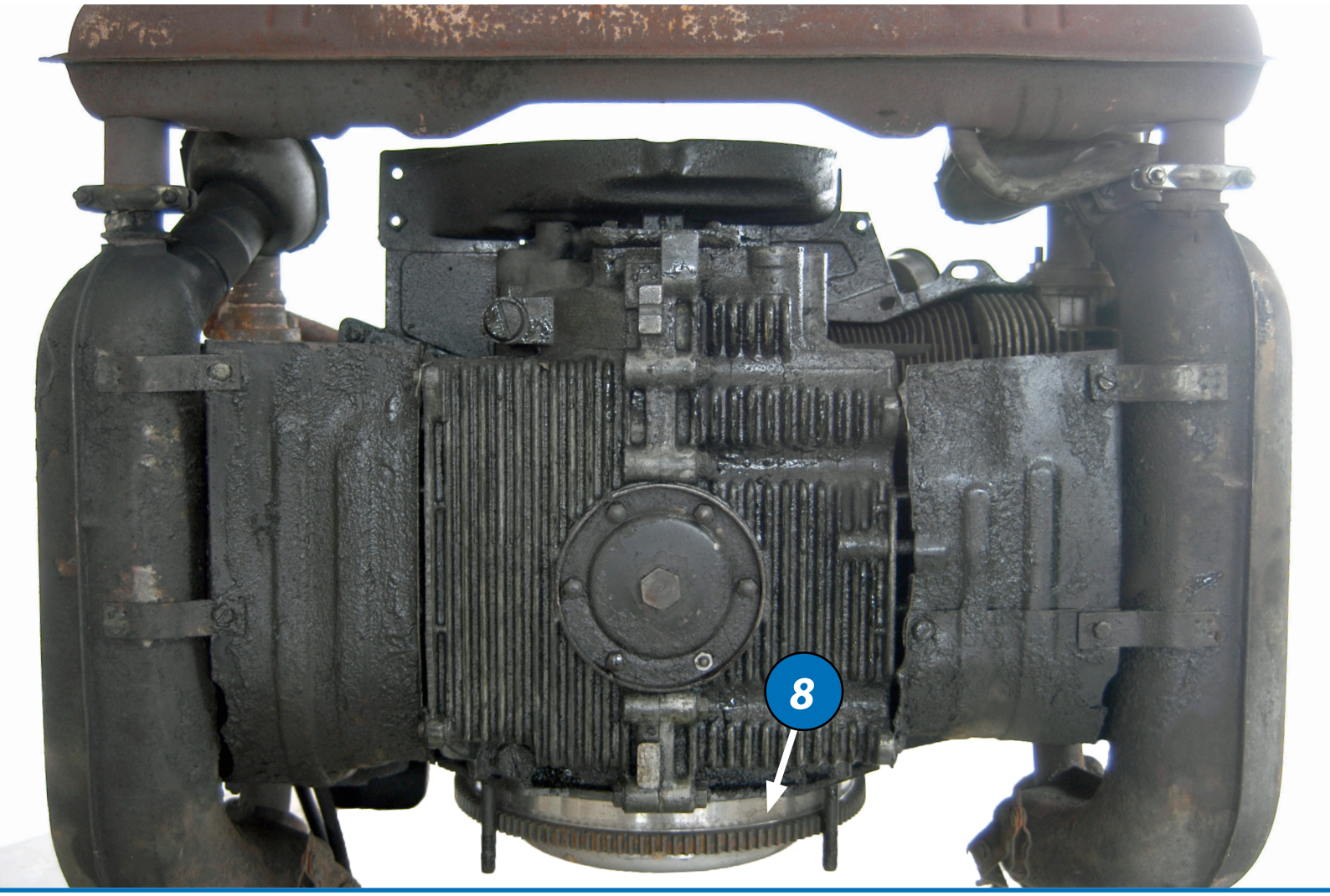
If your engine is dripping oil it is not always easy to know if the flywheel bearing or O-ring is the cause of all. You will have to look underneath your car somewhere near the flywheel, where the gearbox and the engine meet, if engine oil is leaking. The problem is that engine leaks in that place don't always mean that you have a damaged flywheel bearing, it can also be cause by a damaged oil cooler (picture below, number 9). The oil cooler (9) is installed very close to the flywheel (8) as you can see on the picture below. Our experience confirms that many VW enthusiasts tend to replace the flywheel bearing to fix an oil leak while there is nothing wrong with it. You will need to remove the engine, the clutch assembly and flywheel bolt, this is a big job, especially on younger engine models.



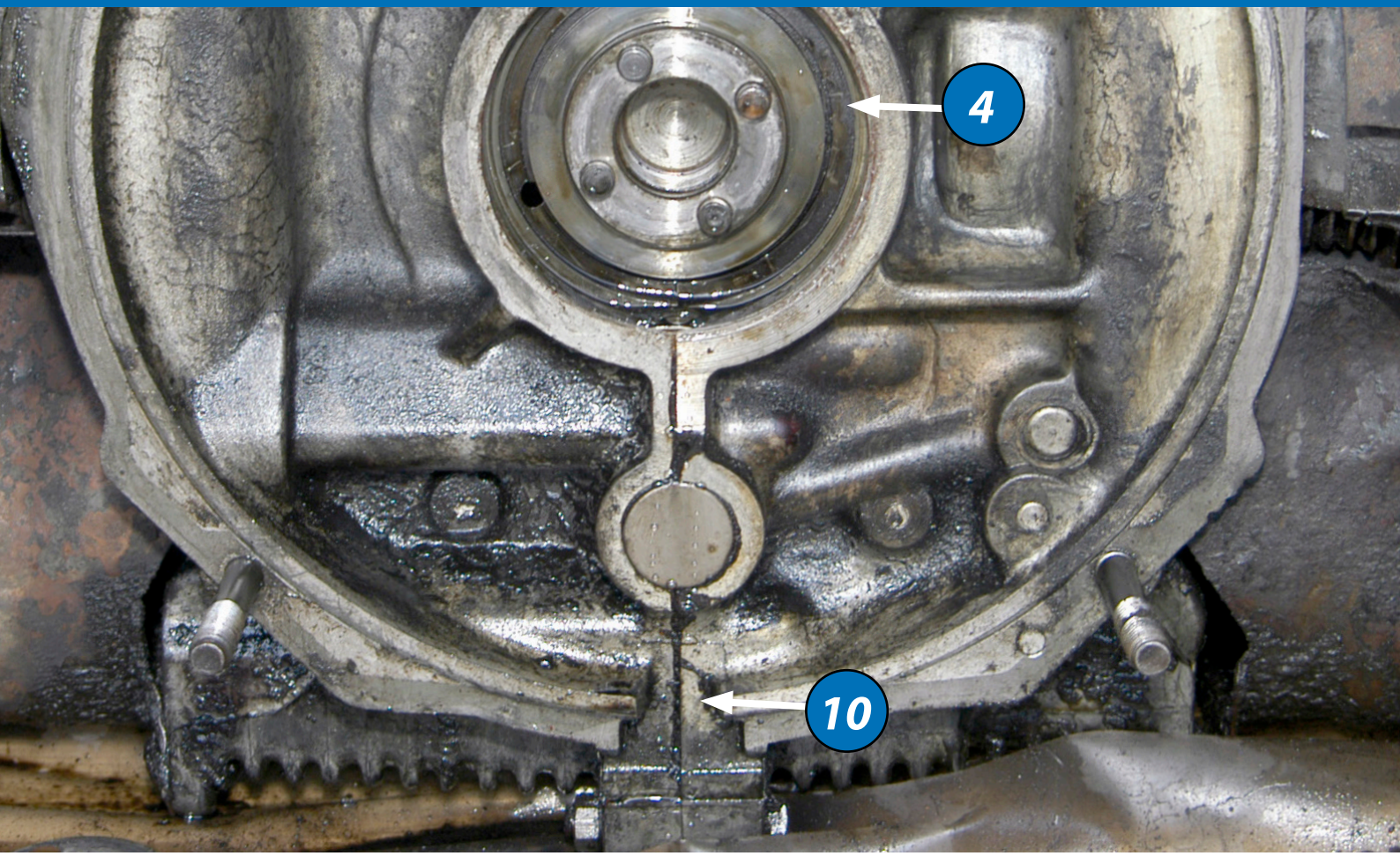
# crankshaft axial clearance

If your engine looks like this one below, then it is very difficult to diagnose any oil leak. You will need to clean the engine first (without removing the engine) and drive for a long time and then take another look under your car to look for fresh oil leaks. This should help you to come with a better diagnose.

You'll find it odd that the oil will be visible under the engine if your flywheel bearing is damaged. One would think that the grease accumulates around the flywheel and stay there. Well no, there is an opening just in the middle of the crankcase, that allows the excess engine oil to escape, this will avoid that the clutch disc is damaged by the engine oil.



# #30 Engine




We show this opening (10) on the picture above. Number 4 shows where the flywheel bearing needs to be installed (bearing is not shown on this picture). It becomes obvious now that a leaking bearing will cause engine oil to drip along the crankcase down the engine. The air flow under the car will cause this oil to spread all over the bottom of the engine, at some point of time it is not possible anymore to define the source of the leak, you will need to clean the engine.

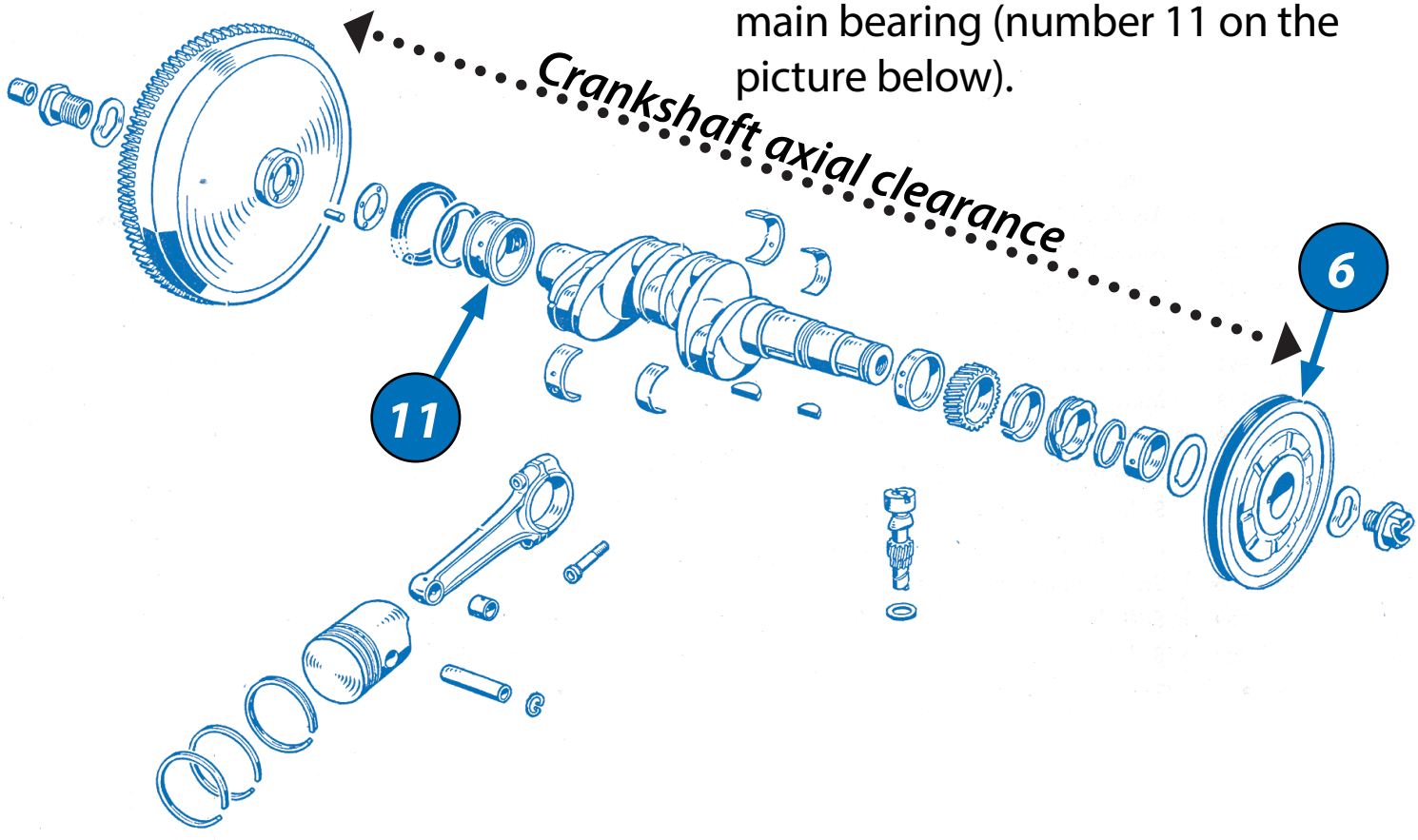
Let's assume that the oil leak is really caused by a damaged flywheel bearing or O-ring (or paper gasket). The natural reaction of any VW owner would be to remove the engine, the clutch assembly and replace the bearing. Well, you first need to make sure that the crankshaft axial clearance is not too big, does this sound too technical for you? It isn't really. If the clearance is too big it makes no sense to replace the flywheel bearing, you will end up with an oil leak anyway.

# crankshaft axial clearance

## What is axial clearance?

You can measure the axial clearance while the engine is still built-in by measuring the clearance on the crankshaft pulley. This is not a precise measurement by all means, but good enough to tell you if it makes sense to fix the oil leak by replacing the flywheel bearing, or not. It will avoid a lot of unnecessary work and spending money to solve basically nothing.

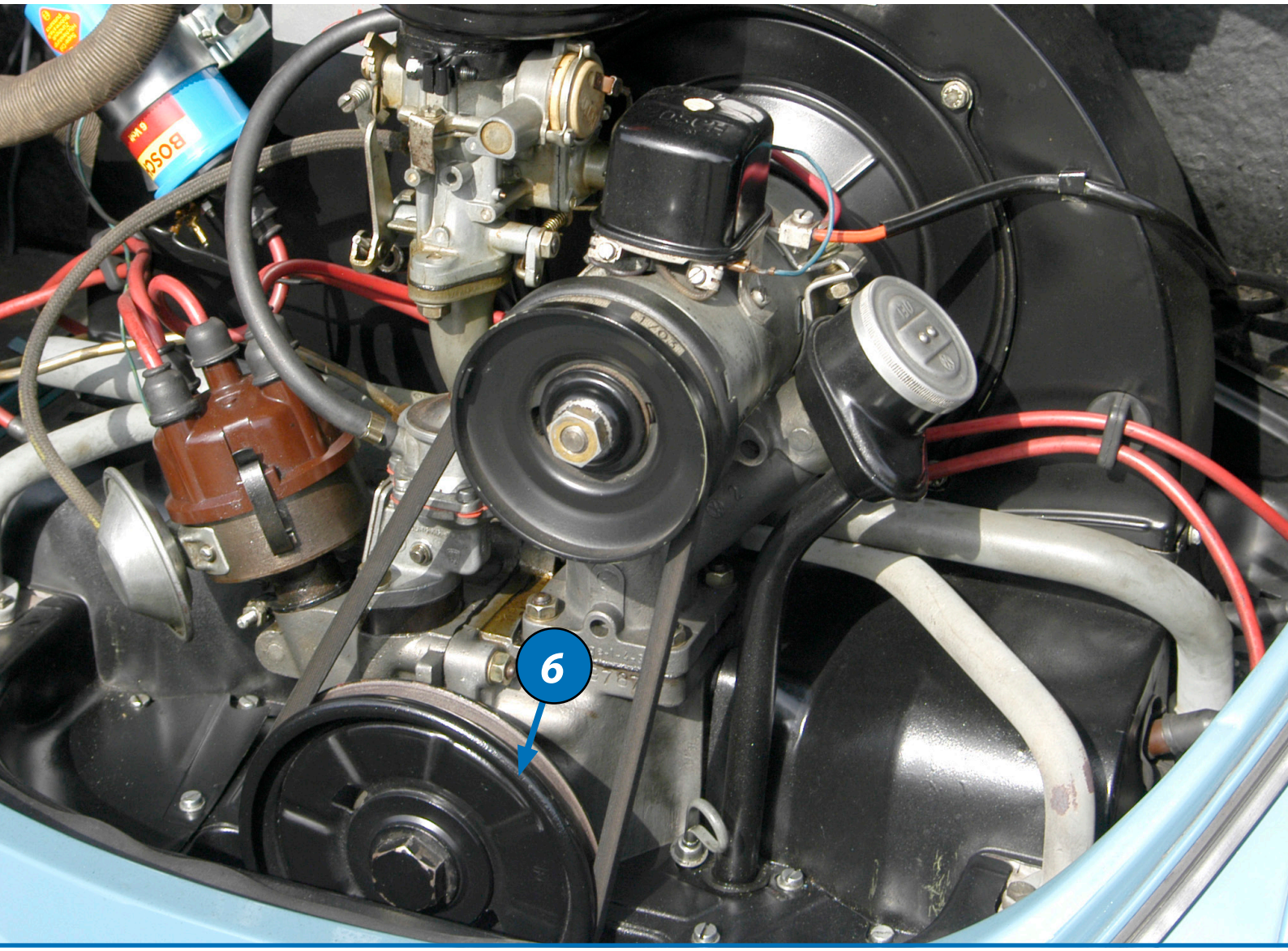
We need to explain what crankshaft axial clearance really is, we do that by using the drawing from page 43 again. The dotted line shows what we mean with axial clearance. It is easy to have a first impression of the axial clearance by pulling and pushing the crankshaft pulley (6). This type 1 engine crankshaft pulley is very easily accessible under the engine lid. The excess clearance is caused by excess wear on the first crankshaft main bearing (number 11 on the picture below).



# #30 Engine

Too much crankshaft axial clearance is common with high mileage engines. Every time the clutch is used it will cause a very high pressure on the crankshaft and the first main bearing causing them to wear down.

Not only the first main bearing will wear but also the crankcase, causing excess play or crankshaft axial clearance. It is therefore advised to release the clutch pedal when the engine is idle (in a traffic jam for instance) to avoid the excessive pressure on the first main bearing. Excess play will increase faster with the performance of your engine.



# crankshaft axial clearance

You can have a first impression of the axial clearance by pulling and pushing the crankshaft pulley shown on the picture on page 50 (number 6). A healthy engine should have between 0,07 and 0,13 mm axial play, you can feel a tenth of a millimeter without using advanced measurement tools. If you hear a clear sound like "click click" or "clack clack" or something like that, the clearance is probably too big. Use a micrometer (shown on the picture below), if you don't have one you may use a simple vernier calliper gauge instead.

The crankshaft axial clearance on a type 1 engine may be up to 0,20 mm, this is quite common for high mileage engines. If the clearance is bigger than 0,30 mm it means that the crankcase and the crankshaft first main bearing are worn out. Replacing the flywheel bearing makes no sense at all in this case, a complete engine overhaul is necessary anyway.

For a more exact measurement you will need to remove the engine and the clutch assembly and measure the axial clearance on the flywheel.


Are you impatient to know how to measure the crankshaft axial clearance? Read the next issue of this technical magazine.

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