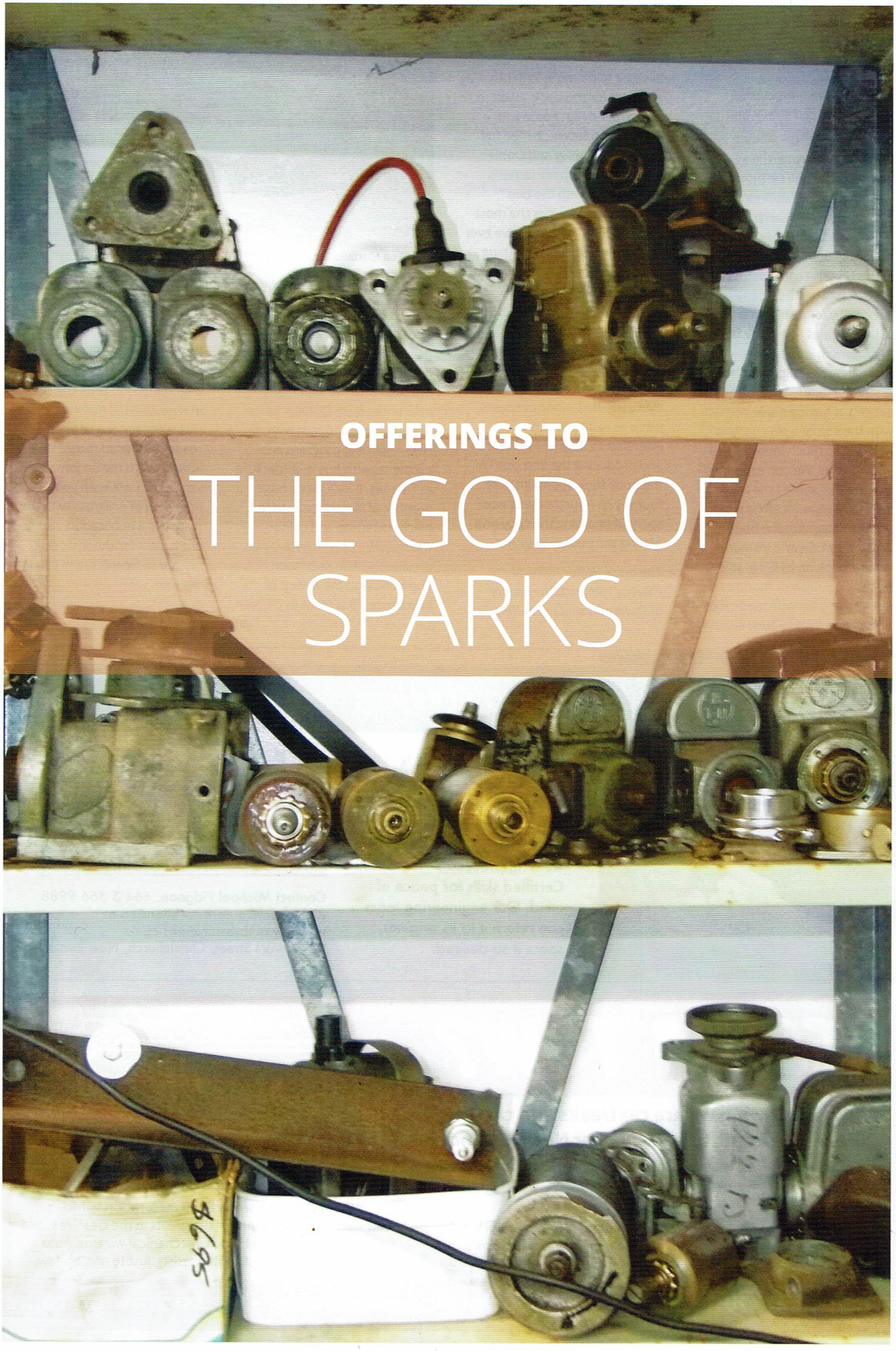


OFFERINGS TO

THE GOD OF SPARKS

Words and photos
Stuart Francis

At the start of most motorcycle rallies there is a select group of riders trying to coax a spark from their machine's reluctant magneto. Having been there a few times myself I empathised with them. The endless kicking, running and bumping, or being pushed, resulting in a couple of tantalising ignitions, whilst the pints of sweat pour down the inside of your waterproofs, can test the patience of anybody. There are also more subtle problems that might indicate a weak spark; the bike feels like it is running out of petrol (but isn't), misfires on wide throttle openings, hesitates on sharp throttle openings or refuses to start when hot.

There are four main types of motorcycle magnetos:

fixed magnet, fixed HT coil and switched magnetic field (eg; Dixie or Splitdorf)	**fixed magnet and rotating HT coil** (eg. BTH or Lucas)
rotating magnet and fixed HT coil (eg. Lucas SR or PAL)	**rotating magnet and fixed separate HT coil** (Energy Transfer Systems)

However they all rely on a coil of wire moving through a magnetic field producing an electrical current, the stronger the magnetic field or the faster the coil moves through the magnetic field, the bigger the current, the bigger the eventual spark. I will not go into the detailed theory of how a magneto works, it would bore most people.

Motorcycle magnetos produce relatively low voltage and current sparks (12 to 18 thousand volts) compared to a good coil ignition system (20 to 30 thousand volts) or some modern car systems that produce very high voltages and currents (50 thousand volts). High currents and voltages are very useful for burning off spark plug deposits and igniting weak mixtures.

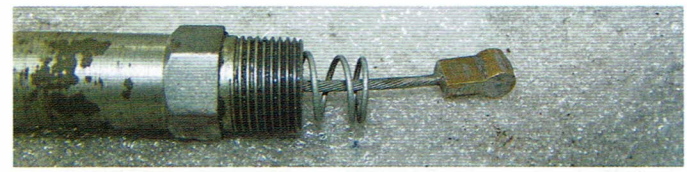
Motorcycle magnetos have another handicap. When being kicked over the coils pass through the magnetic field at a relatively slow speed, producing a low initial current. So to produce a spark at slow speed the magneto must be in good condition. The following are some hints and tips, learnt from bitter experience, that might help restore the performance of your wilting magneto, or just get you home.

SPARK PLUGS

There are two main issues with modern spark plugs, firstly they come with the gap set for modern ignition systems, usually at around 35 thou, and secondly they can come with built in suppressors (see below). The recommended spark plug gaps for most magnetos (when new), were between 20 to 25 thou. The gap can be closed down even further if you are having problems (I once ran a 10 thou spark plug gap for several weeks on a particularly tired magneto). If you are stuck without a feeler gauge the thickness of your thumbnail is a good start point.

SUPPRESSOR CAPS

Most motorcycle magnetos were not designed to run with suppressors. Spark plug, or plug cap, suppressors are carbon resistors which reduce voltage and current at the spark plug gap, throw them away.



▲ Lucas manual advance and retard cable

HT LEAD

Always, always use solid copper HT lead, preferably with the two layers of insulation. Some modern HT leads have a carbon string like core that acts as a suppressor. These can kill a magneto spark stone dead. Have a good look at the routing of the HT cable for rubbing or touching hot bits. I once finished up stranded in the central reservation of a busy British motorway after a HT lead had melted on a cylinder head fin.

HT LEAD CONNECTIONS

Lucas, amongst others, used threaded plastic sleeves and an unusual split copper washer to connect the HT lead to the pickup. A rubber boot covers the HT lead and pickup, with a similar arrangement at the spark plug cap. Over time the rubber boots start cracking or go missing, allowing oil and water to accumulate in the pickup, killing the spark. Vibration can also cause the copper wire to work harden, fatigue and break.

HT PICK-UPS

I could write a whole article just on the fun I have had with HT pick-ups, but the problems usually fall into three main areas: tracking, contamination and brushes. Over time the hard plastic pick-up bodies can develop small cracks which allow the sparks to leak to the nearest metal fitting, usually the retaining clip or screw. The nose of the pick-up gradually accumulates carbon dust and oil creating a conductive mixture. This can be particularly bad on flange mounted magnetos when their oil seals begin to wear. Give the pick-ups a good clean with brake cleaner. Check that the brush actually slides up and down in the holder. Mis-sized pattern brushes can stick and debris can cause stiction.

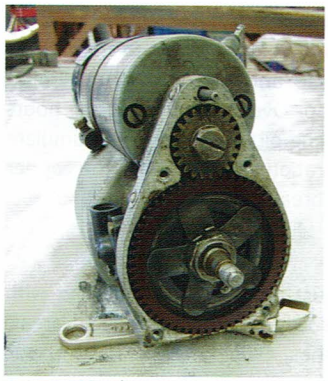
SLIP RINGS

Suffer from tracking and contamination, but have a couple of unique problems; damage and wear. It is not unusual to see chunks of plastic missing from the edge of the slip ring, caused by the safety screw(s) not being removed before the magneto was taken apart. The damage can usually be repaired with araldite or a new slip ring fitted. There are two types of wear, electrical erosion (a small dip in the conductor) or rubbing wear caused by the brush or brush holder nose (if the brush holder fibre washer has not been fitted) both can usually be polished out with emery cloth on a lathe. Always give it a good clean with brake cleaner.

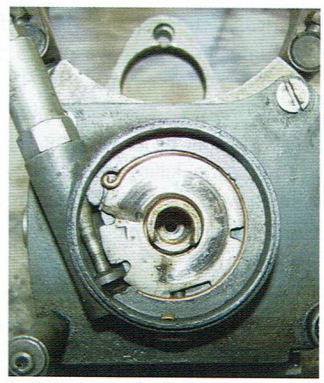
CONTACT BREAKERS AND CAM RINGS

Contact breaker points must be clean flat and square to each other, just running a bit of emery between the points is not good enough. Dress them properly (I use an old diamond faced nail file) and it will make a lot of difference. Check that all the insulating washers are there, and the contact breaker spring is not touching the cam ring at any point. Check that the contact breaker assembly is sitting squarely in the end of the rotor, the alignment tang is in the armature slot and the end bolt is tight. Cam rings on twin cylinder bikes can wear unevenly, producing significant changes to the firing points. Always check the fully advanced position on both cylinders and the points gap is the same for both cylinders. I once built a twin cylinder magdyno for a Scott from bits I had lying around. Although it produced a good spark the engine never felt right. A check

▲ (L to R) Magnetos - BTH Flange mounted,Lucas SR1, early BTH twin. Lucas facecam. (Front row LtoR) Advance and Retard units - BTH and Lucas.

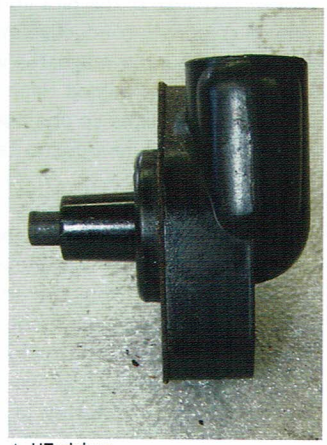


▲ Lucas Magdyno

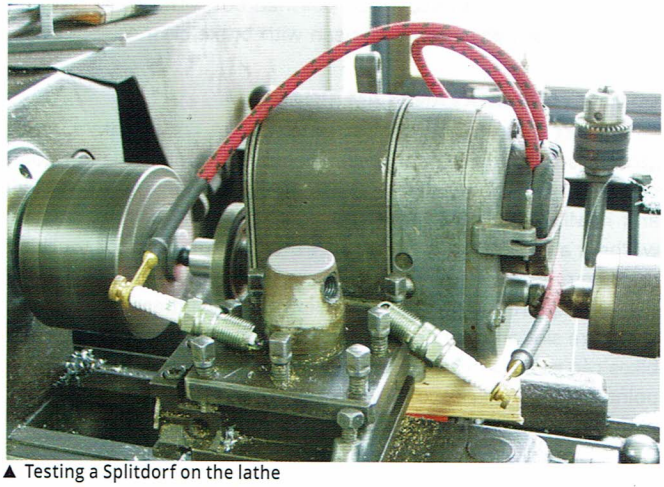


▲ Face cam and advance and retard actuator

▲ Harley-Davidson Fairbanks magneto



▲ HT pickup



▲ Testing a Splitdorf on the lathe

revealed a 20 degree difference between the two firing points.

MAGNETS

These gradually lose their magnetic strength. This is a very slow process that reduces the size of the spark. Older horseshoe magnets are most affected, but it happens to them all eventually. If your magneto has not been re-magnetised in the last 25 years, it is about time to do it. Magnets also gradually lose their magnetic strength as they get hotter. Always fit a keeper plate across the poles of the magnet if it is removed or the armature is removed.

BEARINGS

Magneto bearing wear can have an insidious affect on performance. Any end float on the angular contact magneto bearings results in side play, both of which can affect contact breaker opening. At slow speed there is a perceptible time for the contract breakers to fully open, any delay due to wear slows this process and weakens the spark (a very real problem with face cam contact breakers). Most magnetos have thin shims which can be removed to correct end-float. Make sure the paper insulators the bearings sit in have not broken up or disappeared.

CAPACITORS

Are fitted to increase spark voltage and eliminate sparking at the points. A small amount of sparking at the points is not unusual but continuous sparking usually means the capacitor needs replacing. Capacitors can be susceptible to heat. If the spark disappears when the magneto is hot it is possibly the capacitor. Rotating coil magnetos invariably have a capacitor buried in the armature. They are a pig to get at and are best replaced by an expert.

EARTHING BRUSHES

All rotating coil magnetos are fitted with an earth brush or contact. They are usually in a separate spring loaded holder (Lucas), or hidden at the back of the contact breaker plate (BTH). Make sure they are there and can move in their holders and give them a good clean.

V TWINS

These are always a compromise, usually producing a strong spark to one cylinder and a weaker one to the other. Not much you can do about it unless you can change the laws of physics or adopt the racing JAP approach of fitting two single cylinder magnetos.

INSULATION

Early magnetos used a varnish called shellac to insulate the windings. It gradually deteriorates, particularly when hot. Sudden failures of the varnish locking up the magneto are not unknown. If you see a small tar like mark on the inside of a rotating coil magneto it is time for a rewind. Modern insulating varnishes are very stable.

CUT-OUTS

Magneto cut-outs work by short circuiting the contact breaker. If you have lost a spark always try disconnecting the cut-out, as wiring defects and faulty switches can cause shorts to earth.

ADVANCE AND RETARD MECHANISMS

Magnetos have a sweet spot for generating the best spark, a mechanical advance and retard mechanism changes the contact breaker opening around this point. Usually achieved by moving the cam-ring or face-cam through about 15 degrees, giving 30 degrees of advance on a four stroke. Make sure the cam is sitting properly on the pin that limits cam movement, the cam actually moves smoothly through its full movement and the cable is properly adjusted.

AUTOMATIC ADVANCE AND RETARD MECHANISMS

Have the advantage that the points are always opened at the sweet spot, giving the best spark. However they can bring their own problems, like

sticky operation and advancing too early. Sticky operation is usually diagnosed after the kick starter has tried to launch you over the handlebars because the mechanism is stuck fully advanced. Advancing too early is a more subtle issue, usually diagnosed by unexpected pinking at slow engine speeds and is invariably due to ageing springs and wear in the mechanism, so get it rebuilt.

OTHER MECHANICAL ISSUES

The drive to the magneto is usually through a gear, or sprocket, sitting on the tapered end of the armature. It is not unknown for the drive gear, or sprocket, to slip on the shaft ruining the ignition timing, usually more of a problem with magdynos (combined magneto and dynamo) because of the greater drive loads. Have a really good look at both tapers, if at all marked, lap them together with grinding paste. An obscure problem I once encountered was a bent armature. It took some time before the penny dropped.

BITSAS

Be very wary of magnetos that somebody has put together from bits they had in the back of their shed. Magnetos are usually taken apart in the first place because something is wrong with them. It is fairly easy to assemble what looks like a good magneto, but it doesn't work or produces an anaemic spark. The manufacturers made most parts physically interchangeable so they could build different versions of the magnetos for right and left hand rotation, singles and twins, manual and automatic advance and retard, face cam and cam ring operation. These variants were usually built by changing the cam ring, cam ring housing and contact breaker assembly, leading to a distressing array of similar components that can easily be confused.

WEATHER PROTECTION

Early motorcycle manufacturers loved siting the magneto directly in front of the engine, just the spot to catch, muck, manure and water thrown up by the front wheel or draining off the front mudguard. Some manufacturers attempted to protect them with covers and brims on the back of the front mudguards. However it is not unusual to find these magnetos covered in a film of muck held in place by a fine mist of oil that always seems to be present. When damp this film can make an excellent conductor for sparks. A good wash down with brake cleaner and a check of weather seals, like rubber boots and brush holder gaskets, can significantly reduce the possibility of breaking down in bad weather.

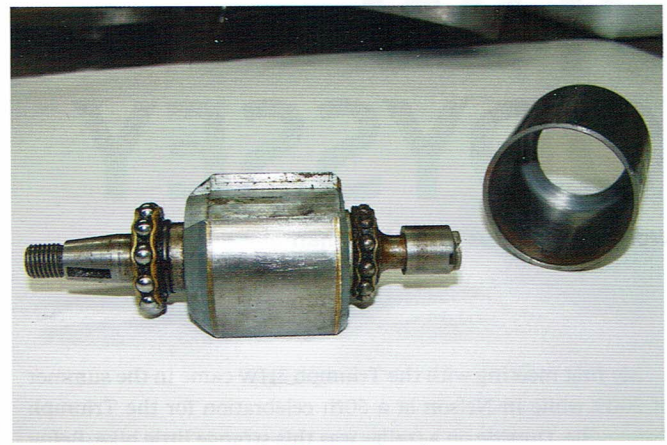
COMPRESSION RATIOS

Higher compression ratios have a marked affect. Denser mixtures require a stronger spark to jump the gap and ignite the mixture. A tired magneto on an old side-valve will probably fire it up, but the same magneto on a BSA Goldstar wouldn't have a hope of firing.

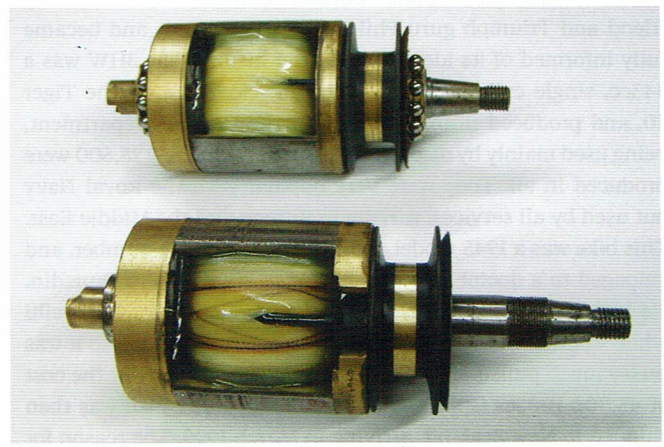
TESTING

A good magneto has a particular feel when rotated by hand, you should feel a definite drag just before the points open, then a little kick as they open. You should be able to flick it over by hand and get a reasonable spark using a fresh spark plug. I run rebuilt magnetos on the milling machine for at least an hour to check for problems. If you are having problems with an intermittent spark, run the machine in a dark corner of a garage, you might be surprised to see sparks leaking out.

I cannot claim this is a definitive list of potential problems, just my 45 years' experience of working on motorcycle magnetos. Do you have any other problems you would add to the list? BW



▲ Lucas SR1 rotating magnet (with keeper sleeve)



▲ Lucas rotating coil armatures - lower one is from a Magdyno

▼ Magneto testing