DAN'S MOTORCYCLE REPAIR COURSE IGNITION TIMING

- Ignition Timing Ignition Theory.
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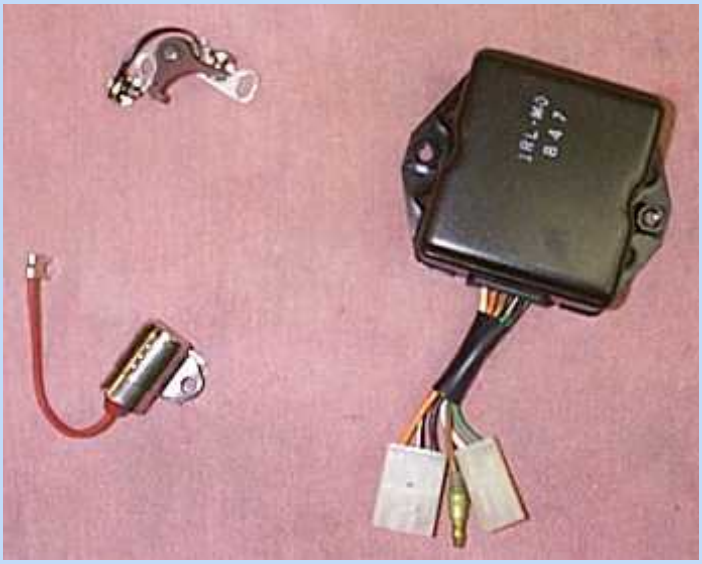
- Electronic Ignition A Pointless Discussion!
- Timing a Battery/Coil Ignition Is there a Point to this Discussion?

IGNITION TIMING



¶ Ignition timing seems to be the one thing that terrifies the home mechanic most. I've seen guys leap right into gear boxes, tear off top ends without the slightest hesitation. But set the ignition timing? NO WAY... they are scared stiff of it. Others figure they can throw in a new set of points, set the gap with a matchbook cover and drive on. In reality there is no reason to fear ignition timing or to do it haphazardly. Ignition timing is quite simple and the benefits to be gained are great... namely more power, longer engine life and better gas mileage.

When combustion occurs it does not take place instantly. It requires a period of time. Depending on the RPM the power stroke can be .05 of a second at 1200 rpm to .0057 of a second at 10,500 rpm. Now even though the time for combustion at 1200 rpm is not much, it is still over 8 times what is available at 10,000 rpm.

The reason that this small amount of time is important is because the combustion process is not as much an explosion as it is a controlled burning. The time available for this controlled burning decreases as the rpm goes up. To compensate for this, the point where the spark occurs, to start the combustion process, must occur earlier Before Top-Dead-Center (BTDC) of the compression stroke. To accomplish this weights and springs are attached to the points cam. As the cam spins on its shaft, centrifugal force causes the weights to move and turn this cam on its shaft, advancing the timing of the spark, thus giving the combustion process more time to occur as the rpm goes up. Full advance is usually reached on most engines by around 3000 rpm.

Most motorcycle engines with points have only a Centrifugal Advance. A few have a Vacuum Advance. Newer engines with electronic ignitions usually have an electronic advance. Some engines have fixed timing with no automatic advance at all. The advance is fixed at so many degrees Before Top-Dead-Center (BTDC) and does not vary. The lower the compression ratio an engine has, the more spark advance it needs. This is because rapid combustion is aided by a high compression pressure. Because the combustion process takes place quicker with a high compression ratio less time is needed, therefore less spark advance. Conversely lower compression pressure slows the combustion process, necessitating more spark advance. Now why all this about compression pressure and

spark advance? Simply this, as an engine wears out it starts leaking compression past rings and valves. This lowers the compression pressure (ratio).

What does this mean? You got it, we need to advance the ignition timing as an engine ages.

OK...Great...Now What? Well, if the engine is worn, lots of miles or hard use, we need to advance the point at which the spark occurs. This works best on large 4-stroke engines although it can be done on small ones too, but it is harder to do. I don't do this to 2-strokes. They are just a different breed of engine. I don't do this with flywheel magnetos (Honda 50's, 70's etc.) either, because it is a lot of work with that type of ignition system. On many of the newer motorcycles you just can't do it without major modification, but on almost all points ignition machines and a lot of electronic ignition ones, you can. I don't do this with engines that have real good compression because they don't need it. On these engines the stock timing marks will probably work best. This is for old, worn, tired, engines. However, I have heard of this method being used with heavily modified engines, to get a starting point in the tuning process.

Now when we increase the spark advance (the point when the ignition spark occurs, at the sparkplug, before-top-dead-center of the compression stroke [BTDC]) we get more power BUT we also get more heat. There is a point after which we get lots more heat and very little extra power. We want to STOP before we get to this point.

The drill is this... With the engine at normal operating temperature and idling, advance the timing slowly. You will hear the engine speed up. Move the timing back and forth, advancing and retarding it till you get the highest engine idling speed. Then back it off (retard it) just a bit. The engine speed slows down just a little. You are still idling, don't touch the throttle.

Go for a short ride and make sure the engine does not "ping" under load. Then check the color of the spark plug(s) to make sure it's not running too hot and you are done!

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FLYWHEEL MAGNETO TIMING

Motorcycle Magnetos are great things. They require no battery and, in general, give good reliable service. They are harder to adjust, and it is not easy to adjust them using the method I gave in the Ignition Timing Page. Basically they come in two types, the Points type and the Electronic type. Let's talk about the Points system first.

LOW TENSION MAGNETO WITH POINTS

Most Japanese dirt bikes made before 1980 had points ignition (but not all!) Most (but not all!) of the two-stroke engines had fixed advance. That means there was no variable advance of the ignition timing. Most of the four-stroke engines had a variable advance. The reason for a centrifugal advance is this. An engine is easier to start with the timing of the spark retarded from the place where it runs best. It also helps to prevent kick back. This is not much of a big deal with small two and four stroke engines but it **IS** a big deal with a large engine.

Kick back is when the air/fuel mixture lights off BEFORE the piston reaches Top-Dead-Center. This sends the piston backwards if you are kick starting, have your foot on the kick start lever and don't kick hard enough. In the worst case, it can snap back and break your leg.

Low Tension Magneto

High Tension Magneto

When I talk about Low Tension Magnetos I mean electrical systems with a separate Ignition Coil located outside of the Magneto's Flywheel. High Tension Magnetos have the ignition coil on the stator plate under the Flywheel.

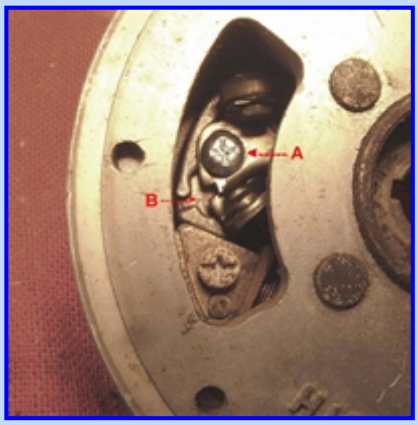
Let us start from the beginning. Pull the Flywheel cover and find the points wire that comes out of the top of the crankcase. It is usually a black wire with a white strip or a solid black wire but not always. Check your shop manual. When you find the points wire connect a Buzz Box to it and turn it on. Now turn the engine flywheel till the "F" mark on the flywheel matches the stationary mark on the engine crankcase. Listen to the tone the Buzz Box is making. The tone will change when the points open. If the marks are right on then you need go no further. If they are off or if you are getting no spark, then we have to dig a bit deeper.

Our main concern is that we have spark and that the spark occurs at the right time when the engine is at full or maximum advance. Most four-strokes, namely Hondas, can be timed in the retarded position. But some, like Harleys, need to be timed in the advanced position. A lot of the small Two Strokes made by Yamaha, Suzuki and Kawasaki have spark advances. I usually time the Kawasakis and Suzukis in the retarded position and most Yamahas in the full advance position. Obviously, if there is no spark advance you time the engine at full advance. Look in your Shop Manual (you do have a Shop Manual, don't you?) to find out what that is.

The timing marks are set up a number of different ways. Some have the advance and Top-Dead-Center (TDC) marks on the crankcase and one moving mark on the flywheel. Click on the picture to the right, and you will see two marks on the crankcase and the one on the flywheel. This engine rotates counter-clockwise, so the first mark is the full advance mark, and the second mark is TDC. You want the points to open when the moving mark, exactly matches, the full advance mark. This example is an old Hodaka 100cc engine with no automatic advance. If you do not know the direction of rotation simply push on the kick starter lever.

The example to the left has one mark on the crankcase and all the other marks on the flywheel. This Honda engine (50-70cc) is timed in the full RETARED position. This is because it has a centrifugal spark

advance. The "F" mark is when the points open and the spark occurs. The "T" mark is Top-Dead-Center. The two marks on the left are the full advance marks. At 3000 or so RPM the spark will occur between these marks. To check this you must use a timing light with the engine running OR with the engine off, physically turn, and jam in position, the advance unit. Then check it. Most of the Japanese engines I time in the retarded position except for the Yamaha 2-stroke singles. They seem to have weak advance springs, making timing in the retarded position iffy. But that's OK...Yamaha was thoughtful enough to put a little hole in the flywheel which lines up with a hole in the advance unit at full advance (a lot of them, anyway!). Just put a small drill into the holes to lock it in full advance! Others have a lever you push to get full advance.



In the picture on the left, you can see "A", the points and the screw that holds them in, and "B", the adjusting groove. If you loosen the screw, you can open and close the point gap, with a screwdriver in the adjusting groove. It sounds so easy, and it can be... sometimes...and then again, sometimes not. The point gap regulates how much time the coils have to build up the spark. Some systems charge the coil with the points open and some with the points closed. We won't go in to that here. We just want the engine to run good.

Now adjust the point gap open or closed until the Buzz Box changes tone exactly when the moving mark on the flywheel and the stationary mark on the crankcase coincide. Now tighten the points screw and check again. You will find in six times out of ten, the timing has moved. Rats! Look at how much it moved and in what direction. If it advanced just a little bit, set it a bit retarded and then tighten the points screw. Or visa versa. Check the timing again and you will find it is right on when the points screw is tightened. This may take several tries to get it right.

If you want you can turn the engine flywheel until the points open as wide as they can and then measure the point gap. It should be within whatever plus or minus specification the manufacturer gives. For Japanese engines it is usually between .012" to .014" (0.3mm to 0.4mm). If the point gap is bigger or smaller then the manufacturers specification you may or may not get a spark. To get the best spark keep the point gap within the manufacturers specifications.

Not only must the points open at the right time for the engine, but they must open at the peak of the charging cycle of the coils. As the magnet in the flywheel spins around the ignition stator coils electricity is built up in the ignition coil. When the points open, it disrupts this electric field, causing the spark that fires the fuel/air mixture in the engine. This is usually engineered into the Magneto unit and you can't adjust it. If you adjust the points to the right Ignition Timing, but don't get a spark, it might be because the Points Cam Follower, or Heel (the part of the point that the points cam pushes against) is worn. Back in the day I have also heard of the Points Heel being called a Points Slipper or Lifter.

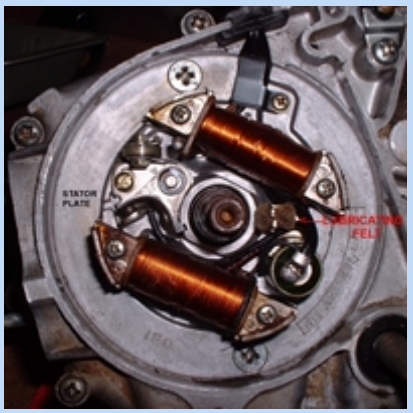
This wear on the points heel causes the points to be out of time with the rotating magnet even when the Ignition Timing is set right. The cure is a new set of points. Most of the wear on Magneto Points is not on the Contact Points, but on the Points Heel. This is because the voltage across the points is so low, around 1 to 3 volts. The low voltage takes a long time to wear the points out. Battery ignitions have 6 or 12 volts so they wear out much more quickly. Magneto points that look good can, in reality, be bad.

If the points are just a tad rusted you can clean them up a bit with a strip of 100 to 150 grit sandpaper folded grit side out. I prefer to use a Flex-File but I don't think you can get them anymore. Just drag the sandpaper back and forth across a closed set of points till they are shinny. When done blow the points off with compressed air and clean with acetone. They sell metal points files but I never could get them to work.

If you have a lot of miles or hours of running on a set of points or if they are giving you any trouble at all, **REPLACE THEM**. I have spent way too many hours of my life trying to make a bad set of points work and it never seems to work out to my benefit. If in doubt replace them. I realize that these days new points may be hard to get. I still say **REPLACE THEM**. Remember to lube the Points Lubricating Felt.

When you get the used, worn out points in your grimy little hand don't just throw them out. Take them apart and save the screws, washers, nuts, and insulators. For the most part these do not wear out and are very hard to find if you need one. I keep a little bottle of old screws around and every once in a while they come in very handy.

Everyone tries to sell you a new condenser but condensers rarely fail. In the last forty years I have changed out hundreds of points but only about two or three condensers. To test, charge them up with a 12 volt battery. Negative to the condenser case, positive to the pigtail wire. Then touch the pigtail wire to the condenser case. If you get a nice spark, the condenser is good. Yes, I know some are soldered to the points wire. Unsolder the condenser and separate it from the rest of the wires, then solder or clip a temporary wire on and test for spark.



To replace the points you must remove the Flywheel. Then remove the one screw holding the points to the stator plate. Now loosen the points wire screw and remove the point wire. Throw the old points out and install the new points. Screw the point screw in and hook up the points wire. Be aware there are two point contacts to each set of points. One is screwed to the Stator Plate and is grounded. The other is movable and is insulated from the grounded point. The point wire is connected to this movable point. The pivot point of the movable point, the spring and the screw connection to the points wire are insulated from the stationary point. If this insulation is worn or if the point is improperly assembled, allowing the movable point to be grounded to the stationary point, the points will not work. The two points must have contact ONLY through the round points themselves.

One thing to remember. When replacing the points wire, take a good look at how the wire is placed running to the points. Things are real tight under that flywheel and there is not much room. If you position the points wire wrong, part of the spinning flywheel could wear through the wire's insulation and short out the wire and the points. Take a good look at the points wire before you change the points and reposition it on the new points in the same way.magneto_condenser.jpg

The spark occurs when the points open. We want them to open when the piston is in the right position before Top-Dead-Center (BTDC). The mark on the flywheel and crankcase are just tools that allow us to set that opening point-of-time. It is hard to tell when the points open. We need some way to know exactly when they open. I use what is called a "Buzz Box". It makes a buzzing noise that changes tone when the points open. You can also use an ohm meter or a piece of cigarette paper. The cigarette paper is actually very accurate. Just put it between the points and pull gently so as not to tear the paper. When

the points open, the paper will come loose. Remember the timing marks must match when the paper pulls loose. You can buy four packs of cigarette papers on Amazon.com for under $5.00 delivered. That gives you 128 cigarette papers. That should do a few bikes.

Now a lot of Magnetos on smaller Japanese bikes have Stator Plates that are bolted to the crankcase with screws that have no adjustment but an equal number have Stator Plates that have elongated holes and are adjustable. On these adjustable Stator Plates the drill is this. Set the points gap to the correct value with the Flywheel in place. Then check the timing. If the timing is off, pull the Flywheel off and move the adjustable Stator Plate. Install the flywheel and retest. If it is still off do it again until the spark occurs at the correct place. All this is somewhat more difficult and time consuming because all this adjustment is UNDER the flywheel.

Once all this is set, theoretically, when the points are worn out, you should be able to replace the points with a new set, set the gap and all will be correctly timed. Also you can advance the timing on a worn engine, as I explained in Ignition Theory Page, to make maximum power and still keep the right point gap.

Another way to set timing is with a dial indicator put down the spark plug hole. Most Shop Manuals give how many thousands of an inch or millimeters Before-Top-Dead-Center (BTDC), where the piston should be. When the piston is at that spot, say 1.9mm BTDC, the points should open, causing the spark to occur. If you time an engine with a dial indicator there is no need for timing marks, however, if the engine you are working on has no timing marks, you can make your own. Simply make two side by side marks, on the flywheel and crankcase. You can make these marks any where on the flywheel and crankcase but they must match each other when the piston is at the right spot BTDC and the points just opened. Some engines require the removal of the cylinder head to use the dial indicator.

To get to the points, we must remove the flywheel. to do this you MUST use a flywheel puller. You will have to get one for your engine. I have over 30 of them. All different. If you use a gear puller, you can break the flywheel....very expensive.

IF YOU DON'T...I DON'T CARE
IT'S NOT MY FLYWHEEL!

To remove the flywheel nut, you have to have a way to lock the engine. I use an air gun to loosen them and the worlds best strap wench (Briggs & Stratton part # 19372) to hold the flywheel while I torque the nut. Play it safe and torque that nut! The flywheel is spinning at 6 to 12000 RPM, between your legs. Do you really want it to break or come loose? You can also lock the engine by putting a length of cotton rope down the spark plug hole, with the valves closed and the piston coming up on the compression stroke. Any small bits of cotton left in the engine will burn up and not hurt any thing. (at least, I have never had any trouble)

Make sure you put the special points grease on the points cam, and the little Lubricating Felt that presses against it. If that little felt is real dry, put a single drop of oil on it along with the grease to sort of fill up the felt. If you do not, the dry part of the felt will pull the grease into itself, and off of the cam, giving rapid wear to the points heel.

Interesting... in the real world all things go from complex to simple. Dry and oily go to a uniform state. Two things go to one. They tell us that evolution is true, that simple goes to complex. Yet we never see it in the real world. We see the opposite... complex goes to simple. So much for the lie of evolution!

The last thing to do after you have finished setting, checking, and double checking every thing, is to clean the points off with Acetone. Do not use Gasoline because it will leave a very slight residue on the points. Acetone will not. You don't have to remove the flywheel to do this. I did just to make a better picture. It is **VERY IMPORTANT** to do this. Use a 3 by 5 card cut into 1/4" strips. Dip one end into the Acetone and pull it through the points. Do the same with the other end to dry them. Make sure no bits of paper get caught in the points. ANY oil on the points will cause them not to work.

James 2:10 **"For whosoever shall keep the whole law, and yet offend in one point, he is guilty of all."** No matter how clean and well maintained you keep your bike if you offend with neglect of your points you will be guilty of all because your bike will not run.

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ELECTRONIC IGNITION

**"But God hath chosen the foolish things of the world
to confound the wise..." First Corinthians 1:27**

Electronic Ignition... so easy to get to, so easy to test... so easy ! I hate electronic ignition systems. At least, I hate to work on them. I wish I could tell you I know everything about motorcycle electronic ignitions, but, well, after working on these things since they first came out I can categorically state that I don't know 'nothing about them. So I'll just ramble on about them for a while, and if you read real carefully, you will know as little as I do !

Most Electronic Ignitions have four parts that can fail. trigger (pickup) coil, a source coil, a CDI unit (Black Box) and an ignition coil. The trigger coil tells the black box when to trigger the spark. It does this when a small magnet on the flywheel passes the trigger. The source coil produces the power. The black box coordinates everything and tells the ignition coil when to fire the spark plug. This is for a magneto and requires no battery, as the power comes from the source coil. Battery Ignition CDIs use the battery as a power source. The battery is then recharged by the charging system.

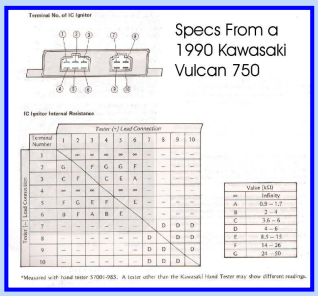
Now, when I say CDI I mean Capacitor Discharge Ignition, but I am also lumping in all types of ignitions that don't use points. Each manufacturer has their own design and way of thinking. However, they all seem to have those four parts. Trigger coil, source coil, black box, and ign coil. Usually, they give you specs on the trigger unit, source coil, and ignition coil. Sometimes, they give specs on the CDI box too. These specs are given as resistance values in Ohms. That means we can test them to see if they are good... sort of... most times... maybe ! Some manufacturers also give values for the black boxes too, and some don't. All this means these things are very hard to test accurately. Fortunately, most of the electronic ignition units are quite reliable and require no service, but this plus turns to a minus when they do go bad. They are very hard to trouble shoot. To top it off, most motorcycle CDIs are expensive to replace, and when they go out, the bikes are too old to justify the expense of replacement.

They say electronic ignition doesn't change once it is set. BUT, IT DOES ! Sometimes, it will change as it fails. This can give some pretty weird running. It can also cause the engine to overheat and seize. This is something to remember when you rebuild an engine that blew up for seemingly no reason.

OK, we can use an ohm meter to check most things except the black box, and sometimes, even the black box... If we are lucky ! Well, maybe things tested Ok. You have to remember, on all electrical things, they test either bad or they might be good. There are a number of very expensive testers out there, and they all claim to work great. But do they ? Let me tell you a story. I once had a snowmobile come in which would die (no spark) after 5-6 minutes of running. I had factory specs on everything including the black box. Everything tested OK, even when hot. Long story short, I finally ended up talking to the owner of a business that made aftermarket, replacement, snowmobile CDI boxes. He told me all the factory specs were wrong, and gave me some new specs that he said sometimes worked and as he was

very knowledgeable about electronic ignitions I asked him what tester he used. He told me he had tried them all and none of them worked. He said for each new CDI box design his company bought an engine, and modified it so they could run it with an electric motor. They could then test the black boxes by substitution. Customers could send in their factory CDI boxes and he could test them to see if they were good. He said they had a whole warehouse full of these modified engines. This was back in 1988-89. I like to think they have something better now... however, I still can't afford a tester other than an Ohm meter.

The reason I'm telling you all this, is to give you an idea of the amount of hassle these things can be. Many times I've read factory bulletins telling their people in the field to be more careful. They're sending back, under warranty, too many "bad" boxes that turn out to be good.



All right, we have no spark. Check the resistance, in Ohms, of the Trigger coil, Source coil and Ignition coil. If one is out of spec, replace it, but first check all the plug in connectors. Check and clean all the ground connections and make sure the kill button is working right too. Also, remember some bikes have safety kill switches at the clutch lever, the side stand, and who knows where. Look for them and make sure all of them are working right. Check each Ohm reading several times and remember most specs give a temperature to check at, usually 70 degrees. So don't leave the bike out overnight at 30 degrees and expect to get an accurate reading. Sometimes there will be a spec for the black box, and sometimes not. Here are the specs on a Kawasaki Vulcan. Others, if they give any, look similar. As you can see, there are a fair number of tests to perform. Maybe this is why a lot of manufacturers don't give any specs. Honda used to give specs, but it seems they don't anymore. Yamaha doesn't give any. Kawasaki and Suzuki both sometimes give specs and sometimes defer to special factory testers. Others ? You will have to look in the shop manual.

The shop manual will give you the color of the wires to test and the correct resistance too. If everything is within spec, recheck all the connectors and the grounds. If all is OK the only thing to do is replace the black box. Sometimes you can get the part off a working bike and substitute it for the part in question. Most times this can work pretty good. Other times the bad part can take out other good parts. The reason this can happen is because these systems produce very high voltages. That voltage has to go somewhere. Sometimes it can burn it's way through the side of the plastic case. The good news is that this is quite rare in most motorcycle systems. Don't you love the way I use most and sometimes and might and maybe ? There's good reasons why electrical parts are sold with no warranty.

Another thing to check is the air gap between the trigger and the magnet on the flywheel. Usually this is done with non-magnetic, brass, gauges. You can also use a piece of plastic of the right thickness. That thickness is usually .005" to .010". Try to get the parts as close as you can, without them hitting.

Sometimes, there is no separate trigger unit. Everything is in the coils or the black box. The circuitry reads the voltage rise and triggers the spark at the right time. They do have little ignition units that are used on lawnmowers and small engines. They tell me some of these units can be used on motorcycles. I've never used them on a bike, but they do work on other small engines.

Most Dirt bikes are a CDI magneto, and do not require a battery. Most street bikes are a battery charged CDI, and need a fully charged battery. That battery also has

to run the starter, lights, radio, and other stuff in addition to the ignition. Different things require different power requirements from the battery. We think of the battery as supplying a steady 12 volts and it should. But, things can vary. What does all this have to do with electronic ignition ? Most electronic ignitions require a full 12 volts to give out a good spark. If you let the bike sit a long time or the battery is weak, you may not get a full 12 volts. Now the starter may spin just fine, but the starter requires amps more than volts. Think of it like this. Amps are volume, volts are pressure. Amps won't jump a spark plug gap and volts won't spin that starter. At least they won't in the numbers that we deal with. Anyway, the starter is spinning but the ignition is not getting enough volts to fire the spark plug. The moral ? Make sure you have a good, fully charged battery in the machine before you start hunting for ignition problems.

Don't unplug anything while the engine is running. That includes the spark plug cap. These systems can produce a lot of volts, like 18,000-30,000 and more. It's got to go somewhere. Readers Digest magazine had a big expose' on bad auto mechanics. They pulled one spark plug cap loose and took it to a bunch of different mechanics. They complained that a lot of those mechanics did detailed, expensive tests, instead of just popping the plug cap back on. Those mechanics didn't do anything wrong. Pulling that plug could have fried the entire ignition system. I've seen it happen. When you check for spark, ground that plug to the engine. The spark should easily jump a 1/4" gap. If it won't jump 1/4", or more, outside the engine, it won't jump .030" inside the engine under compression. A handy tool is a spark tester. There are lots of different types. You can buy one or you can make one yourself real easy. Take a new spark plug and bend the side electrode out straight. Now solder a small clamp on the side and you are done. Clamp it to the cylinder head and hook up the spark plug cap. Crank the engine and you can easily see the spark. The engine can and will run if you connect the tester clamp to the end of the spark plug. Provided, of course, the plug is good and installed in the engine.
Remember, that spark is what sets the air/fuel mix burning. It can do the same outside the engine too.
Make sure there is no spilt gasoline or other flammable mixtures on or near that Spark Tester. Keep a fire extinguisher handy !

What if there's a misfire at, say 1/2 throttle, but only under load ? Carburetion can cause a miss that looks, acts, and feels exactly like an ignition miss. How do you tell the difference ? Easy, Hook up a timing light. Use one of the types that does not have to be hooked to a battery for power, if possible. A lot of the old style lights were like this. Tape it to your handlebars and go for a ride. Look at the light. If the light looks bright and steady when the misfire occurs, then the problem is in carburetion. If it goes out when the misfire occurs, then the problem is with the ignition. There are all kinds of ways of doing this and you can use different tools, like plug caps with lights on them. The big thing is being able to see when the spark occurs... or doesn't occur.

Well, there you go. Hopefully all this will help. One thing for sure... you now know as little as I do !

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TIMING A BATTERY AND COIL POINTS IGNITION SYSTEM

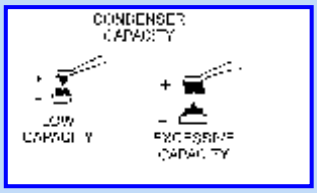
"Yea, the light of the wicked shall be put out, and the spark of his fire shall not shine." Job 8:5

Well, if you are one of those wicked people who don't bother to maintain your points ignitioned bike you will find the spark of your fire does indeed go out. So what do we do to prevent this ?

Points Ignition is on it's way out, but there are still a lot of them out there. Most engines (but not all) made after 1980 have an electronic ignition and no points. Most engines (but not all) made before 1980 have points. To find out look under the points cover. this cover will usually have two or three screws holding it on. On most single and twin cylinder engines it is usually on the cylinder head, right or left side. On most four cylinder engines it is usually on the crank end and again it can be on either the right or left side but it seems mostly on the right. Three cylinder engines seem to be mostly on the left.

If there is any doubt as to the condition of the points, replace them. Sometimes a good looking set of points can cause a funny misfire that can only be cured by a new set. If the points are pitted badly you will not be able to get an accurate gap setting. Replace them. I have spent way too many hours trying to make a used set of points work, in vain hope of saving $10-$15. Save your time and nerves, buy a new set of points. Interestingly enough, it's been my experience that condensers almost never wear out. I have found maybe four or five bad condensers in the last 35 years. Everybody pushes you to buy them, but I never replace them unless they test bad. They make little cheap testers (at least they used too !) that work quite good. A rough and ready way to test them is to connect the pig tail to the positive terminal of a 12 volt battery and the body to the negative terminal. This charges them up. Now ground the pig tail to the body and, if it is good, you should see a nice fat spark. In some cases the condenser will have two leads. One goes to ground and one to the points hot wire.

Connect them by the color coding of the wires. If both wires have the same color, they can be connected either way. Same way to test. One wire to positive and one wire to negative to charge and then touch them together. You should get a nice spark if they are good.
The condenser keeps the points from arcing when they open. The condenser can be anywhere in the line (wire) going to the points. Sometimes this is quite a ways away from the points. Like under the gas tank. The capacity of a condenser is measured in microfarads (0.2 microfarads being the average capacity) and that capacity is matched to the points. If there is a big build up of material on one of the points it means the capacity of that condenser is too big or too small for that set of points. If the negative point (grounded or stationary point) loses material, with the build-up on the positive (Moveable) point. The condenser capacity is too low. If the build up is on the grounded point (Stationary) the capacity is too high. While you are replacing the points go ahead and take the points plate off and check out the automatic spark advance unit. It is usually attached to the point cam. Make sure it is working smoothly.



Ok, we got a new set of points and we found where they go... now what ? When you connect the points wire to the points it must go to the movable point and that point is insulated from the stationary point. The little screw that holds the point wire MUST be insulated from grounded, stationary point. There are usually several little fiber washers and a fiber tube that keep the point spring and screw from grounding.
Turn the engine over until the highest spot on the points cam aligns with the points heel. This is the spot where the points are at their maximum opening. Now use a feeler gauge, of the right thickness, and set the point gap. After you tighten the point screws, recheck the gap. Most times it changes a little and it may take several tries to get it right. Point gap can be as little as .010" or as much as .022". Look in your shop manual. Most Japanese bike have a gap of .012" to .016", so use .014" and you will be about right... at least for Japanese bikes.

Now take a circuit tester light and ground one end to the engine and the other to the hot wire going to the points. Sometimes, it's easier to connect to the points spring. Turn on the ignition and turn the engine backwards with a wrench on the crankshaft nut or bolt. If the points are on the left side of the engine this would be clockwise. If the points are on the right side of the engine it would be counter-clockwise. Keep turning until the points close. Keep going till the flywheel mark, usually an "F", has moved well beyond the stationary mark on the crankcase. You go well beyond the crankcase mark so any play in the spark advance will be taken up when you turn the engine forward. Some European bikes use "O", Harleys use a vertical line for the front cylinder and a "O" for the rear, and sometimes a "O" and a "OO". Like always, check the manual.

Now turn the engine in the direction of rotation slowly until the "F" mark and the crankcase mark line up. The light in the circuit tester should come on just as the two marks line up. If they don't, loosen the screws that hold the points carrier plate to the engine and turn it one way or the other till the marks line up. Tighten the screws and recheck. If the engine is fresh and strong, time it so the light comes on exactly when the marks match. If the engine is worn, you will want

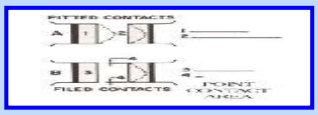
to advance the timing (See the Ignition timing page.). More wear, less compression, more advance. If in doubt, just use the stock timing marks. When you tighten the points and points plate screws, the points and plate will usually change just a little. Sometimes they change a lot. Recheck the timing after you tighten everything up. If the timing was right on and then advances when you tighten the screws, loosen the screws and set it a bit retarded. When you tighten the screws, it will advance a bit and be dead on. Do the opposite if the timing retards when you tighten the screws. You will also notice two marks on the flywheel that are before (Advanced from) the "F" mark. These marks are the full advance marks. If you shine a timing light at them with the engine running four or five thousand RPM you will see that they are supposed to line up with the stationary mark. You will also see lots of oil flying everywhere if the flywheel is the "wet" type like the Honda Trail 90s, 160s, 175s, 350s, 450s and others. Unless you want to make a special cover with a window in it, you don't really need to use a timing light. Bikes of this type seem to time just fine in the retarded spark position. If the bike is one of the Honda fours, the Yamaha 650 twin and others, you don't have to worry. You can use the timing light.

Some bikes have a timing hole. This hole is covered with a plug. You remove the plug and replace it with a special clear timing plug. This keeps the oil in the engine and off you. Examples of this would be Honda Gold Wings and all Harley Davidsons. The plugs don't seem to work all that well unless you screw the plug in so it almost touches the flywheel. Then it works real good ! You can do this with the Harleys pretty easy, just screw it in a bit more. Others are harder, but you get the idea.

These points plates all have elongated holes in them allowing you to adjust the plate. Sometimes if you need more adjustment, you can take a small rat tailed file and file more length to the elongated hole.

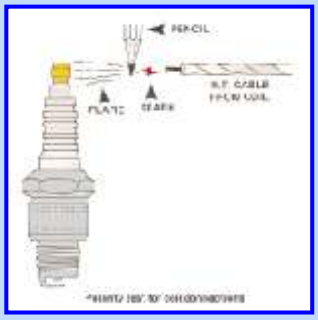
Point gap is not supposed to be used for the adjustment of timing, but sometimes we can use it for that. Wear, on the different mechanical ignition parts, may require us to use it to adjust timing. Other times the manufacturer designs it that way, even though that is not a good thing to do ! The gap of the points is supposed to control how long the Ignition Coil(s) is charged by the battery. The time the points are closed is called the Dwell Angle. This angle is given in the shop manual. This can get complicated because some systems charge the coils when the points are open and others when they are closed. We won't worry about that and anyway most of the points we will be dealing with charge when the points are closed and fire the spark plug when the points open. Just be aware that you can vary timing a little with the point gap, but you want to stay within the maximum and minimum specs so the coil will charge right.

Some twin cylinder bikes, like the old 350cc Honda twins, have both points screwed to the points plate. On these bikes you must use the point gap to adjust at least on of the cylinders. Usually, you can set the gap on one point set, turn the point plate to set the timing and then use the point gap to adjust the timing on the second set of points. Now check the gap on the second set and if it is within spec you are done. If not, you will need to juggle settings on the other set of points and points plate to get everything within spec. To help things out, some manufacturers use an extra plate that holds one set of points and bolts to the main points plate. It is moveable, so you can keep the gap right and still adjust the timing for that point after you have adjusted the other set with the main points plate. Most four cylinder bikes that use points have this extra plate. Some twins use them too.



Points tend to blacken with corrosion when left sitting for a long period of time. You can clean them with a points file. I don't use the metal ones that look like small files. I never could get them to work right, the metal used in points is just too hard to file good. It's also not a real good idea to file points if they are badly pitted because it cuts down on their contact area. If you do file badly pitted points you must file ALL the pits away. I use a flexible type that has grinding compound imbedded in it, or a piece of 100 grit sand paper folded back to back. This just cleans up the point surface. If the points are badly pitted, replace them. Now blow everything clean with compressed air and clean with some contact cleaner. Finally, clean the points with a 1/4 inch strip of paper cut from a 3 by 5 inch card and dipped in acetone. Also, put a bit of points grease on the points cam, points heel and the points lubricating felt. If the felt is old and dry, lube it with grease and put one drop of oil on it. If the felt is old and dry, and you only put grease on it, the dry center will pull the grease into the center and away from where you want it... on the points heel. The oil kinda "charges" the dry felt center, preventing this.

The Yamaha XS1100 is the only bike engine I know of that has a vacuum spark advance. Why have vacuum advance ? Under part throttle, air intake into the intake manifold is restricted, so a vacuum develops in the manifold. Because of this vacuum less air/fuel mixture is drawn into the cylinder. This, in effect, lowers the engines compression and slows the burn rate of the fuel mix. To get the full power out of the engine under these conditions requires more Ignition advance. The Vacuum advance gives you this advance when there is vacuum in the intake manifold. Most car engines have a vacuum advance, but it just didn't catch on for motorcycles.



If you reverse the low tension ignition coil connections it will reverse the polarity. It takes 40 % or so more voltage to fire the spark plugs on a ignition system with positive polarity. On most bikes you would have to really work at it to do this. However, some four cylinder bikes like the early Honda fours are designed this way with double ended ignition coils. One lead is positive and one lead is negative. This means two of the plugs will require a lot more voltage to fire than the other two. Not much you can do about it, but if two plugs start fouling out on these bikes, this might be the reason. To test polarity put a pencil lead between the high tension lead and the spark plug. If there is a flare from the pencil to the spark plug, the polarity is correct. If the flare is between the lead wire and the pencil the polarity is wrong.

I've found that a set of points seems to go out of time in about 2000 miles. If you are willing to live with lousy performance, they can go upwards of 8000 miles.

With the ignition on, you should have battery voltage going to the points. With the ignition on, if you take a screw driver and ground out the the moveable point, when you remove the screw diver from the ground, you should get a spark at the spark plug. With the ignition on and the points closed, open the points with a small screw driver. This, also should produce a spark at the spark plug. The spark should easily jump an air gap of 1/4" or more, to ground, outside the engine.

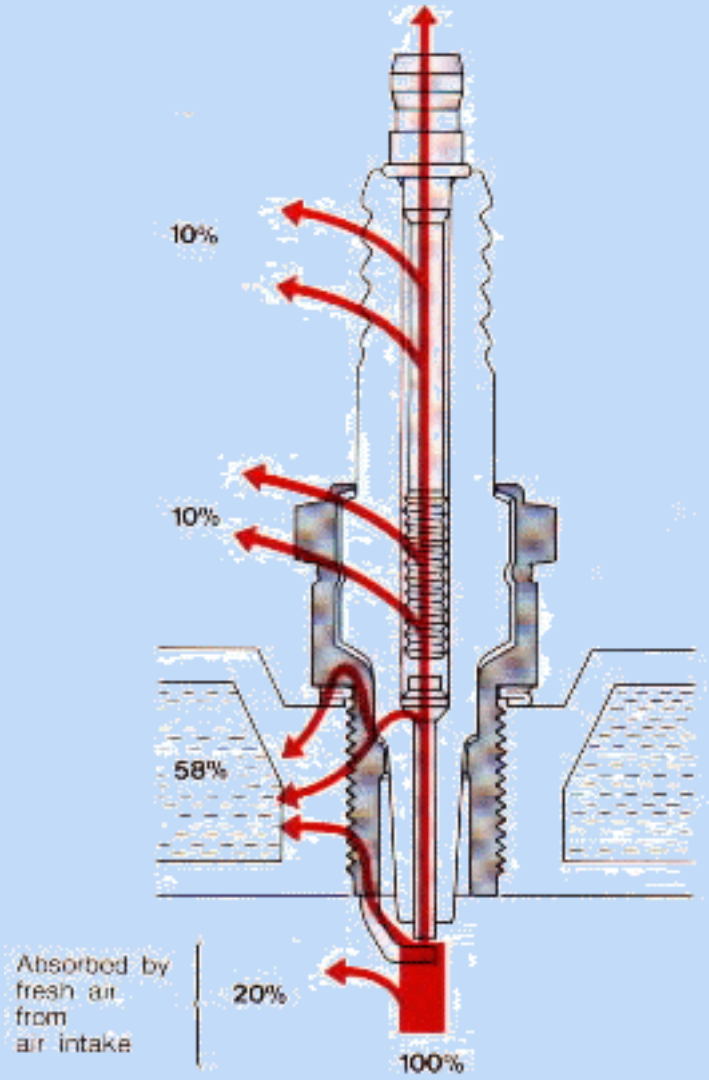
Most motorcycle coils are weak when compared to car coils. You can use car coils BUT you have to do a lot of modification to the points cam so you don't over charge the coils. Seems to me

the old "CYCLE" magazine had quite a write up on how to do this but I guess now that ranks right up there with performance tweaks for a 486 computer !

I like points ignition systems. If they start to fail it always seems you can fiddle with them and limp home. If something needed replacing, you didn't have to get a loan from the bank to buy the part. Too bad they are fading away like old soldiers.

Top

SPARK PLUGS



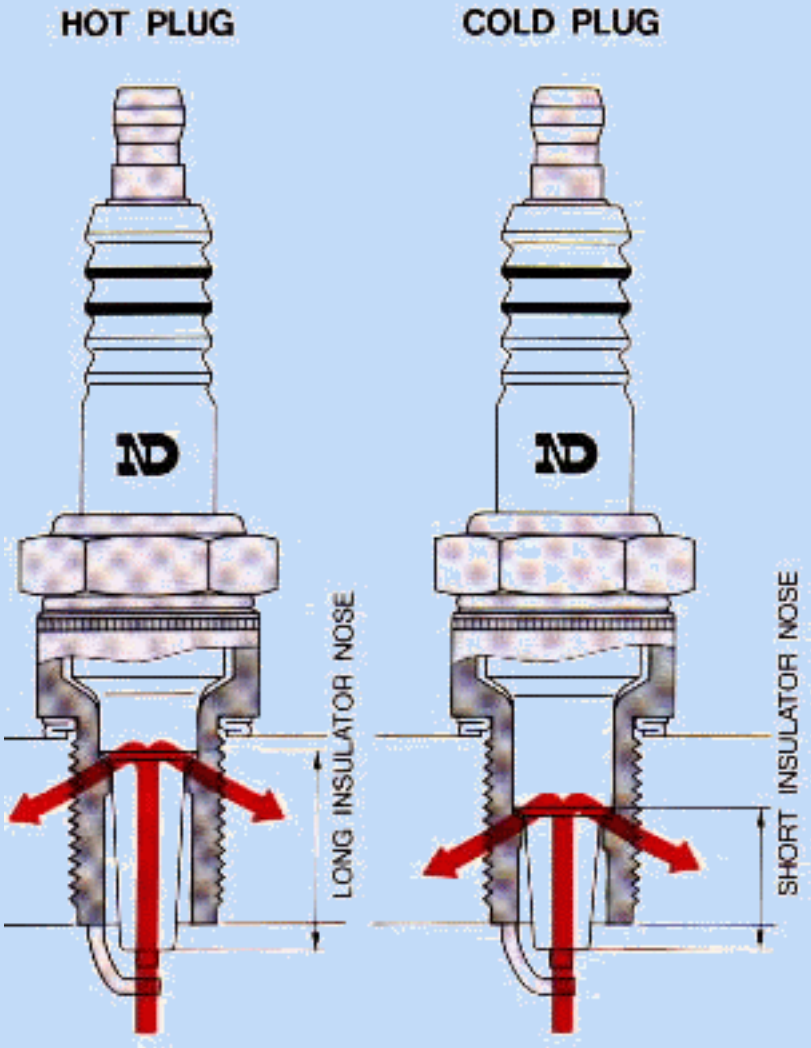
Spark plugs....We can make this easy or we can make it hard. Let's start with easy. After running for a while normally, stop the bike and take the spark plugs out. They should look a light chocolate brown in color. If , black and sooty the engine is running too rich in the fuel departement or too cold of spark plug. If black and shiny (oily) they are oil fouled. If they are whitish you are running too lean a fuel mixture and/or wrong ignition timing or too hot of spark plug. When you see this, your engine is about to blow up!!!

If you would like to see more Spark Plug Images... 29 to be exact, Click Here. Be patient, it takes awhile to load !

Now the harder stuff. A spark plug does not make your engine run hotter or colder. The

terms hot or cold refer to the temperature of the tip of the spark plug itself. The plug must keep a temperature of, between 752 and 1652 degrees Fahrenheit. If it gets too hot it can fire off the air/fuel mixture at the wrong time. This can cause detonation and/or pinging which will put a hole in your piston... not good. If it gets too cold it will not burn off the carbon and fuel deposits on it's tip and the plug will foul out (stop working) not good either.

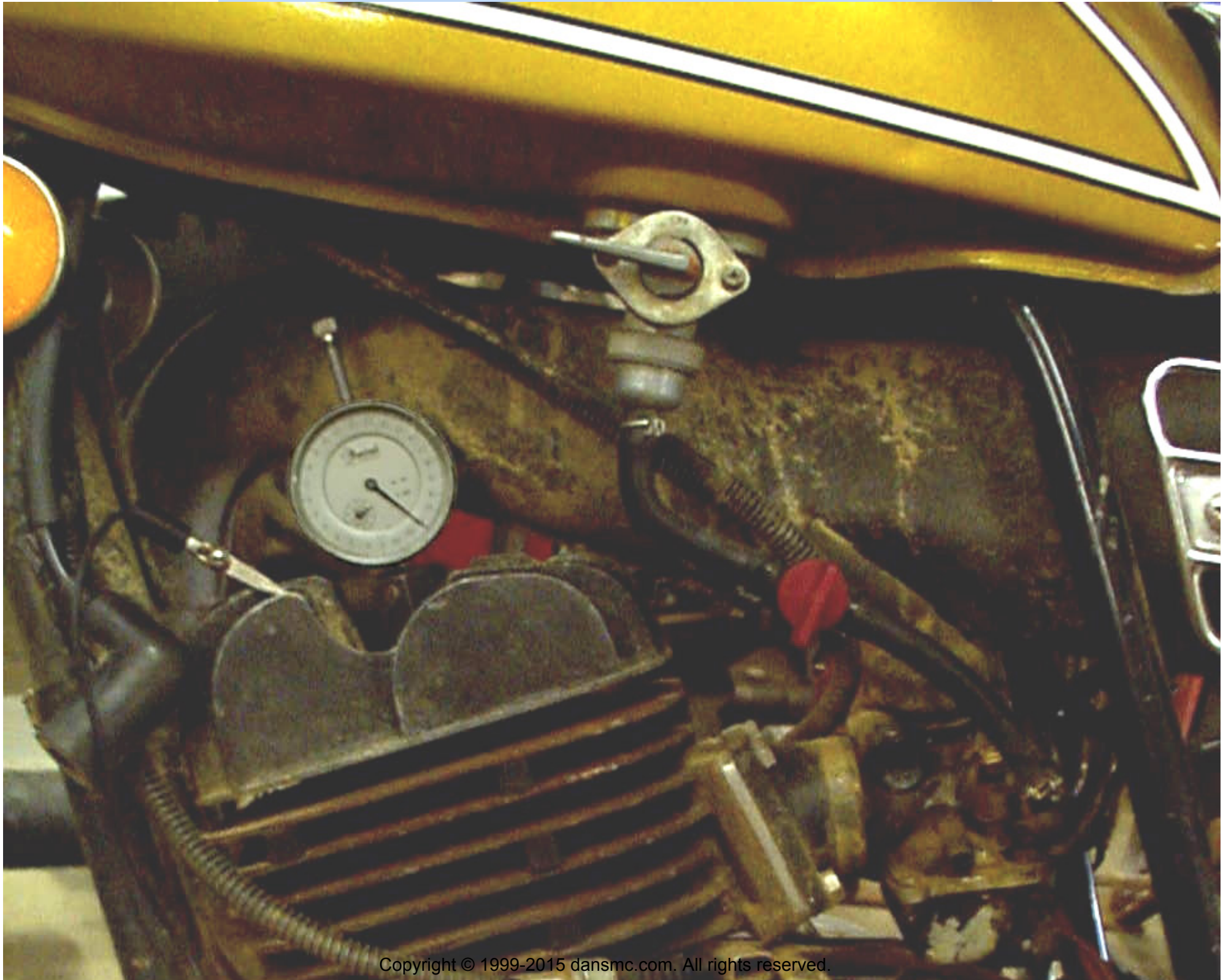
The heat range of a spark plug is controled by the length of the center electrode. A longer one is hotter because it takes longer for the heat to flow through it to the cylinder head. As you might think the cooler plug has a short center electrode.

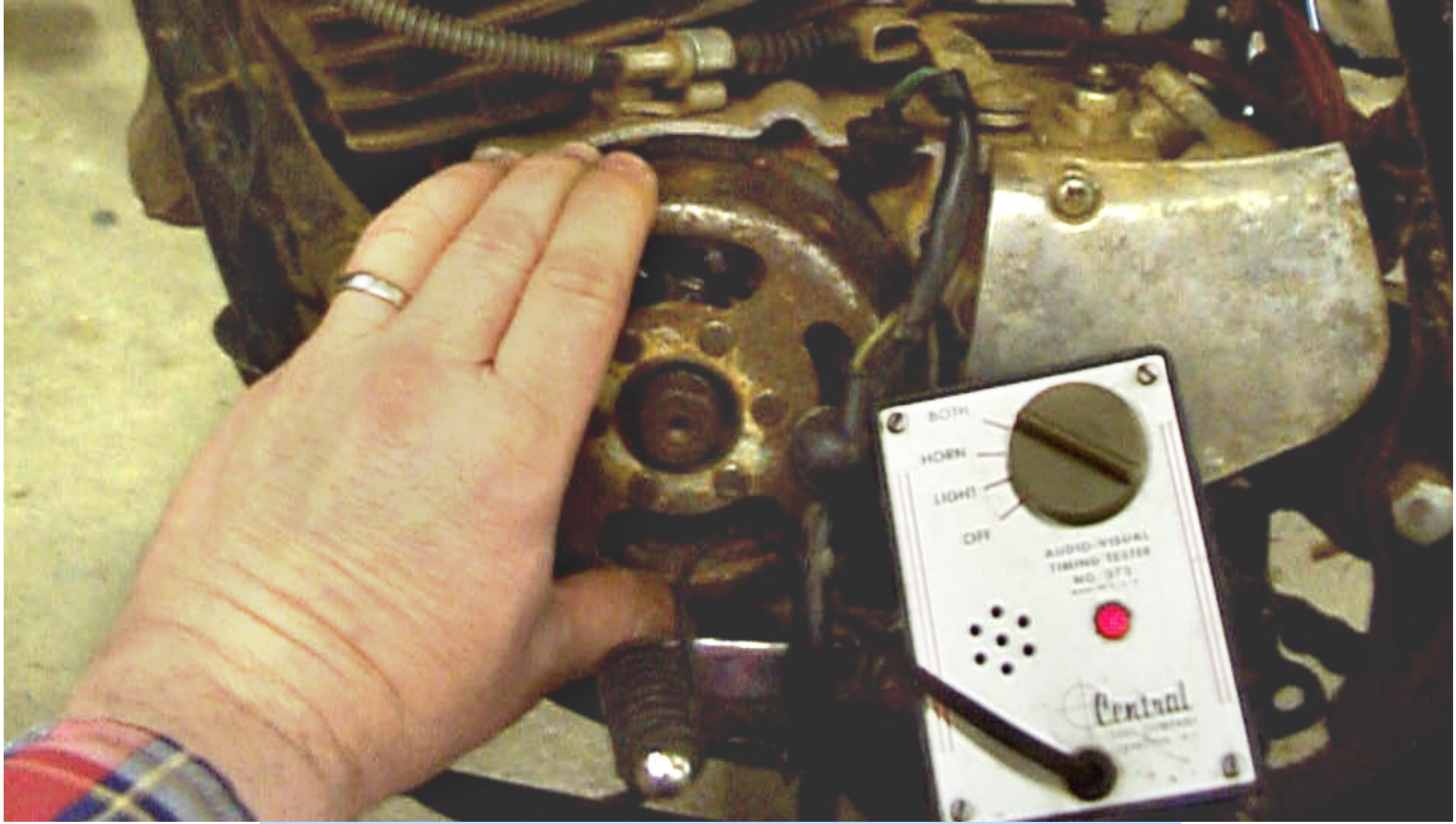


To get a true plug color reading you must run the engine,on a level road, at the throttle setting that you want to test, for about a mile, then kill the ignition, pull the clutch in and coast to a stop. Then pull the plug and look at it. This could be a real thrill on most of the newer street bikes.

As the engine ages and more oil gets past the rings a hotter plug may be in order. If you ride at low speeds all the time a hotter plug will keep the plugs from fouling. If high speeds are your thing, a cooler plug may be just the ticket. Don't be afraid to pull that plug out and give 'er a read!

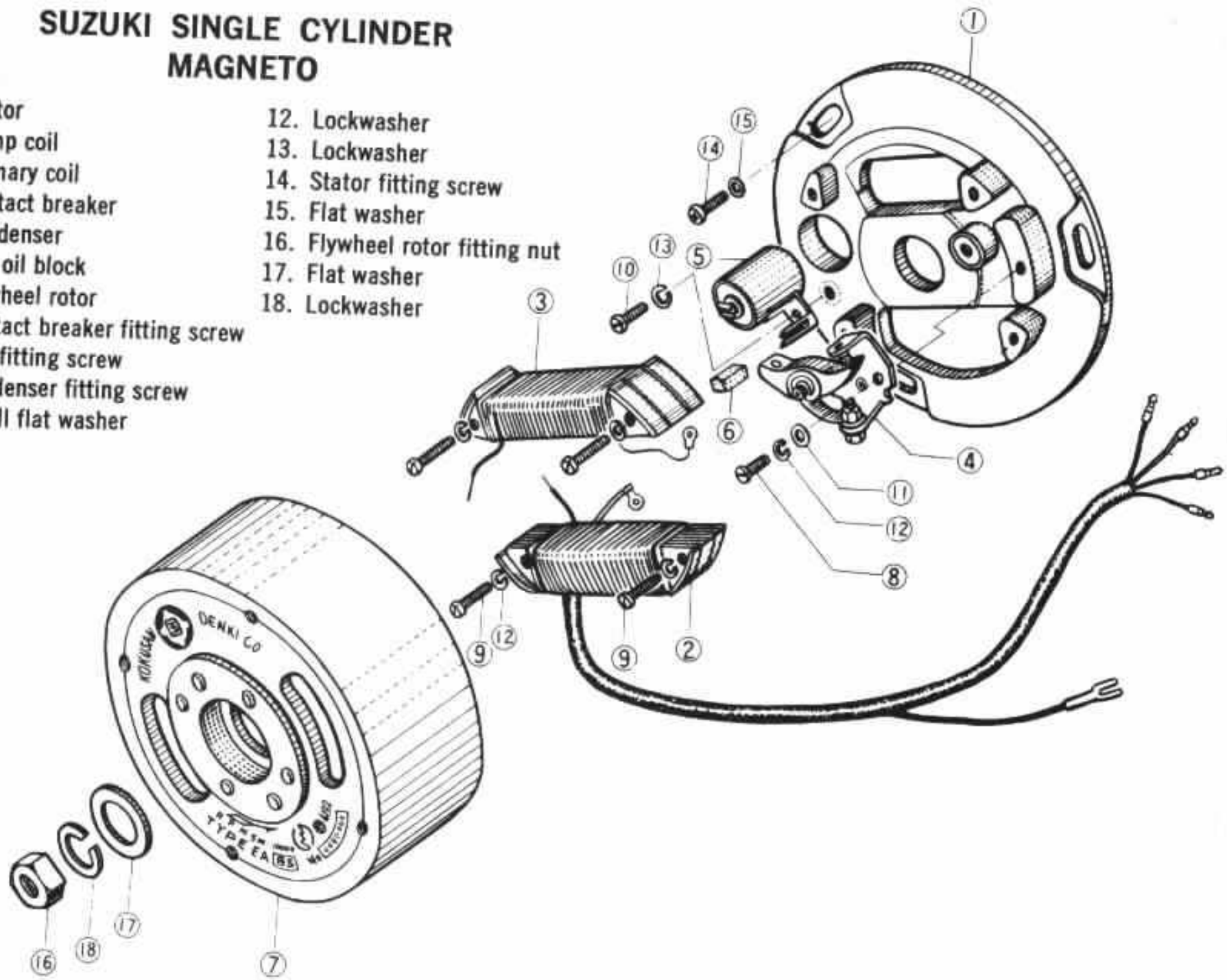
Back to M/C Repair Course

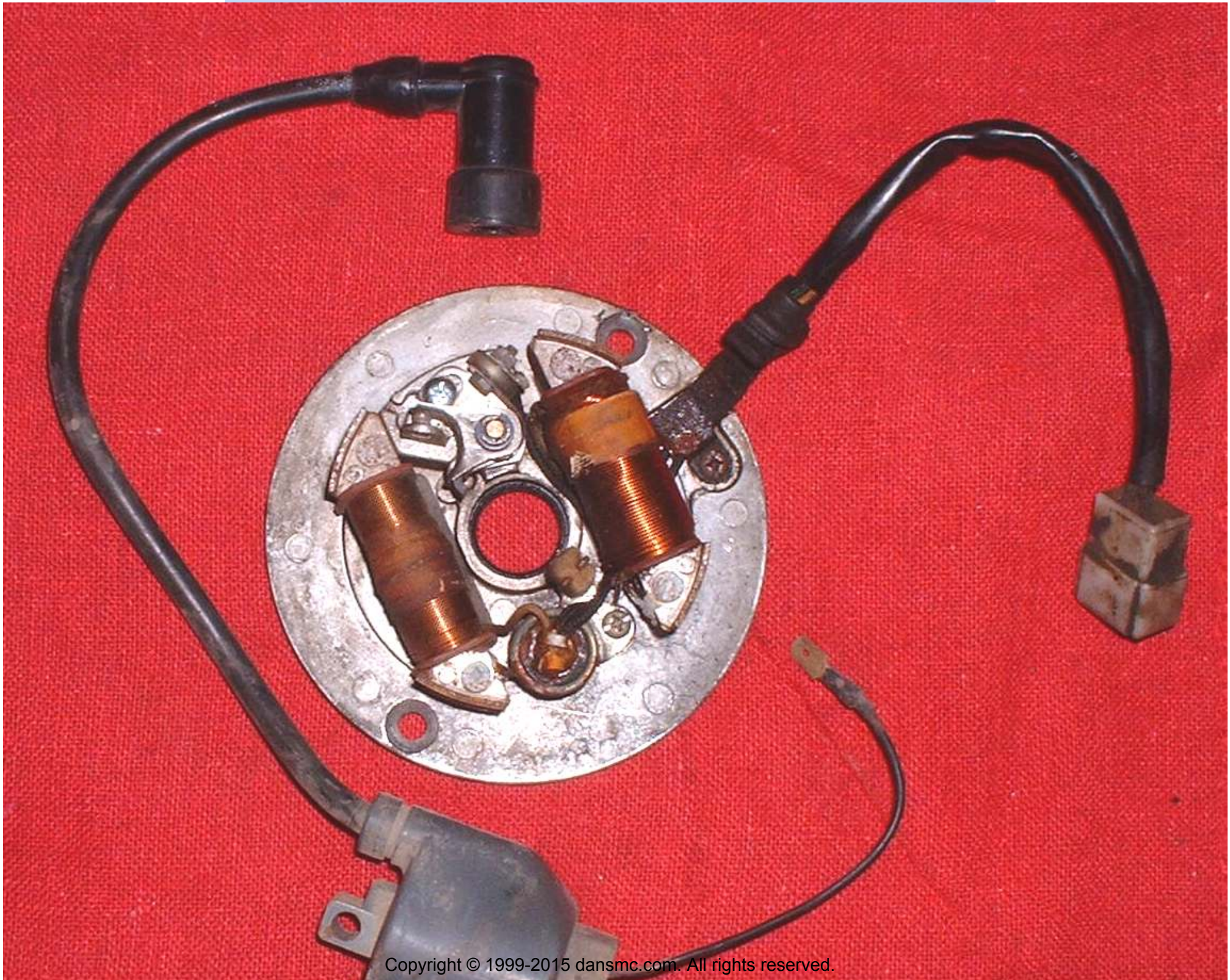


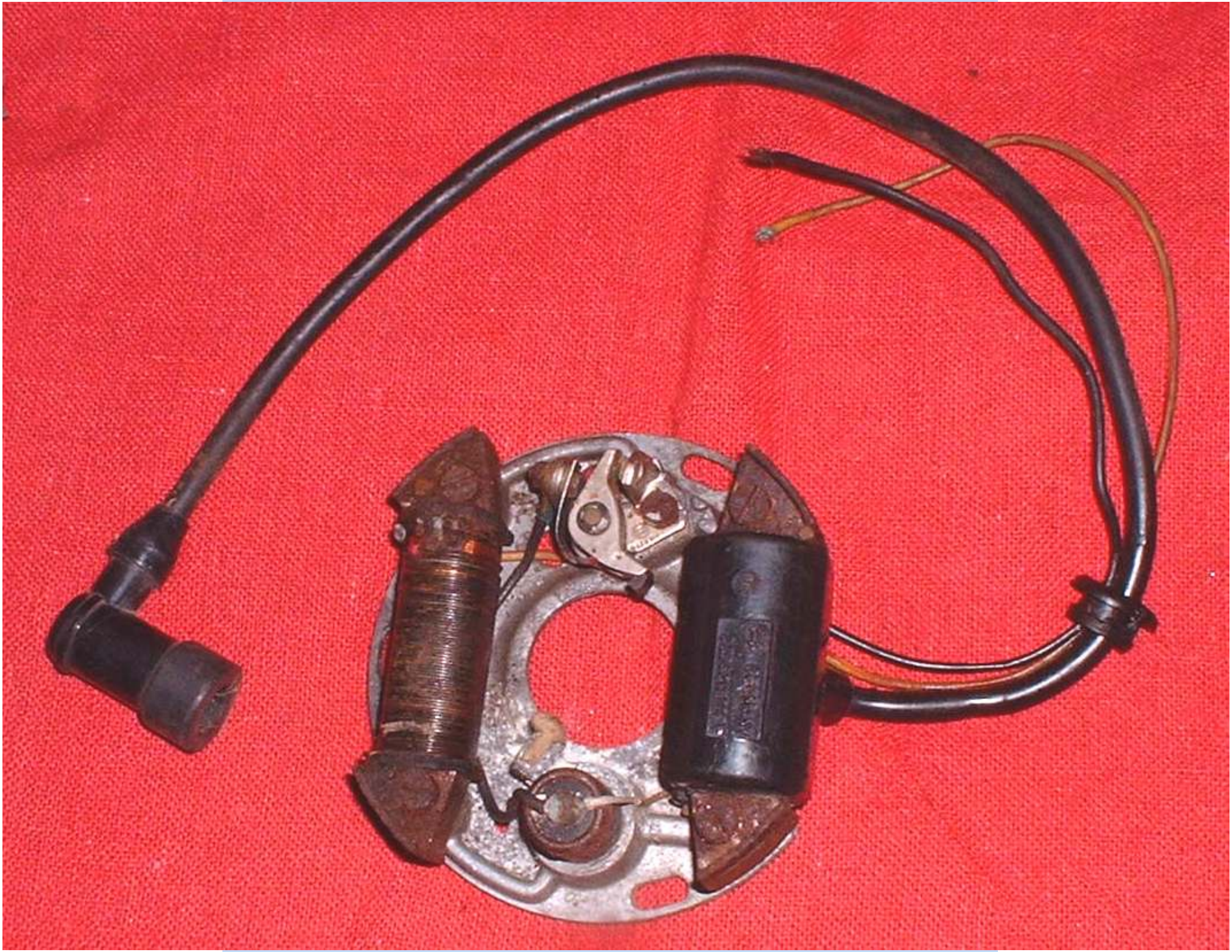


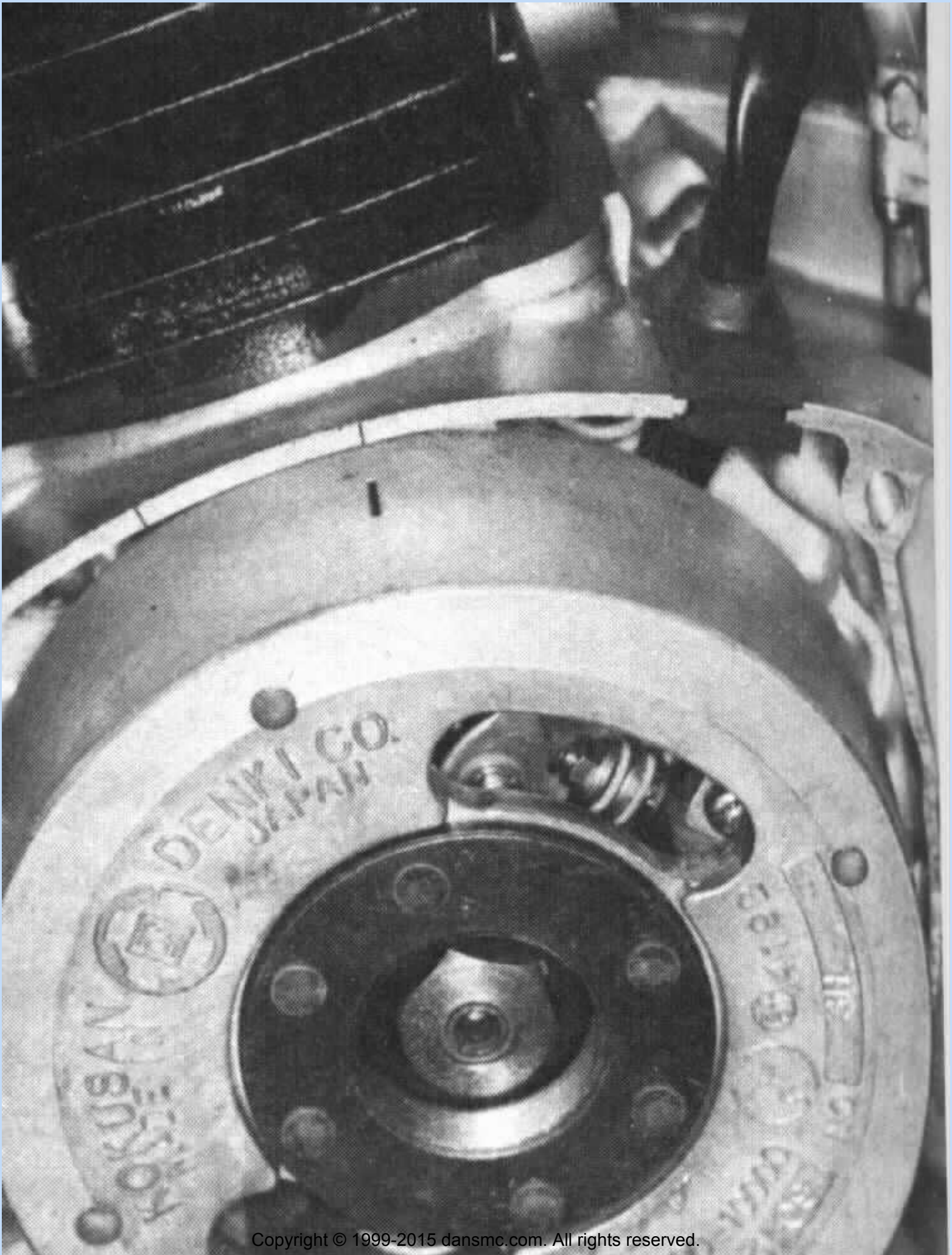
SUZUKI SINGLE CYLINDER MAGNETO

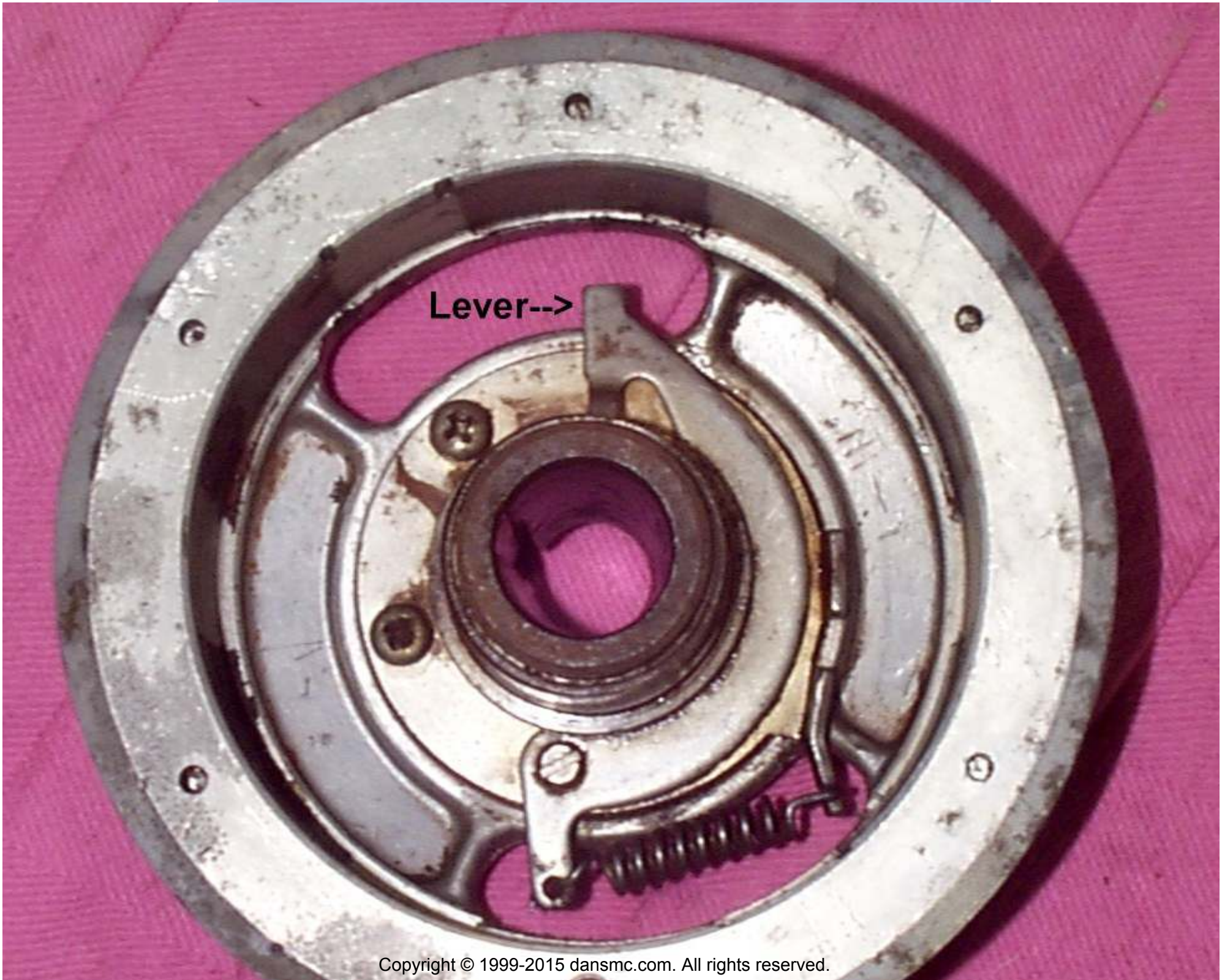
1. Stator
2. Lamp coil
3. Primary coil
4. Contact breaker
5. Condenser
6. Felt oil block
7. Flywheel rotor
8. Contact breaker fitting screw
9. Coil fitting screw
10. Condenser fitting screw
11. Small flat washer
12. Lockwasher
13. Lockwasher
14. Stator fitting screw
15. Flat washer
16. Flywheel rotor fitting nut
17. Flat washer
18. Lockwasher

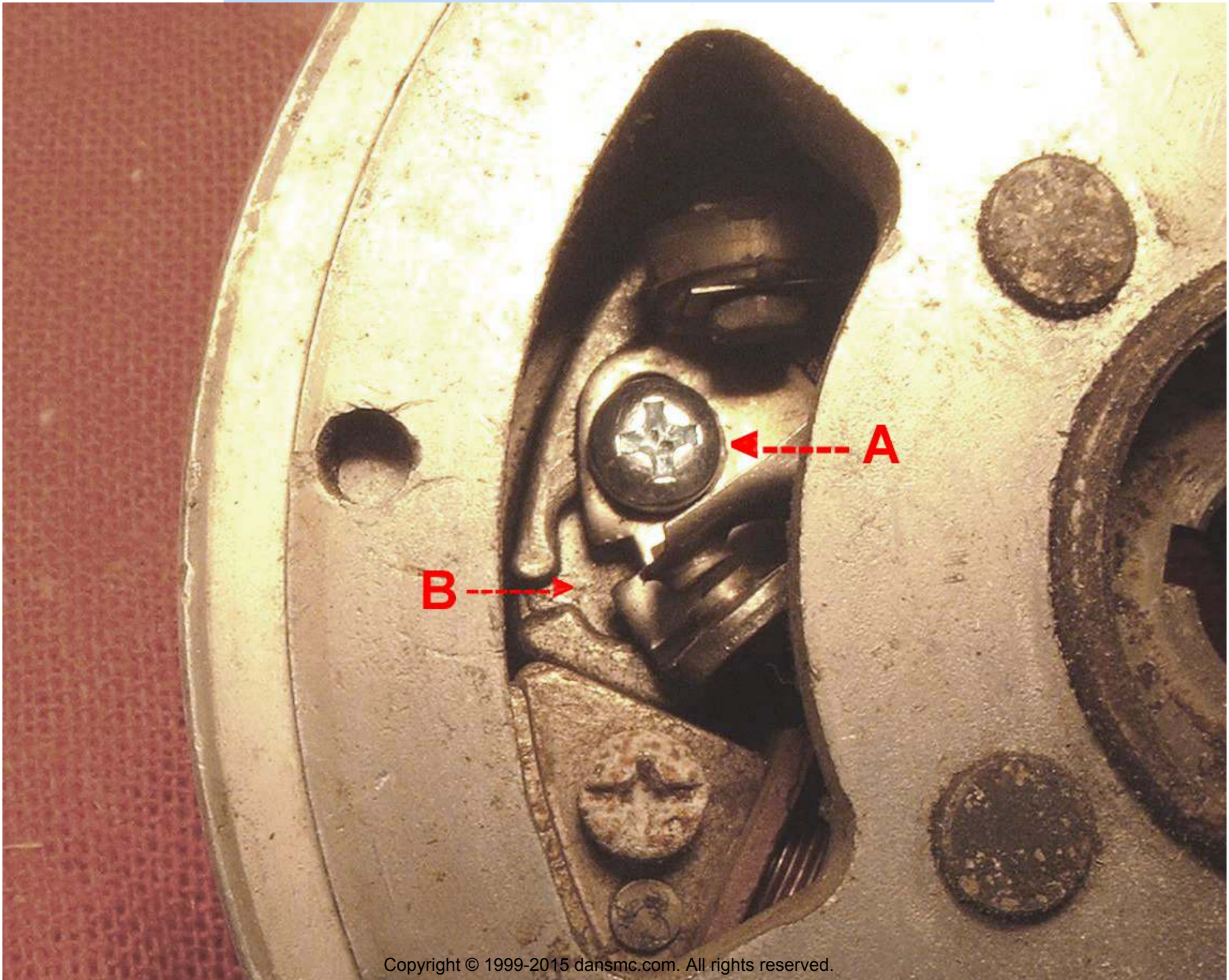


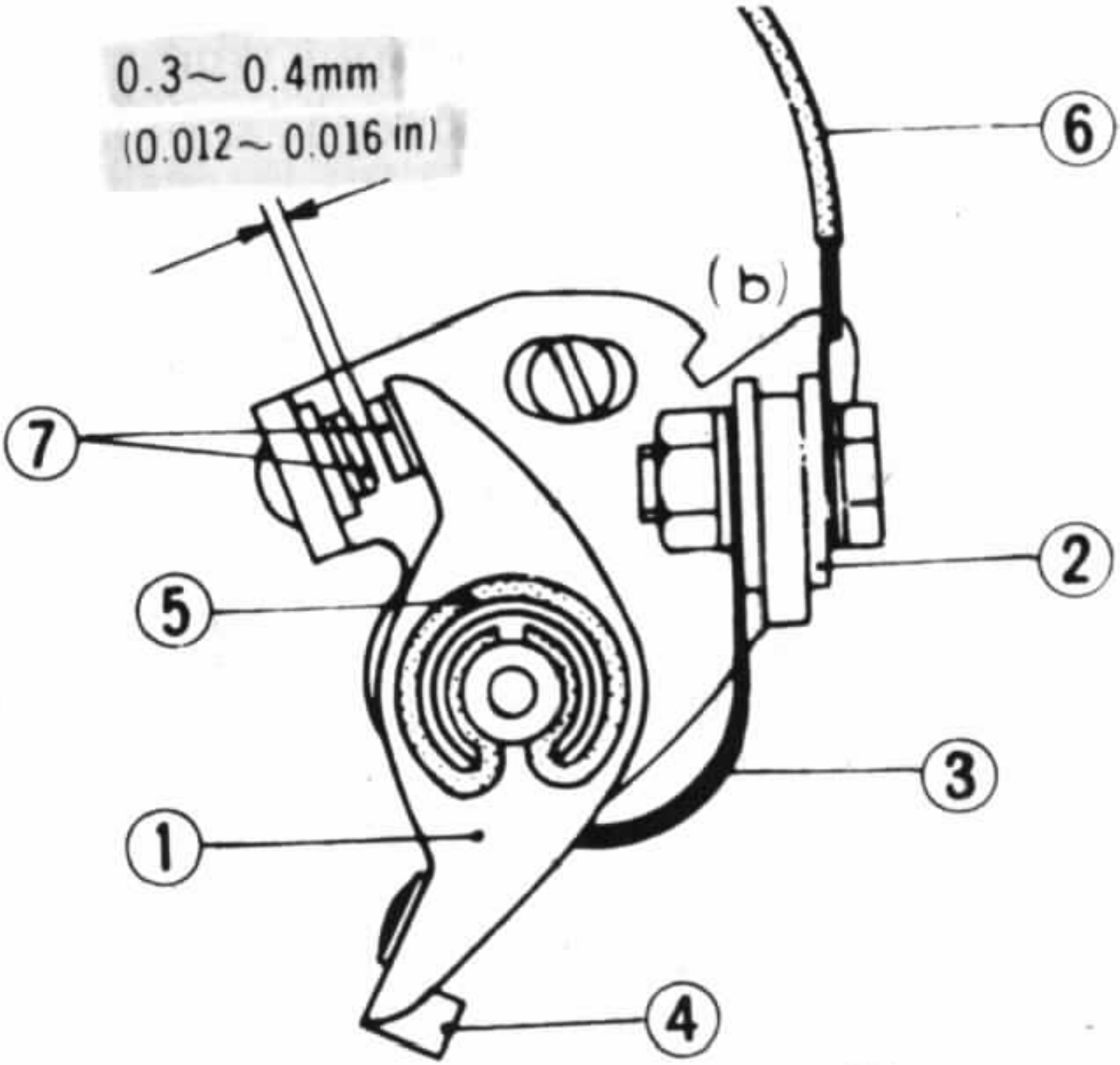








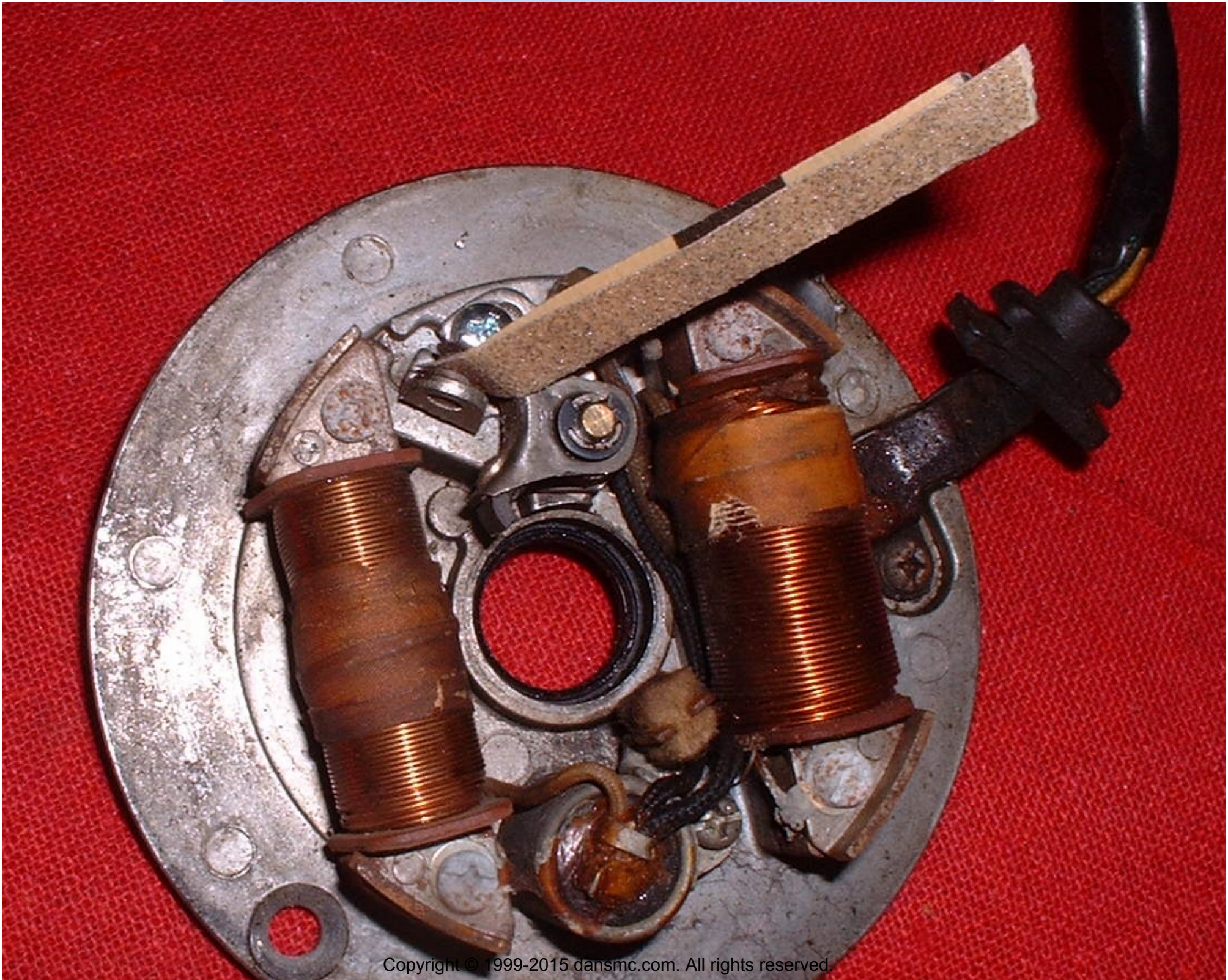


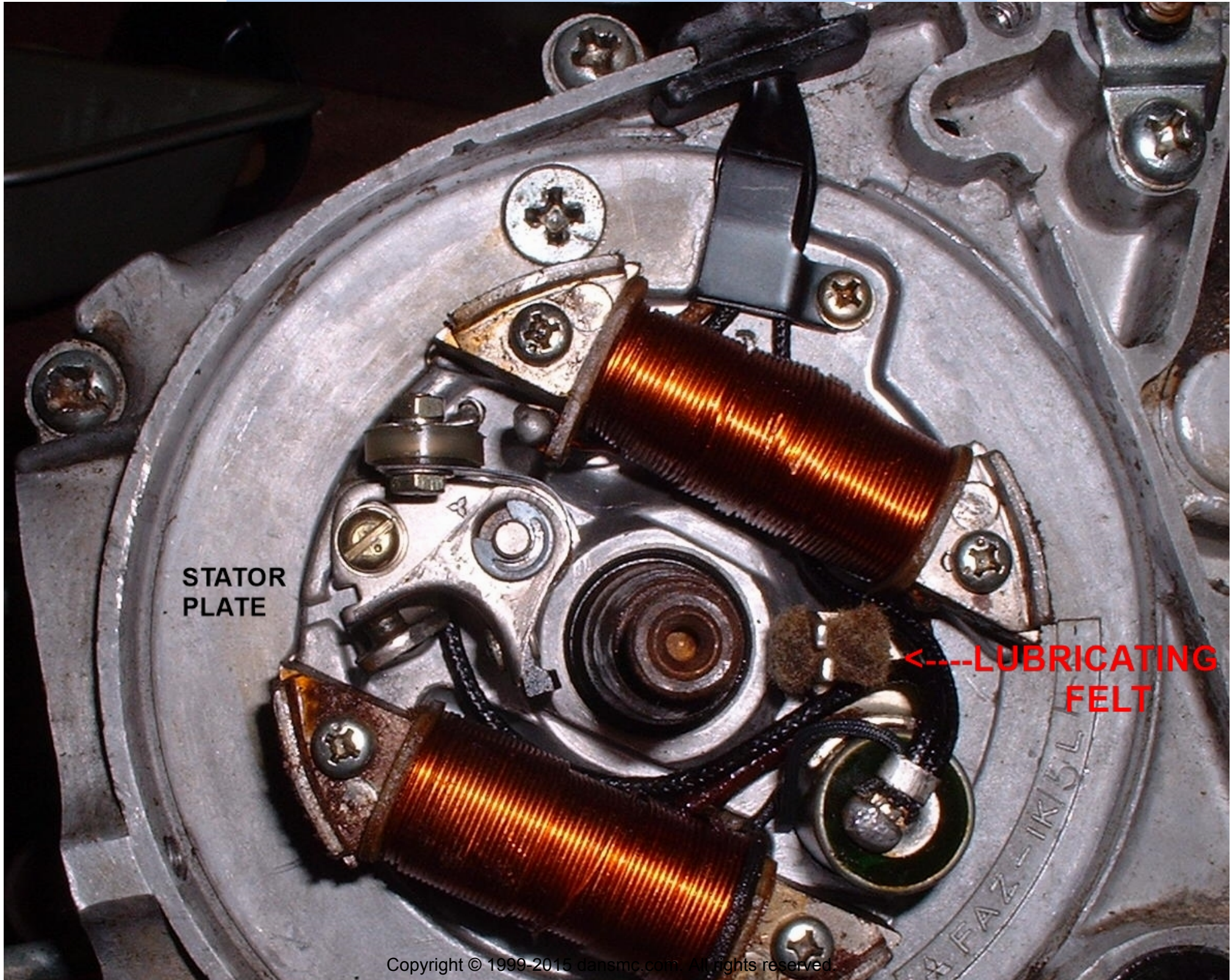


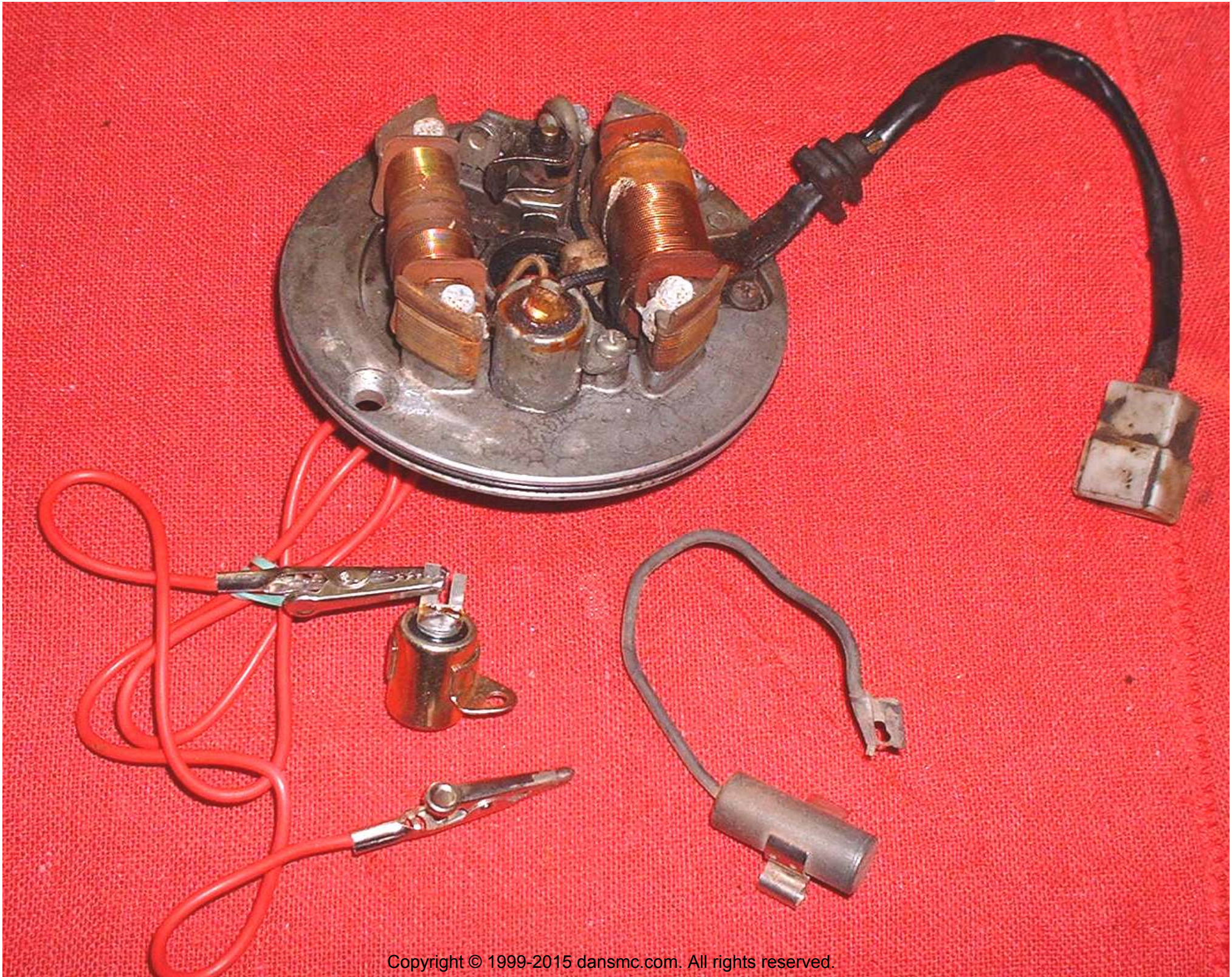
Contact breaker assembly.

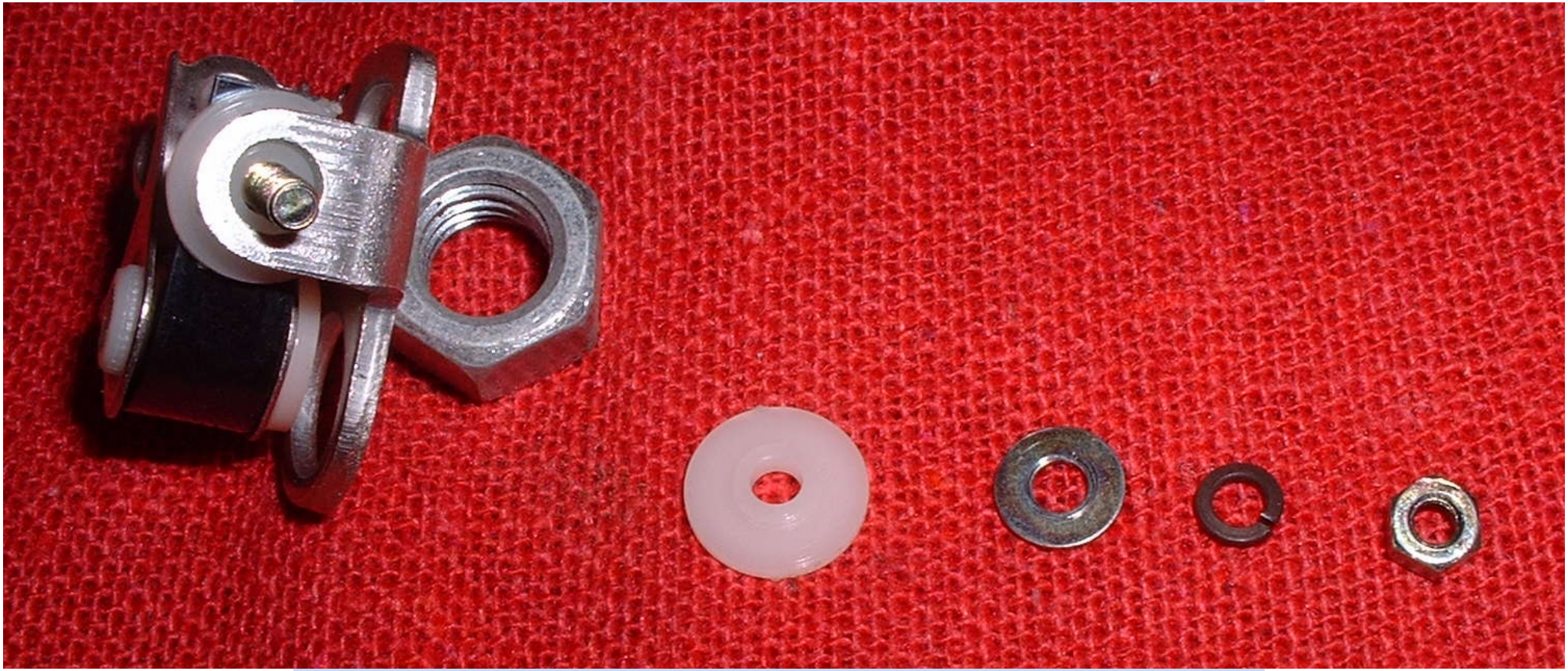
1. Contact break arm
2. Insulator
3. Spring
4. Cam follower
5. Circlip
6. Wire from primary coil
7. Contact breaker points

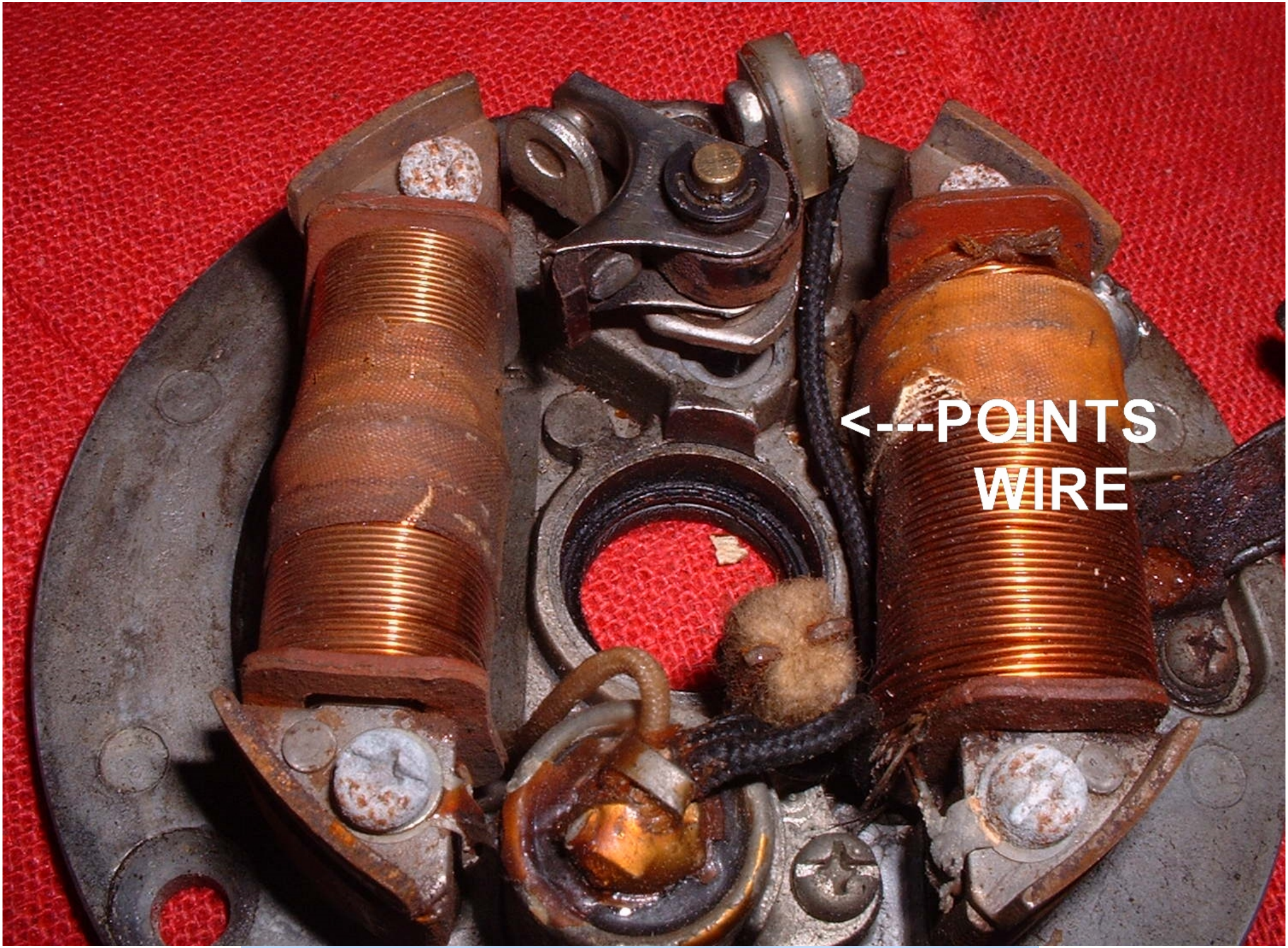
6. Wire from primary coil
7. Contact breaker points

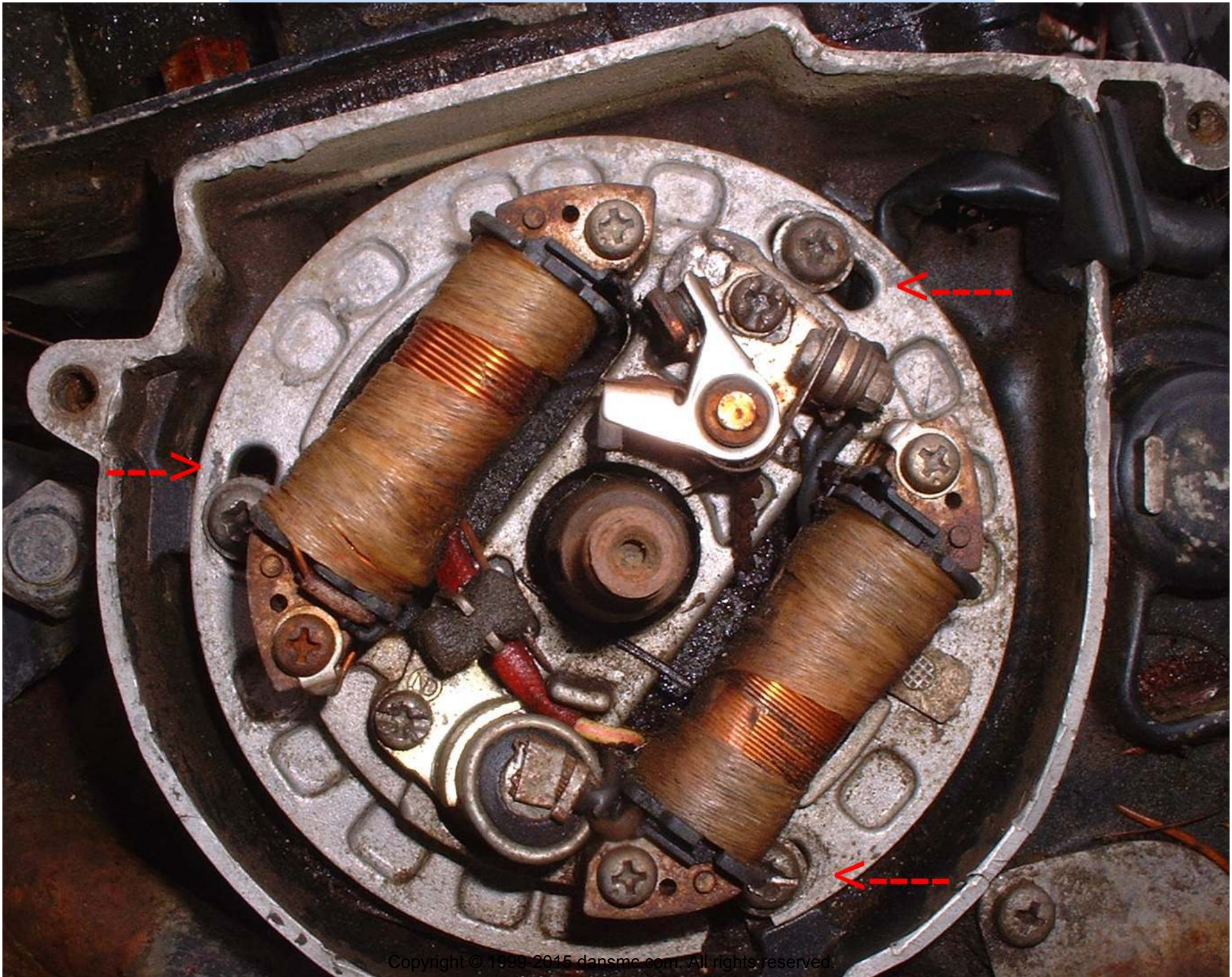


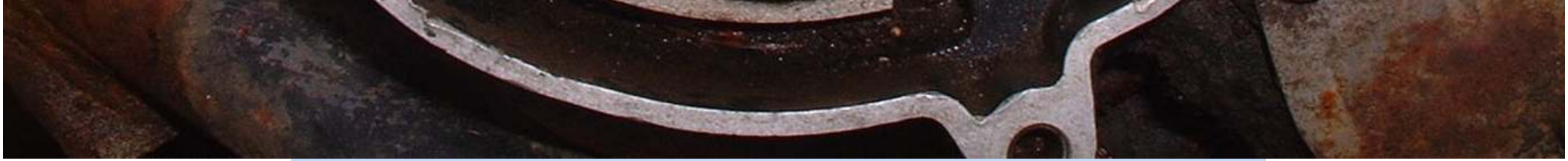


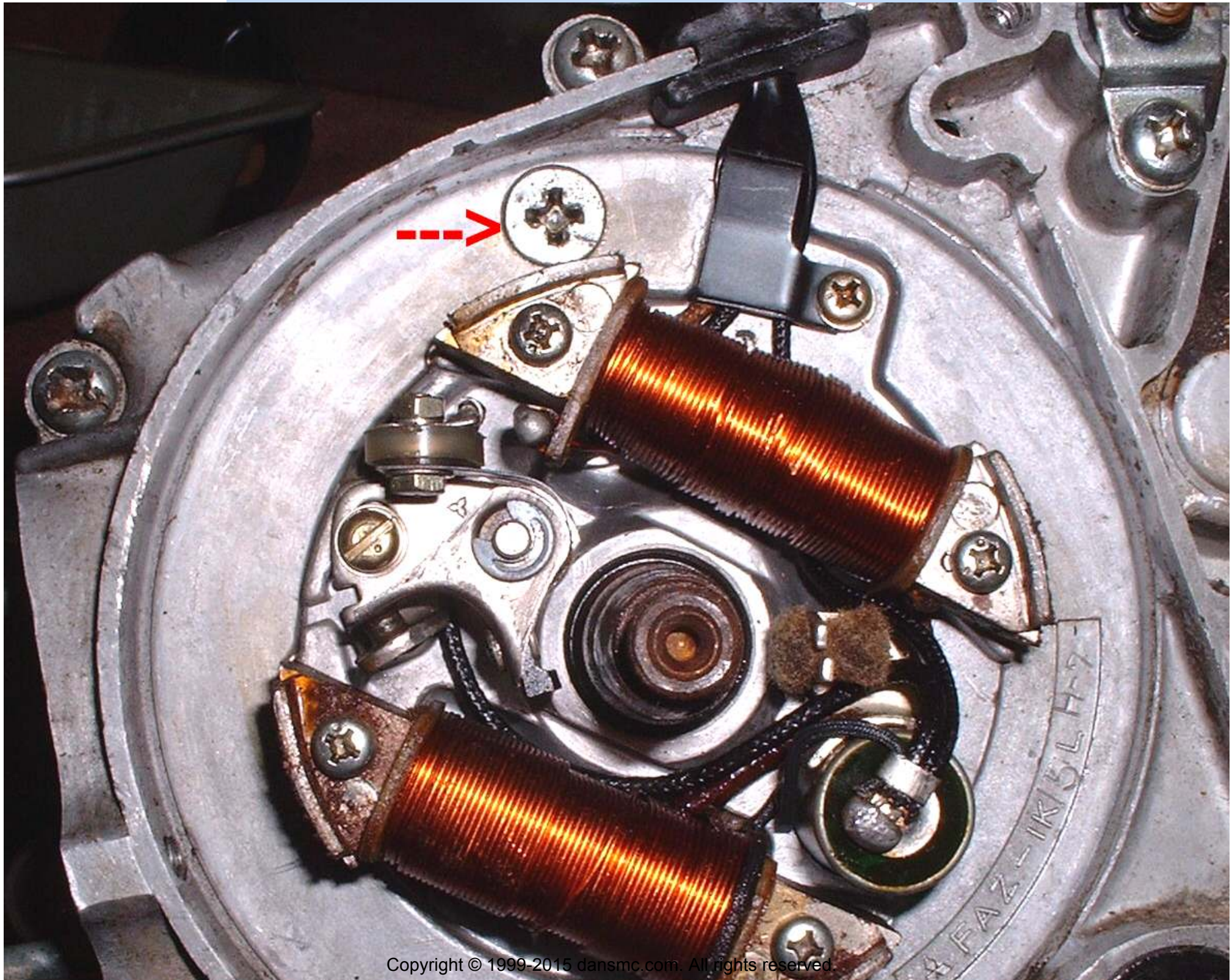


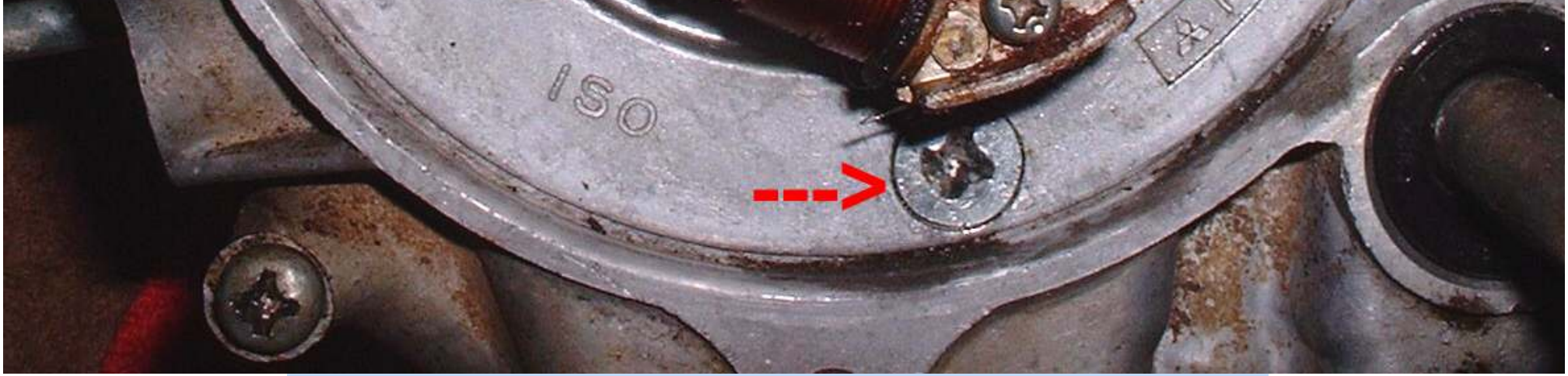


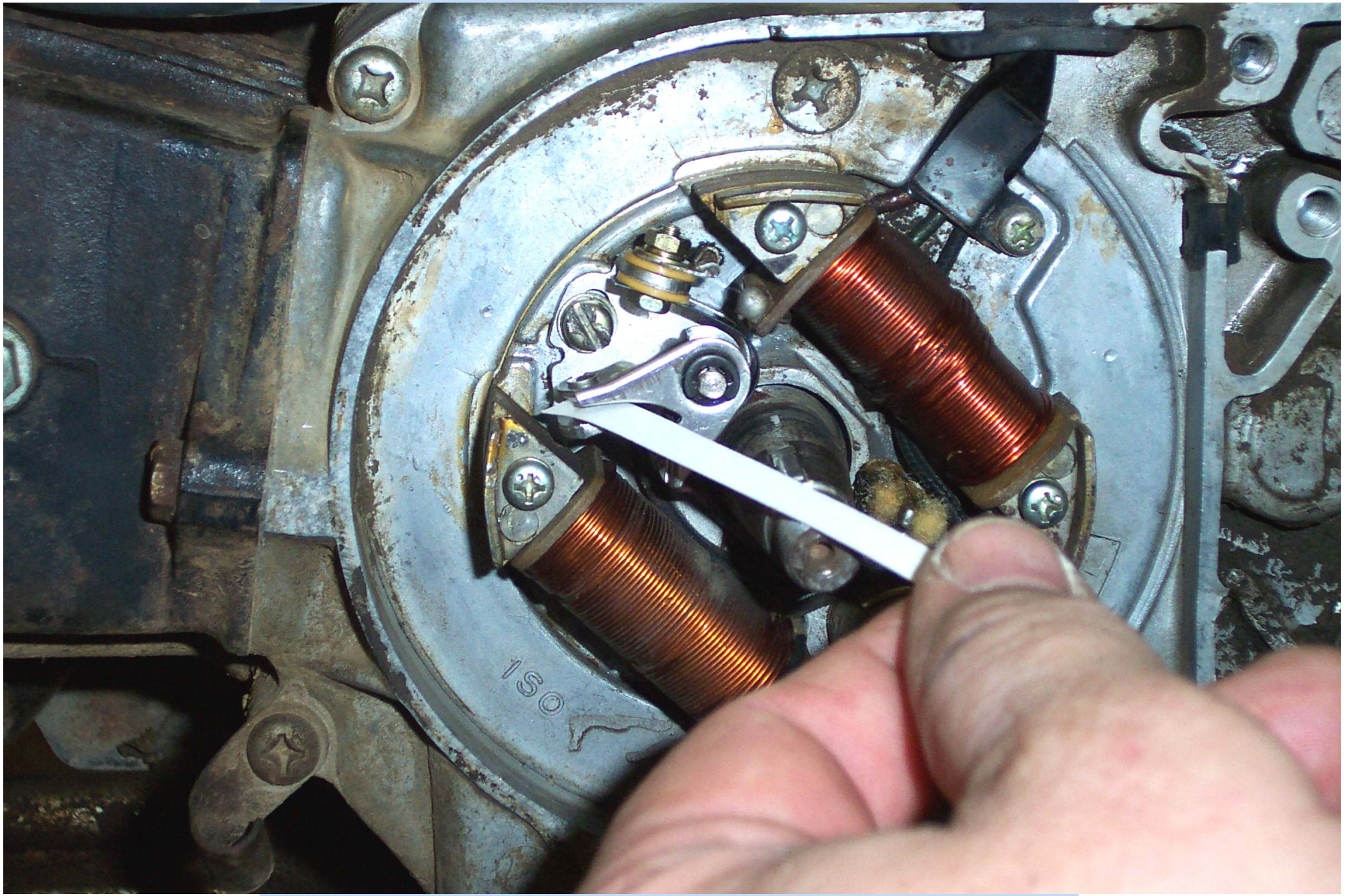


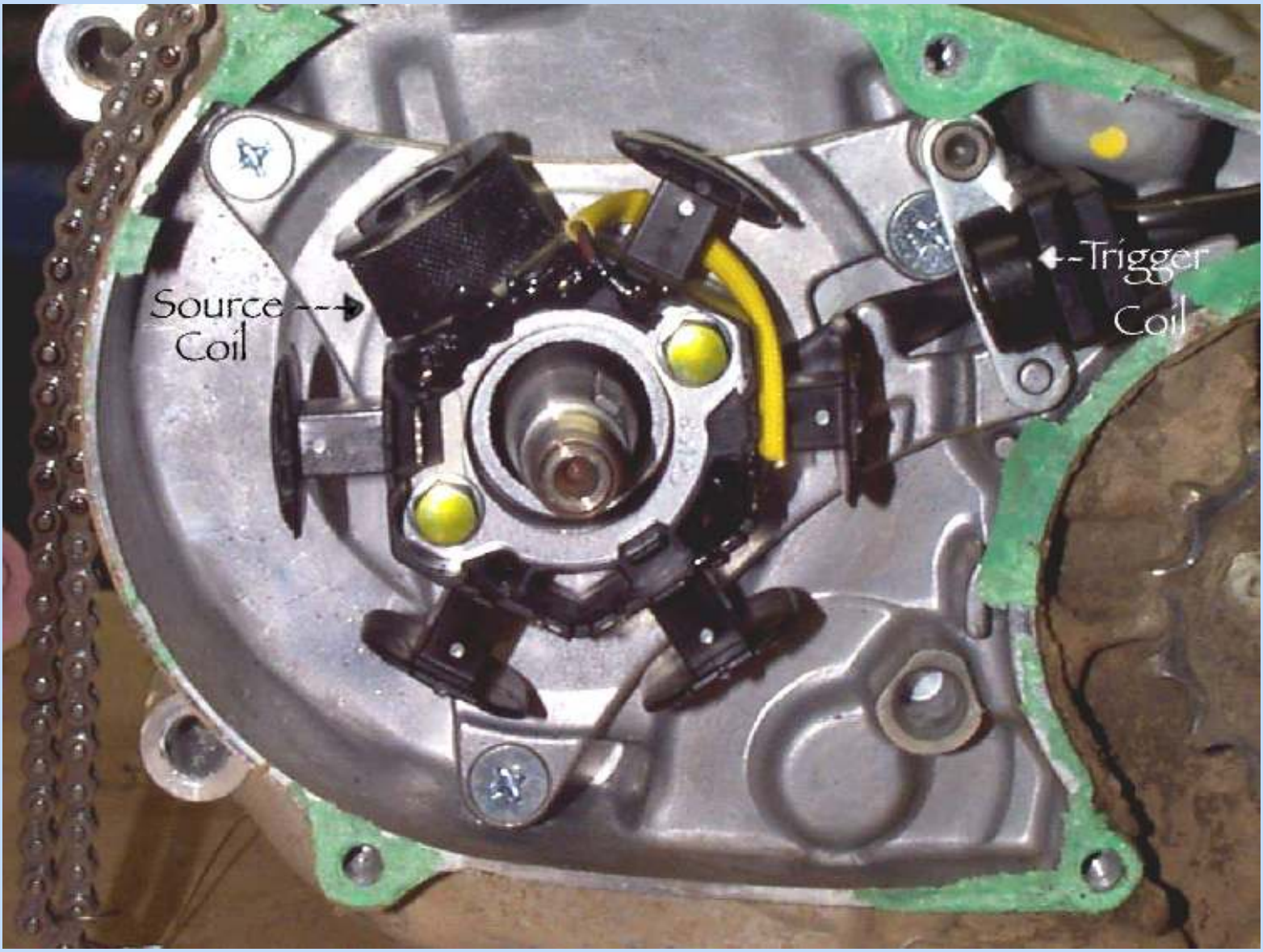


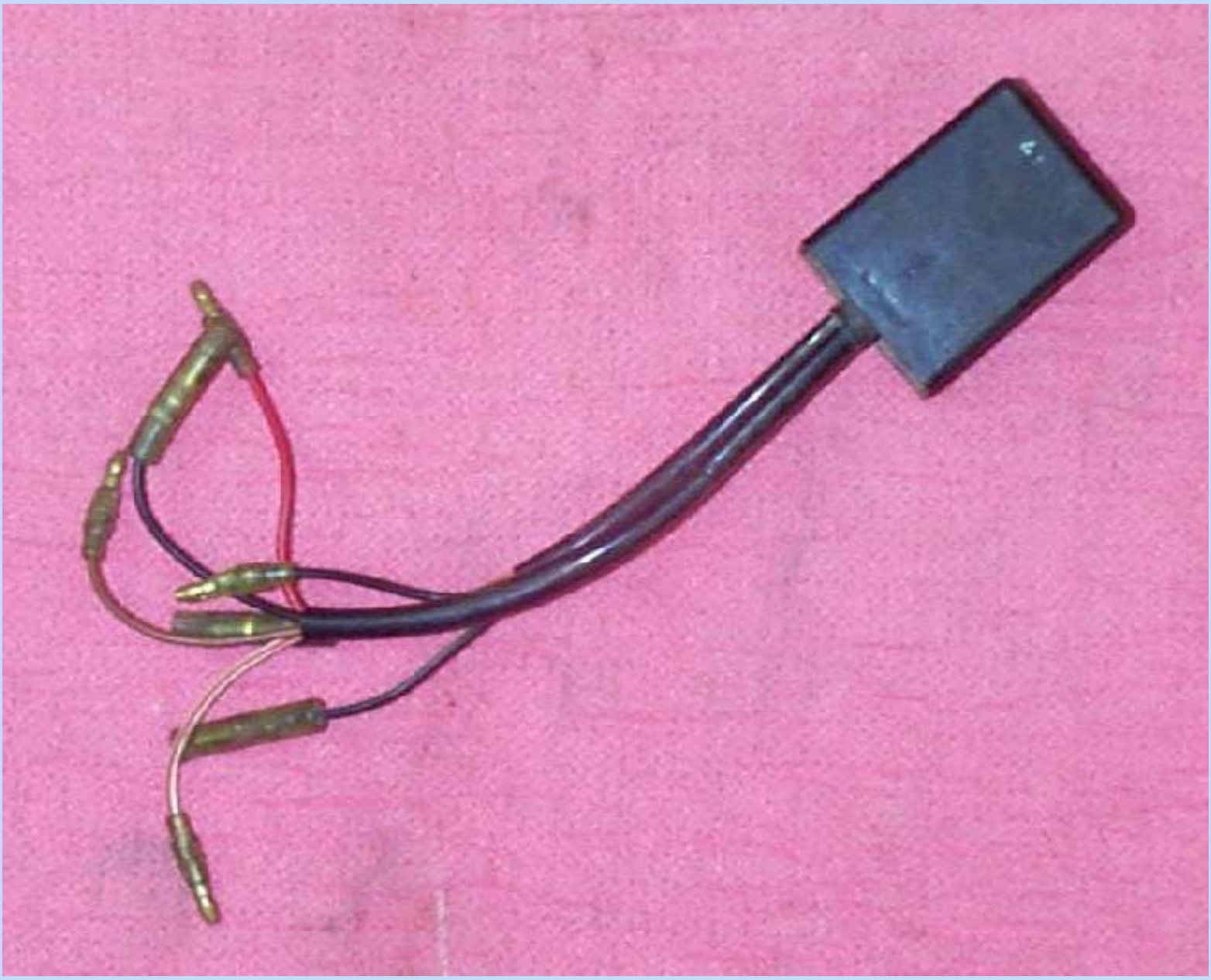






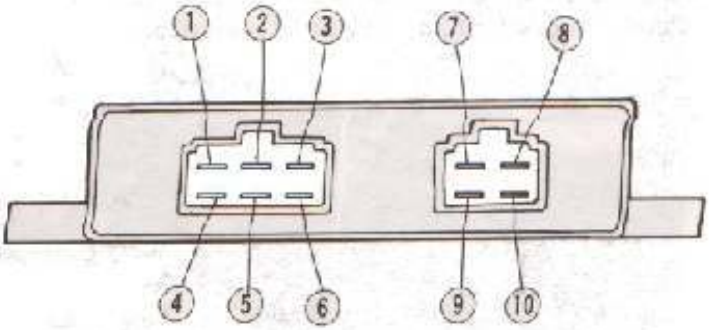






Specs From a 1990 Kawasaki Vulcan 750

Terminal No. of IC Ignitor

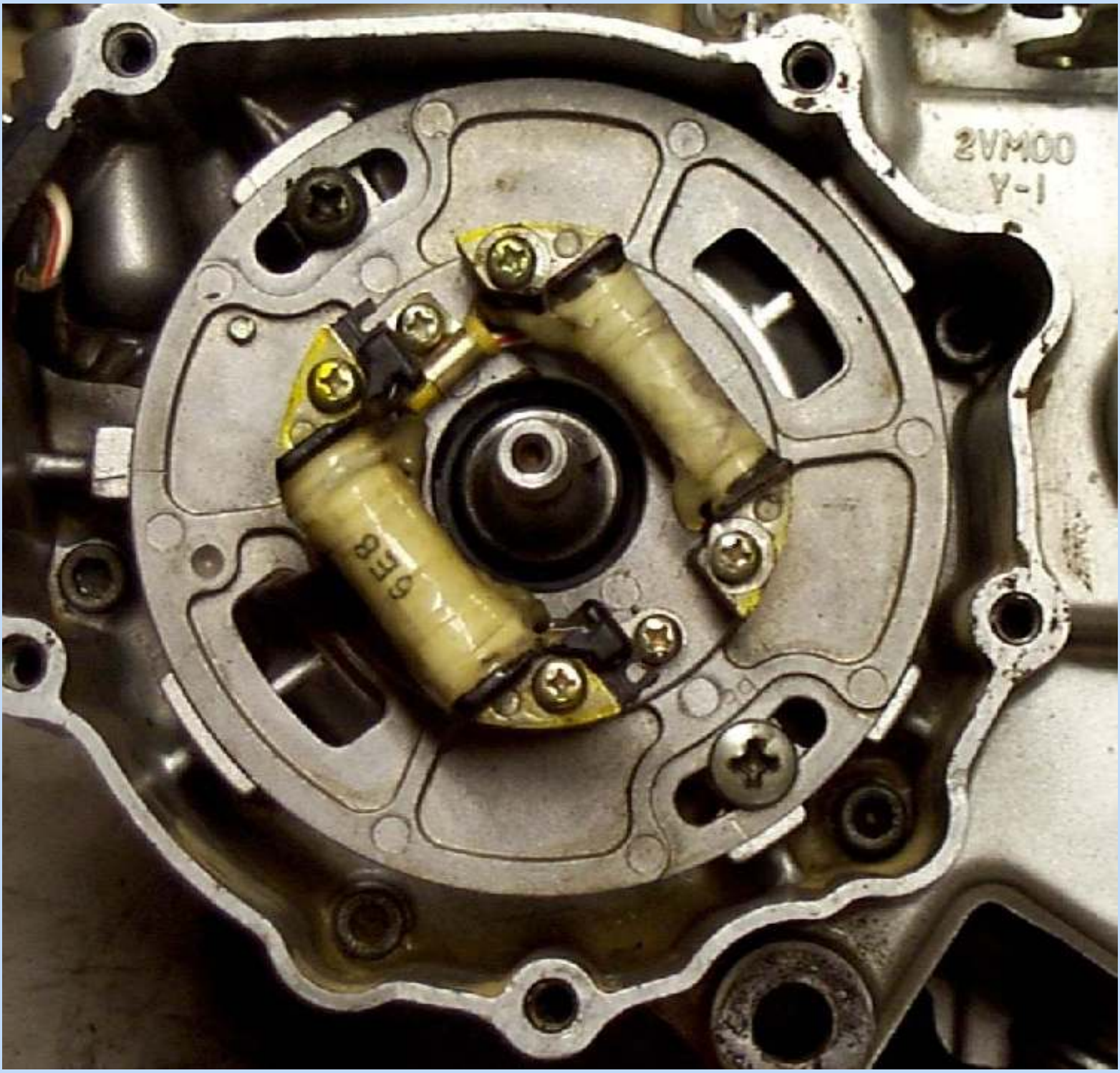


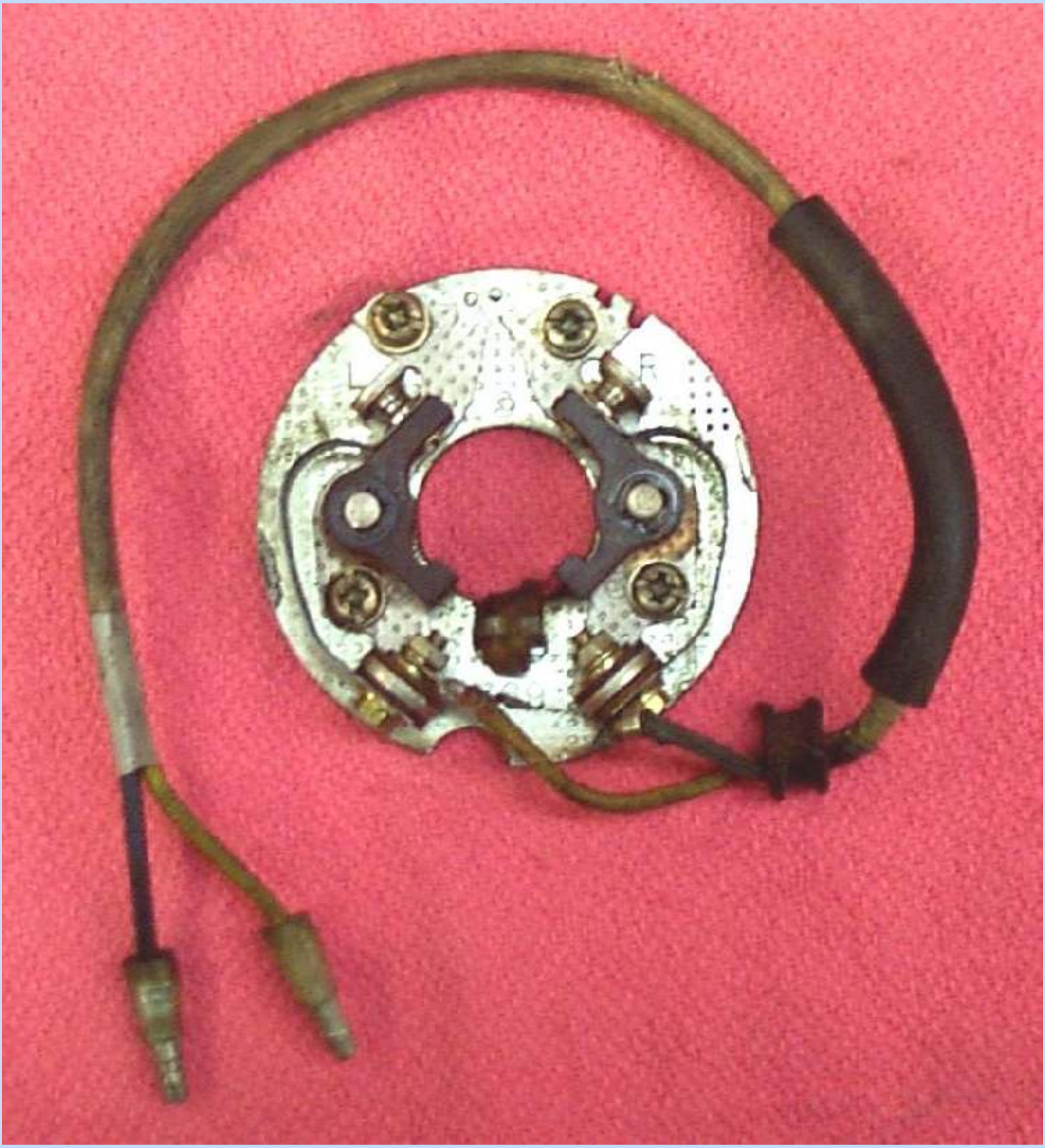
IC Ignitor Internal Resistance

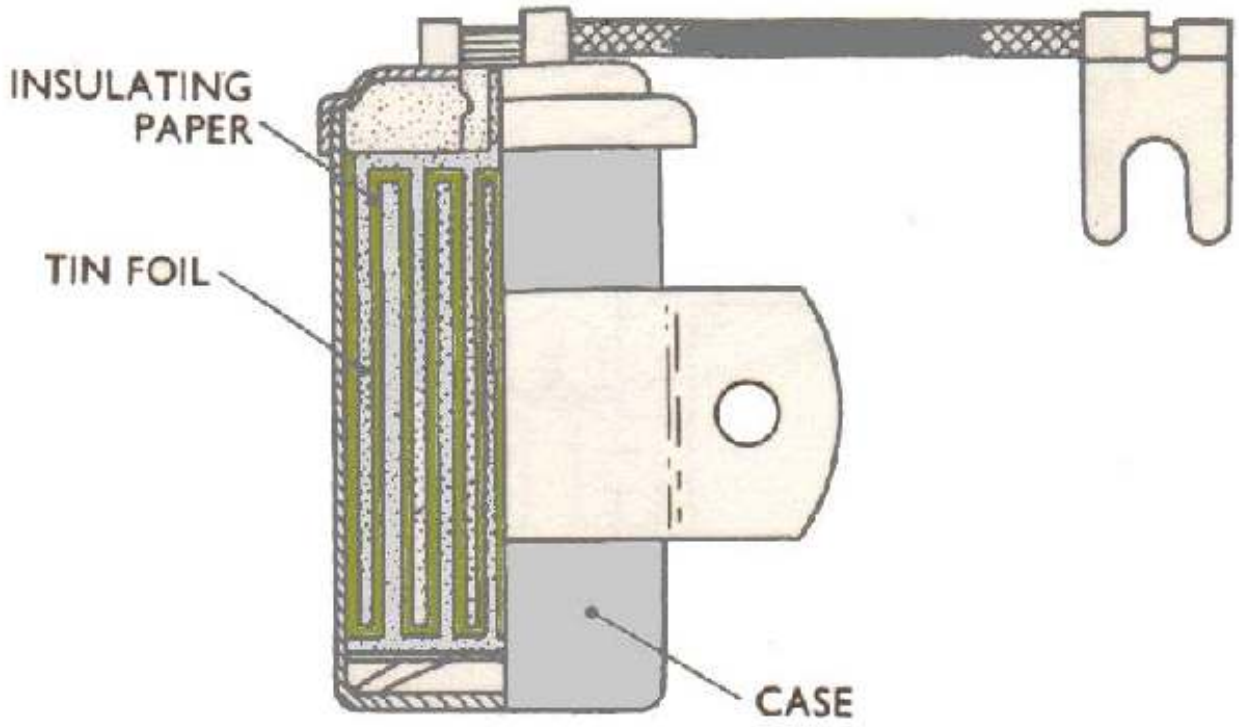
Tester (−) Lead Connection \ Tester (+) Lead Connection	1	2	3	4	5	6	7	8	9	10
1		∞	∞	∞	∞	∞	—	—	—	—
2	G		F	G	G	F	—	—	—	—
3	C	F		C	E	A	—	—	—	—
4	∞	∞	∞		∞	∞	—	—	—	—
5	F	G	E	F		E	—	—	—	—
6	B	F	A	B	E		—	—	—	—
7	—	—	—	—	—	—		D	D	D
8	—	—	—	—	—	—	D		D	D
9	—	—	—	—	—	—	D	D		D
10	—	—	—	—	—	—	D	D	D	

Value (kΩ)	
∞	Infinity
A	0.9 – 1.7
B	2 – 4
C	3.6 – 6
D	4 – 6
E	8.5 – 15
F	14 – 26
G	24 – 50

*Measured with hand tester 57001-983. A tester other than the Kawasaki Hand Tester may show different readings.

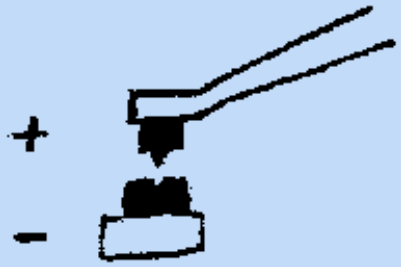




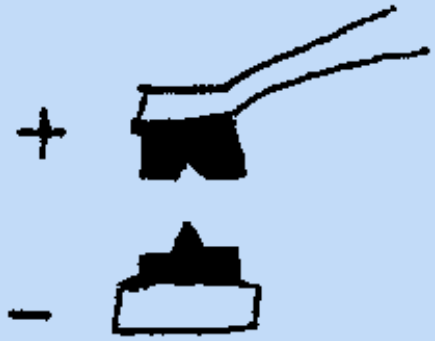


Capacitor (condenser) is used to prevent arcing across distributor points by providing reservoir for storage of electricity.

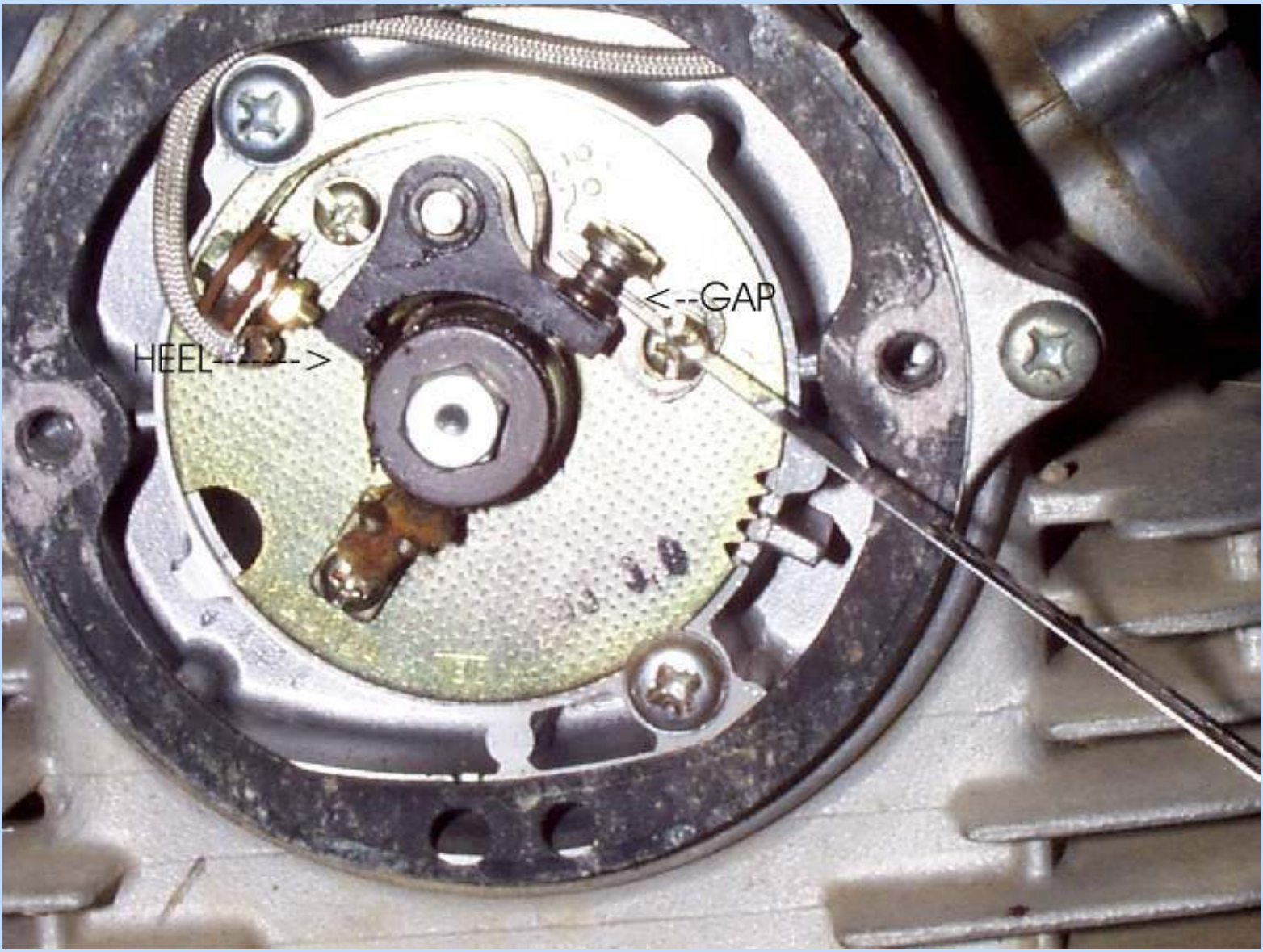
CONDENSER CAPACITY

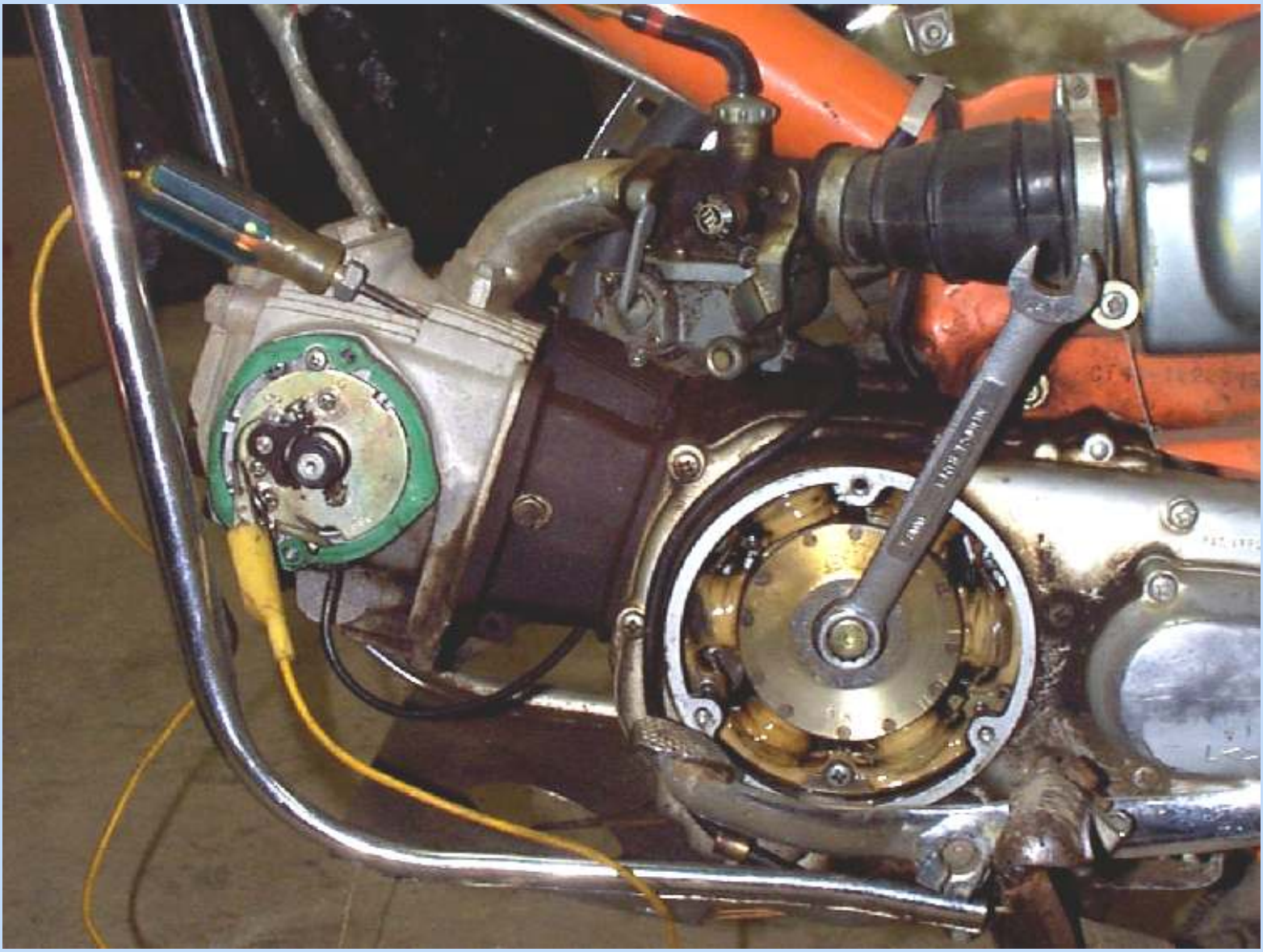


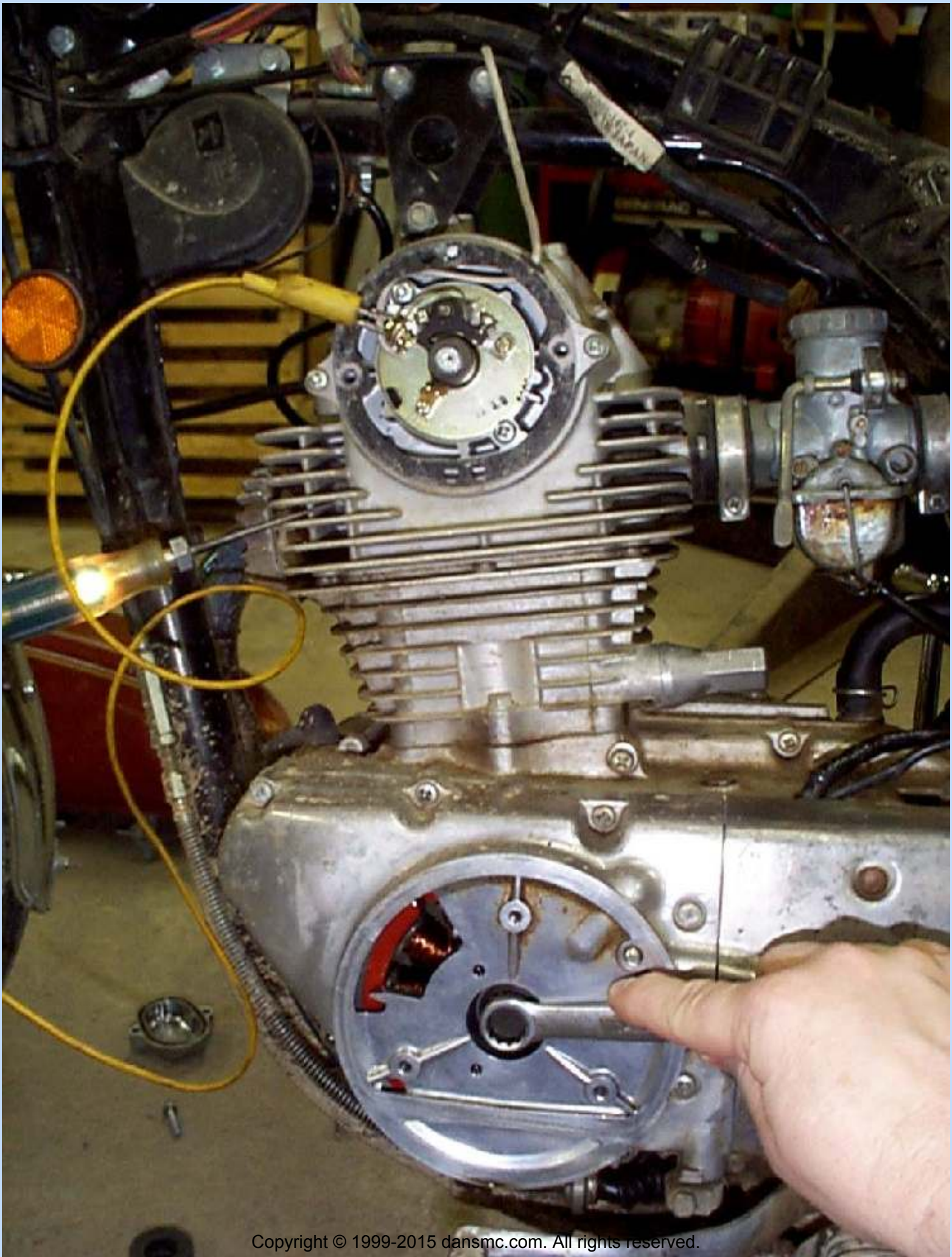
LOW CAPACITY

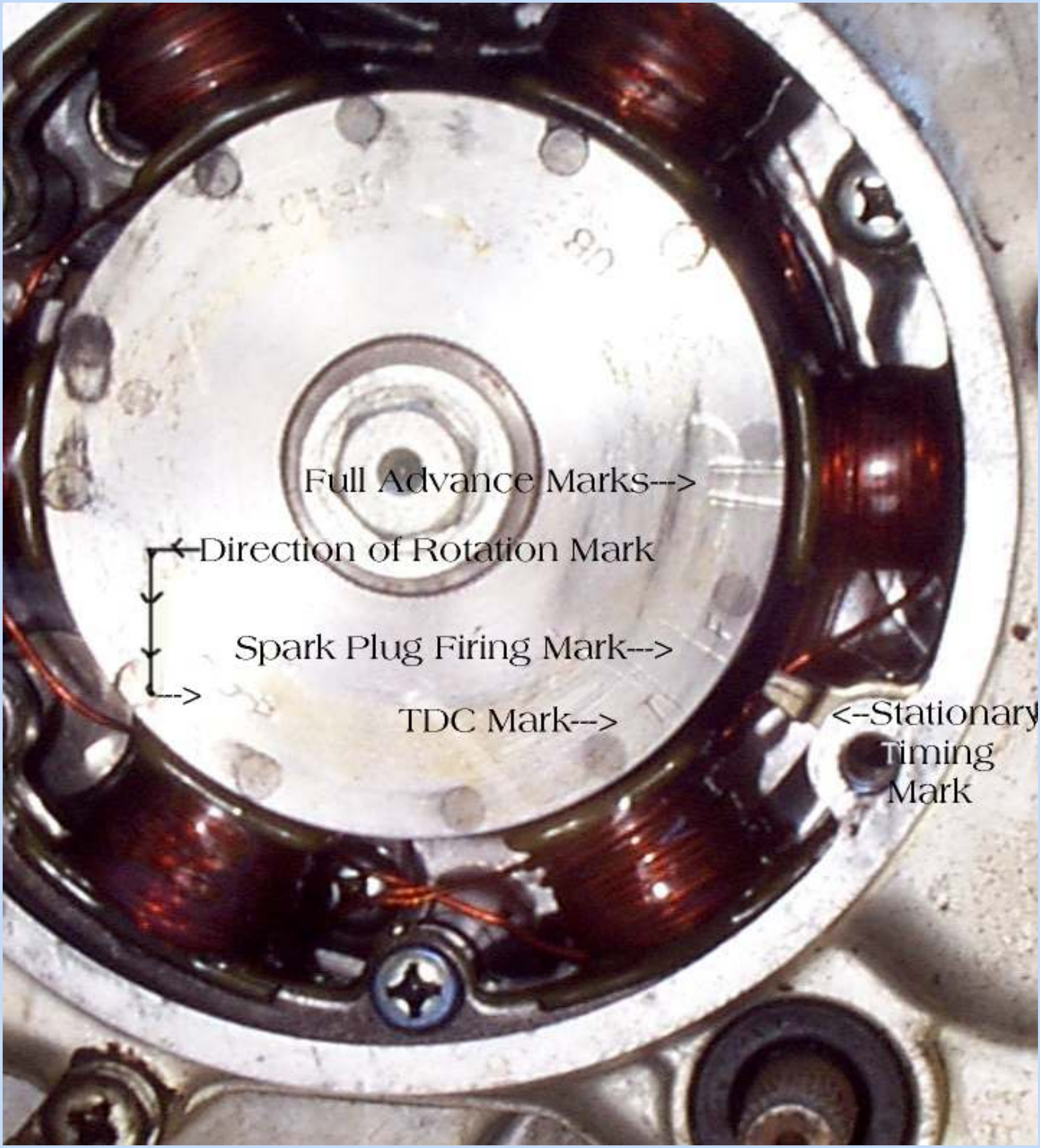


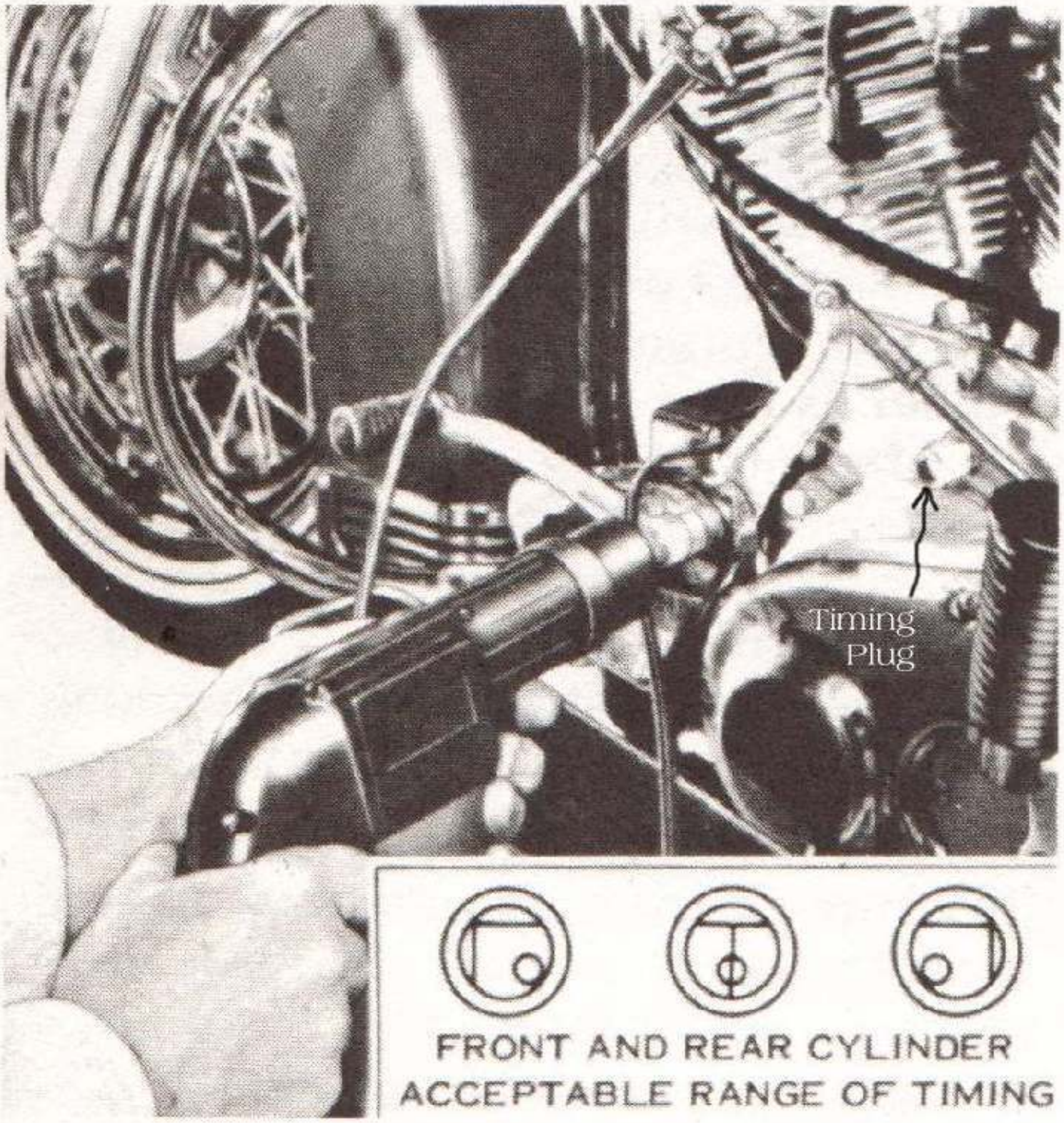
EXCESSIVE CAPACITY



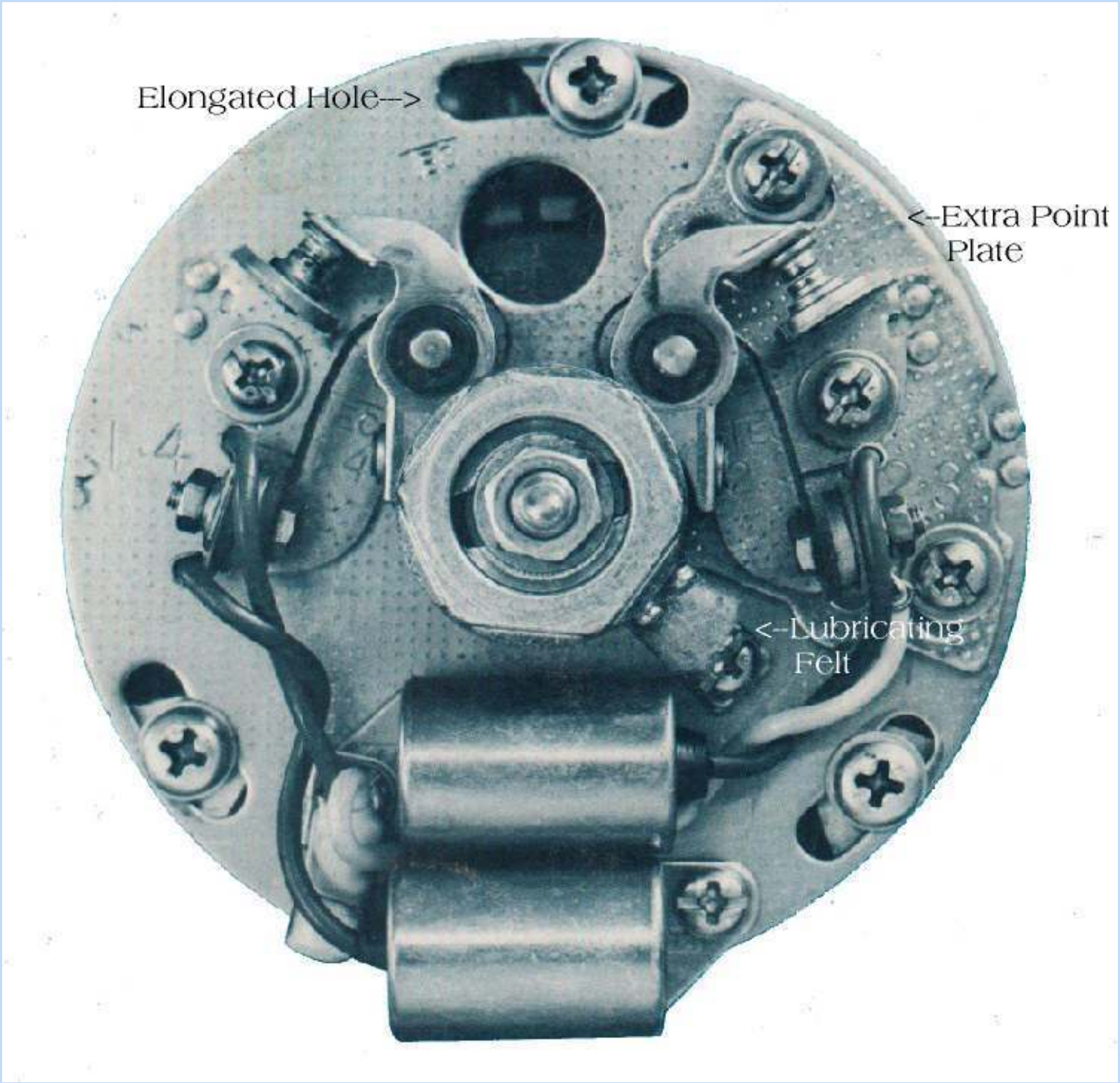


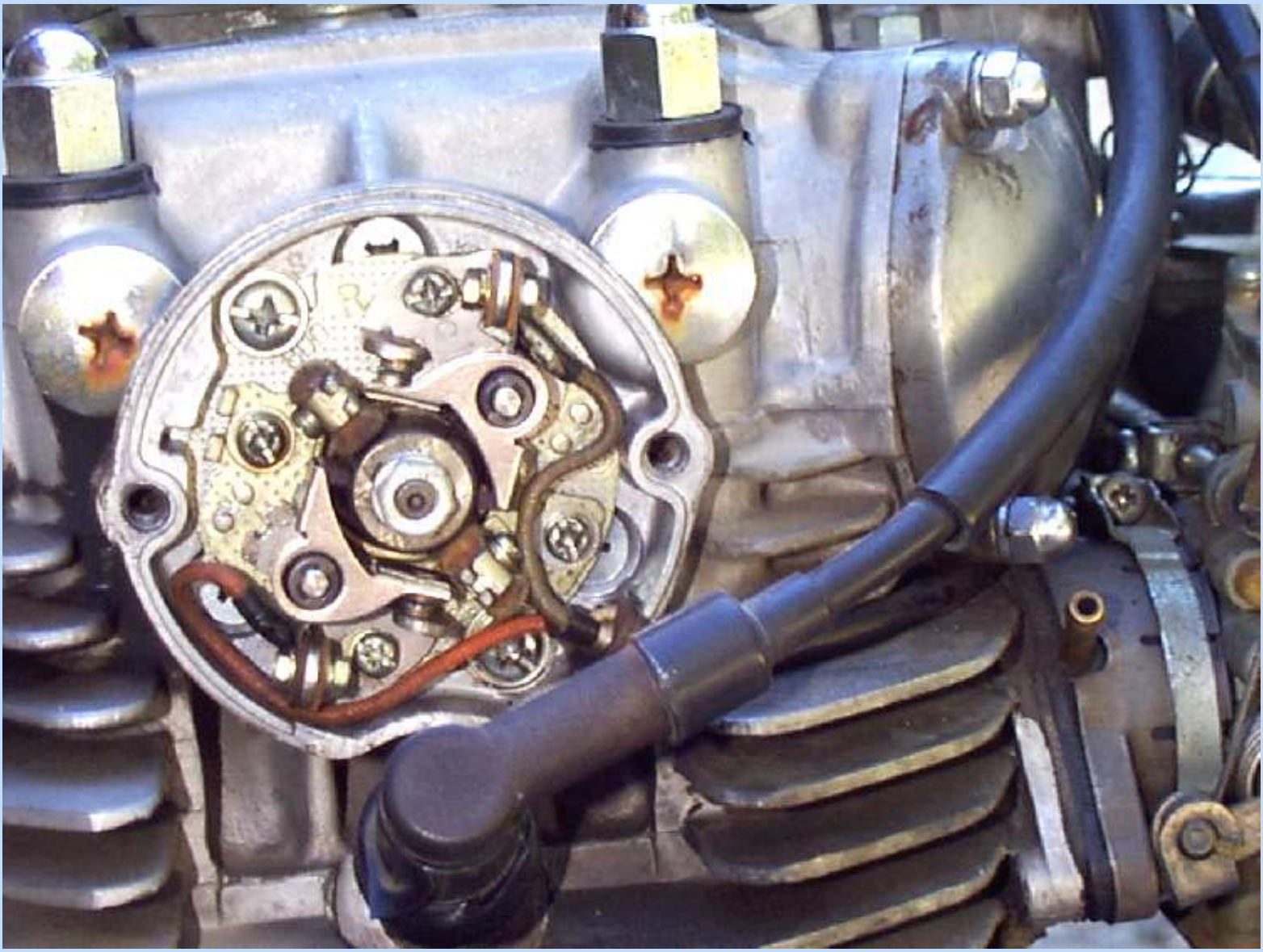


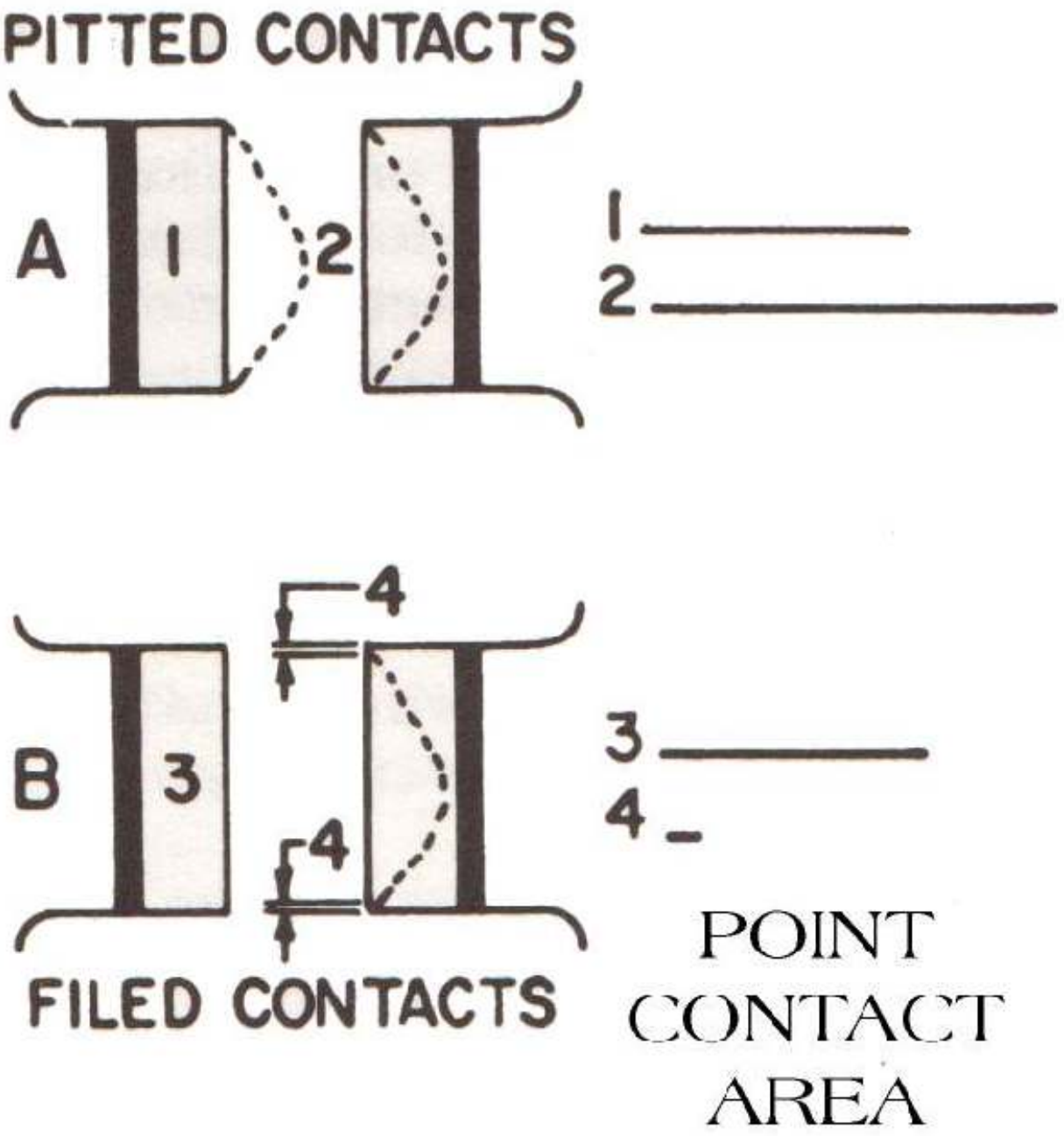


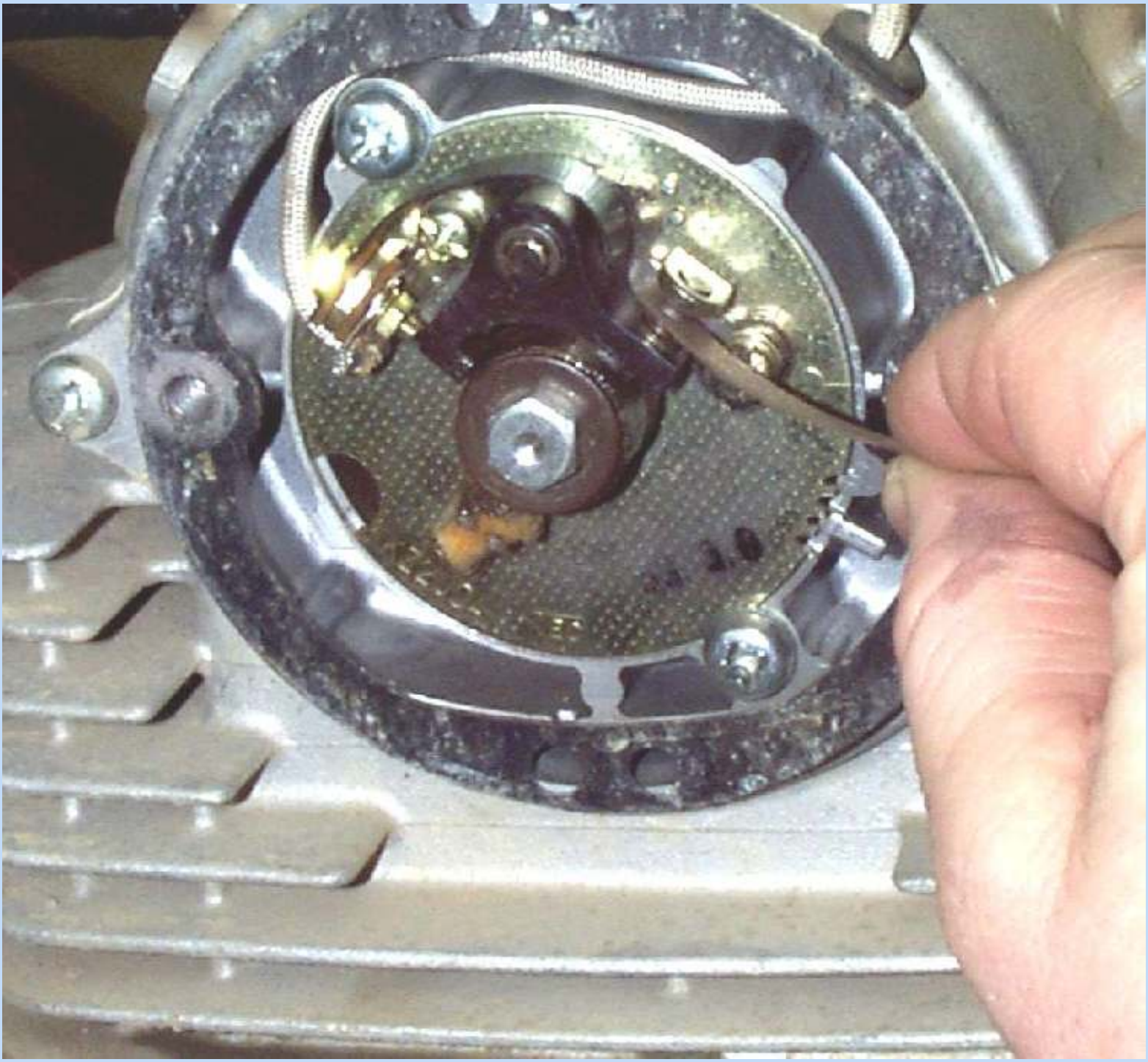


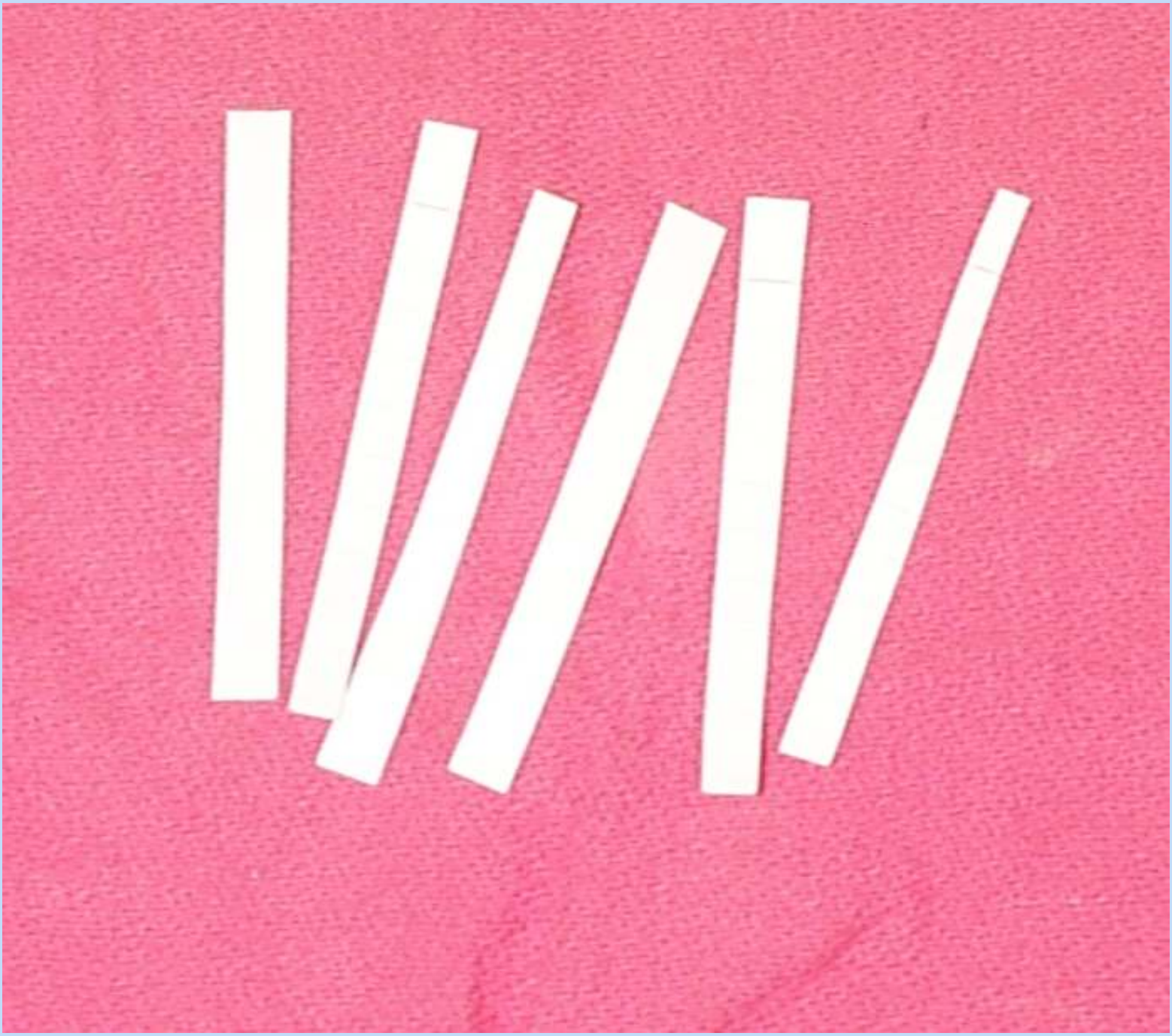
Timing with a strobe light

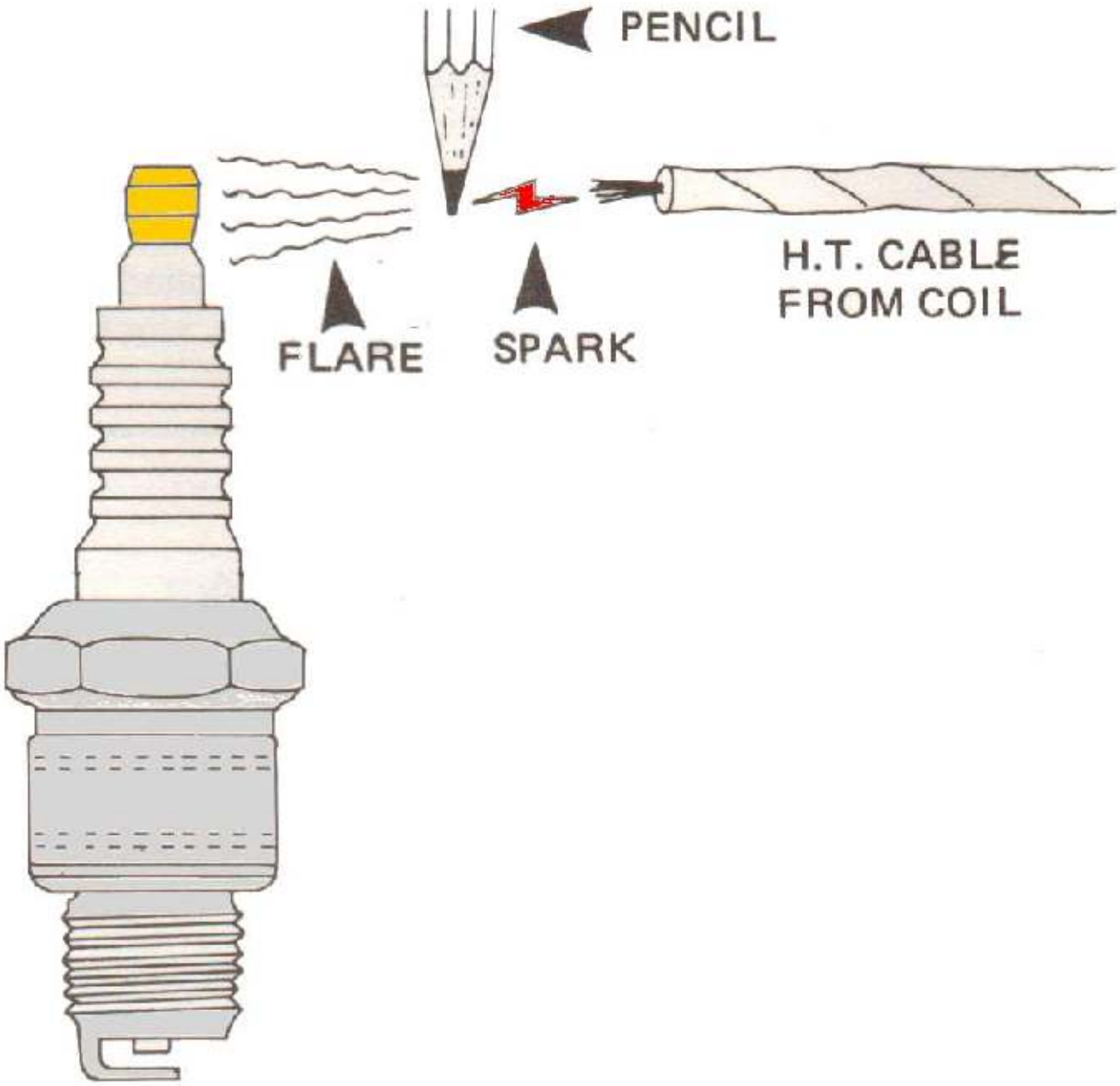












Polarity test for coil connections