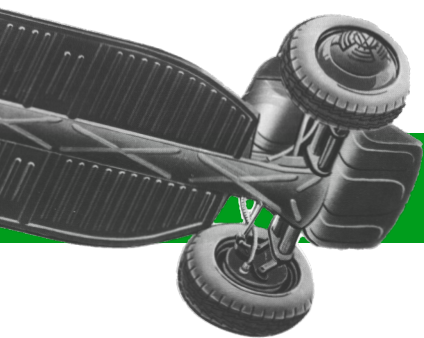
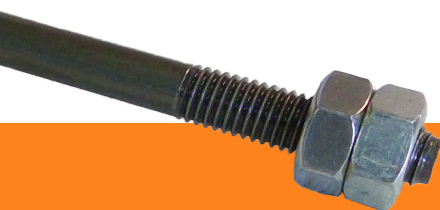


14



#40- Buying a VW: underneath the VW 1200

page 02



#41- Technical: remove a threaded stud

page 24



#42- Electrical: ignition timing - static

page 28



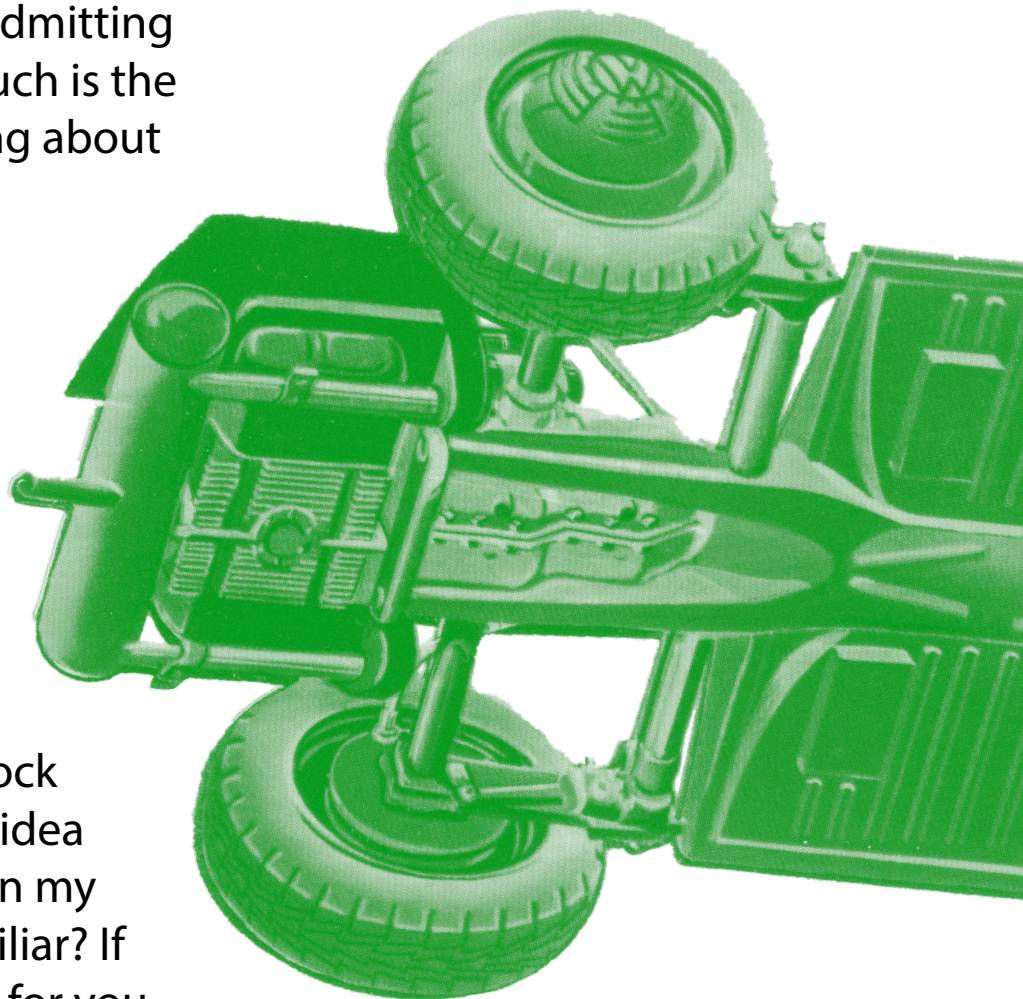
Introduction

When I have a chat with a VW owner I always ask the following question: *"how much do you know about how your classic car works?"* I get most of the time a positive answer, while I can see on their expression that it isn't really true. I'm sure they couldn't show me where the starter is located on a VW Beetle. Admitting that you don't know much is the first step to start learning about your VW.

I remember the time when I bought my first Beetle, I had troubles to start the engine after a long drive. I knew the starter was the cause, one told me that knocking hard on the starter should unblock the pinion but I had no idea where the starter was on my Beetle. This sounds familiar? If so, this article is written for you.

We will study the VW 1200 and the VW 1303. We will start with the bottom of the car.

We show below the drawing of the bottom of the first generation VW Beetle. This model was very basic, the younger models got more complex but the original concept was kept intact.

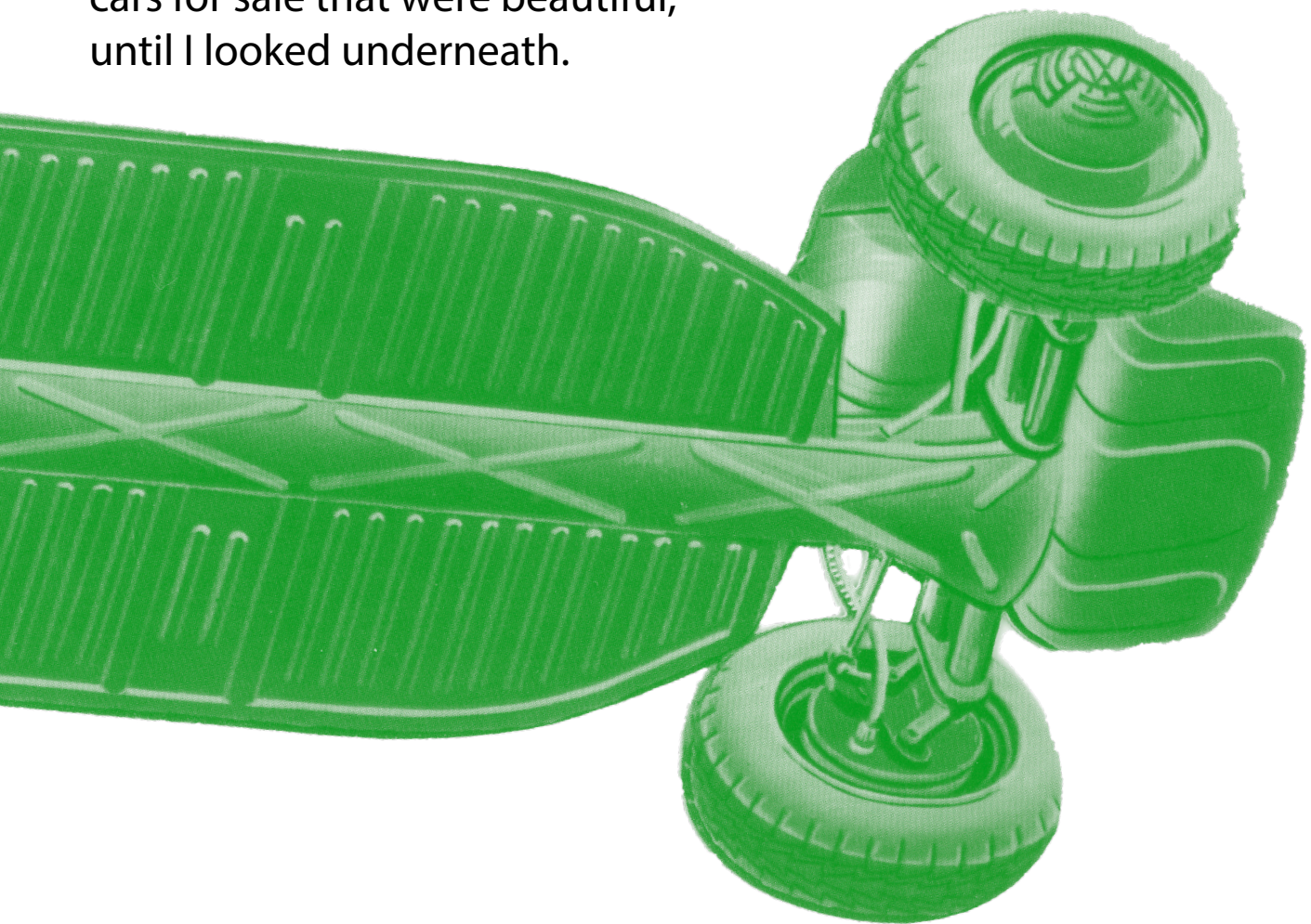


underneath the VW 1200

The first time that you crawl underneath your classic VW, there are many parts you won't see, because you don't know how it all works.

When buying an oldtimer it is very important to inspect the bottom of the car. The visible top part is the most obvious to look at I know, but, I've seen many cars for sale that were beautiful, until I looked underneath.

So, take the time to study both the top and the bottom of a VW you plan to buy. Jack up the car if possible or take it to a garage nearby and put it on a lift. If your plan is to buy an original VW then you will also have to compare what you see with what is described in specialized classic car books.

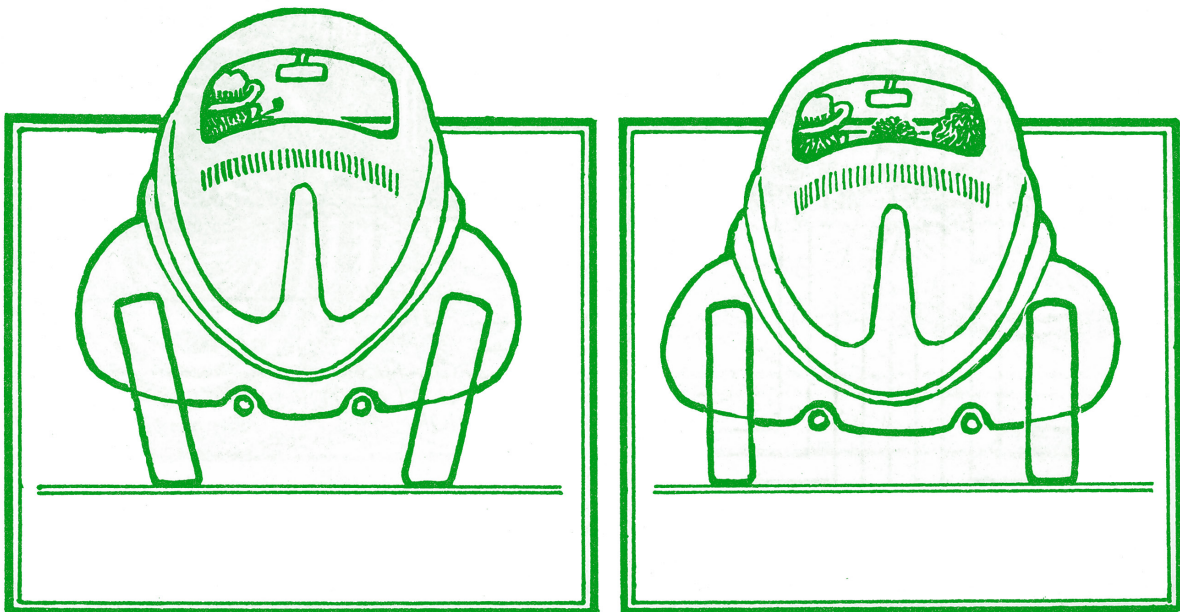


Underneath the VW 1200 - the rear

This is the first in a series of articles about discovering your classic VW. We will start with studying the bottom of the VW 1200, the VW 1303 will be next. Analyzing these two models should cover about 95% of all models of the air-cooled Volkswagen family. It will help you to better decide if you want to buy the VW you see, or not.

The VW 1200 has **swing axles** installed at **the rear** and the VW 1303 has **IRS (independant rear suspension)** drive shafts. The swing axles are installed on the "old generation" Volkswagens but also on younger "standard" Beetles. The IRS drive shafts were used on the younger generation air-cooled Volkswagens. It is easy to recognize if swing axles are installed, just look at the position of the rear wheels as shown on the drawing below, they tend to incline inwards.

You can recognize the older VW models with swing axle from the typical position of the rear wheel, they are inclined towards the inside of the car, the more load the more the wheels will tend to move to the outside.



© *How to keep your Volkswagen alive - John Muir*



underneath the VW 1200

You also recognize the swing axle on the typical trumpet shaped swing axle boots (1a and 1b) installed on the gearbox side. These boots can be in one piece (1a) or split (1b). The split boots are used when you have to replace them but you don't want to remove the swing axles.

swing axle

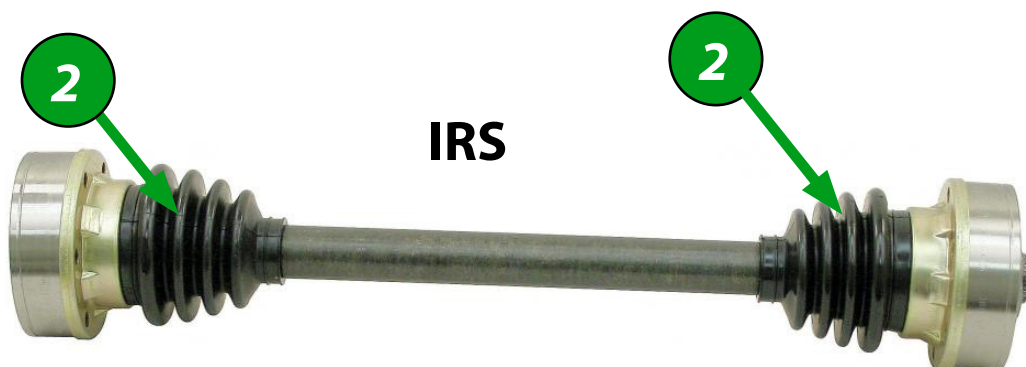


Below we show a swing axle boot, this is a split type used when you want to replace the boot without dismantling the swing axles.

The IRS is a cardan shaft based drive shaft as shown on the picture below (2). The main difference between a swing axle and an IRS drive shaft is that the latter is articulated on both sides, which offers a better handling and improved driving comfort.



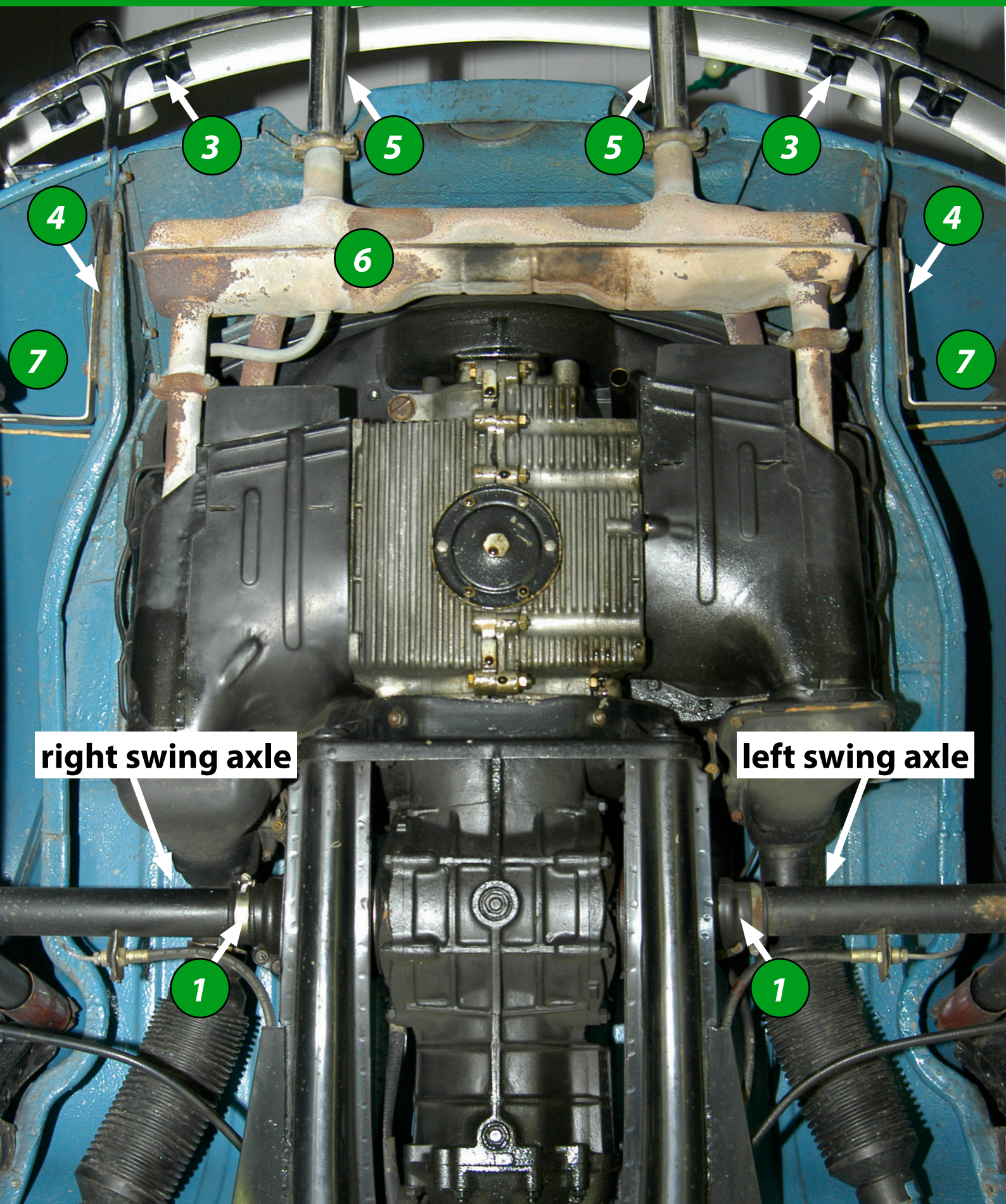
We show an IRS axle with its typical accordion shaped boots to protect the cardan drive shaft against water and dirt.



IRS

#40

Buying a VW



underneath the VW 1200

The rear bumper

If you want to follow along, it is time to crawl underneath your VW, read the instructions first in [edition 03](#) to know how to jack up the car using a standard VW scissor jack (use an additional jack stand for security). The picture on page 6 shows what you should see now. Let's discuss all visible parts now starting from the rear of the car.

You can inspect the rear bumper without crawling underneath the car of course. Check the bumper brackets (3). If the bumpers are in bad shape, it could cost a lot depending on how old your VW is. The older the car the more expensive a new bumper set will be. While you are underneath the car, pay extra attention to the bumper supports (4) attached to the body of the car. If it was involved in an accident at some point of time, it should be visible if the repair was not done properly. The bumper support on both sides tend to rust over time, you can of course replace the bumper support metal sheets (4), it is not too much work for a professional body shop specialized in air-cooled Volkswagens.

3



4



Exhaust tail pipes

A 1960 type 1 engine with carburetor will have two exhaust outlets with a chrome exhaust pipe on each side (5). These tail pipes have a muffler built-in on our VW 1200. Make sure they are well attached, they should be capable of supporting your full body weight. Don't forget if the car is jacked up with a scissor jack that it could tilt!



5



The exhaust

The exhaust (6) will show some corrosion if it has been driven for very short drives or if it didn't run for some time. Replacing the exhaust is not too difficult, but if the engine was never removed or if it wasn't removed for a long time there could be a lot of rust making the removal more a pain than fun. Replacing the exhaust is a job you could do at home and it is not too expensive. A little rust on the exhaust parts is normal, as long as you don't discover holes the car could drive for some time without intervention.

6



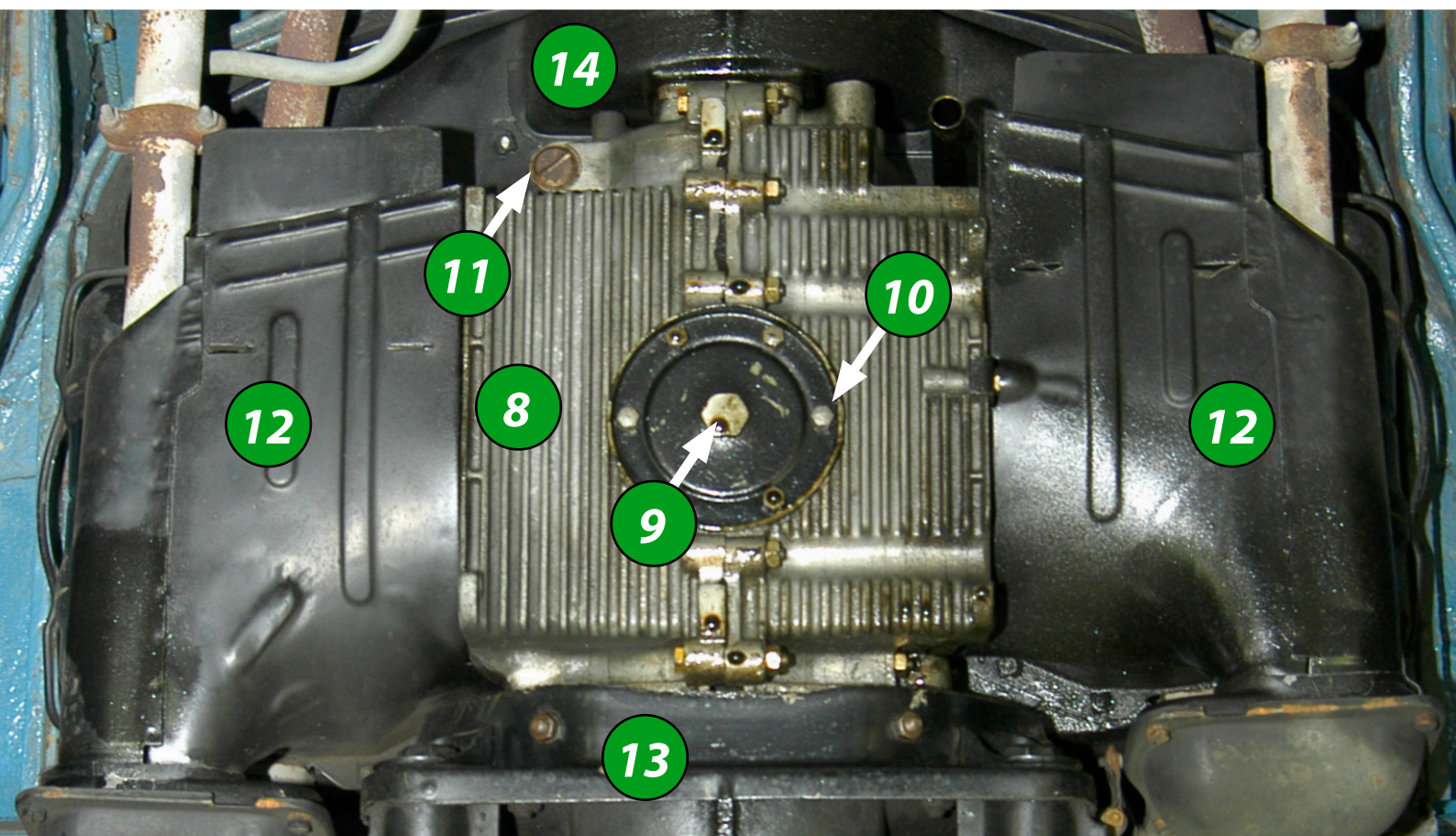
underneath the VW 1200

Fenders

You have a good view on the inside of the fenders now (number 7 on page 6). The inside of the fenders can be in a bad shape, check if there is not too much mud piled up, if so, it shows that the car was not well taken care of. Check the spots where the fenders are bolted onto the body of the car. You can not see all parts of the fenders from here, but try to inspect as well as you can.

The engine

At the bottom of the crankcase (8) you see the sump plate secured by small cap nuts (10) and a big bolt in the middle (9) to drain the engine oil (not used on all engine types). By removing the small cap nuts (10) you can remove the sump plate to clean the oil screen. Additionally one or two big bolts are installed (11), they cover the oil regulation springs.

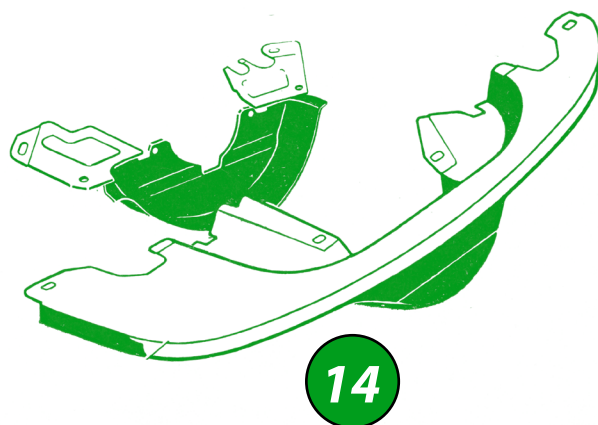
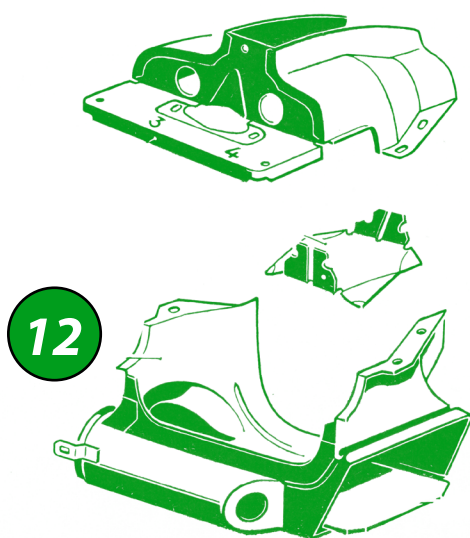
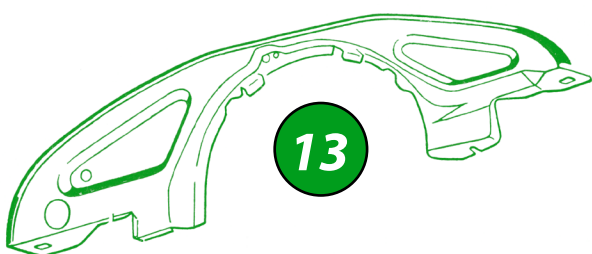


Engine tin plates

The bottom of the crankcase should be dry, not showing dirt or oil. If it does, it shows that the VW you are looking at was not very well taken care of, you will have some work in the future detecting oil leaks and resolving different oil leak sources.

We have discussed this topic in [edition 07](#) and [edition 08](#).

You can see some of the engine tin plates (number 12, 13 and 14 below and on page 9). The doghouse hiding the cooling fan under the engine lid is also part of the cooling system tin plate collection. If the car misses some of the tin plates it means that it received insufficient cooling, the engine could have suffered from that. The engine tin plates are an essential part of the cooling system of the air-cooled engine.

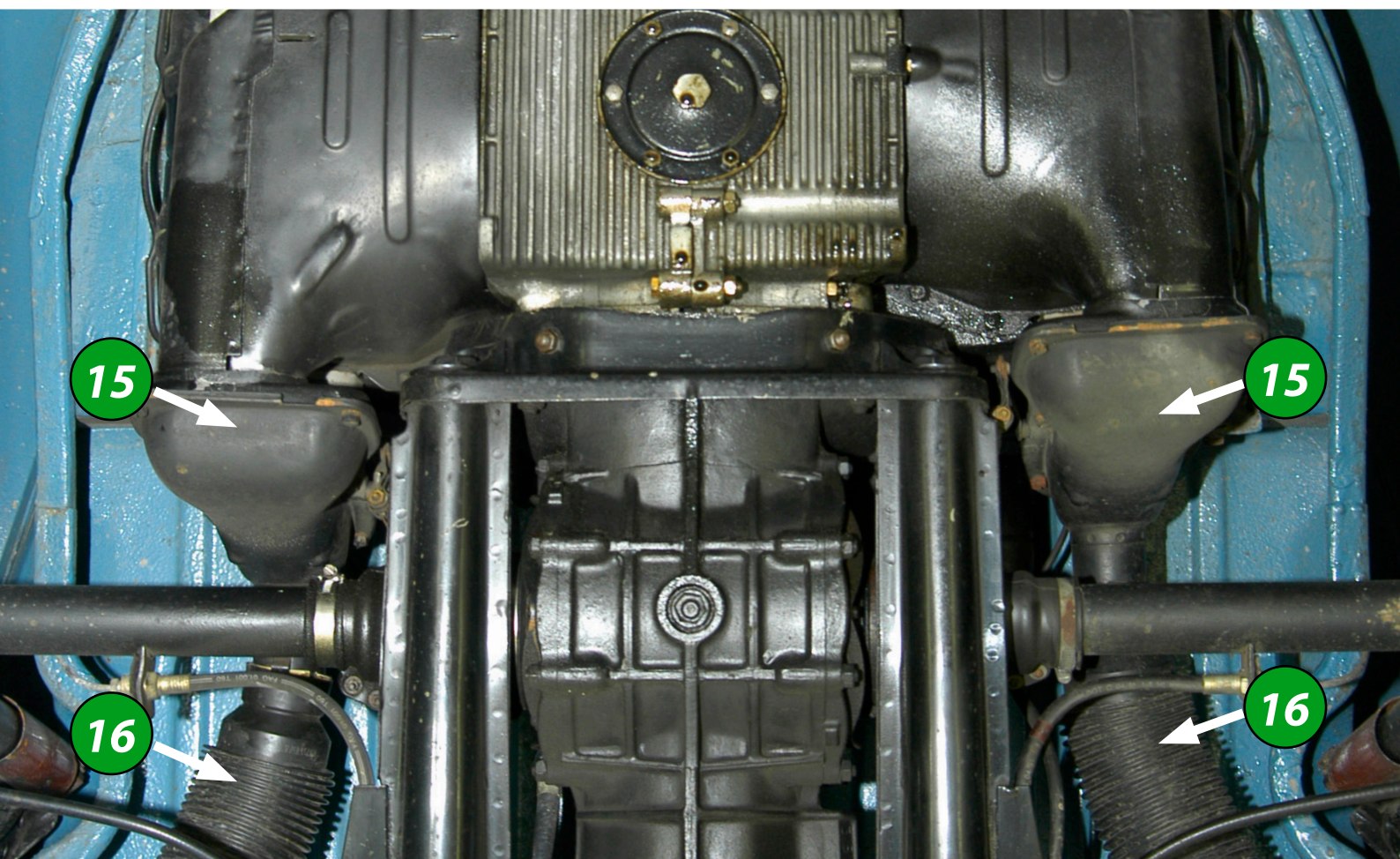


underneath the VW 1200

Heat exchangers

There are two heat exchangers (15), one on each side of the car. They connect to the engine on one side and to the front of the car on the other side through heater hoses (16). The heat exchanger control cables are not visible on the pictures here, they run from the inside of the car to the heater control boxes (15). We show the controls on page 12 on separate pictures from our webstore.

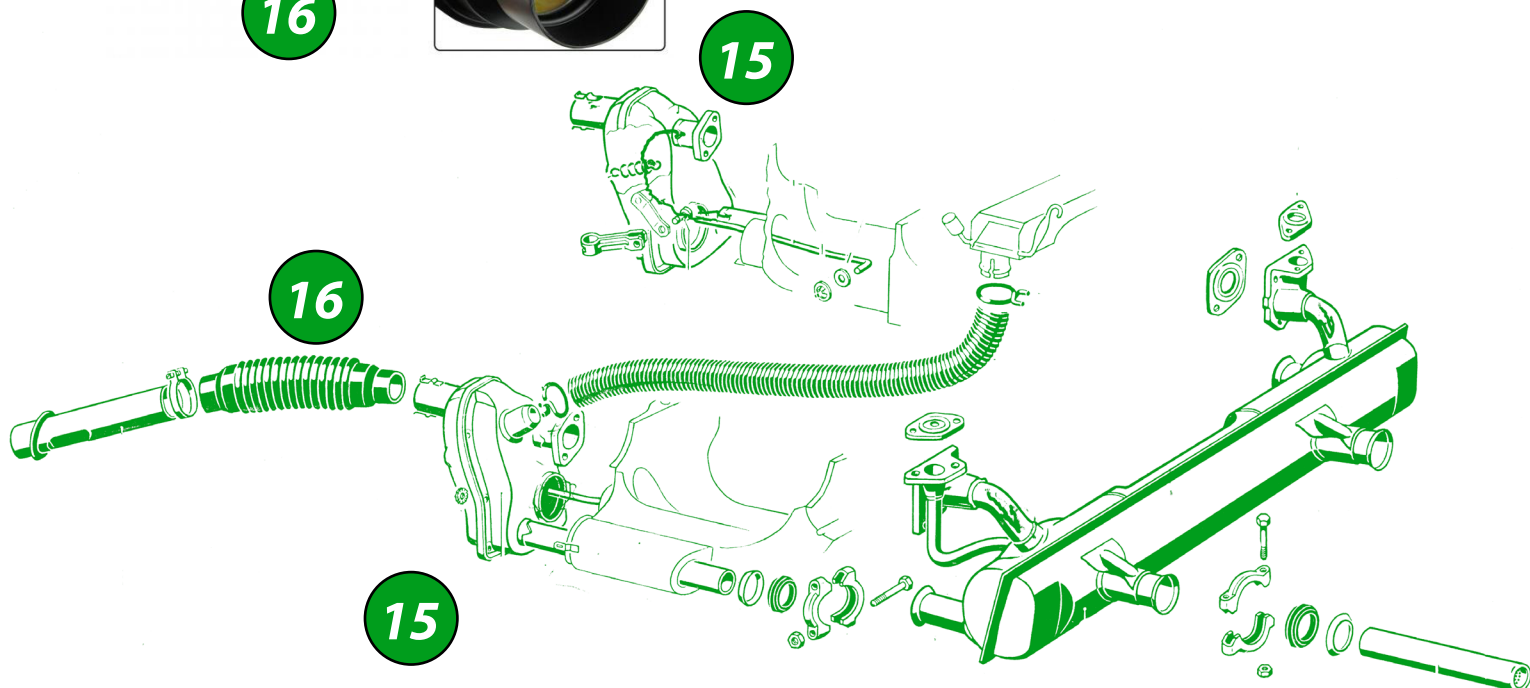
Try to pull these control cables, you should hear the heater control boxes open and close. If nothing happens, the heater control boxes could be damaged. Check if there are holes in the heating system parts, everything could look a little rusty, that's normal. Replacing the heat exchangers will require you to remove the engine from the car.



Below we show a technical drawing of the exhaust and heating system (number 15 and 16) of our 1960 VW 1200. The heater hoses (number 16) is connected with the inside of the car. New heat exchangers are more expensive for older Volkswagen models.



Go to our webstore to view all heating system parts.

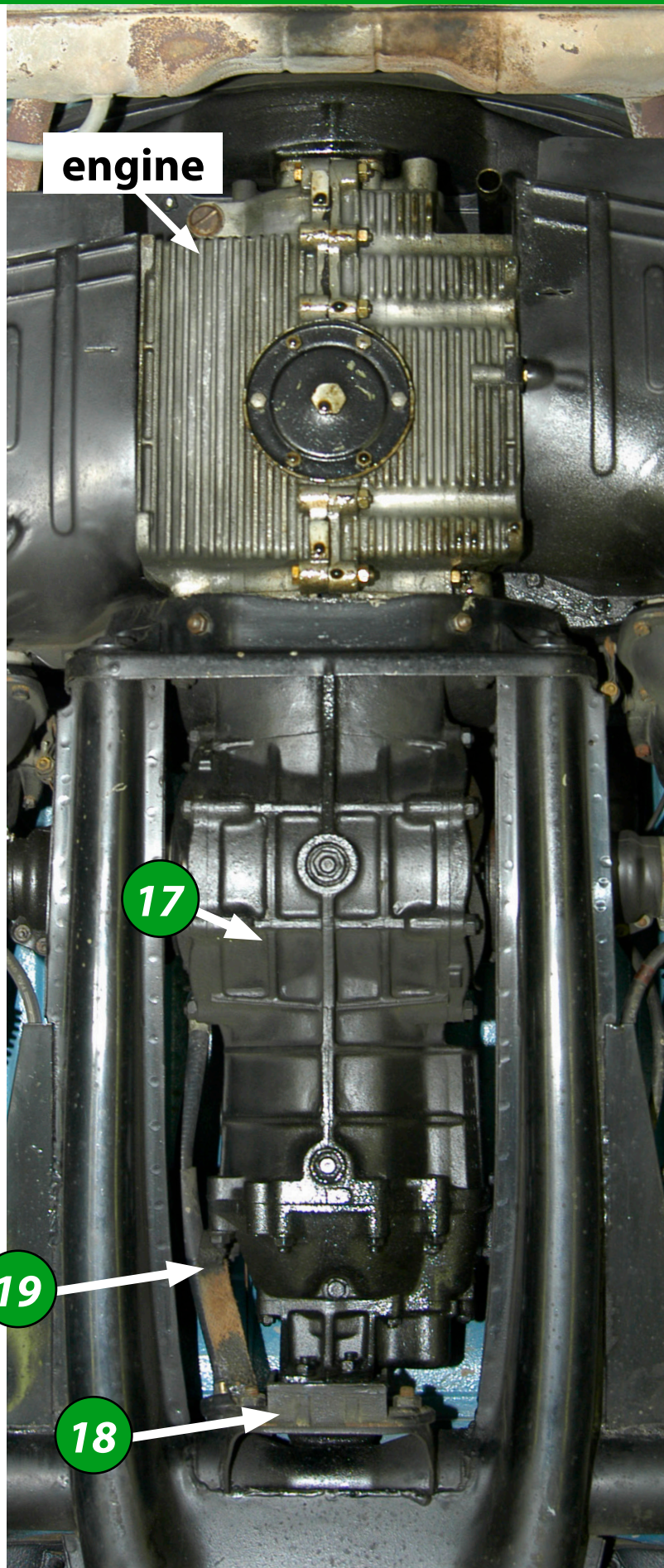


underneath the VW 1200

Gearbox

The engine "hangs" on the gear-box (17) and is attached with four bolts. We have explained this in [edition 13](#). The front of the gearbox (below on the picture on the right) is attached to the chassis with a silent block (18). Check if the silent block is in good shape, if it isn't cracked or damaged. A worn out silent block will influence the driving behavior of your VW.

One or two Allen bolts on the bottom of the gearbox are used to drain the transmission oil. Another bolt on the left side of the gearbox (right side on the picture) is used to fill the gearbox. No oil or dirt should be visible on the gearbox, if so, I'm sure the gearbox didn't receive new oil for a long time. A partial or complete overhaul of the gearbox could be necessary, check with a Volkswagen professional.



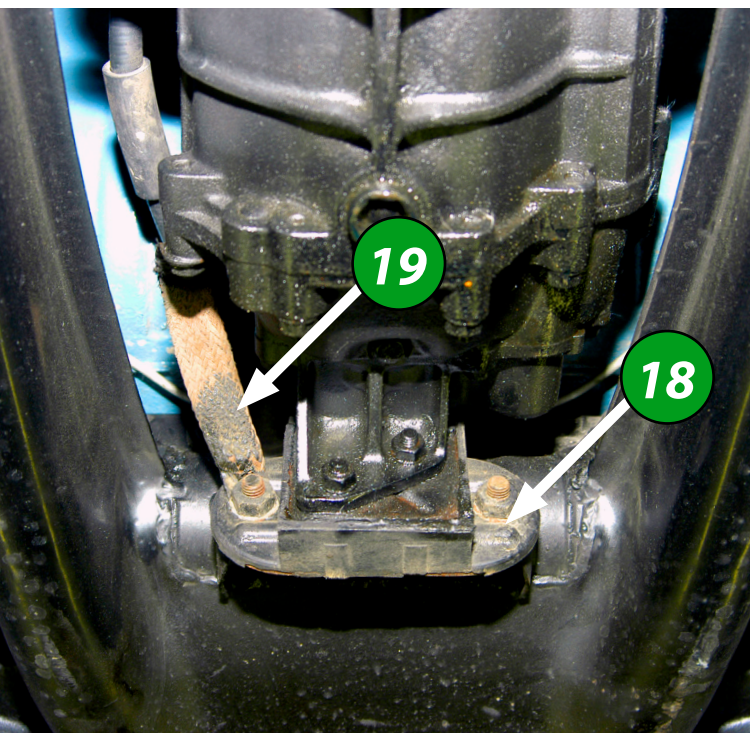
As we said earlier, the engine "hangs" on the gearbox and the gearbox is bolted onto the chassis using a rubber silentblock (18) in between the gearbox and the chassis. To connect the engine and the gearbox to the electrical ground, a ground strap (19) is used. This braided wire should be in perfect shape to take care of the electrical current running from the engine to the battery.

We show the gearbox/chassis silentblock (18) below and the braided ground strap (19).



The clutch

The clutch is activated by the clutch cable (number 20 on the picture on page 15). You can see this cable on the right hand side when you are underneath the car. It is a tick cable (thicker than the throttle cable, number 22), that connects to the clutch control lever (21) located at the back of the gearbox. Pull the clutch cable, you should feel some play, just about 1 mm. If this is the case, the clutch is adjusted correctly. The lever and the cable are not very visible on these pictures, we have discussed this topic already on [page 37 in edition 09](#) with detailed picture.

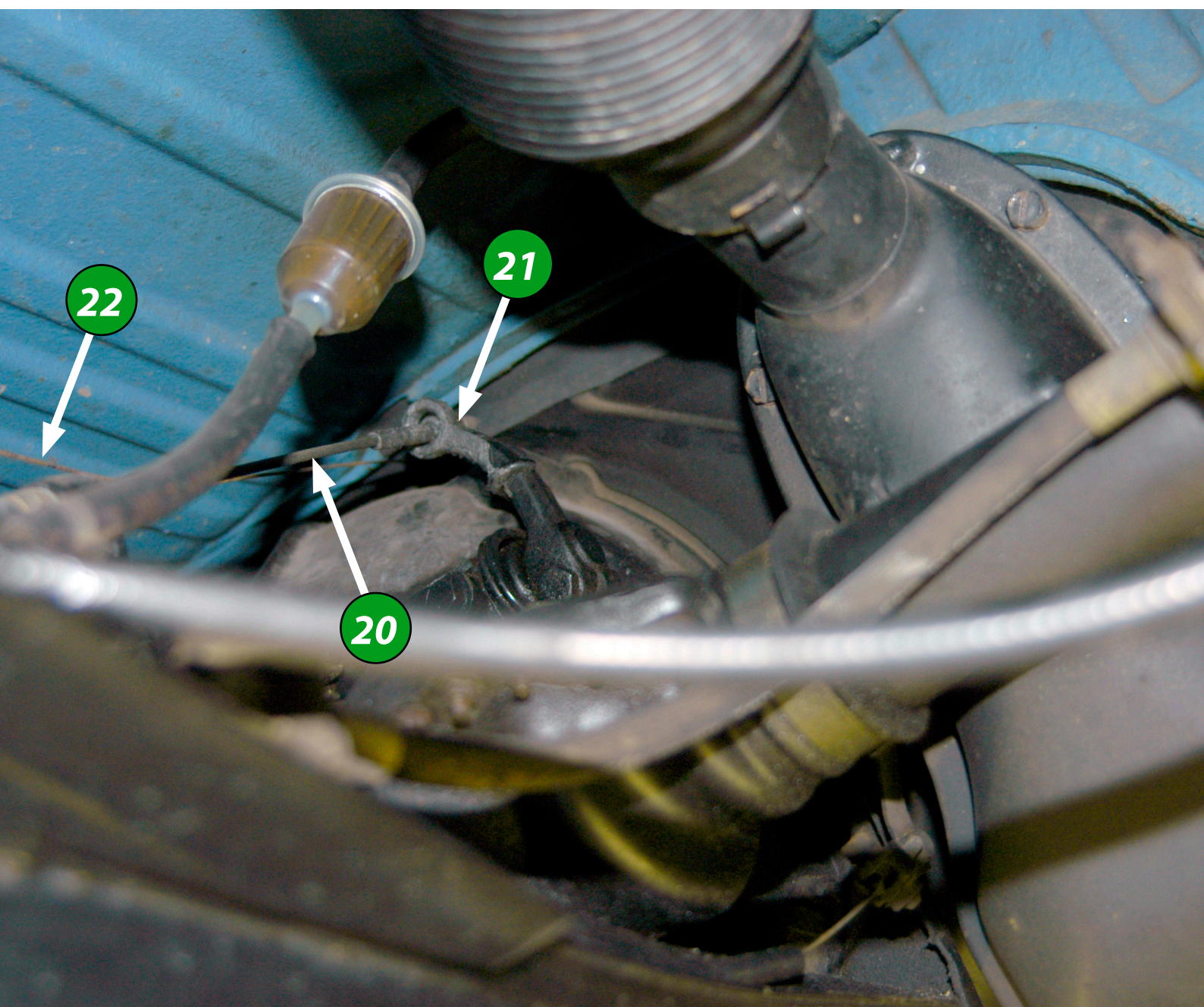


underneath the VW 1200

Throttle cable

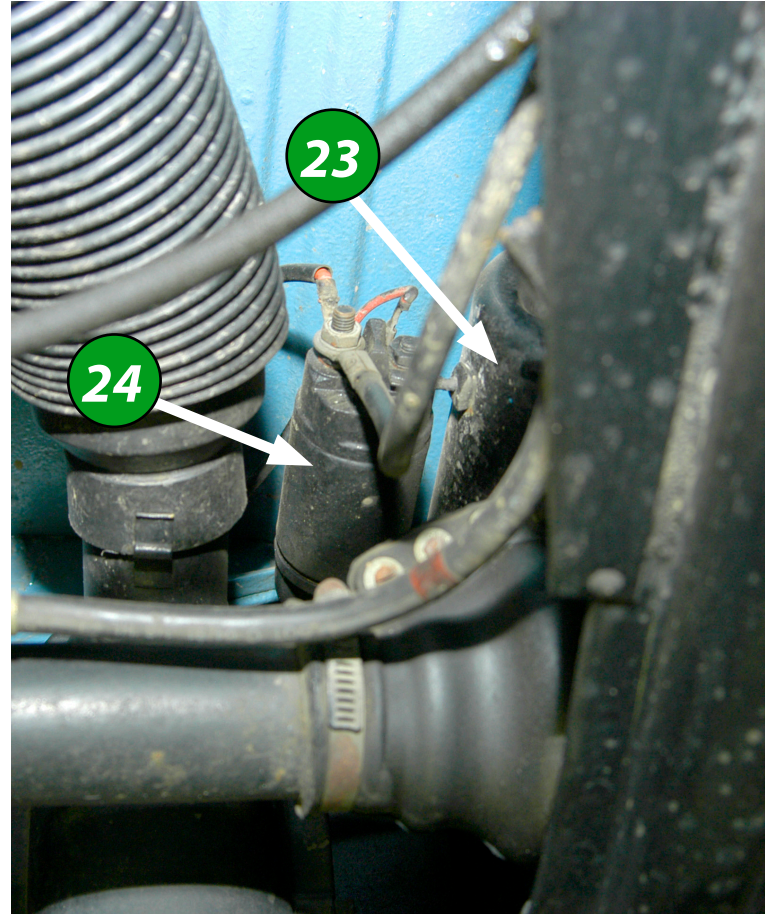
A much smaller metal cable is visible on the picture below, this is the throttle cable (number 22). It connects to the throttle pedal in the front of the car and to the

carburetor throttle lever on the engine. Pull the cable gently, you should hear the mechanical sound of the carburetor lever moving.



Starter

The starter (23) is installed on the right side of the car (left side from underneath the car) on the rear of the gearbox. You should see a cylindrical shaped unit with electrical cables connected to it. The starter is made out of two parts, the starter motor (23) and the starter relais (24), the latter is also called the solenoid. The electrical starter can fail if the car wasn't used a lot in the past, and when you take it for a long drive. Replacing or repairing the starter is a good idea if this occurs, you can do that without removing the engine.



Transmission

The power of our VW 1200 engine is transmitted to the rear wheels through the gearbox and the swing axles on both sides ([refer to page 5](#)). Check if there are no cracks in the rubber boots. Rotate the left and right wheel separately, you shouldn't hear too much friction if the

brakes are well adjusted. If you still hear a lot of friction after adjusting the rear brakes, there could be an issue with the rear wheel bearings. If you don't have enough experience to make a good diagnose, check with a classic Volkswagen specialist.

underneath the VW 1200

Rear brakes

You should see the brake lines on both sides, they run from the inside of the car through the chassis to the rear wheels. There is a brake cable to operate the emergency brake (100% mechanical) and an hydraulic brake line to operate the rear drum brakes. The hydraulic lines are a mix of rubber hoses and metal brake lines, they are operated with the brake pedal. Check if the rubber hoses aren't cracked and if the metal lines aren't corroded. The brake fluid is very corrosive, so a very small leak



left rear brake

right rear brake

can damage the body or chassis of your VW. Replace all brake lines and hoses and brake fluid anyway if the car didn't drive for many years, you will have brake problems for sure if you don't.



right swing axle

left rear brake

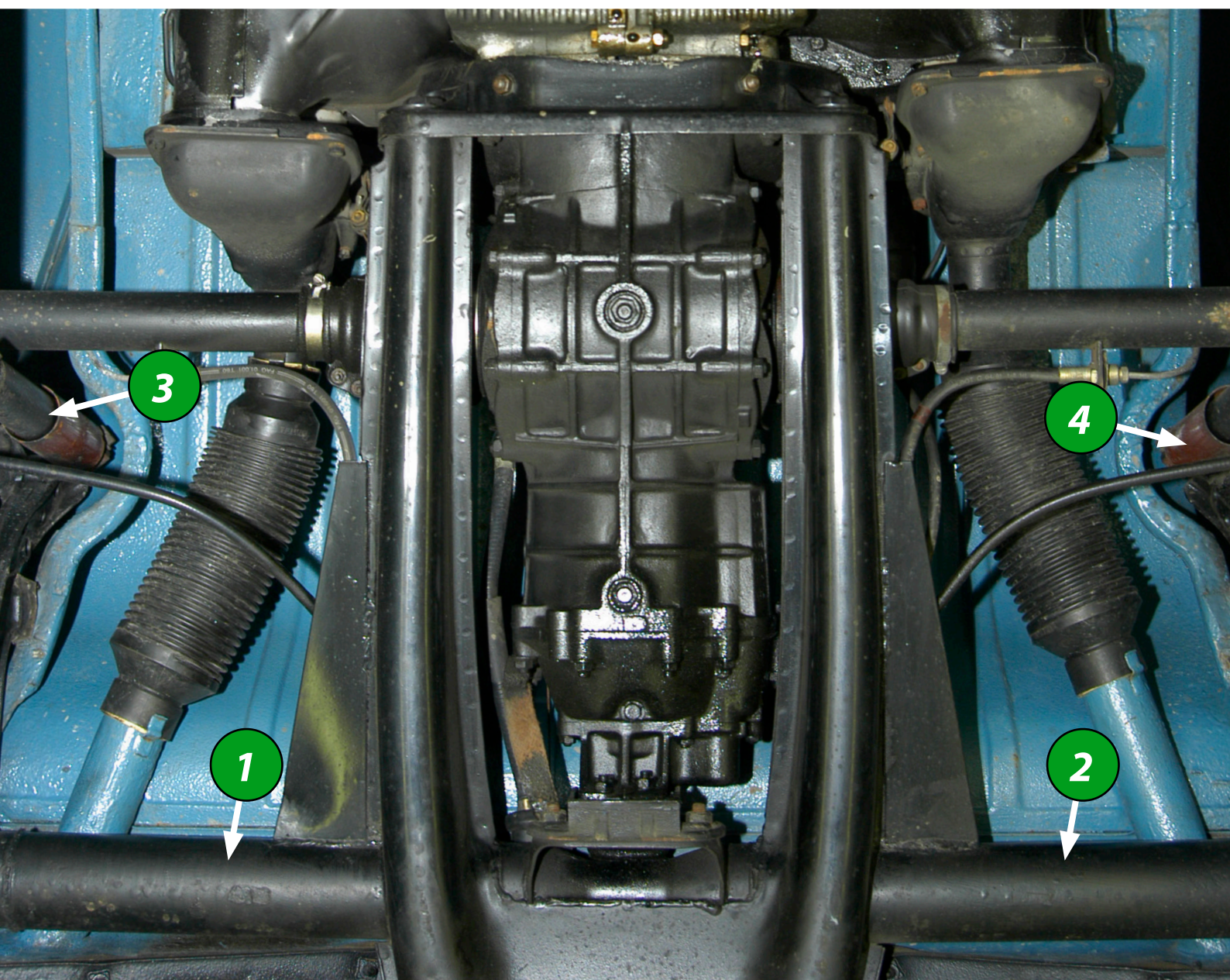
right rear brake

right swing axle

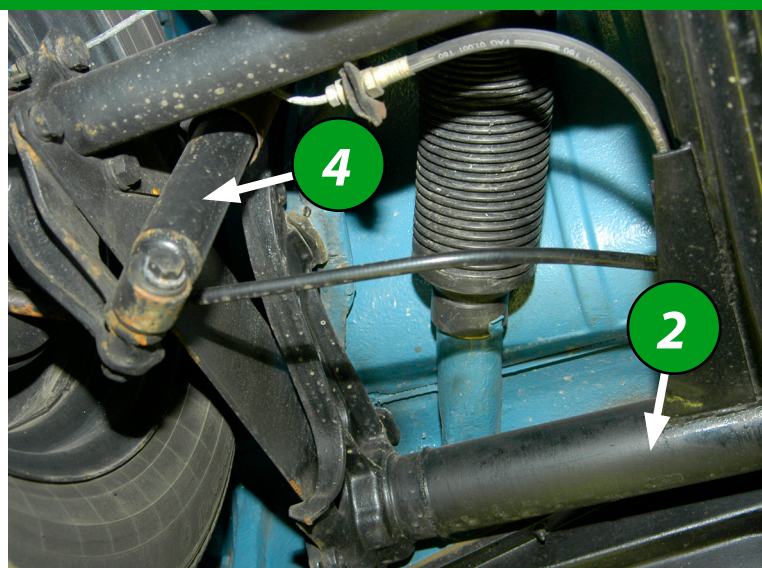
Suspension and shocks

The rear suspension on all air-cooled Volkswagens is based on the torsion bar principle. The pre-loaded torsion bars will compensate for the unevennesses of the roads you drive on.

- 1** right hand side torsion bar housing
- 2** left hand side torsion bar housing
- 3** right hand side rear shock absorber
- 4** left hand side rear shock absorber



underneath the VW 1200



To avoid that the car will jump up and down, shock absorbers are installed on both sides. You should see the suspension above you if you are lying down under your VW, behind the wheels are the shock absorbers (3 and 4). The torsion bar housing on both sides protects the torsion bars against dirt and water (1 and 2).

If oil filled shocks are installed, check if they don't leak. Replacing both shock absorbers is easy to do and not so expensive. Also replace the bolts and the washer rings while you are at it. We explained in [edition 08](#) how the suspension works.

Running boards

You should have a good perspective on the running boards on both sides now. Check the mounting bolts for rust on the body of this VW. Push and pull gently on the running boards, do you hear crisping sounds? If so, there could be a lot of rust accumulated behind the running boards, the heater channels could be corroded. Replacing the running boards is easy, replacing the heater channels will require a "full body restauration".

Body and chassis

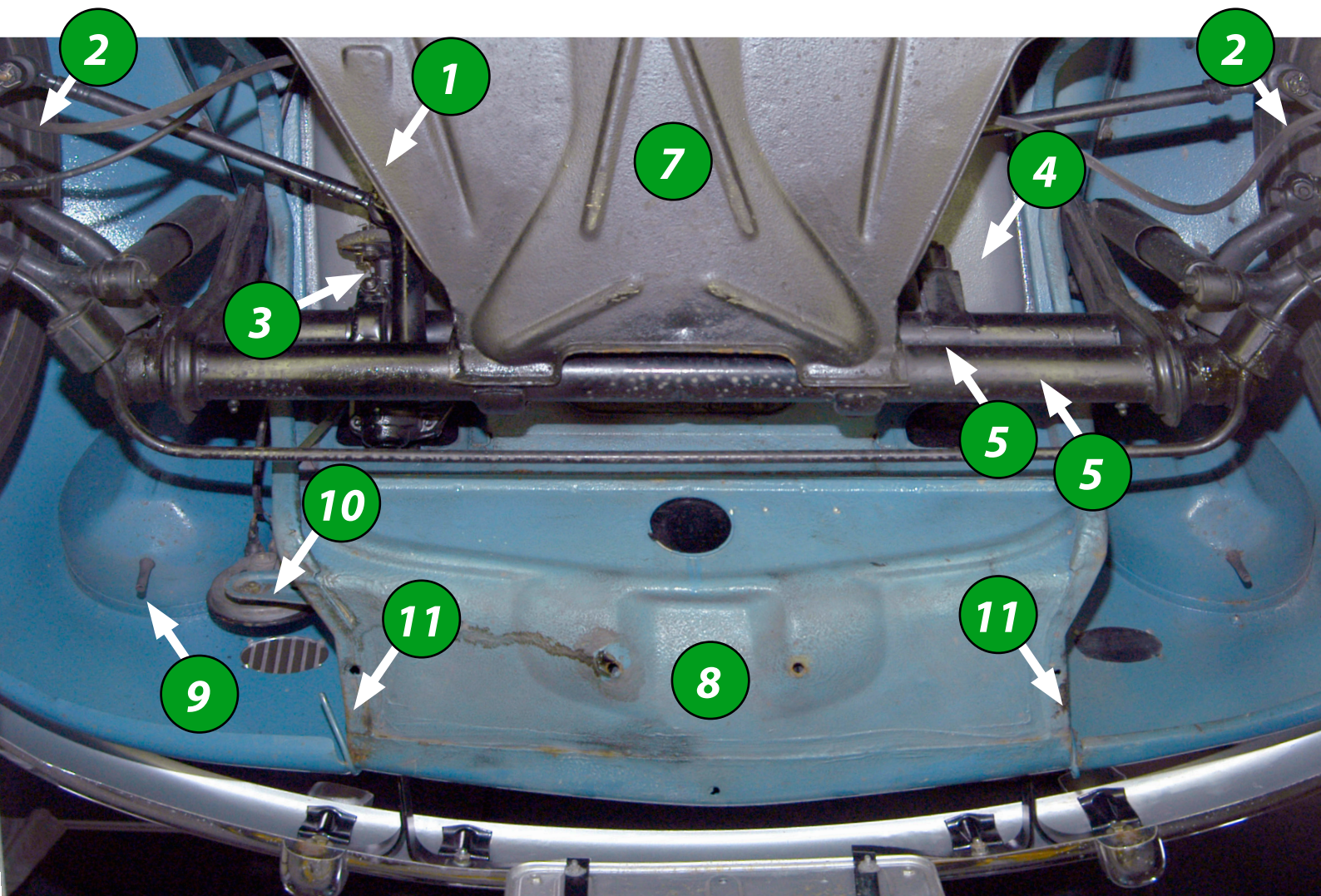
Take some time to inspect the chassis and the body for rust.

below - the front

All air-cooled VW's have the typical torsion leaves suspension **in the front**, the VW 1303 (but also the 1302, 411/412 and the T25/T3 Bus) is equipped with the more "modern" MacPherson struts. We explained how the front suspension works in [edition 08](#), read that article by clicking on the underlined blue text above.

Master brake cylinder

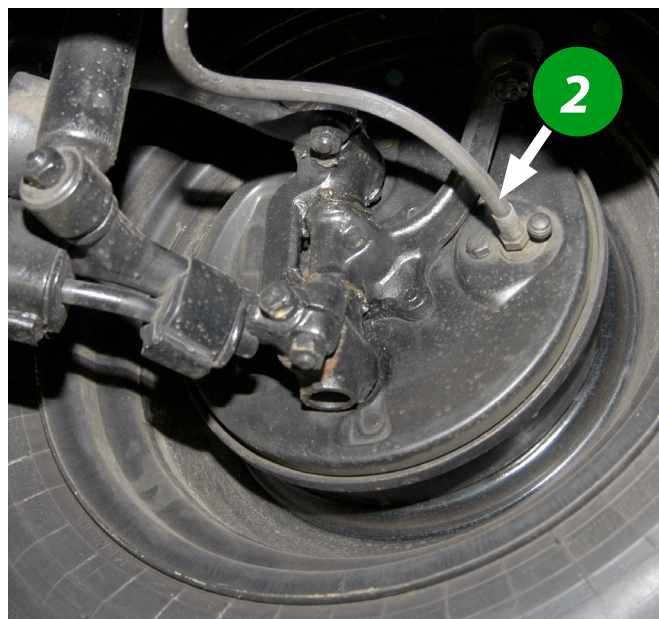
It is very difficult to see the master brake cylinder from this perspective, it is hidden behind the frame head (7) on the left side on the picture below (1). We show where it is located with the circle number 1 below. Check if there are no leaks and if the brake switch cables are properly installed.



underneath the VW 1200

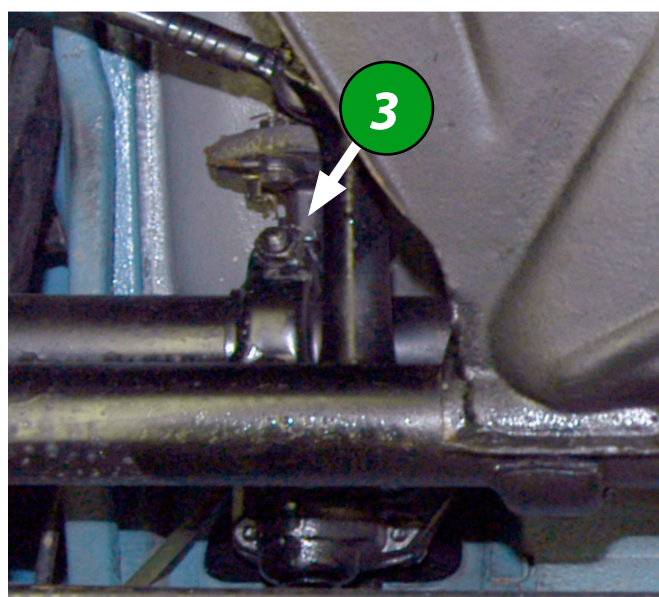
Front brakes

You should see the drum brakes left and right above your head (2). Check the rubber hoses and metal brake lines for wear and leaks. Rotate both wheels, if you hear friction sounds the brakes are not well adjusted. Or, maybe the front wheel bearings are worn out. Consult a VW specialist if so.



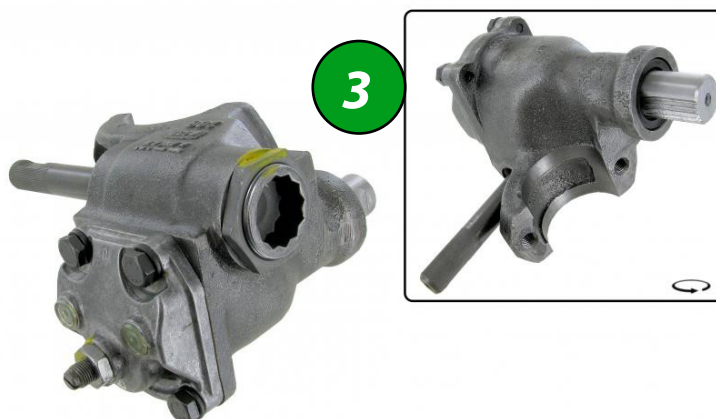
Steering box

The steering box (3) transforms the steering wheel rotation into turning wheels. Ask someone to turn the steering wheel and watch what happens (be careful that the car is stable). Check the steering box for oil leaks. Replacing the steering box is easy but expensive.



Fuel tank

You should be able to see the bottom of the fuel tank (4), check for ruts and fuel leaks.

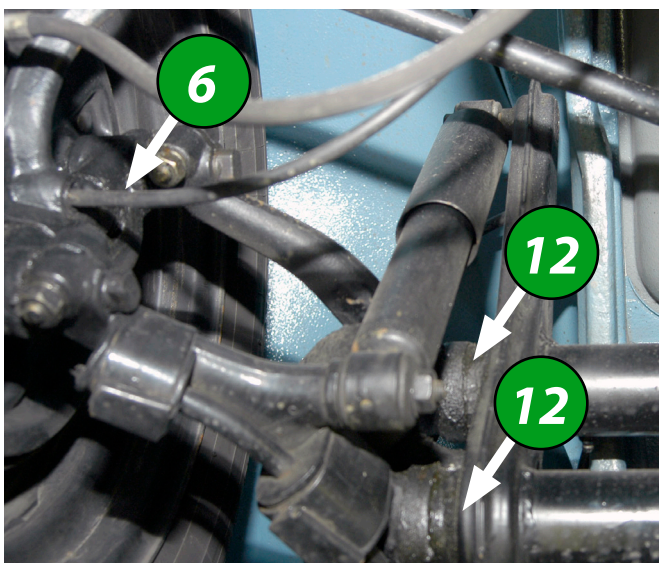


Suspension and shocks

Torsion leaves are installed in the two front axles, we explained how the front suspension works in [edition 08](#). The front suspension should be saturated with grease (12), add more grease through the grease nipples to make sure they are. If everything looks very dry, it is not normal and the front suspension could have suffered from that.

Speedometer cable

On the left side of the car is the speedometer cable (6), it runs from the dashboard inside the front left wheel.



Body and chassis

The frame head (7) should be clean and not showing signs of corrosion. Plan a complete restoration if the frame head is in bad shape.

The spare wheel holder (8) is a weak spot of the VW Beetle body. It will show signs of corrosion or in worst case signs of a collision. Check it carefully. Also check the headlight housing (9) and the drain tubes.

Horn

Check the electrical connections on the horn (10).

The front bumper

The front bumper and the support brackets (11) are very visible from here. Check all the parts just like you did for the rear bumpers. Vintage bumpers are very expensive, so buying a car that has good bumper is key.

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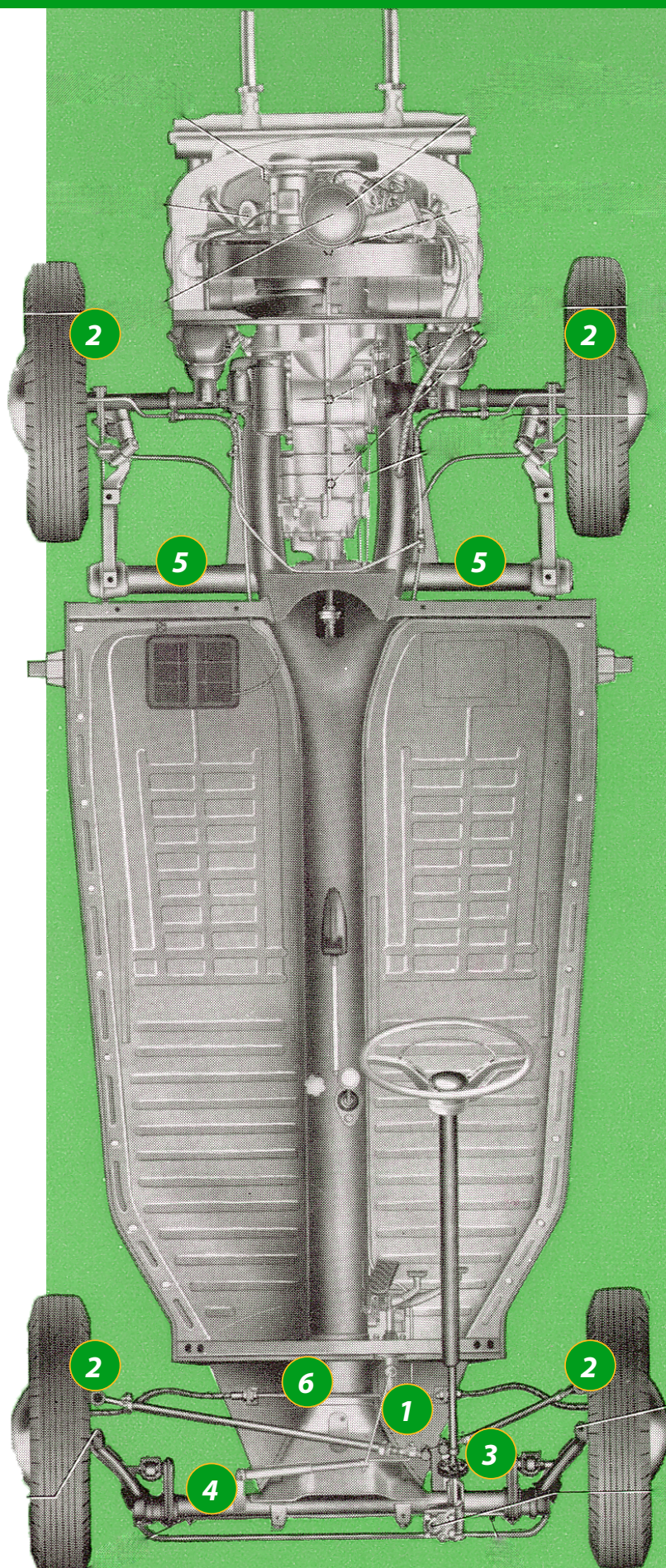


underneath the VW 1200

This is the end of the first part of this series about inspecting a classic Volkswagen before buying. We started with our VW1200, next time we'll continue inspecting a 1303S.

We show on the drawing on the right hand side some of the parts we discussed in this article. It is a different view, from the top this time, without the body installed. Try to recognize all the parts before you decide to buy your first VW.

- 1** main brake cylinder
- 2** drum brakes
- 3** steering box
- 4** torsion leaves
- 5** torsion bars
- 6** frame head



Introduction

You will get to a point where you think: *"how will I do this?"*.

In this particular case I was stuck with a threaded stud on my 45 year two-cylinder air-cooled boxer engine. Genuine studs are very expensive, so trying to remove the original ones without damaging them is very important to keep the total restoration budget as low as possible. The assignment was to save four threaded studs per cylinder.

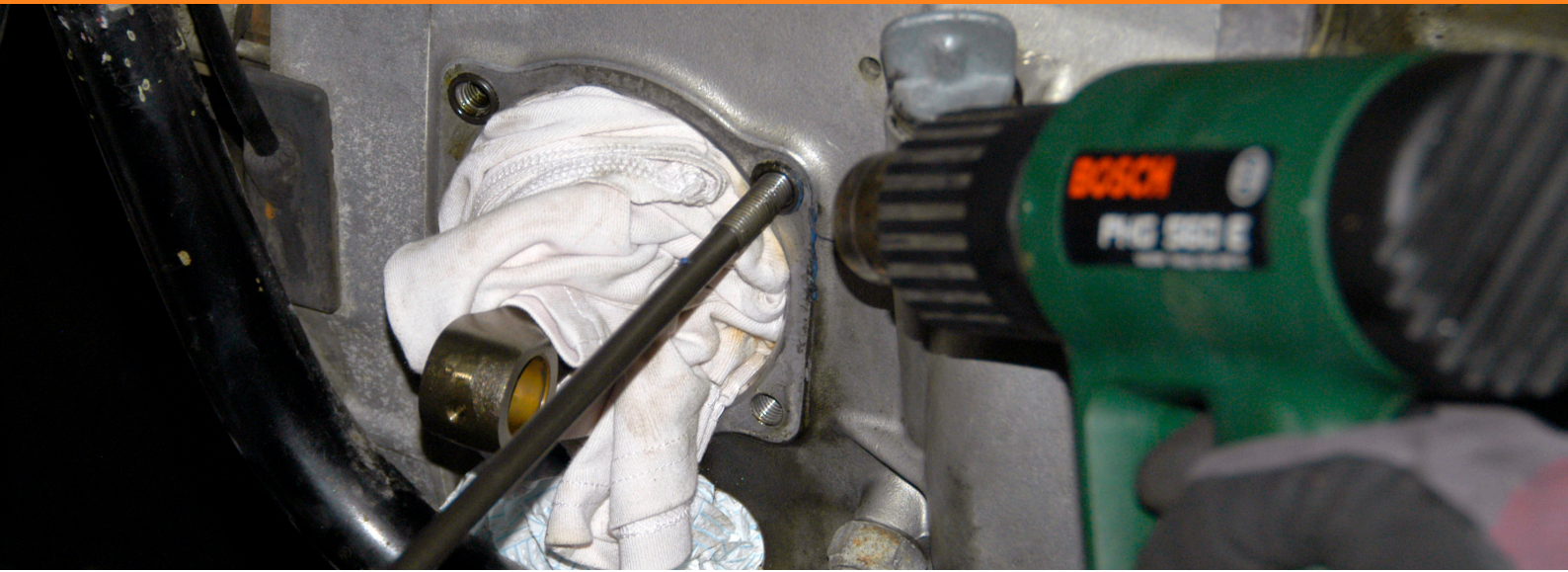
It is a quick fix to remove the studs using pliers, but you will damage the metal surface. So, how to proceed? The double nuts trick will do the job.

Preparations

Don't rush, take your time, damaging the studs is one thing, but damaging the crankcase is a problem at an all other level. So, use some penetrating oil such as WD-40 at least one hour before you try to remove the studs. Then heat the spot where the stud is screwed into the crankcase as we show on the picture on the next page. I know that many of you will skip this



remove a threaded stud



part and first try without oil or heat, it may work out fine, or not, so, just do it. I have done the test on an old engine, without heat and penetrating oil, I tried for

15 minutes to remove the studs, without result. With oil and heat it took me just a few seconds. Now is the time when I turn on my espresso machine and enjoy the view while the WD-40 does its magic.



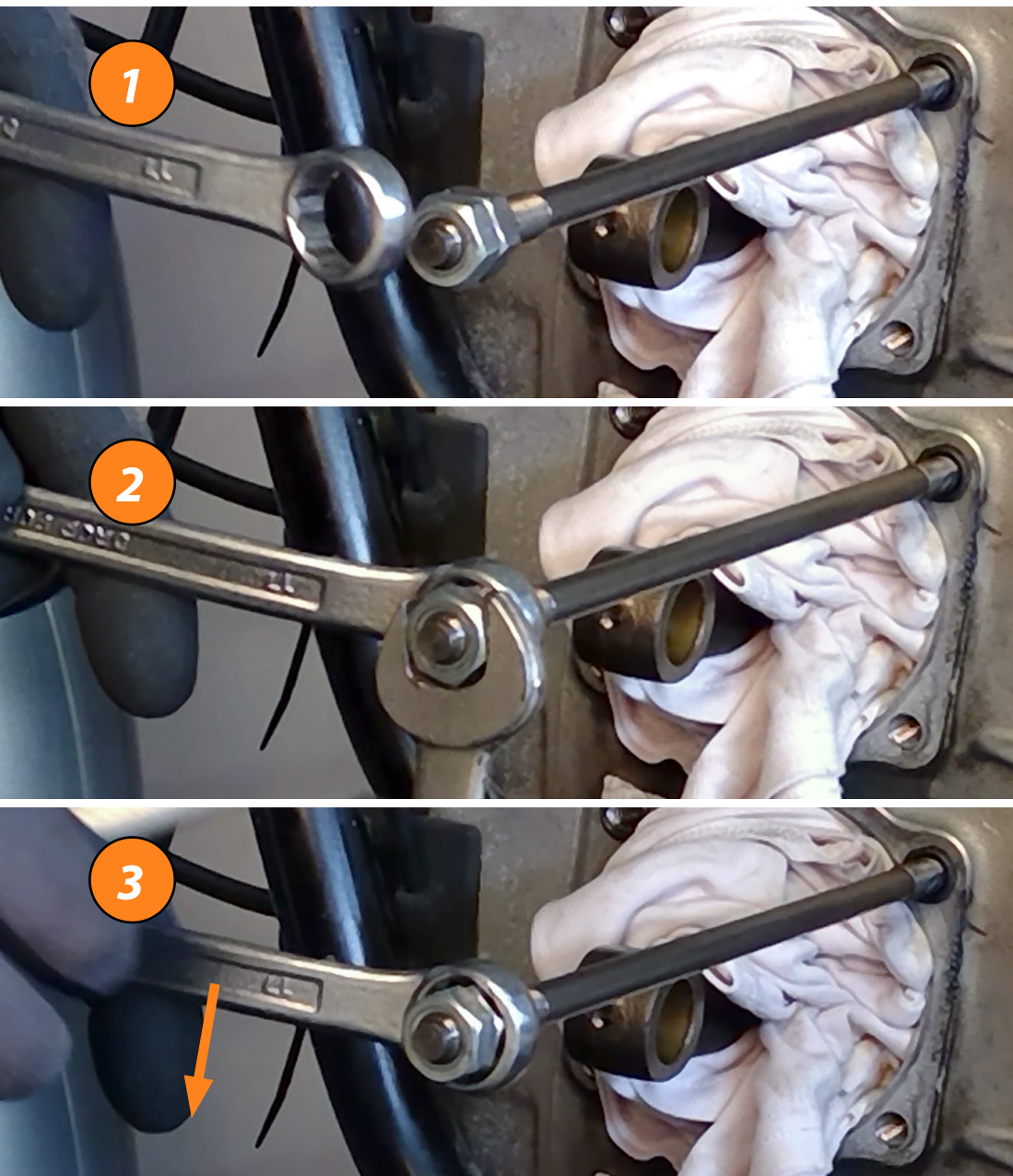
Clean the threaded studs carefully. If they are slightly damaged, you could use an external thread repair tool like the one we show below.

© www.fastoolnow.com

Double nut technique

Make sure both nuts are placed far enough on the thread so that there is enough grip to not damage the thread (1). Secure both nuts, use just one hand

to tighten them (2). If you use two hands you could bend the threaded stud. Now remove the stud by turning the nut closest to the crankcase (3), the stud should come loose easily.



Tip: Use two new nuts. Don't use self-locking nuts, they will be difficult to remove.



remove a threaded stud

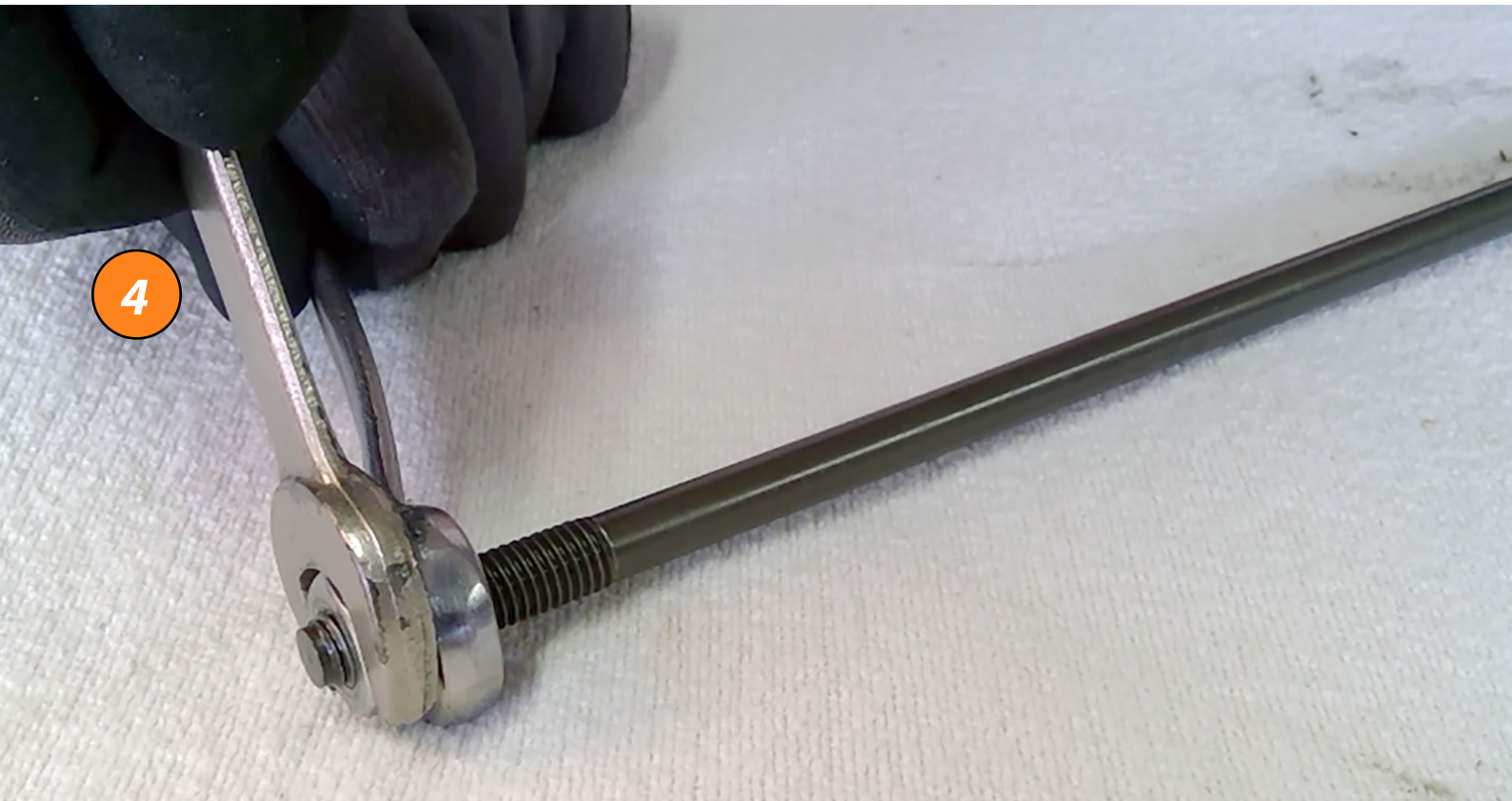
Removing the nuts

You will need to remove both nuts now to be able to reuse the studs. Don't do that on a vice or using pliers, you don't want to damage them unnecessarily. Use a protective cloth and do that on your workbench, use gloves to protect your hands.

Place the stud on the table, use two wrenches. One secured on the workbench for one nut and the other is used to remove the

other nut (4).

I need to do that eight times for my two-cylinder boxer engine. For a type 1 engine, you'll need to do that sixteen times if all studs are seized. They are not all seized hopefully, but in many cases they are on very old engines. I did the job in 30 minutes not including the preparation with penetrating oil. I was able to reuse all parts, I saved about 200 €, not bad at all.



Introduction

We talked about the ignition already in previous editions. These two pages sum up all the articles.

To be able to follow this new article about ignition timing, you need to understand the ignition basics, how the distributor works is explained in [edition 10](#).



coil



spark plugs



distributor



ignition timing - static



vacuum



ignition points

In [edition 12](#) we replaced the ignition points and adjusted them to have a gap of 0,40 mm using a feeler gauge. This 0,40 mm gap will create a 50° Dwell. In [edition 13](#) we checked the adjustment using a strobe timing lamp, the so called **dynamic adjustment**. Now we need to adjust the ignition timing, we explain how to do the **static adjustment** now, the **dynamic adjustment** will follow in the following edition of this technical series.

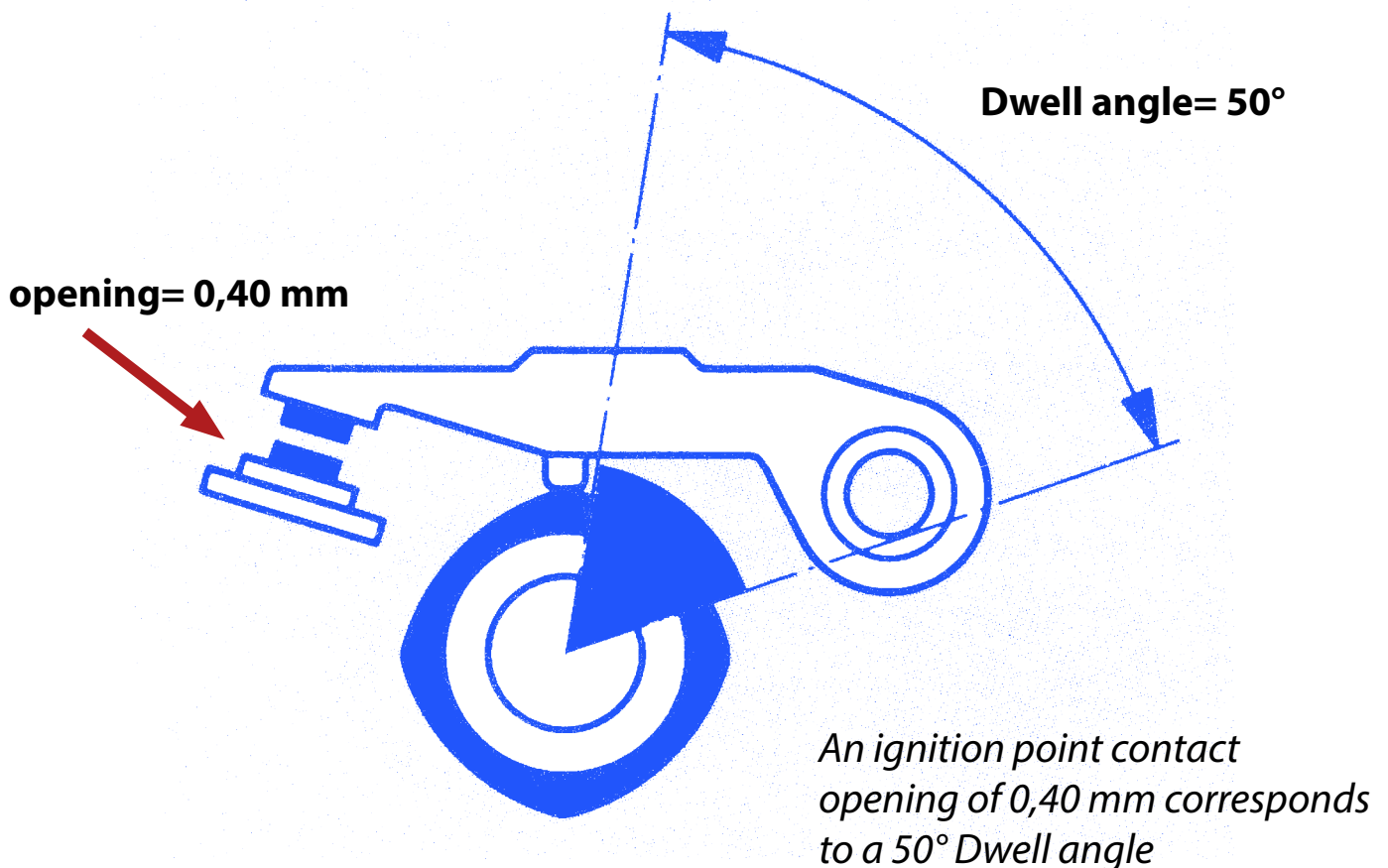


dwell angle

Dwell angle

We explained in [edition 10](#) why the ignition points opening should be exactly 0,40 mm. When the ignition points are closed, so when they will allow the electrical current to pass, the high voltage will build up in the coil. When they open, the accumulated high voltage will generate a spark in one of the spark plugs.

If the ignition points would close too fast again, the spark will not last long enough and the air-fuel mixture will not burn completely. Do you want to know more about the principle of the petrol engine, read [edition 06](#).

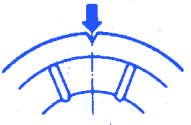

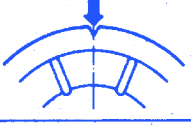
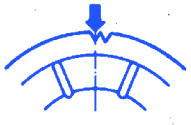




ignition timing - static

So, when the ignition points are well adjusted, your engine will have a strong spark in each of the four cylinders and perform well. Now comes the next question: when should the spark be generated? Just when piston reaches the Top Dead Center? Or just before? Or just after?

The ideal timing depends on the type of engine. You will find the ignition timing information for your engine in the official workshop manuals from the publisher [Bentley](#). Below, we show an example of an ignition timing table as published by the Volkswagen factory.

Volkswagen type 1 engines ignition timing

type	engine number from until	ignition timing	ignition mark on the pulley
1/1200	5 000 000—D 0 095 049	10° voor b. d. p.	
1/1200	D 0 095 050—D 0 675 000	7,5° voor b. d. p.	
1/1200 1/1200	D 0 675 001— D 1 268 063—	0° 7,5° voor b. d. p.	
1/1300	F 0 000 001—F 2 140 820	7,5° voor b. d. p.	
*1/1300	AB 000 001—AB 313 344	5° na b. d. p.	
1/1300 1/1300	AB 313 345—AB 999 999 AR 000 001—	7,5° voor b. d. p.	

Static versus dynamic

We explained in [edition 10](#) on page 22 why the ignition timing needs to be set just before Top Dead Center on most engines. The ignition advance is higher the faster the engine runs. Giving a some advance to the timing will allow the air-fuel mixture to combust before the piston reaches the TDC. We advise you to read the tenth edition before you start to set the ignition timing on your classic Volkswagen.

How do you adjust the exact time when the spark will ignite? By setting the ignition timing. That is what we will explain now. We will set the ignition timing while the engine is not running, this is called a **static adjustment**. Volkswagen explains how to do that in its early workshop manuals, until mid-sixties. This type of adjustment is used commonly on most pré-1970 type 1 engines.

For air-cooled engines starting from August 1970, Volkswagen advises to adjust the ignition timing **dynamically** by using the marks on the rear crankshaft pulley instead. The static adjustment with the test lamp (or voltage detector) is still useful on these engines but only as a temporary adjustment to have the engine running to prepare for the dynamic adjustment.



ignition timing - static

The **dynamic adjustment** we will discuss in the following edition is more precise than the static adjustment, you can also diagnose the advance mechanism (read [edition 10](#)).

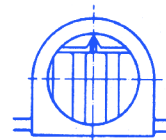
Some engines like the air-cooled 1700 cc type 4 needs 32° advance at 3500 rpm (refer to the red arrow in the table below). You can't set the ignition timing statically on these type of engine anyway, you will need to use an ignition timing lamp (or strobe lamp). Volkswagen describes how to do that in its workshop manuals starting mid-sixties.

To do a static adjustment you'll need a voltage detector like the one in our webstore for instance (picture 1). To do a dynamic adjustment you'll need an ignition timing lamp (picture 2).



Volkswagen type 4 engines ignition timing

4/1700	V/Z 0 000 001—	32° voor b. d. p.
4/1700 E M 249/USA 4/1700 E USA	W 0 000 001 EA 000 001— EB 000 001—	27° voor b. d. p.
4/1800 schakel- bak	AN 000 001— AT 000 001	7,5° voor b. d. p.
4/1800 Automa- tic	AN 000 001 AT 000 001	



3500

onderdruk-
slang(en)
losgetrokken

800–950

onderdruk-
slang
losgetrokken

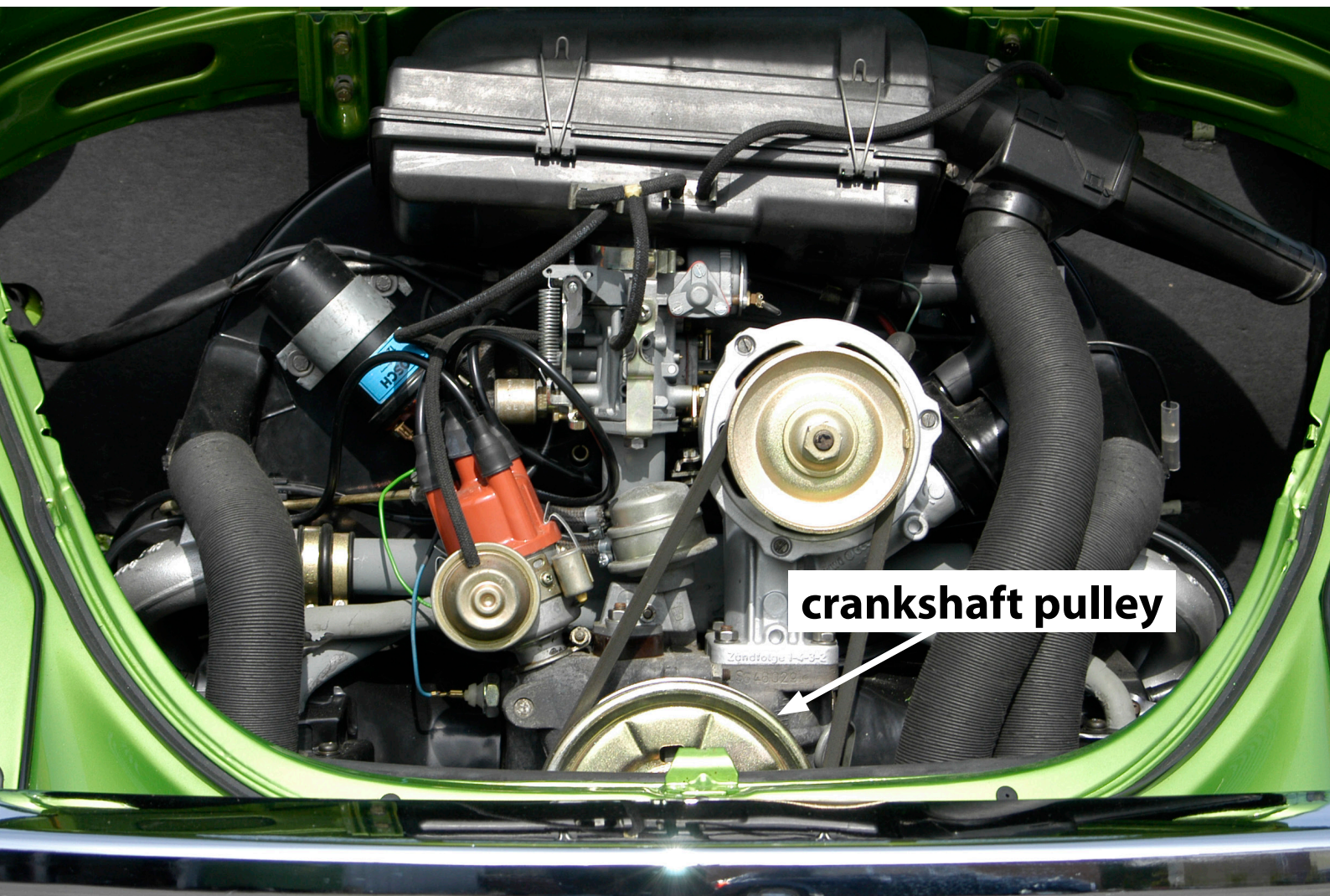
900–1000

Finding the Top Dead Center (TDC)

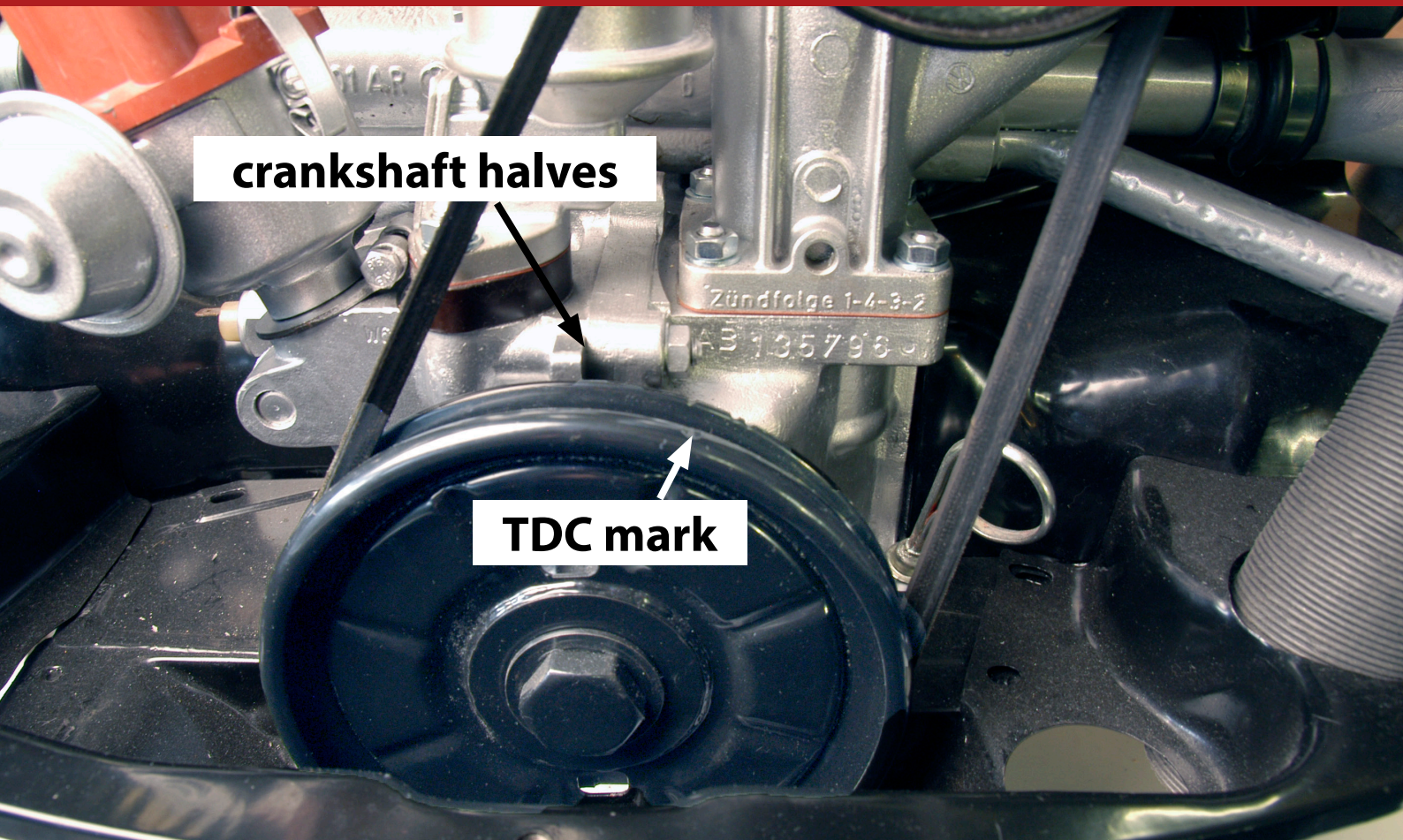
Top Dead Center (TDC)

The ignition advance is given compared to the Top Dead Center (TDC). The TDC for cylinder 1 is reached when the cylinder 1 piston has reached its highest position, when it is the closest to the spark plug.

If your engine is **100% original** then you could trust on the marks in the crankshaft pulley (photo below and on page 35). There should be a circle or mark on the front part of the pulley, this is the TDC mark for cylinder 1 and 3.

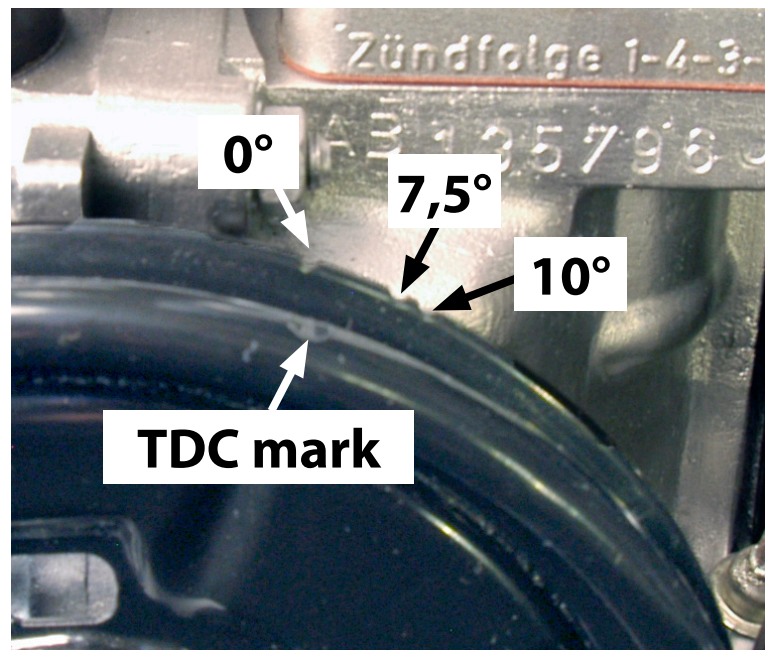


ignition timing - static



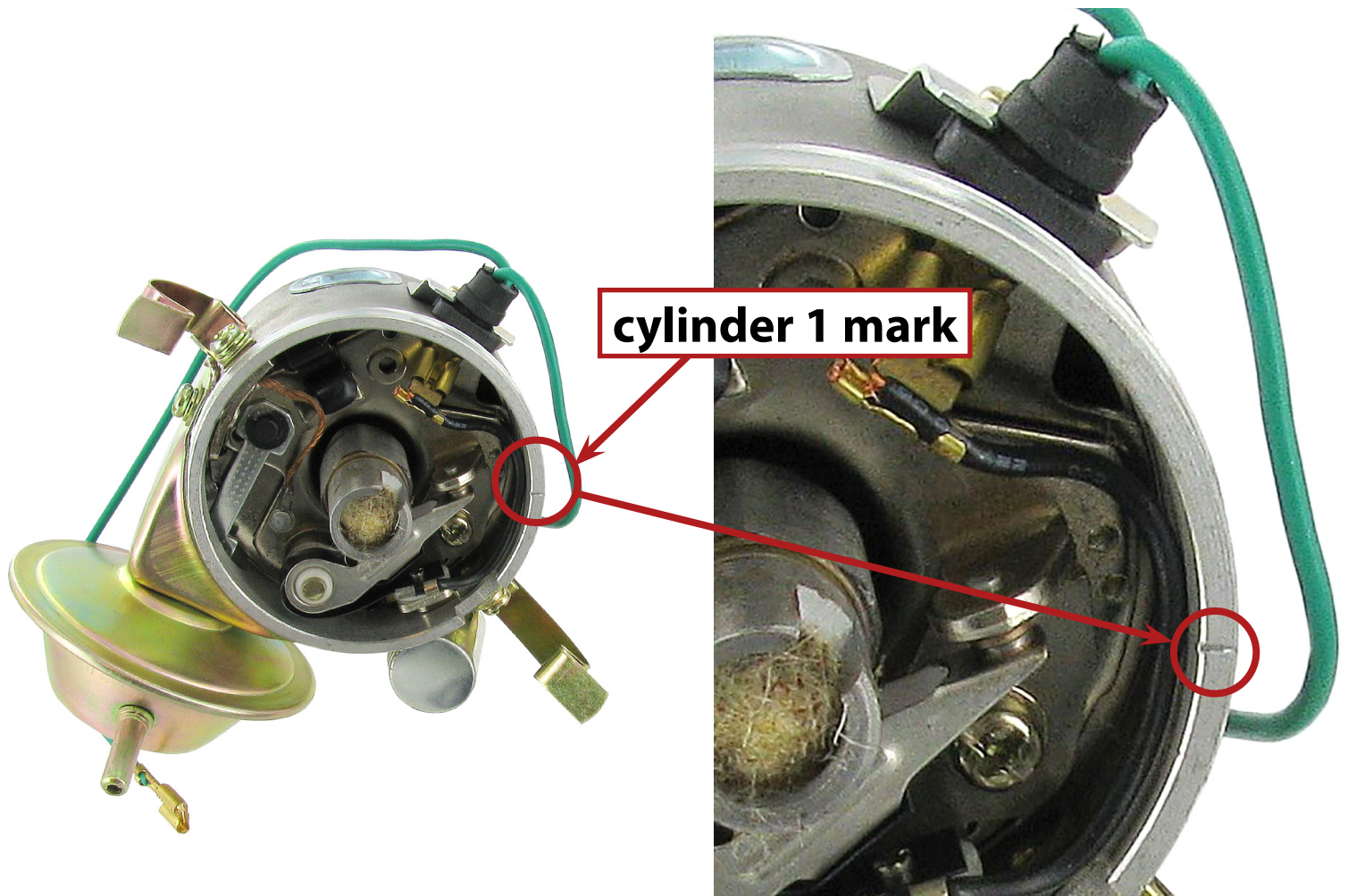
You should see at least one or more marks or dents (we show three marks on our crankshaft pulley below), these marks are the 0°, 5°, 7,5° or 10° marks before the TDC for type 1 engines. It may look a little different on another engine. The picture on the right side show the bigger mark on the front part of the pulley (the TDC mark) on our type 1 AB engine. When this mark is aligned with the centre of the crankcase, cylinder 1 or cylinder 3 are in the TDC position.

We paint these dents with white paint so that they are easily recognizable (view the picture on page 37).

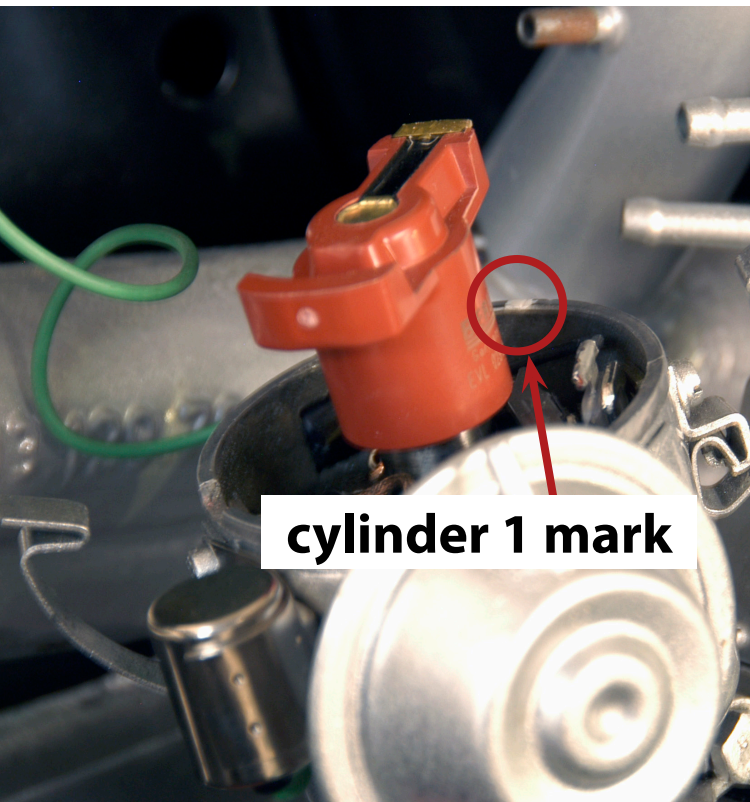


Volkswagen advises to always adjust the ignition timing when cylinder 1 is in the TDC. Some engines could have a slight TDC shift on another cylinder, so it is safer to measure on cylinder 1. How do you know if the piston of cylinder 1 or cylinder 3 is in TDC position? The rotor of the distributor should point towards the small dent in the distributor housing. We show that on the pictures below, this is also explained in [edition 06](#).

You never know if your old VW is 100% original. Is the engine fully original? Maybe another crankshaft pulley was installed. So, I never trust the dents in the crankshaft pulley on a classic Volkswagen I work on for the first time to find out what the TDC is. I use the technique explained in [edition 06 starting page 29](#). This technique always delivers a correct reading, you measure the physical position of the cylinder 1 piston basically.

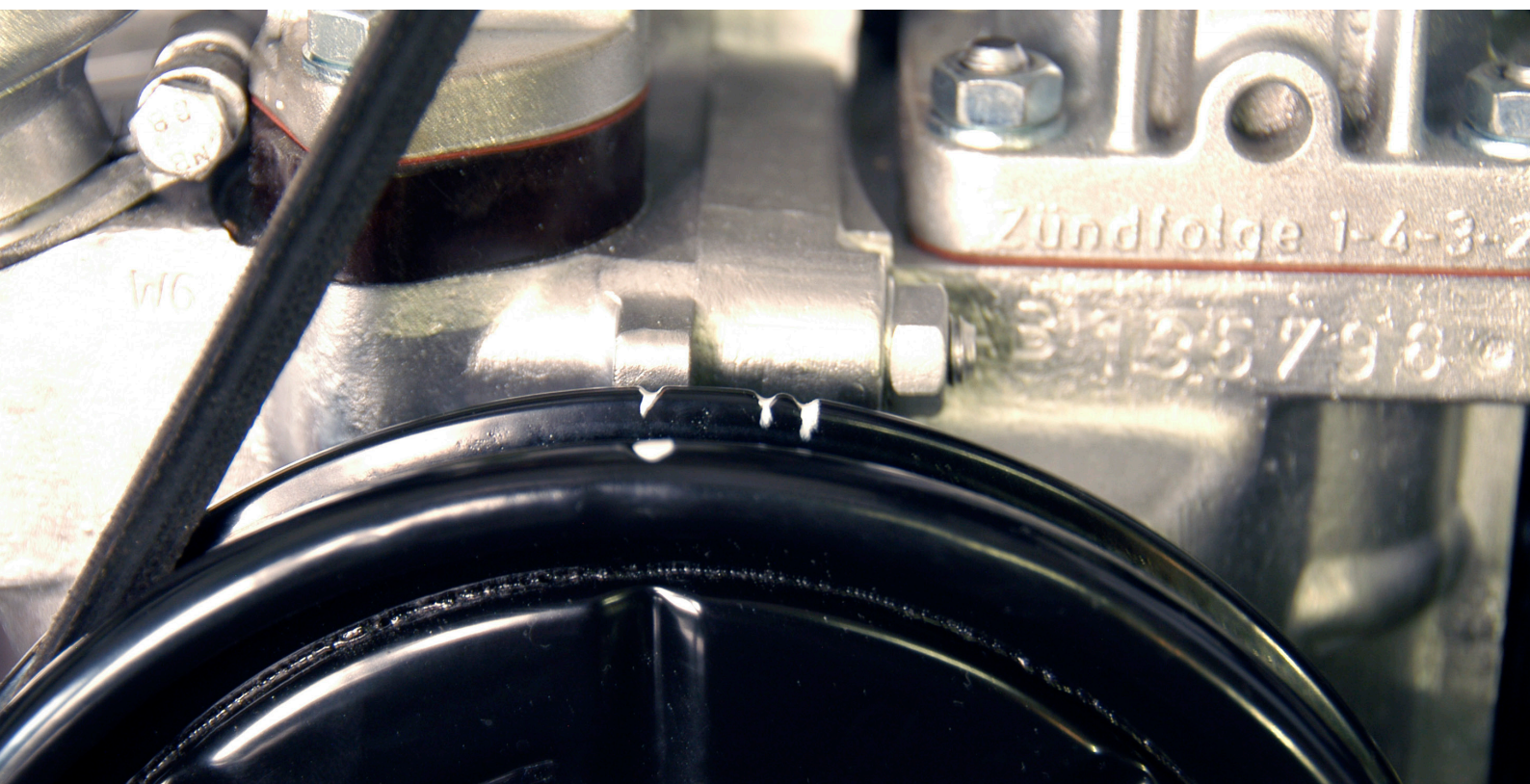


ignition timing - static



The TDC mark on the front part of the pulley is correct on our type 1 AB engine, it is aligned with the center of the crankcase as shown on the picture below, while the rotor point to the dent in the distributor housing. I take notice in my workshop notepad so I'll remember for the next time.

Next is to search for the advance value you need to set for your engine. It will be a value in degrees ($^{\circ}$), always compared to the TDC.



Defining the ignition timing

You will need to search for the ignition timing advance value for your engine. On most air-cooled engine it will be a negative value, meaning some degrees before TDC or an advanced ignition. On some VW engines it will be positive value, meaning some degrees after the TDC. For some engines it is 0° like for the injection boxer engines.

First, find the engine serial number. Ours is AB135796. The first two letters are for the engine type, the numbers are the serial number (sometimes just seven numbers or with two additional zero's after the first two letters). We explained the engine numbering and where to find the engine serial number in [edition 02](#).

We have an online tool to help you to find the type of engine that corresponds with your engine serial number:

www.paruzzi.com/uk/motorcode

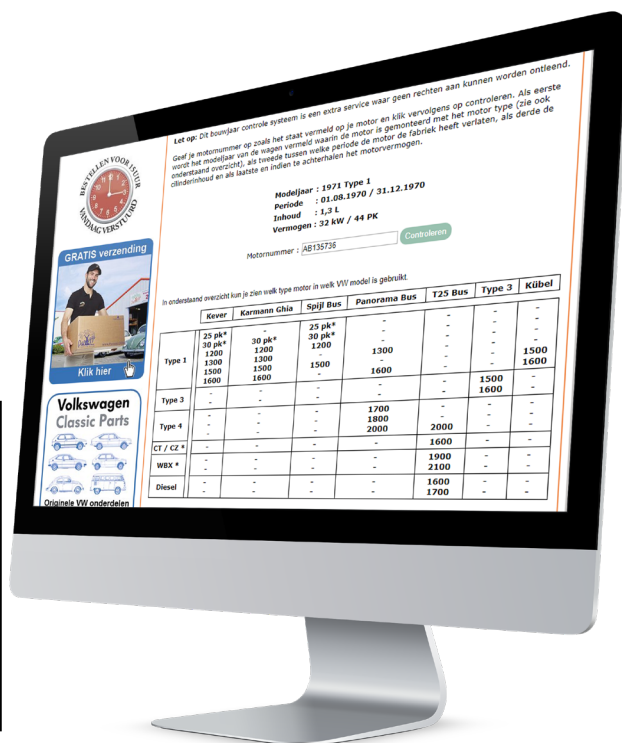
Model year : 1971 Type 1

Period : 01.08.1970 / 31.12.1970

Size : 1,3 L

Power : 32 kW / 44 HP

Engine number :

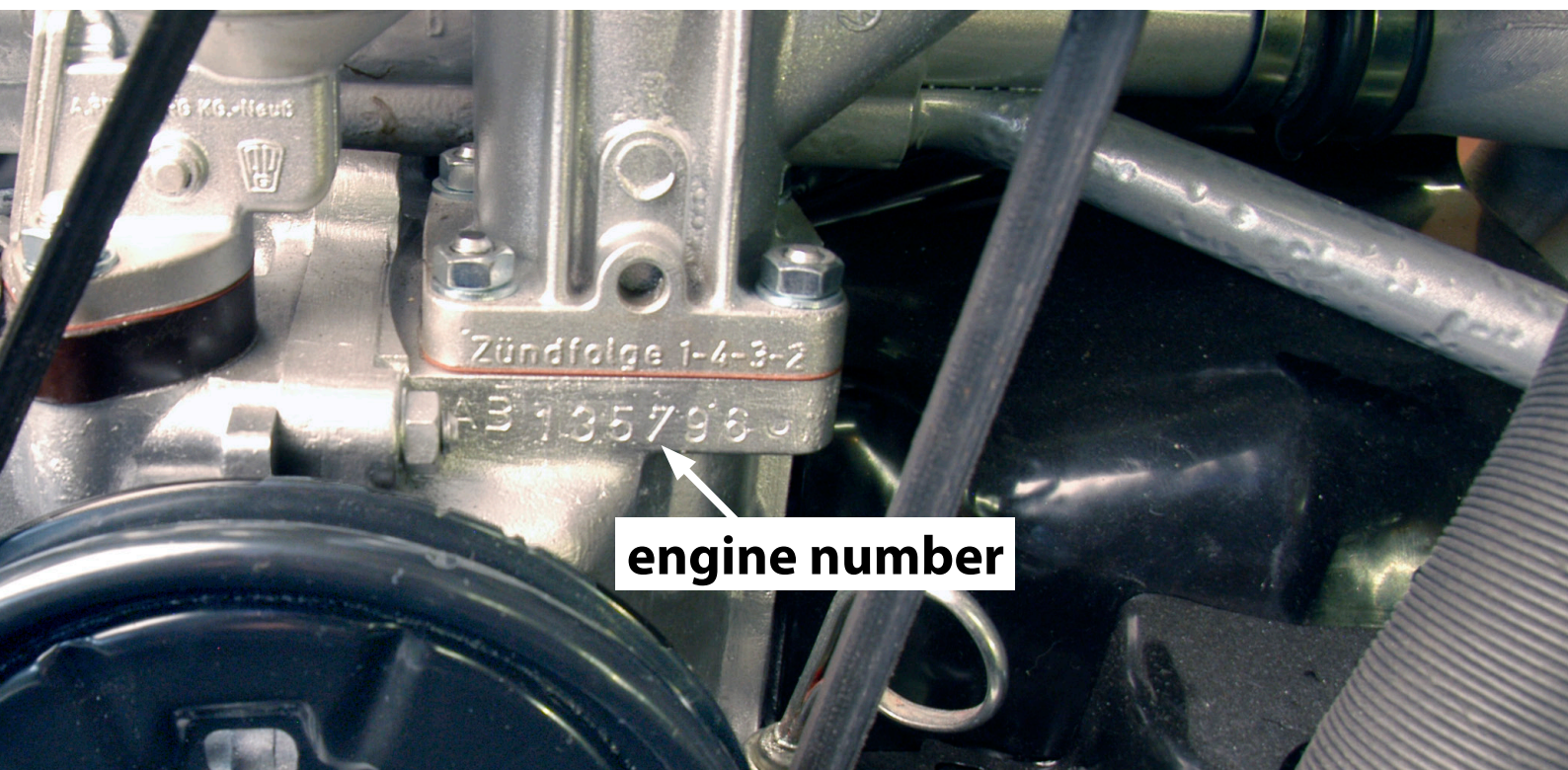


ignition timing - static

Look for the ignition timing value in the VW workshop manual. The value is 5° after TDC for our AB engine. But our engine is not original anymore, the original distributor with two vacuum lines has been replaced with a distributor with only one vacuum line. So, we need to set the advance to 7,5° after TDC (we discuss this issue in the next edition). The original VW tables sometimes also show the marks or dents to use on the original crankshaft pulley and also the rpm to set to measure the advance.

The rpm is not important right now, we will measure the advance with the engine not run, this is a static measurement.

As you already understood, I never trust the marks or dents the first time I work on a car. There are three dents on the rear part of the pulley as you see on page 37 and below. So what I do next is try to find out how much 7,5° is on this pulley installed. It may be an original pulley and I can trust the dents, or not, we'll find out.



You could use a protractor of course, but we use a very basic technique, maybe this is the time you will regret not to have pay more attention during the math classes.

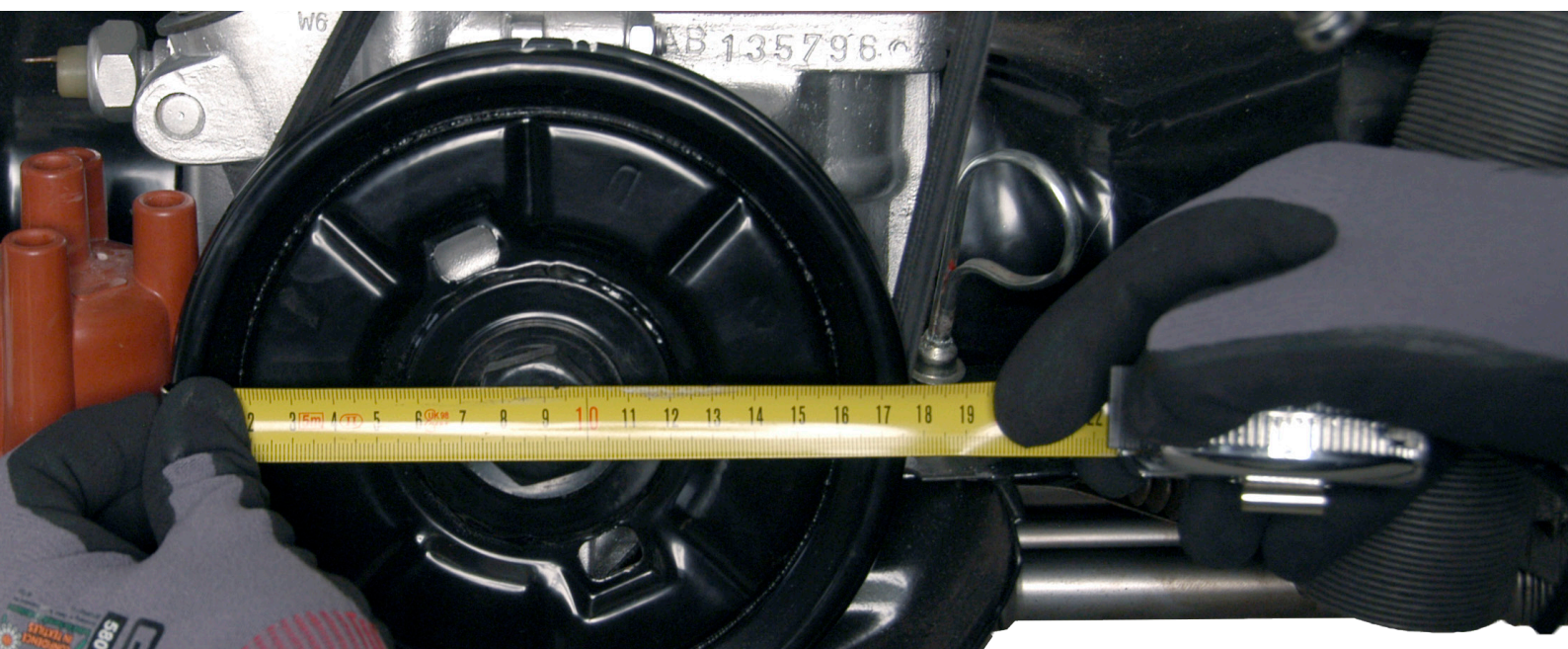
I measure the circumference of the crankshaft pulley, I use some tape that I place around the pulley, after remove the tape I have the exact circumference value. The value is 55,8 cm for our AB engine. A complete circle is 360° as you probably know. If we want to mark $7,5^\circ$ compared to the TDC than the following calculation gives us the distance:

So, the dent for our AB engine should be 11,6 mm to the right of the TDC mark. The engine rotates clockwise, the ignition should be advanced with $7,5^\circ$ compared to the TDC.

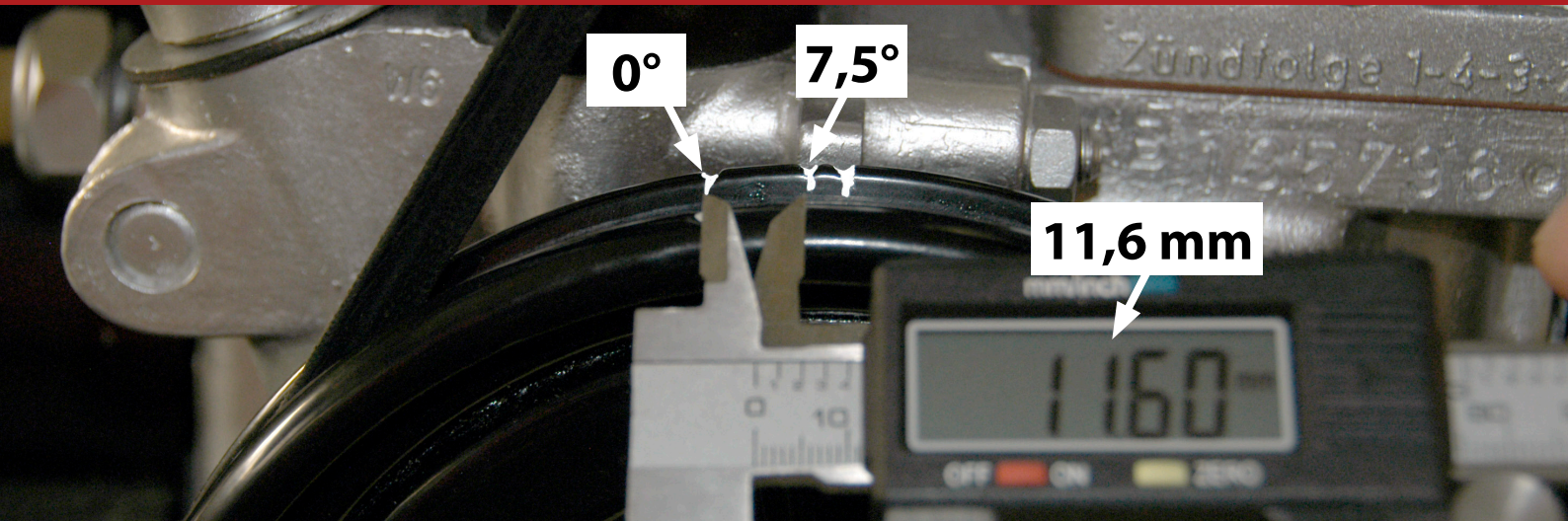
If it is too difficult to measure the circumference you could measure the crankshaft pulley diameter instead. We measure a diameter of 177,5 mm. You can calculate the circumference if you remember the formula from school. If you don't have the Pi (π) value on your calculator, use 3,14159 instead:

$$558 \text{ mm} \times (7,5^\circ/360^\circ) = 11,6 \text{ mm}$$

$$177,5 \text{ mm} \times 3,14159 = 558 \text{ mm}$$



ignition timing - static

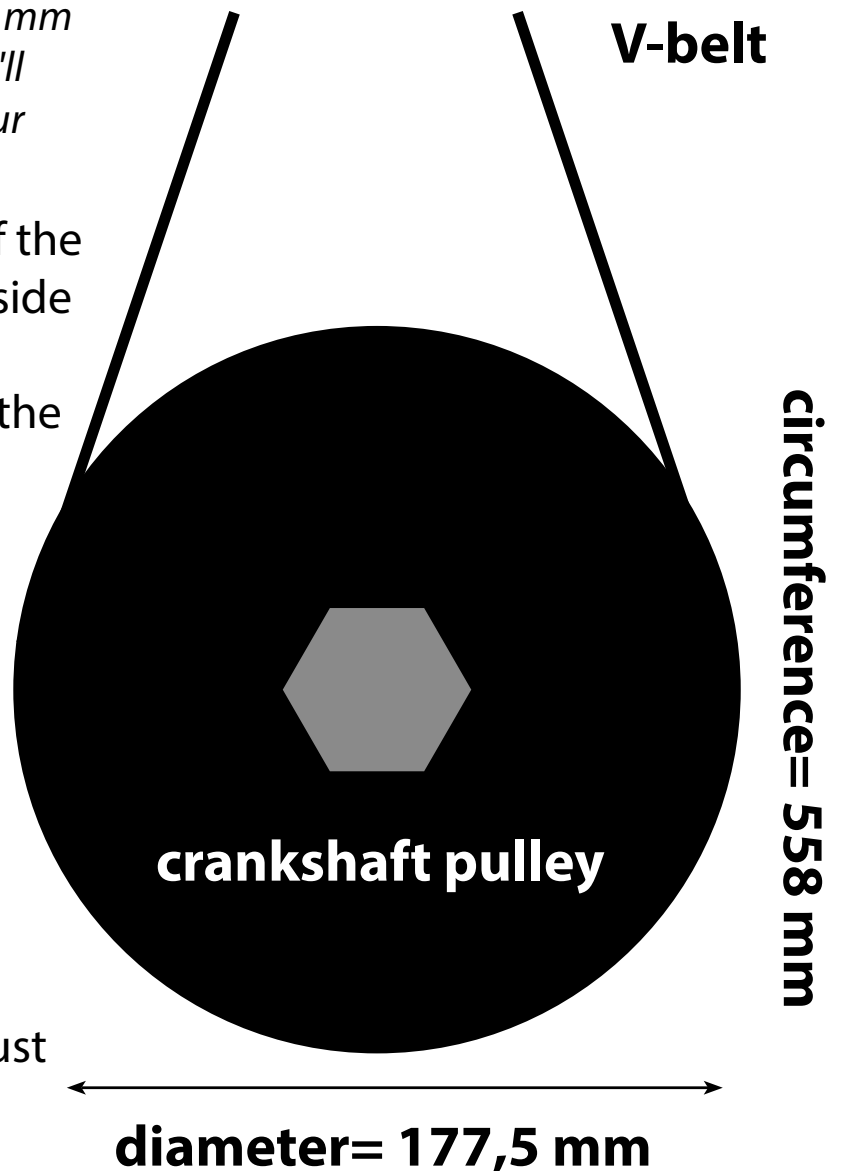


We check if the second mark on the rear pulley half is located at 11,60 mm which should be the 7,5° mark we'll have to use to set the timing on our type 1 AB engine.

You measure the diameter of the crankshaft pulley on the outside of the pulley. There are two types of pulleys installed on the type 1 engines, the 170 mm and the 177,5 mm (also called the 178 mm pulley).

We set the micrometer exactly on 11,6 mm, this confirms that the second dent is the 7,5° advance mark for our AB engine.

We can continue now to adjust the ignition timing.



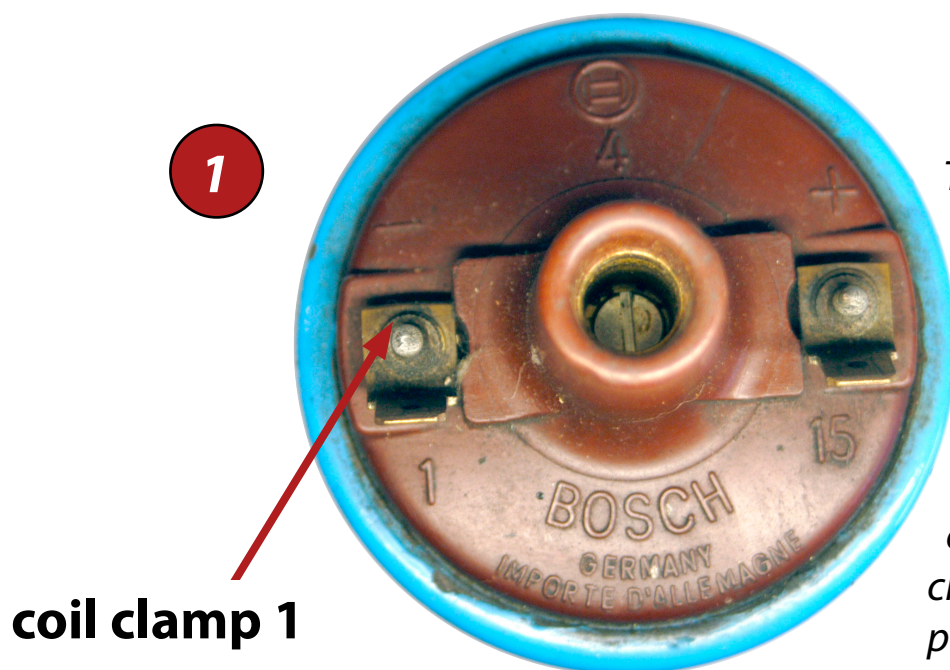
Setting the ignition timing - static

The engine is cold. The ignition is turned off to be able to connect the voltage detector. Don't forget that you are working very close to the high voltage circuit of your engine! Be careful.

Connect one cable of the voltage detector to terminal 1 of the coil and the other cable to the ground of the car. The cable of the voltage detector are interchangeable, so, it doesn't matter which cable goes to the terminal 1 really.

Terminal 1 is marked on the bottom of the coil with a minus sign or the number 1 depending of the type and brand of the coil (picture 1). It is sometimes difficult to read when the coil is built-in. You should also recognize terminal 1 because of the green cable from the distributor connected to it. Read more about the coil in [edition 08](#).

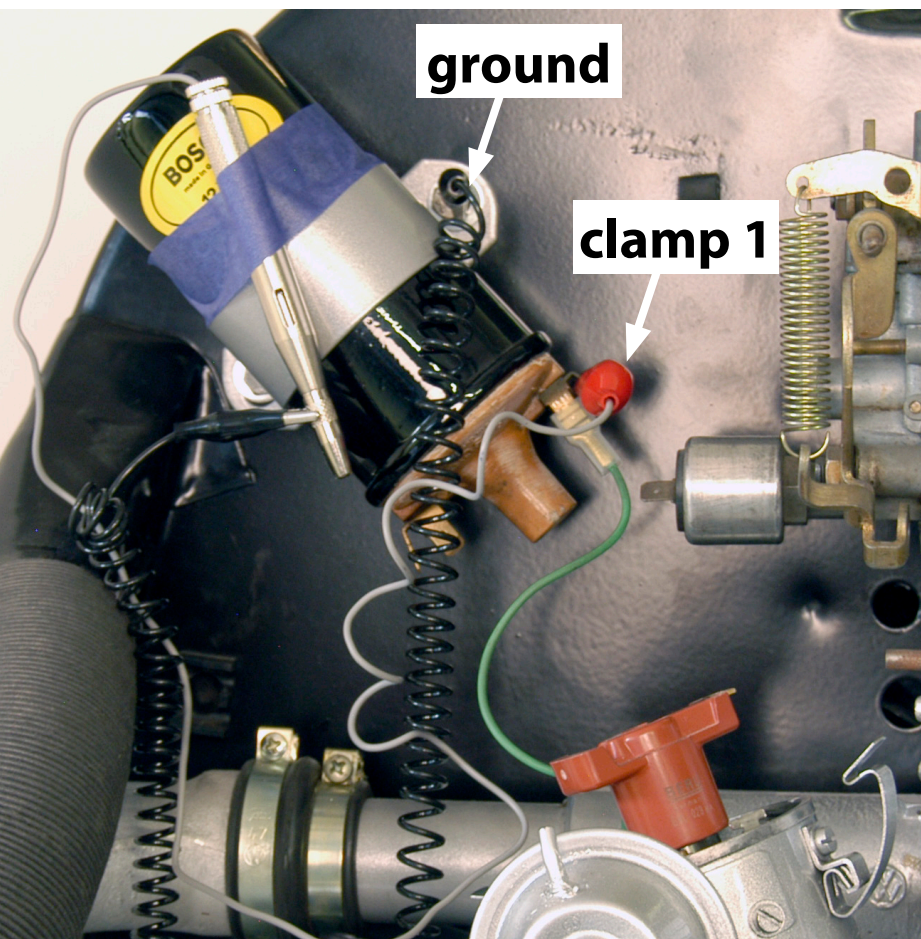
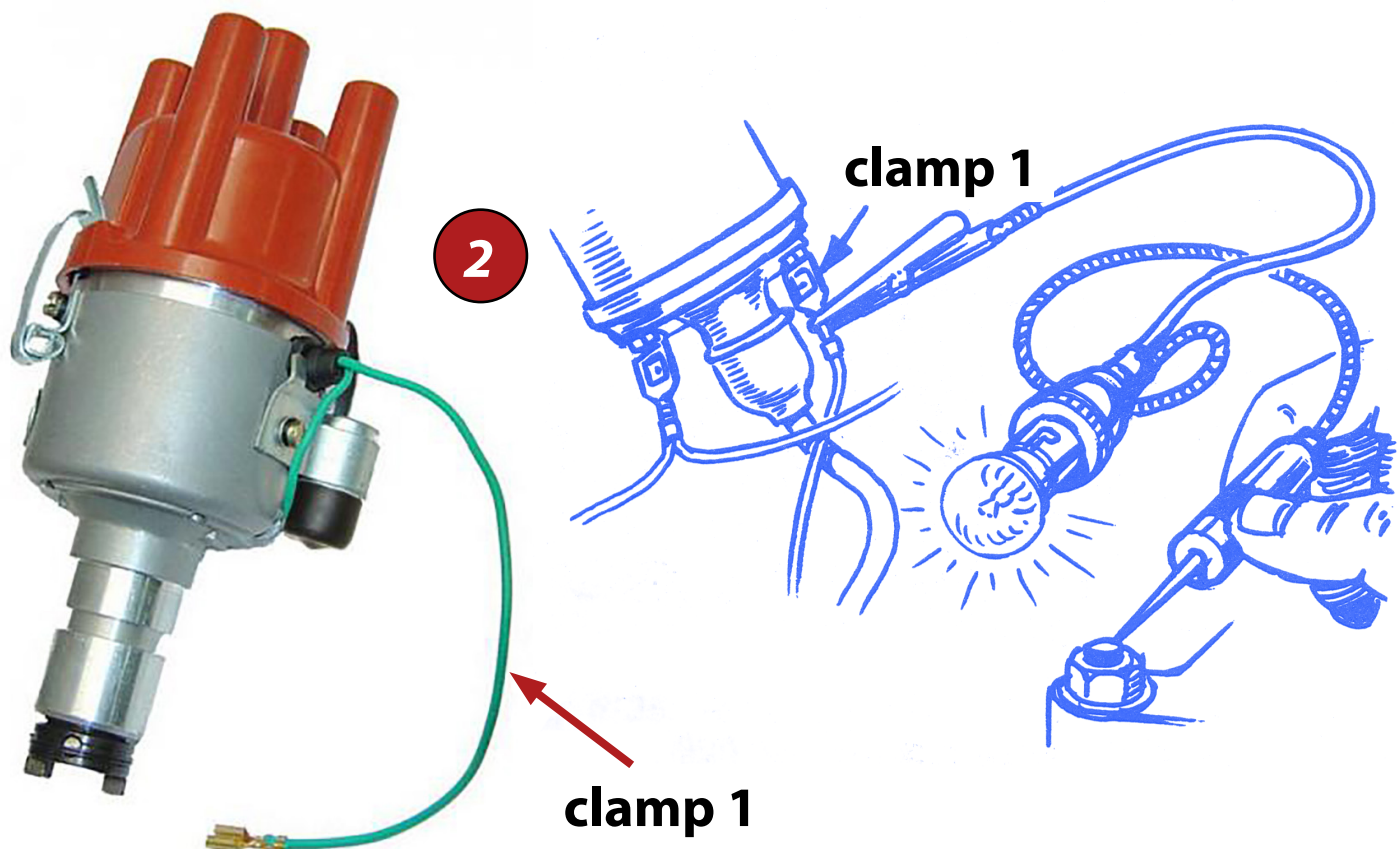
The ground can be a bolt or nut connected to the engine, we use the bolt that secures the coil clamp to the doghouse.



The coil clamps are marked with 1 (ground) and 15 (positive), these marks are visible on the bottom of the coil, difficult to see when the coil is installed. Clamp 1 is connected with the green cable from the distributor, clamp 15 is connected with the positive clamp from the battery.



ignition timing - static

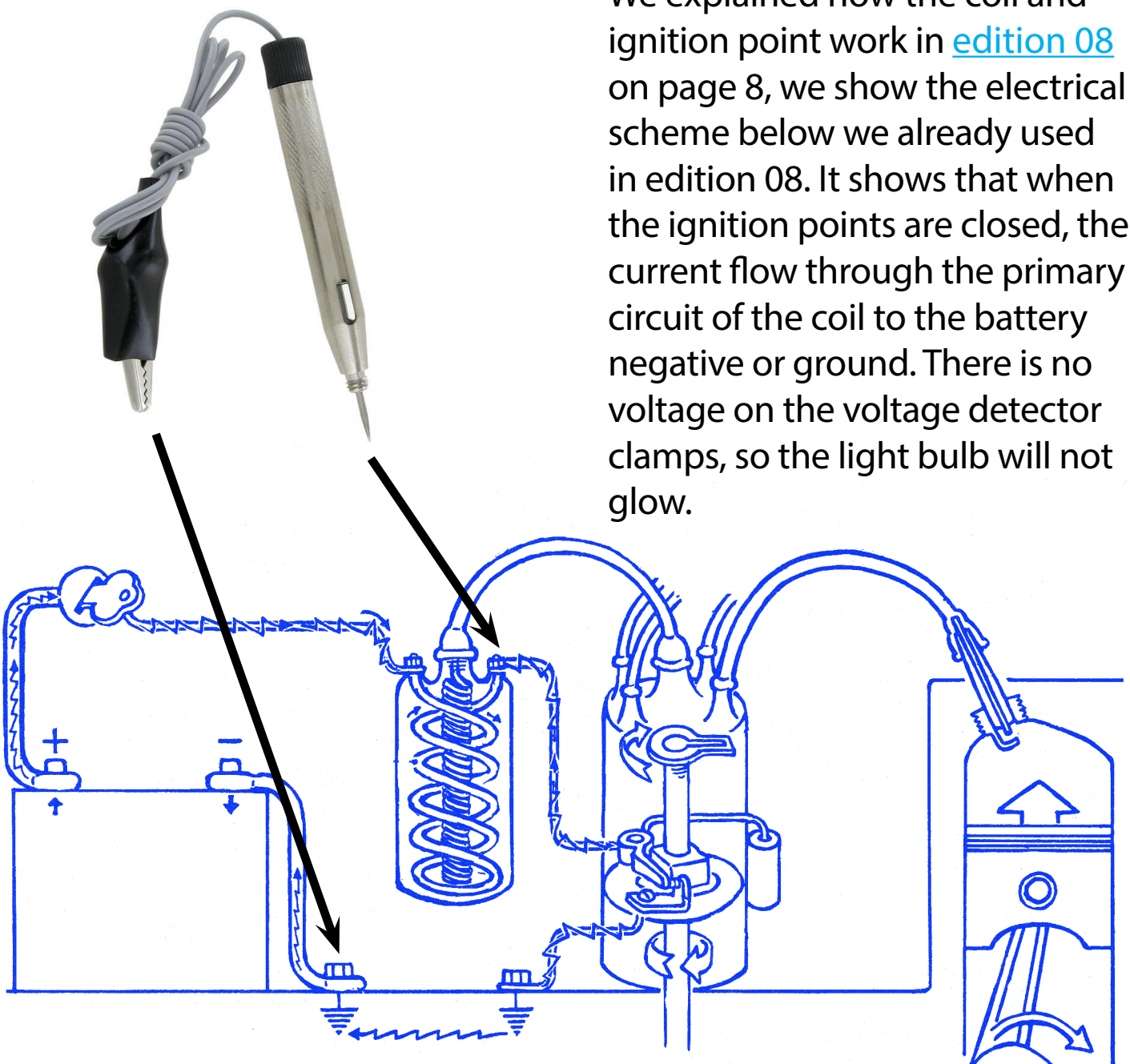


The cables of the voltage detector tool are interchangeable. Connect one cable to the number 1 clamp of the coil and the other cable to the ground. We use the coil support bolt as ground as you see on the picture. We use some tape to secure the voltage detector to the coil so it doesn't wonders around in the engine bay, causing short-circuits.

Now it is time to turn the ignition key into the ON position (don't crank up the engine). If the ignition points are closed (they touch) then the voltage detector light bulb will not glow.

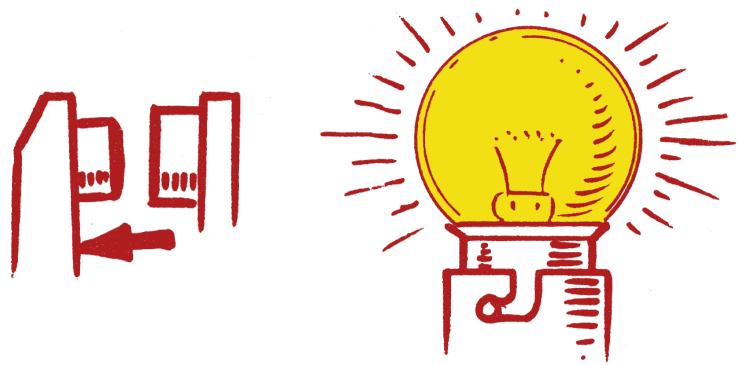


We explained how the coil and ignition point work in [edition 08](#) on page 8, we show the electrical scheme below we already used in edition 08. It shows that when the ignition points are closed, the current flow through the primary circuit of the coil to the battery negative or ground. There is no voltage on the voltage detector clamps, so the light bulb will not glow.



ignition timing - static

The ignition points will lead the electrical current to the ground (or battery negative), no high voltage can be build up in the coil.



If the ignition points are closed when you turn the ignition key on, then a small electrical current will flow from the battery positive terminal to the ground. We measured this current on our type 1 AB engine (picture below), it is 2,51 ampère. It is comparable to

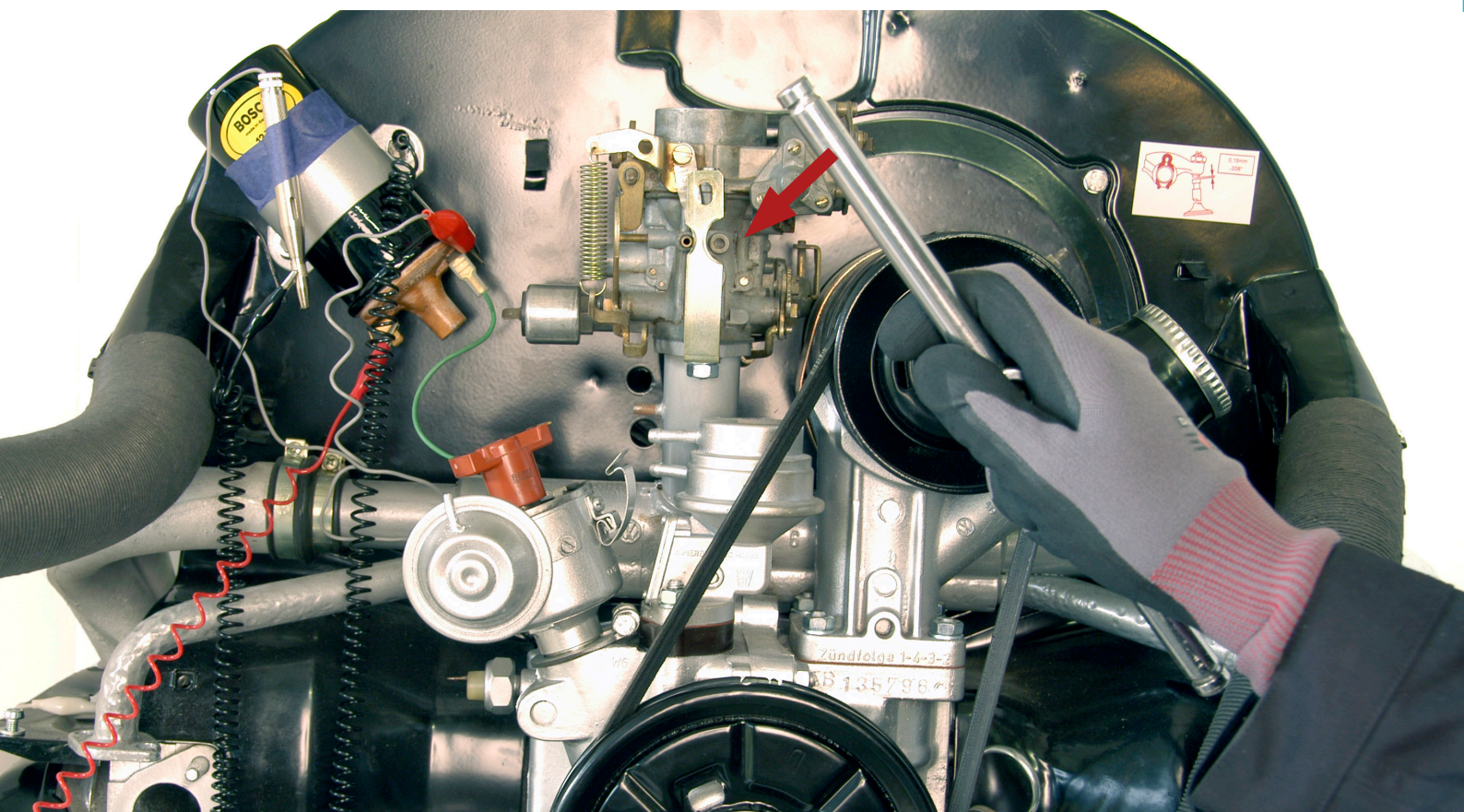
the consumption of a 25 watts 12 volts light bulb in your car. So, if your ignition is on all the time with the ignition points in closed position the battery will be empty fast. The pictures below shows just, the current drops from 2,51 A to 2,48 A in just 3 minutes.



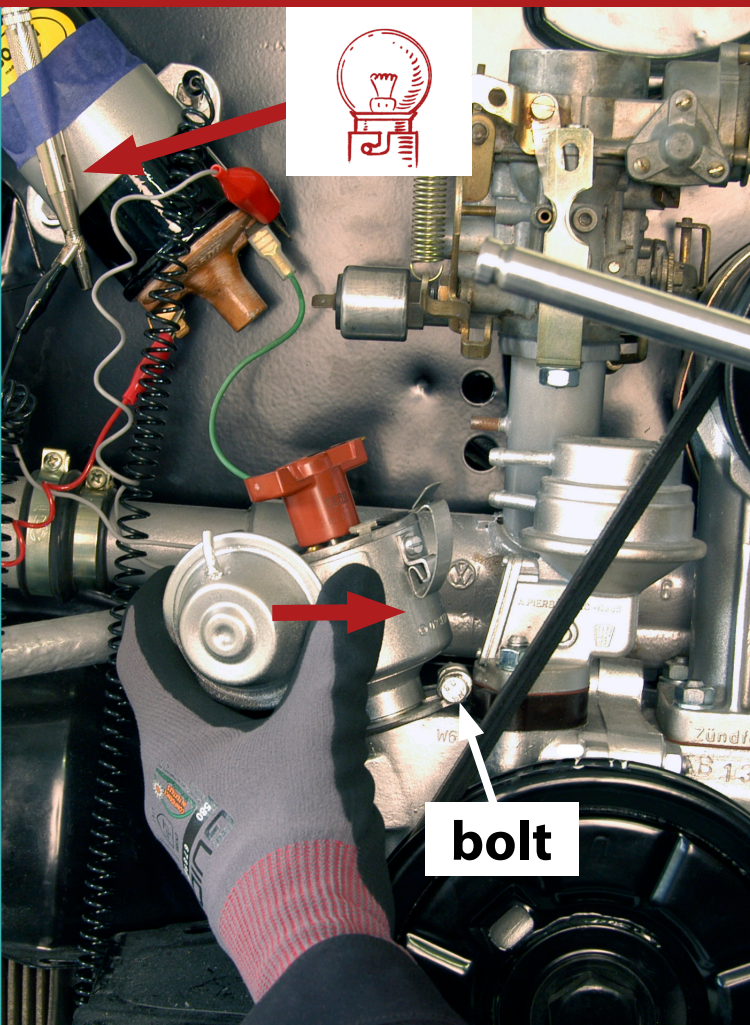
1. The ignition key is in the ON position, the engine doesn't run.
2. TDC mark on the pulley is aligned with the center of the crankcase.
3. The rotor of the distributor points towards the dent in the housing.
4. The voltage detector is connected with coil terminal 1 and the ground.

Use a wrench to rotate the alternator pulley, this is the top pulley on a type 1 engine. If cylinder 1 is in the TDC, then the test lamp (or voltage detector lamp) shouldn't glow. If so, then the ignition timing is not set correctly. The lamp is off when we tried this on our AB engine with the cylinder 1 in TDC position.

Now, rotate the alternator pulley counterclockwise, when the 7,5° dent in the rear half of the crankshaft pulley (bottom pulley on the picture) is aligned with the center of the crankcase, then the test lamp should glow. If this is the case for your engine, the ignition timing is correctly set, don't change anything.



ignition timing - static



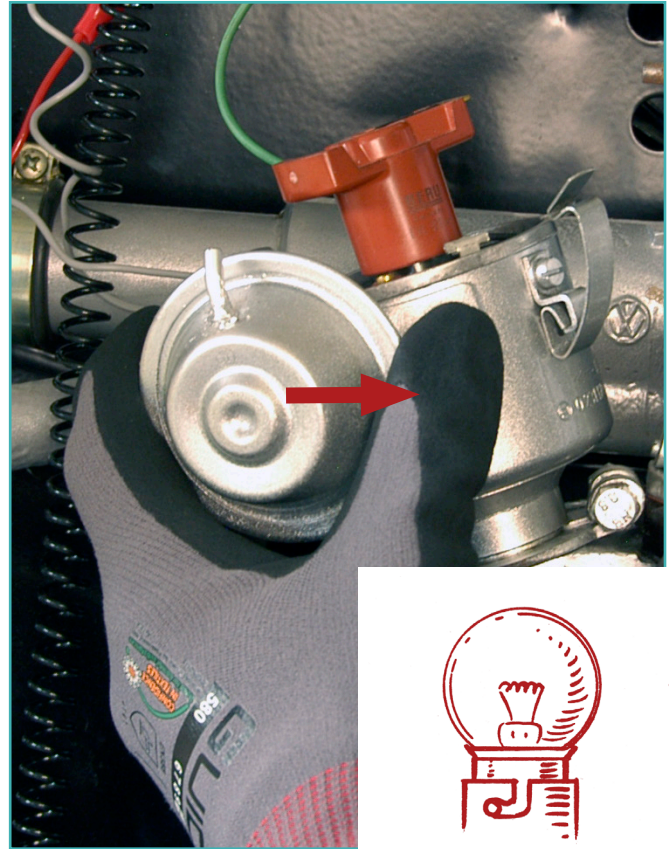
If this isn't the case, adjusting the ignition timing is the next step. To do that you will need to rotate the distributor housing, by rotating the distributor you change the position of the ignition points compared to the TDC. How long the ignition points open depends on the ignition points gap or Dwell as you already know, this is a different story, we explained that in [edition 12](#).

Loosen the nut and bolt that secures the distributor slightly (the bolt is shown on the picture above, don't remove the bolt, just loosen it). Make sure the 7,5° dent is aligned with the center of the crankcase. Rotate the distributor gently counterclockwise or clockwise until the test lamp glows.

The rotor should point to the dent of the distributor as explained on [page 36](#).

Rotate the distributor clockwise until the knob on the ignition points reaches the position as shown on the drawing below (A). The distributor shaft has four cams to open the ignition points, one cam per cylinder.

In this position the ignition points should be closed if the gap is set correctly.

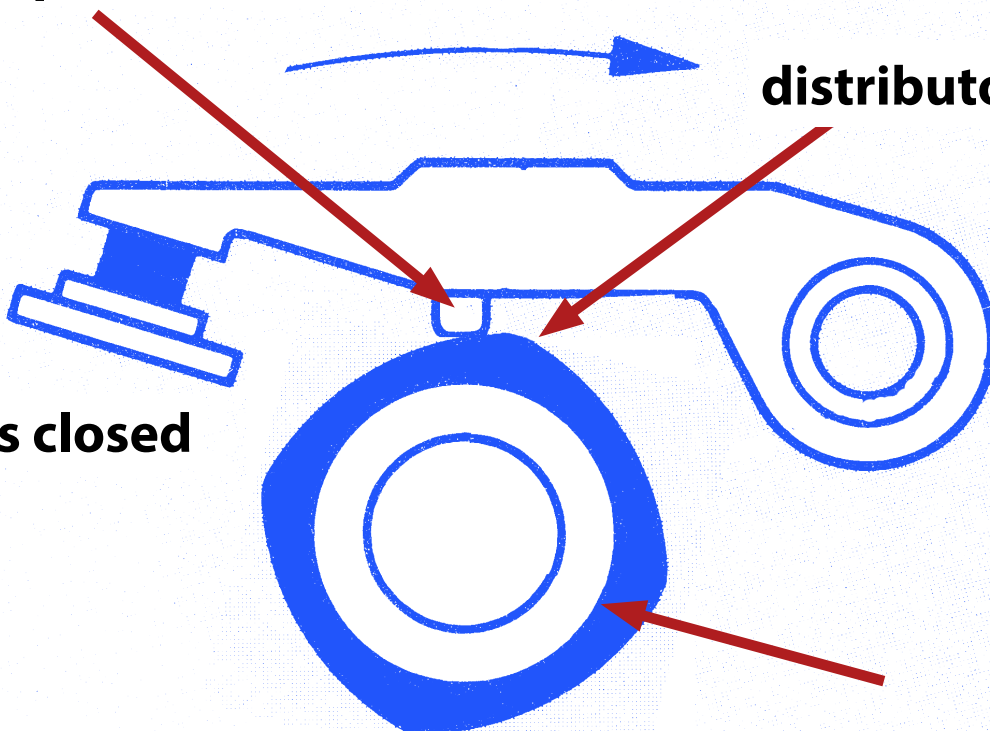


ignition points knob

distributor shaft cam

points closed

A



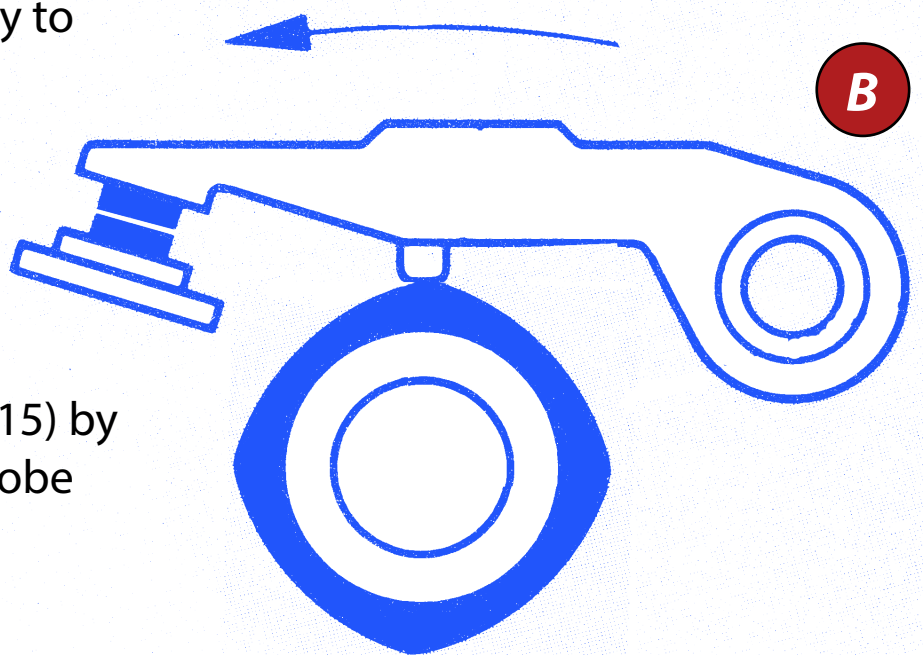
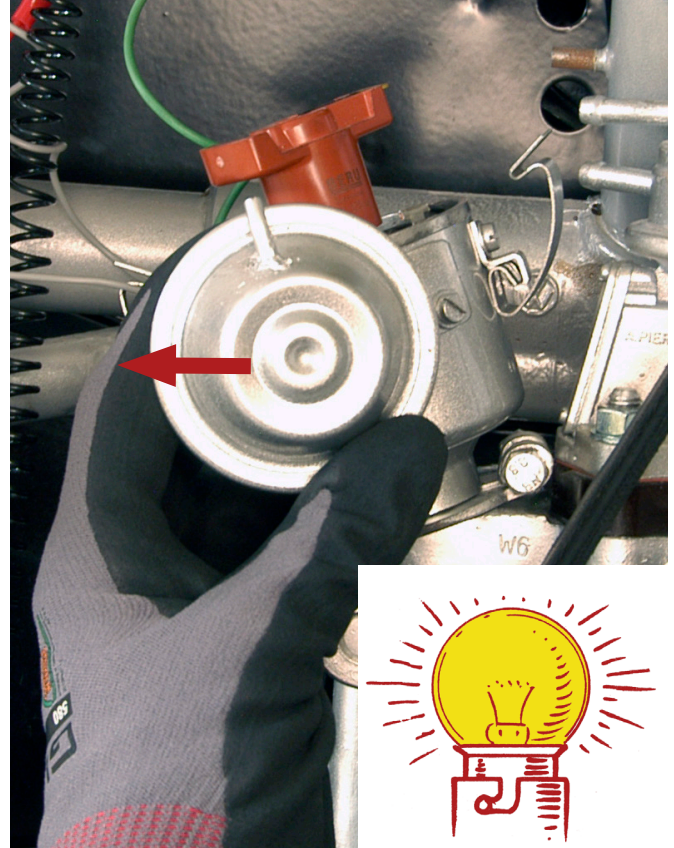
ignition timing - static

Next, rotate the distributor counterclockwise until the test lamp just starts to glow (B). The ignition advance is now set correctly in this position. Secure the distributor bolt and nut.

Rotate the alternator pulley clockwise now. The test lamp should glow when cylinder 4 is almost in TDC, then cylinder 3 and then cylinder 2. When the pulley has done a full circle or 360°, cylinder 1 is in TDC again.

If the test lamp doesn't glow once, it means that the ignition points are not opening. Try to adjust the Dwell again as explained in [edition 12](#) and [edition 13](#).

We will explain how to fine tune the ignition timing next time (edition 15) by using a timing lamp or strobe (dynamic adjustment).









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