THE CAPACITOR

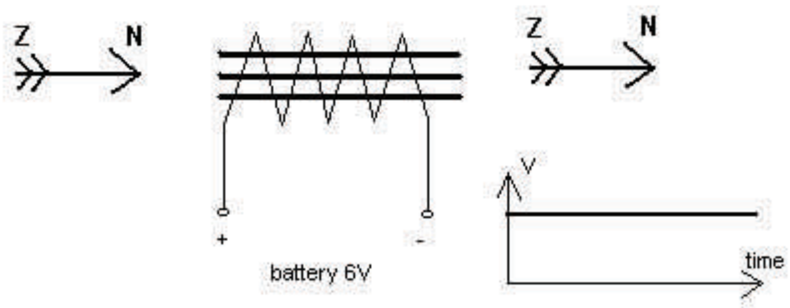
Only one component of the circuit needs some more explanation. That is the capacitor. It has two functions. When the contact points open, the current will try to jump the gap, giving sparks. These sparks are in the first place destructive for the points, but they also delay the current cut-off. That would reduce the strength of the self-induction peak. The capacitor works as a reservoir, and thus prevents this arcing across the points. The other function has to do with the 'sparktail'. After the first tensionpeak, the capacitor releases its energy into the coil, and because it is an open circuit now (points open) this current bounces up and down a couple of times, until it damps out. These oscillations are again transformed to the high-tension coil. The result is that the spark is maintained for a while, so it can reliably ignite the fuel.

Normal values for an ignition capacitor are between 0.1 and 1 µF. This is not very critical because it is a compromise anyway. At low rpm’s you need a bigger capacitor then at higher revs. So the engine designer chooses a value that is most suitable for that application. A fairly vague assumption.

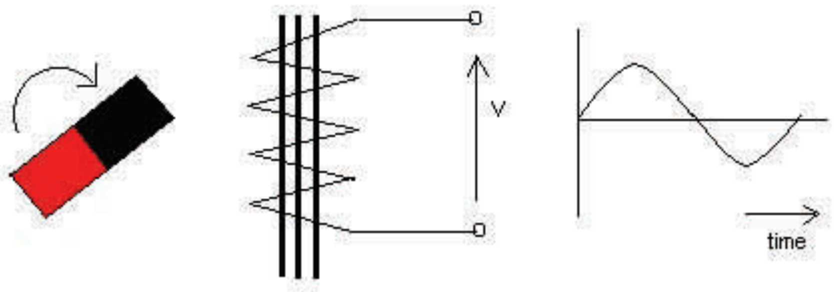
More important is that the capacitor is functioning properly. Because they usually quit when you least expect it, and you can’t diagnose or repair them, you should carry a spare one. There are basically three modes of malfunctioning. A completely shorted capacitor prevents any spark to occur at all. A capacitor with an internal break can’t absorb the electrons anymore, so you will see a lot of sparks at the ignition points. A weak spark at the plug is the result. Finally a capacitor with an internal leak. It will probably work for a while, but especially when hot, the engine gets hard to start. When you have ignition troubles, and you don’t see something obvious amiss, it is a good idea to change the capacitor before delving into the points etc.

ELECTRO MAGNETS

Simply put, if you have a current flowing through a conducting wire, then you can find a magnetic field around that wire. In the picture you see how a DC current (constant voltage in the Voltage-time diagram) through the coil, directs the compass needles. The more current, the stronger the field. You can bundle all that magnetism by wrapping a long wire around an iron core. That way you can make very strong electro-magnets.



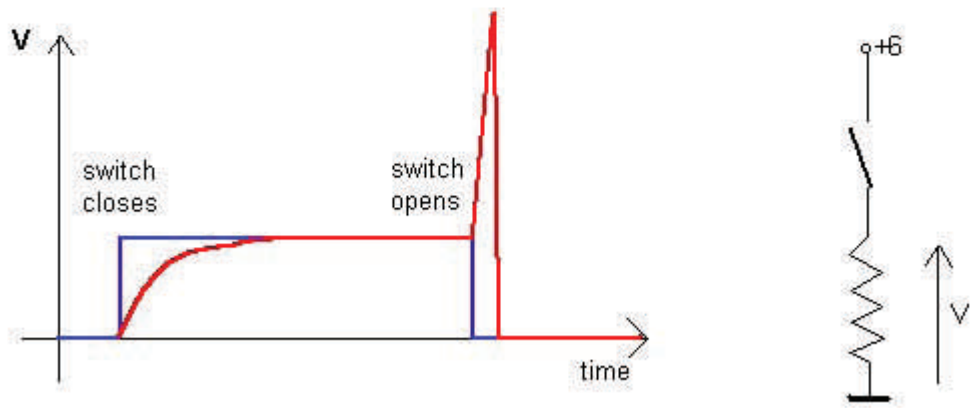
Another phenomenon, is when you have a **changing** magnetic field near a conducting wire. That changing field causes an also changing voltage at the wire-ends. Of course the effect is again greater if the wire is wrapped around an iron core. The picture shows how a rotating magnet gives an AC voltage.



These two effects are for example used in a transformer, that transforms the household 220 Volt AC to, for example, 22 Volt AC. The voltage at the primairy coil causes a current flowing through it. Because it is an al-ternating voltage, the current is running up and down the wire, changing direction 50 times per second. That current gives a magnetic field in that coil. Because the second coil is on the same iron core, that same magnetic field will be there too. And because it is a changing current, it is a changing magnetic field, so a voltage on the terminals of the second coil is the result.

Now the funny thing, the ratio of the primary and secundairy voltage is the same as the ratio of the number of windings of the primary and the secundairy coil. So 1000 windings on the first, and 100 windings of the second give a transformation from 220 to 22 Volt. The same principle is used in the ignition coil, although here it is the other way round, a small voltage change transforms to a high voltage change. The winding ratio is about 1:100 in an ignition coil, so in a 6 Volt system you would expect a high tension voltage of 600 Volt. That is not nearly enough to get a spark. You need between 10 and 20 kiloVolt for a nice reliable spark.

Here another effect is important, the selfinduction of the coil. Because a coil also reacts to its own magnetic field, it tries to resist any change in current.



In the picture the behaviour of the points is the blue line, while the reaction of the voltage over the coil is the red line. When the contact points are closing, the current won't start to flow immediately at full strength, but opposed by the selfinduction will only gradually increase. As a result also the voltage will only gradualy increase. When the points open, the current is suddenly cut off, and the coil protests loudly. The voltage doesn't drop to zero, but an opposing voltage peak up to 200 Volt is the result. This voltage peak, transformed up 100 times gives the neccesary 20 kVolt at the sparkplug.

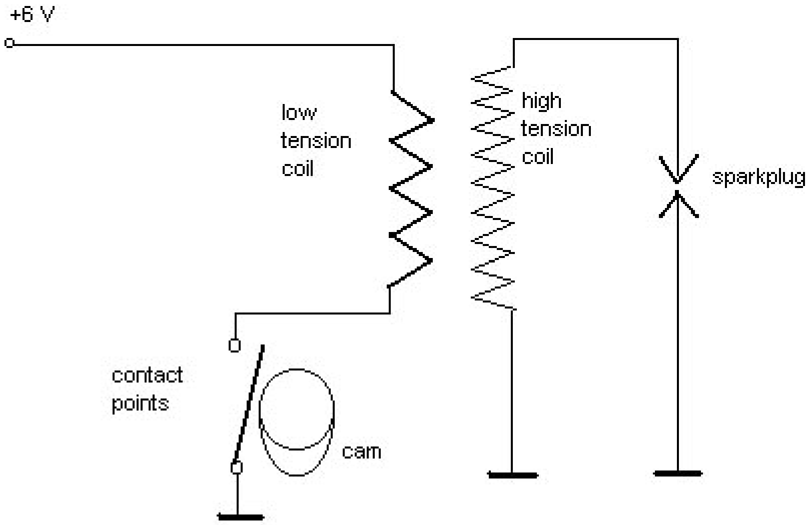
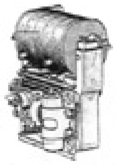


Figure 1

A magneto is in fact a combination of a simple dynamo, the contactbreaker mechanism, the low voltage coil and the high voltage coil. To understand how it works, I can better start with the battery ignition (fig 1). As you see, if the points are closed, current can flow from the battery pluspole through the low-tension coil and the contact breaker to ground, and thus battery minus pole. This is the lowtension circuit. Nothing really happens yet, except the coil heats up. Now if the cam turns round, at some point the contacts will open and the current is cut off. This sudden change is transformed to a high voltage spike in the high tension coil. That high voltage can now jump accros the sparkplug, and thus ignite the fuel mixture. This simple description leaves a lot of questions open. I will answer some of them, as far as they are of interest for a motorcycle mechanic. First I need to explain some of the electro-magnetic theory.

MAGNETO

 Question:

What is this magneto? How should it work, and why doesn't it work in my bike?

Answer:

This article is submitted by Craig A. Vechorik. Bench Mark Works

Does your mag igniton BMW start on the first kick? If properly set up, it should! Although many of the old timers are aware how to set up a Magneto, there are some commonly overlooked items and procedures to remember.

First of all, disconnect the plug wire from the coil, and using an Ohm meter, check the resistance of the wire and the plug cap. It should be ZERO resistance Before all of the hair splitters out there jump my case, let me make my standard Disclaimer of the '90s and say that THIS WORKS FOR ME, and has for years. Yea, I know that BMW started using resistor plug caps in '67 in response to regualtions governing RF interference. I still don't recommend that you use them. A lot of aftermarket companys will sell you /5 or /6 plug caps, but they have a 1000 ohm resistor built in them. If you can't find a source of non resistor caps, head for a chain saw dealer. Remember, that the faster a Mag spins, the hotter the spark. At the speed that you can kick the engine over, the spark is relatively weak, and using resistor caps and plugs is to invite hard starting.

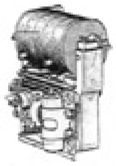
Another problem in starting can be the condensor. ALWAYS carry a spare one with you when you ride a /2, because if it ever fails (and they do) it will quit on you, and will not restart. You don't have to buy one from BMW, either. The condensors I use are for a V-8 Ford, '73 351 ci, and they have their own bracket already on the condensor, and the wire lead has a spade lug on it. This consensor will produce a strong blue spark, and last for many years.

The initial setup of the Magneto is important if it is to produce a strong spark. Check to see if the scribed line on the rotating magnet lines up EXACTLY with the bottom of the "V" notch on the brass plate that the points mount on, when the "S" mark of the flywheel is lined up with the stationary mark on the crankcase. If it is off slightly, loosen the two 6mm nuts that secure the body of the mag to the timing gear cover, and rotate the body to the left or right until a perfect alignment is obtained. I have seen folks use a timing light to check the timing while the engine is running, and to obtain the correct timing, they will move the body of the Magneto. this is NOT the way to set the timing. If you remove the centrifugal advance, you will notice that the points are mounted on a seperate breaker plate, which is held down by two screws. That is the plate which needs to be moved when setting the timing.

Another thing which will cause coil failure, (which is common) is the ventilation system for the electrics. Ever wonder what that little breather air cleaner thing is doing under the 1/2 moon cover on top of the engine? Air is drawn in through the notches on the front engine cover, over the generator and coil, through the little breather, into the Carbs. Check that little breather, clean it, lightly oil it, and put it back. Keep in mind that the timing of an air cooled engine is critical to the operating temperature of the engine, One can easily time a /2 engine staticly. By aligning the "S" mark on the flywheel to the stationary mark on the window of the crankcase, and then using a test light or an ohm meter on the points. (the wires from the coil and condensor must be disconnected) If you use a test light, you must use a battery also, to light the test light. You use the test light AFTER you have set the points to their proper gap. You rotate the breaker plate clock wise (but all I've ever seen is a digital watch P^))to advance the timing or counter clock wise to retard the timing. The idea is that you want to postion the breaker plate so as you rotate the engine, as the "S" mark S-l-o-w-l-y passes the stationary mark, the points open, turning off the test light, or showing an open circut on the ohm meter.

In the end, except for the initial set up and starting of the engine, it doesn't matter too much where the "S" mark appears in relation to the stationary mark, when the engine is running at idle. What does matter is where the "F" mark or full advance mark is with the engine running at riding speeds. The only way to check this is with a timing (strobe) light. This brings us to another common problem. When you use the timing light, do you see two images in the window? At idle or at Full advance? If you do, shut the engine down, and rotate the engine until the points are at their widest. Check the gap with a feeler gauge, and figure out which blade of the gauge fits the gap the best. Then rotate the engine 360 degrees, and check it again. In the ideal situation, with a good advance, assuming that the shaft of the rotating magnet, that the advance mounts on, is not bent, or that you had inadvertently had a speck of dirt on the taper between the camshaft and the rotating magnet when you mounted it on the cam, the point gap should be the same. You do know that both cylinders fire at the same time, but only one of them is on the compression stroke, while the other fires during the exhaust stroke. When you see two images in the window, one side of the advance is worn more than the other, and the points are opening to a different gap from one side to the other of the advance. Slash 5 & 6's will do this also. If they still have points in them. You can cure a /5 or /6 with an electronic inductive ignition system. Too bad that there is not an inductive system for a mag. The wider the images appear in the window, the more worn out the advance is. You can see this condition in the header pipes of the engine. If one is "bluer" and the blue extends further back on the pipe, one cylinder is timed slightly different, and is doing most of the work. On a machine in this conditon, it is hard to get it to run right, it seems as if the carbs are slightly out of sync, and you get vibration at all speeds. Messing with the sync of the carbs won't help it either. the only thing you can do is buy a new advance.

MAGNETO BASICS



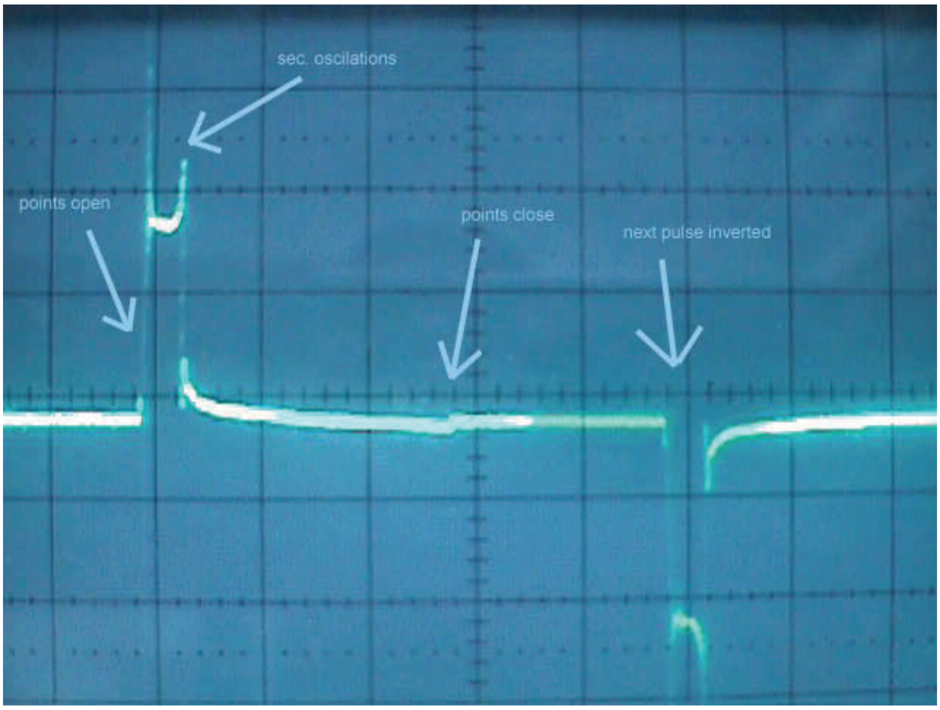
With the principals as described in the chapters "ignition basics" and "electromagnets", the magneto is a lot easier to understand. It is in fact the same as battery ignition, but the low tension circuit gets its energy from a simple dynamo, not the battery. A big magnet turns inside the iron core of a coil. Again a changing magnetic field gives a changing (alternating) voltage on the ends of the coil. For simplicities sake, Bosch has used the low tension coil for this purpose. If the contact points would always be closed, then an AC-current would flow through the low tension coil and the points, swapping direction twice per rotation of the magnet. The strength of this current depends on the strength of the magnet and how fast the magnet turns around. The AC-current will be transformed to the high tension circuit, but that is not enough to get a spark at the sparkplug. So the magneto is designed so we can open the points when the current is maximal. The resultant sudden collapse of the current causes again a selfinduction spike. This spike transformed to the high tension coil gives the spark. Because the strenght of the current depends on how quick the magnet turns around, the resultant spark will also be at its weakest when turning the engine round on the kickstarter, and the strongest at maximum RPM's. That is opposed to the battery ignition. There you always have a supply voltage of 6 Volt, but as rpm's rise, the voltage across the coil doesn't get the chance to rise fully in the short time that the points are closed. That was the main reason why magneto's were used on racing motorcycles. Magneto's were also used on military machines, tractors, stationary engines, etc, because the engine could run without a battery. Similar systems are still used in the two stroke engines of mopeds, chainsaws, lawn movers etc. Here you will find several small magnets on the flywheel. The coil is installed inside the flywheel. They don't call it a magneto anymore, but flywheel ignition.

MEASUREMENTS

Since I am a curious guy, I wanted to know exactly how the BMW /2 magneto works. Here in the lab I have access to all kinds of measuring equipement, but it is impossible to drag the bike inside, hook it to an oscilloscope and start it up. Beside that I also wanted to take some measurements with the magneto rotating but the points disabled.

So I made a jig to mount the magneto in the lath. Now I could measure in the comfort of our workshop without being disturbed by angry managers. For them who don't know what an oscilloscope is, don't worry. It's just a machine to show nice graphs of electrical voltages. The graphs show voltage in the vertical direction. Time is in the horizontal direction.

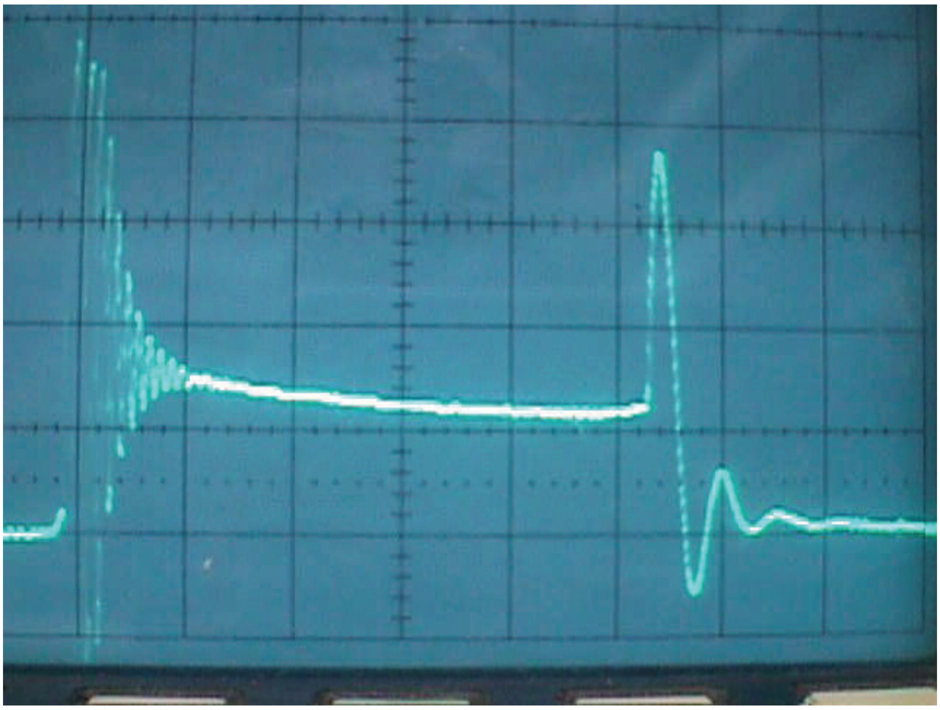
First I adjusted everything so I could see how the ignition pulses look like. With the lath spinning at 520 rpm I got this picture. The magnet is normally mounted to the camshaft which spins at half the speed of the crankshaft. So the 520 rpm's of the magnet are equall to 1040 crankshaft rpm's.



Horizontal 10 ms per division, Vertical   10 Volt per division

When the points open you see how the voltage shoots into the air and oscilates up an down in a very quick rythm. These are the primary oscillations. The voltage oscillates between the primairy coil and the capacitor. Then the voltage stays around 20 volt for a while until the spark extinguishes. At that moment the secondairy coil oscillates a couple of times. That is called secondairy oscillations. A small step is visible when the points close again, and the coil starts to magnetise again. You don't see the voltage rising much here, because the points are closed, thus a short circuit for the coil. Rest assured though that there is a lot of current flowing. The next pulse is inverted because now the magnets north and south pole have changed place.

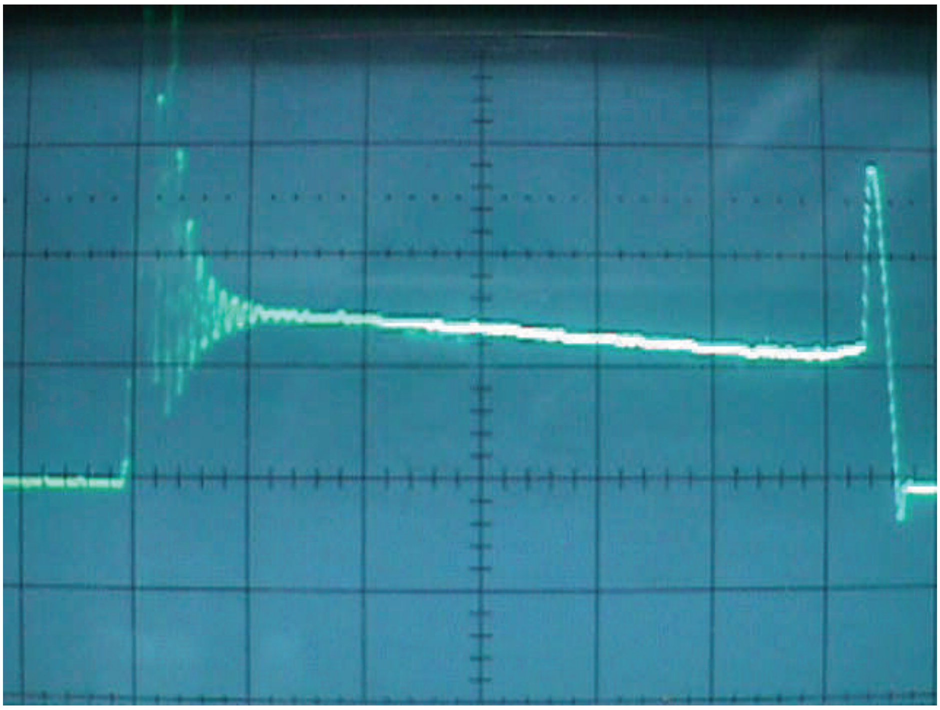
To be able to see the primairy and secondairy oscillations better, I took a new measurement with a magnified timescale.



Horizontal 1 ms per division, Vertical 10 Volt per division

At the far left you see how the voltage slowly rises a couple of volts. The current flowing through the primary coil and the capacitor is now so big that you get a visable voltage drop over the points. When the current is at its maximum, the points open. Due to the selfinduction you get such a big voltage spike that it doesn't fit on the screen. Between primairy coil and capacitor the voltage oscillates until it is damped out. After 5 ms you see a new oscillation . According to my textbooks that is the secondairy oscillation. When the spark extinguishes, the secondairy coil is still at several hundred volts. That voltage oscillates because there is no current path anymore. These oscillations are transformed back into the primairy coil.

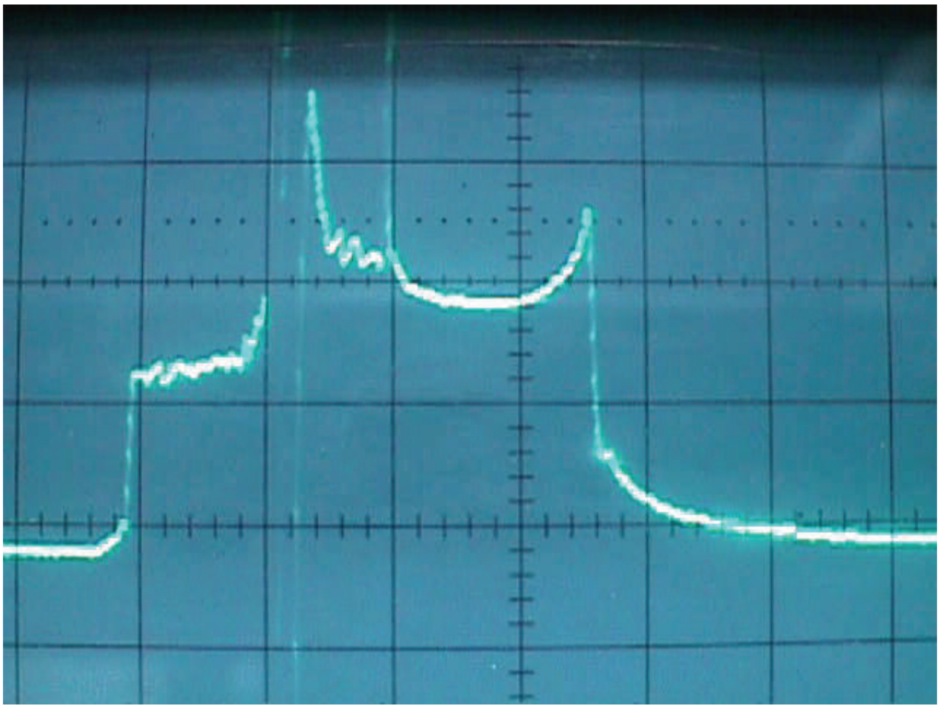
For the record I also took a meassurement at 3000 rpm = 6000 rpm at the crank.



Horizontal 1ms per division, Vertical 10 Volt per division

You don't see a lot of difference. The spark is about just as wide.

To show the importance of the capacitor I made a meassurement without capacitor. With sparks flying between the ignition points I got this picture at 520 rpm.

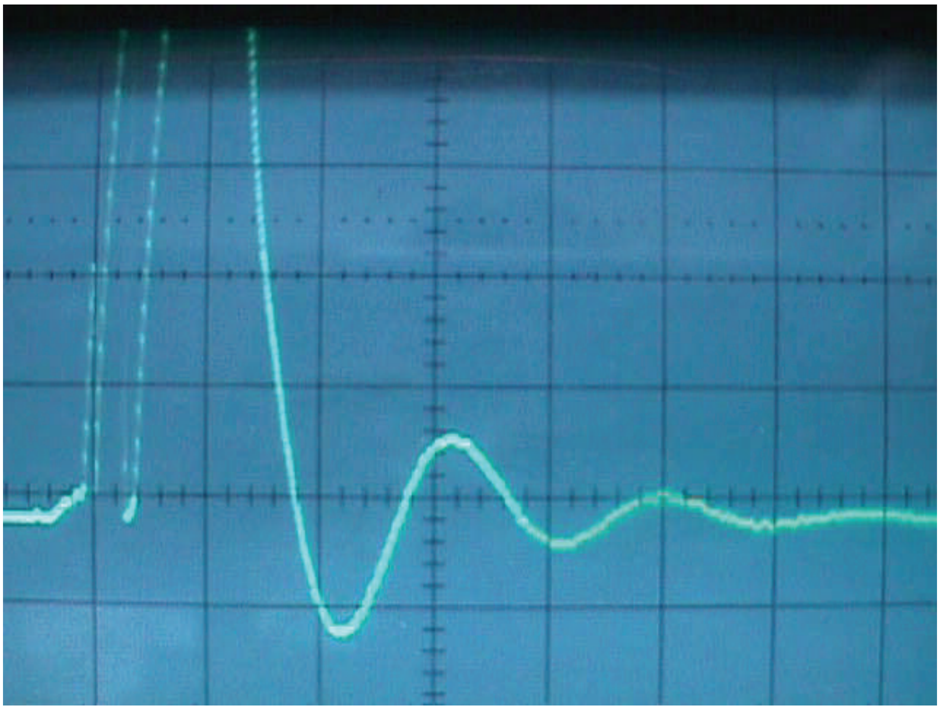


Horizontal 1 ms, Vertical 10 Volt.

When the points close, all the arcing between the points delays the spark more then a millisecond. At 520 rpm camshaft speed, the crank turns around at 1040 rpm. So 1 ms is a 6 degree delay. You can't see in

this picture the difference between the first voltage spikes, but because the primairy oscillations are a lot less, I conclude that there is a lot less energy available for the spark.

Then I connected a 7 microF capacitor over the points instead of the normal 0.25 microF capacitor. I got these results:

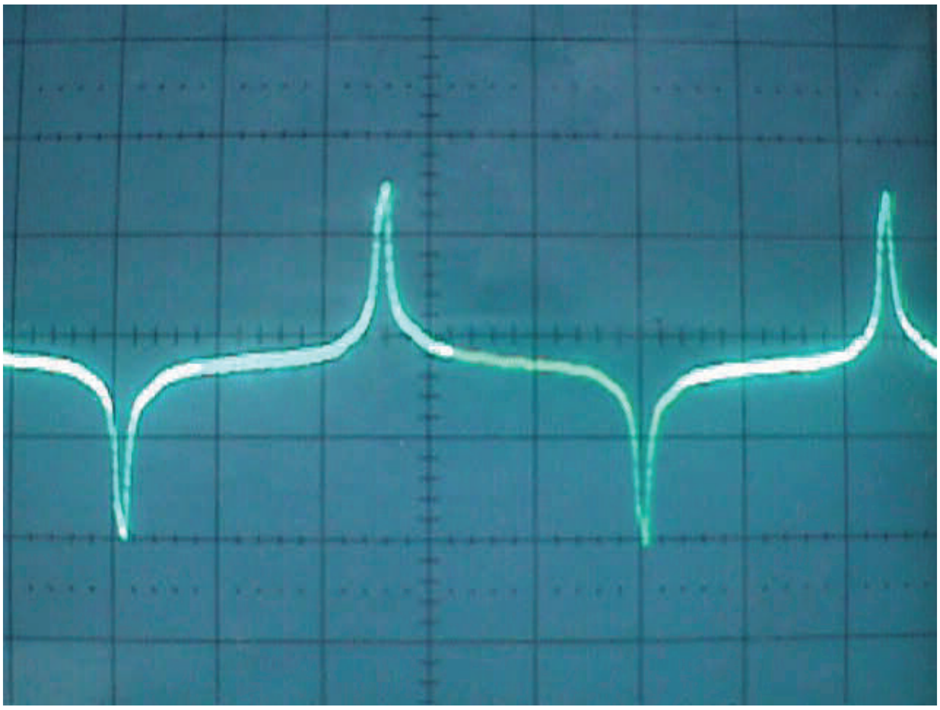


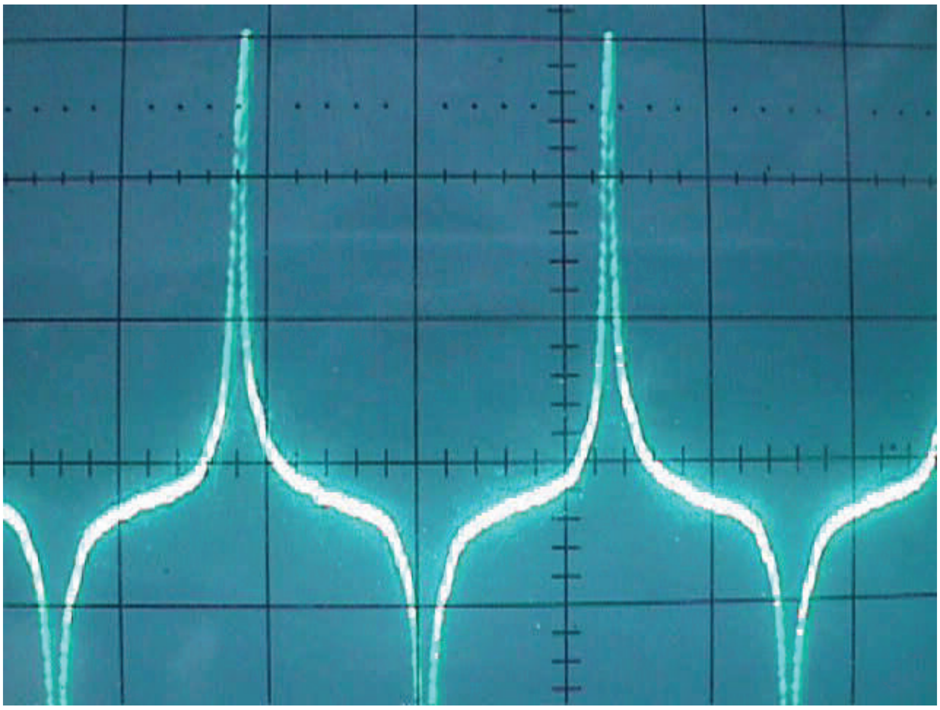
Horizontal 1 ms per division, vertical 10 Volt per division.

What I think is the worst for the spark in this picture, is that the rising slope of the oscilations is much slower then normal. Too much energy is absorbed into the capacitor instead of in the primairy coil. The system is not very critical for the capacitance though. When I connected two 0.25 microF capacitors parallel (creating 0.5 microF), I couldn't see any difference.

I have detected a fault in my own magneto though. When I first meassured, I found a short delay when the points opened, together with a lot of sparking between the ignition points. In my case there was a broken soldering at the connection of primary coil and capacitor. That creates a series resistance between capacitor and coil, with the same result as a weak capacitor.

To conclude this series of meassurements, I disconnected the coil from the ignition points. The idea was to get an impression of how the magnet puts energy into the coil. When the current can't flow through the points, the voltage will rise according to the energy that is stored in the coil. I made measurements at two speeds, 520 and 1000 rpm.





Horizontal 20 ms, vertical 10 Volt

As you can see, the voltage depends on the rotational speed. What is far more intersting is that it is very critical WHEN you open the points. The point of maximum voltage, or maximum energy is the famous abrisz point. You also need enough room for the advance. When the timing is advanced at higher revs, the abrisz point stays the same. So the points open at a less effective moment. Luckily there are two effects helping to get a good spark at high revs. First the voltage is higher, second the pulsewidth increases relative to the width of the ignition period.

SETTING THE MAGNETO

Because the magneto has a low supply voltage when starting the motorcycle, it is important to setup the magneto right. The points should open at the most effective moment. In practice that is luckily quite easy. For them who want to read more about the details, have a look at "abrisz". The magnet that is attached to the camshaft is marked. Also the magneto baseplate has a mark, a small notch in the top edge of the brass plate. When the S-mark on the flywheel is in the middle of the inspection hole, these two magneto marks should line up. It is a little difficult to see. Looking from the side you get too much deviation. Usually I lay down on the floor, peeking from below. Then I feel the two marks with a small screwdriver. If the screwdriver sticks out perpendicular to the brass plate, it's okay. On some models you can see it between the horn and the front fender.

When the marks are a little bit out of line, you can loosen the two M6 screws that hold down the magneto body, and turn the body. When the error is very big, you will have to rotate the magnet. The magnet has a non-indexed taper fit on the camshaft. That means that you can loosen the magnet, turn it in the right position and retighten it again. Have a look at tools to see how you can loosen the magnet.

Next you set the points opening width. Turn the engine until the points are opened maximal, and set the points width to about 0.4 mm. Always set the points width first, before you set the timing, because changing the width, also alters the timing.

A common mistake in the BMW world is to set the timing by turning the magneto body around. They loosen the M6 bolts, then point a stroboscope at the timing marks on the flywheel, and turn the body until the S-mark is in the middle of the inspection window. All very convenient, but with this method you throw away the abrisz setting that you made some paragraphs before. The proper way for setting the ignition timing is to remove the centrifugal advance unit, loosen the two screws that hold the pointsplate, turn it a little, reattach the advance unit, check the timing again, etc. You can turn the pointsplate without interfering with the pointswidth or the abrisz setting. Because this is a little inconvenient, there is a special pointsplate available that replaces the whole brassplate, and which makes it possible to change the ignition timing directly.

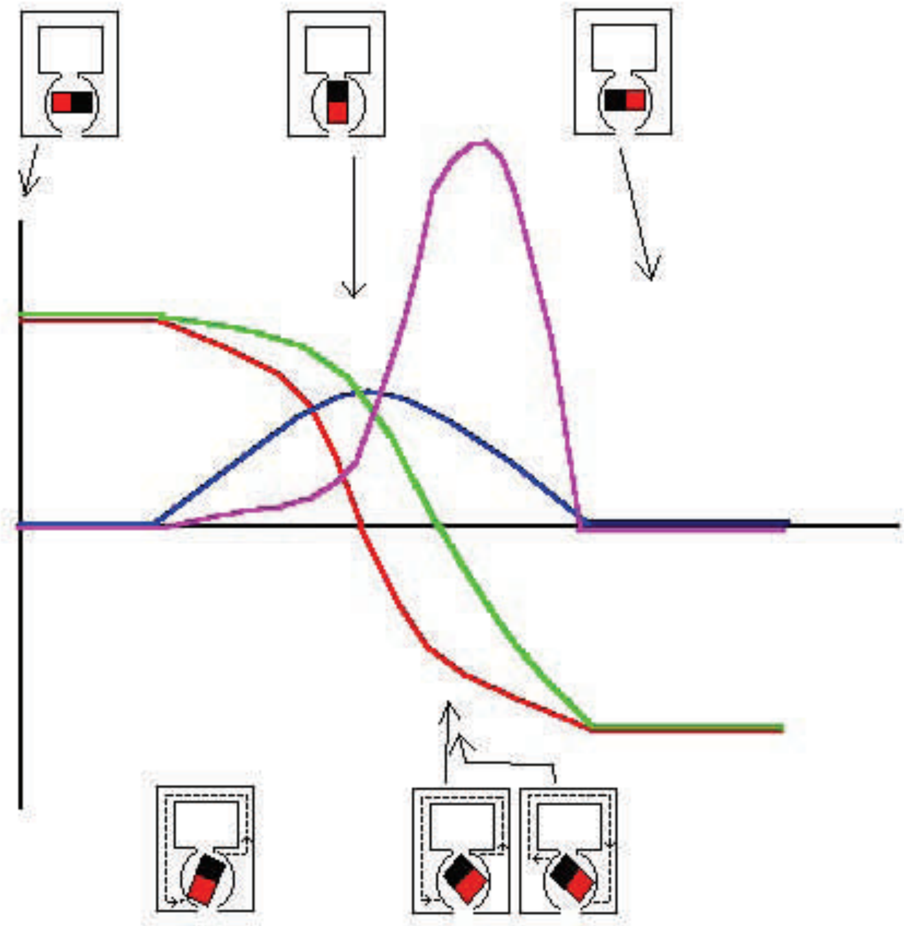
For checking the ignition timing I recomment to use a stroboscope. Direct the beam of the stroboscope at the inspection port, and you will see an image of the S-mark, which should be in the middle. When you use the static timing method, don't send a big current through the primairy coil, because that can impair the magnetic strength. So either use a buzzer or testlamp with a small battery or disconnect the wire from the points to the coil.

The Abrisz

Usually the engine will run, also when the magneto is not setup perfectly. But there are a lot of circumstances where you need the strongest spark you can get. For example when starting, when it is cold, your piston is a bit worn, the carburettor needs a tune-up etc. In most texts about the BMW magneto's, the autor puts a lot of emphasis on the correct adjustment of the Abrisz. When the flywheel S-mark shows up in the middle of the inspection window, the points should open and the mark on the magnet should point straight to the mark on the magneto body. They call it the right Abrisz point. And they are hundred percent correct.

But what is that Abrisz? Curious souls who can't find a descent explanation of that word in their dictionary should read on. Others who never liked maths or physics can better stop reading now.

Abrisz means something like "tear off". And what tears here are magnetic field lines. To make everything a little more clear, I made this picture. The picture is not a wonder of graphics art. Neither have I checked everything 100%, but the principals I describe here don't contradict with my own measurements.



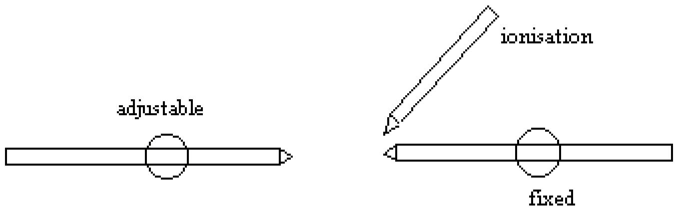
The red line describes how the magnetic flux of the rotating magnet devellops during half a camshaft rotation. I have put little magnetos on top so you have an idea of what position of the magnet equalls with the points of the curve. What you see looks a bit like a cosinus with flattened tops because of the wide poles of the magneto body. When the magnet is horizontal, the magnetic flux in the body is maximal. When the magnet is vertical, the flux through the body is null.

The magneto not only has a rotating magnet, but also a primairy coil. The rotation of the magnet is a changing magnetic field, so causes a current in the coil. That current is proportional to the rate of change of the magnetic flux. The current through the coil causes its own magnetic field in the magneto body. That field is directly proportional to the current. I painted that with the blue line. As you see it is null when the magnet's flux is constant, but rises when the magnet's flux is changing. It has its maximum when the magnet's flux is null, because that is the moment of largest change.

The resultant magnetic flux of these two magnetic sources is the green line. It is simply a summation of the two. The funny thing now is that this line doesn't go through zero when the magnet is vertical, but a little later. The devellopers from Bosch have carefully meassured that point and marked it for future reference, for example during tune-up. This point is when the magnetic field lines tear off from one stationary pole and fly to the other side, changing direction in the process. This tearing off of the magnetic field lines is the Abrisz point. I painted the small magnetos at the bottom of the picture, with a thin line that shows how the magnetic field lines change, just before and after the Abrisz point. The distance between the stationairy pole and the magnet-edge at this point is also called the "Abrisz". In old fashioned magnetos it was a datapoint in milimeters, but we have it easier because the magnet and the body are marked.

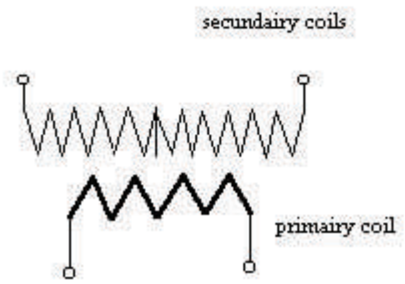
What is so important about this point? Well, the total magnetic field causes a primairy **CURRENT in the coil, that is directly proportional to the change of magnetic flux in the magneto body. I have painted that with the purple line. As you see it has its maximum just at the Abrisz point. That is the best place to open the ignition points for maximum effect.**

When confronted with mysterious ignition problems, it can be very helpful if you can verify the strength of the spark. Holding the sparkplug-wire a couple of millimeters from the crankcase, while jumping on the kick-starter is not a very conclusive procedure. It is imprecise and not repeatable. It is much better to rig up a "three point spark tester".



You can make this tester from three lengths of brass M3 stud for the electrodes. Make also three brass pillars, into which you screw these studs. Then arrange the electrodes on a piece of insulation board. The sparkplugcap is connected to the fixed electrode. The adjustable electrode is connected to ground and the ionization electrode is loose, and is only there to get more precise results. Its point should be very close to, but not touching the fixed electrode's point. Screw out the adjustable electrode with little increments at a time, until you stop getting sparks when jumping on the kickstarter. A /2 magneto should be able to jump about 8mm gap or more on this instrument.

When you do resistance measurements on a /2 coil, you might be surprised that you don't find any connection between the secondary coil output and ground. In all my textbooks you only find diagrams of magnetos with a single output. In these the secondary coil has one lead connected to the sparkplug, the other to ground or the primary coil which is in practice almost the same (20-kV doesn't recognize a +/- 6-Volt difference). Not so on the boxer twins. After I dismantled an old defective coil, I found this diagram:



So with a resistance meter, you find a very low resistance between primary coil input and ground, several hundred kiloOhms between the two secondary outputs, and infinite in-between all other points.

This arrangement has a weird influence on the polarity of the sparkplug. Normally, electrons flow from the coil to the sparkplug central electrode, jump to the ground electrode (spark), flow through the crankcase metal to the other sparkplug ground electrode, jump again to that central electrode (spark in the exhaust stroke), and back to the coil, now on the other terminal. Now if you attach the magnet 180 degrees around, OR you exchange the spark plug wires, the electrons flow in the other direction. There is no easy way to detect this, and it could mean more difficult starting when it is very cold and wet.

Another little coil detail that is very important for its health. Below the two secondary coil terminals, you see small metal pointers. The distance between these pointers and the terminals should be 10 - 11 mm. This "safety gap" is there to allow the spark to jump, when it can't jump elsewhere (i.e. a loose sparkplug cap). If the spark can't jump over somewhere, it will try to jump through the coil insulation, and that is not good of course.

A standard coil failure is overheating. The coil is placed on quite a hot spot. And that heat deteriorates the coil-insulation. When it gets too weak, the coil will develop an internal short when hot. As soon as it cools down, it works again. A typical situation: You ride in stop and go traffic. Suddenly the engine dies. You try everything to start it again. You kick it and you curse it, and in the mean time the coil cools down. Suddenly it starts again, and you ride it a little while, until it gets hot again, etc. Only a new coil can cure this failure, but the same symptoms can be caused by a bad capacitor too.

BMW has provided a ventilation system for the electric’s though. Air is pulled from the gap at the lower end of the front engine cover, over the electric’s, through the topchannels of the crankcase, through that little meshwire filter to the carbs. The vacuum of the carbs cause the ventilation air to flow. So it is important to keep that small meshwire clean and lightly oiled.

The ignition points are real wear items. They get burned, get contaminated with oil and grease and the little cam follower wears down. So it is important to use a good capacitor to prevent sparks, exchange leaking engine oil seals, not to use oil or too much grease on the felt greasing pad, and making sure that the points are toughing square and parallel when you install a new set. Especially the Asian replacements for the original, now extinct, Bosch points, need quite a bit of bending to get them right. A points file is only a tool to get you home. When the points are filed or grinded, they usually turn bad again in no time.

A difficult to find ignition failure is a weak ignition-lock spring. On the boxers this is usually no concern. The ignition spike that you push into the lock opens two contacts that shunted the primary winding previously. But on the single BMW's (R20-R27), this same contact closes and makes sure that the 6-V battery voltage is connected to the ignition system. Now if the spring is weak, or the contacts are too far apart, this connection can start to vibrate with a stuttering ignition as a result.

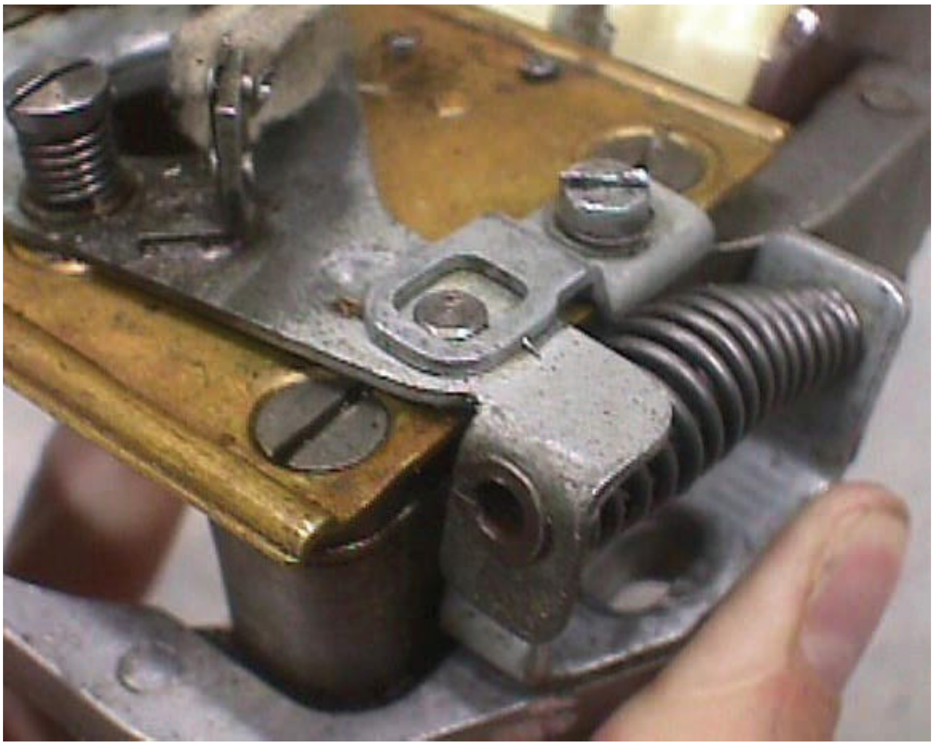
Mention of the singles brings me to an error that only catches them who really care about their bike. If you take apart the centrifugal advance of a single to clean and grease the weights, you can accidentally assemble the cam 180 degrees around. If you then try to start the engine, the sparks will occur in the end of the exhaust stroke, when they won't do any harm, but not any good either. If you have jumped 20 times or so on the kickstarter, there will be enough gas in the cylinder, and the starter kicks back violently. That is not nice for your leg.

The centrifugal advance unit is another typical wear item. And not a cheap one. Not only the pivot points of the weights wear out. On the boxers the unit has two ignition cams, 180 degrees apart. On a new unit, these cams are nicely symmetrical, but they wear uneven. When you use a stroboscope to time the ignition, you see two S-marks jumping around in the inspection window. When they are particularly far apart, you probably need a new centrifugal advance. Other, but less plausible reasons could be a bent camshaft taper, grit between the magnet and the camshaft or a bent magnetshaft to which the advance is mounted.

Sometimes you might want to know, how wide the ignition inspection hole in the crankcase is. For example, BMW defines a maximum ignition point deviation between the two cylinders of 2 degrees. It would be nice if you can correlate this to the size of the inspection window. The boxers have a 22 cm flywheel and a 16 mm window. That is approx. 8 degrees. The singles have an 18 cm flywheel and also a 16 mm window, thus about 10 degrees.

The BMW workshop manual is particularly vague about how you time the ignition. On one point they state that you should setup the magneto carefully to get the right abrisz. At another point they say that you must turn around the whole magneto body for setting the advance. That way you upset your abrisz point again, which will make starting the bike more difficult. Luckily Bosch knew better how to set the ignition timing. When you remove the advance unit, you will see thet the points are installed on a seperate plate. That plate is screwed with two M3 screws onto the body. The holes are slotted, so you can move the plate around, thus setting the ignition timing. The only drawback is that you must remove the advance unit every time, when you want to set the timing. So setting the timing is a matter of measuring, removing the advance unit, adjusting the points plate, re-mount the advance, measure etc. A bit cumbersome but not difficult. It works the same on the singles R25-R27.

The R68/R69 is a little bit different. Because of their tremendous high compression ratio (1:8), they were prone to pinging when you only could find poor petrol. On these sports bikes BMW didn't want to compromise, so they put an extra manual advance lever on the handlebar. With this lever you could retard the ignition 10 degrees, enough to avoid the pinging on low octane fuel. The static timing was 12 degrees BTDC with the lever fully advanced. This resulted in an ignition timing between 2 degrees BTDC (lever fully retarded, centrifugal advance at rest) and 42 degrees BTDC (lever fully advanced, centrifugal advance fully open).



The magneto is a little bit different. Again the points are mounted on an extra plate. This plate can be rotated. The plate has an extra brace sticking out to the left. To this brace the bowden cable of the manual advance is attached, with a big spring to keep it fully advanced. The free play of the bowden cable is adjustable at the ca-blecover side. The rotation angle at which full advance is reached is adjustable with a clamping screw near the brace.

Setting the ignition timing of these magnetos is different then the other /2's. My method goes like this. Place the ignition points plate in the mostly advanced position, with the lever fully advanced. This you do with the clamp screw, I mentioned above, turned loose. The big spring will push the brace down. Now start the engine and let it idle. Point the beam of your stroboscope at the inspection window and you will see the S-mark somewhere in the corner. Now grap your manual advance lever and turn until the S-mark moves into the middle. Now quit the engine, turn the clamp screw tight, and you are done.