

## 5.2 Magneto, Dynamo, and Alternator Data

## EXPERIMENTS WITH A MAGNETO

After quite a search I located a 180° B.T.H. magneto which I considered would suit my 1930 Replica Scott. After exchanging a Norton gearbox it became possible to evaluate that I now had a squat type B.T.H. with a cast-in Cobalt Steel magneto roughly the size of a matchbox. The condition of the magneto was excellent, almost like new and it had a good spark on one side and a fair one on the other. The direction of rotation was R/H and as I intended to drive it from a sprocket on the clutch drum giving a quieter more rigid drive it would have to be converted to L/H rotation. Now over the years I had converted several single cylinder magnetos with excellent results to different rotations and knowing the construction of the B.T.H. I went ahead and made up a magneto drive platform with a clearance of ½ inch above the clutch sprocket. This was done to enable the mag. to fit under the cast alloy gearbox cover and thus look original.

The first snag I ran into was the positioning of the advance and retard enclosed tubular mechanism. It did not work smoothly with the changed direction, and no way would it fit under the alloy cover. With some thought and patience I fitted the end bearing plate and rotating cam from an earlier B.T.H. of which I had parts. The arm of this was adjustable through 360 degrees so could be located in a more convenient position to connect a cable for the hand control. The use of the earlier model parts (the critical measurements of both were the same) simplified the exact location of the position of maximum magnetic flux and so I drilled and tapped a location peg. The slip ring for the H.T. pick-ups was known to be R/H but by limiting the advance and retard movement should be quite useable. With everything connected, the motor started readily and a road test undertaken.

All was well for a mile or two then it cut out onto one cylinder, must have oiled a plug, but before I stopped, with the throttle open on one cylinder, it again fired on two with a great burst which almost left me behind. Again all went well for a mile or two and with no warning miss it cut onto one with the same results, suddenly firing on two again. After changing plugs, retiming onto the opposite cylinder the trouble continued till finally I removed the mag. It still had a good spark on one side and a fair one on the other. It was then I handed it to a firm of so called "experts" to find out why the spark should differ from one side to the other and to cure the problem; mechanically and electrically it was like new.

After a week they informed me that without a left-hand slip ring they couldn't do anything with it, a price of \$60 (U.K. £30) plus fitting was quoted. This I quickly rejected, suggesting this was not the trouble as I had asked. On receipt of my magneto I was both amazed and very annoyed at the treatment it must have received. Screws were mutilated, it was scored and scratched, and to make matters worse, would now hardly produce a spark. Harsh words were spoken to the offending firm and they have since lost business from my friends and associates.

This did not overcome my problem, however, so I sat the mag. on a shelf and proceeded to build yet another drive platform, this time to take a motorcycle generator which in turn drove a small Renault car distributor with two cams ground off. All this again fitted under the gearbox cover and with the addition of a coil and switch and battery gave me very good service. Performance was first rate with miles of control over advance and retard. Always in the back of my mind was where would I obtain another cap and rotor or points for such an orphan distributor.

V16/8 Feb. 1990

The magneto problem did occupy my mind on several occasions and during one of these I measured it up and found the earlier B.T.H. mag had the same major dimensions. Removing the external magnet from the earlier model I found it would neatly fit the later one with the thin cover removed. There were no mounting holes but this was only a trial. My! What a transformation it made to the spark, it now had two very good sparks. I then elongated in the direction of travel the H.T. pick up mounting holes and drilled and tapped same. This then gave me more advance and retard without changing the slip ring. I now used the magneto with very good results for quite some miles, then with another brain wave I dismantled the mag, made a puller and removed the end bearing and carefully removed the slip ring, marking the slip ring spool carefully and with a fine saw cut off the protruding boss which takes the H.T. wire to the brass segment, Araldited the cut off boss back out the other side of the spool, and after a couple of days to set drilled the angled hole down to the brass segment. I now had a left-handed slip ring ready to refit. This was duly done and it worked perfectly, and has since done many miles without any troubles.

My Replica is unusual in that it will idle and two-stroke very slowly when warm and using  $\frac{3}{8}$ " reach plugs has great resistance to oiling in spite of my natural habit of over-oiling both my Scotts.

Hoping some of this may help a member to put life back into a poor magneto.

Les Heath — New Zealand

AND.....

Levin  
New Zealand

Dear Brian,

Re Magneto article

Perhaps I should have mentioned that the direction of the points travel (trail or leading) does not affect the magneto performance at all the speeds I have tried it at. B T-H cams are very smooth in operation, and I used the same contact breaker because the L/H one I had was not nearly so good as the R/H one. The armatures are all the same, single or twin, and it is the slip ring which differs, plus the cam ring of course, which makes up the twin. I hope to have another couple of articles for you in future, such as a flywheel type magneto, and wider big-end bearings.

Regards — Les Heath

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### THE B.T.-H. MAGDYNO

In the February issue, on page 239, I queried the very compact size of the B.T.-H. magdyno on Alan Drew's 1929 Flying Squirrel; as to my ignorant gaze there didn't seem to be enough room for a conventional dynamo armature and other innards.

Three members took the trouble to write and tell me the secret, Glyn Chambers, George Stevens, and Ken Lindsay. Ken even sent me three photographs of the device, and the shots below graphically tell the story.

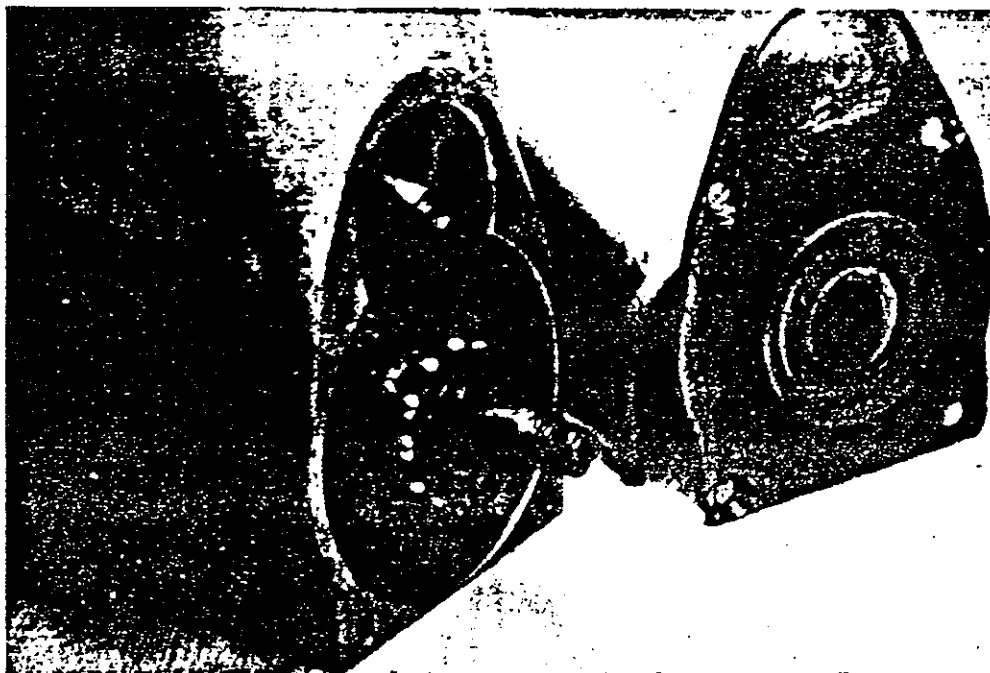
The dynamo is set at an angle to the magneto, and driven by a pair of bevel gears, thus giving a very neat and compact instrument.

What I still can't understand is the fact that the dynamo is geared UP by a factor of about 1:2! If so, surely the device can't have been intended for use on a Scott, where the magneto runs at engine speed, as opposed to half engine speed on a four-stroke. On full yowl that poor little dynamo must turn at about 10,000 r.p.m.! (Lucas of course, made special magdynos for Scott to avoid this very problem).

The general consensus of opinion of the device is that the magneto part is superb, and the dynamo absolutely useless, churning out about 15 watts on a good day with a following wind. The other problem, according to Glyn Chambers (page 305, April issue) is that it doesn't seem to be compatible with a Lucas CVC unit and light switch. Perhaps some masochistic member who has persevered with the problem could write to Alan Drew or Glyn Chambers with some sound advice?

Ken Lindsay is obviously a bit that way inclined, as he is looking for a pinion to go on the end of his dynamo armature (As can be seen in the photos his magdyno is minus the vital bit). If anyone can help please get in touch with Ken at The Farm, Melkinthorpe, nr. Penrith, Cumbria CA10 2DR.

B.M.



Nepean  
Ontario  
Canada

Dear Mr Editor,

### **The BTH Mag-generator**

This may be a belated topic by now, referring as it does to the article on the BTH mag-generator page 342 in the 1990 June edition of *YOWL*. My excuse for even bothering is that not much is known about this device and there may therefore have been no communication to you on the subject — I wouldn't know anyway since I haven't seen a *YOWL* since that issue; (miserable unfortunate ME).

I only came across one example myself. It was part of that "Most Unfortunate of all Scotts", about which a tale is yet to be told. My brother Derek owned this machine and one day I shall write the story. The mag-generator was one of the better parts but still left a lot to be desired; the weak output of the dynamo being the major disappointment.

Now we get to the details. That 10,000 RPM may sound horrific, but just show me a Scott that will hold 5000RPM for long. Dynamo revs at cruising speed will be more like 6000. I did many, many thousands of miles on my '28 Flyer with a Lucas Magdyno with 2:1 gearing, once I got a decent armature in it and a later type of CVC unit. The early and smaller units were not temperature compensated and used to overheat the dynamo, resulting in the connections all flying out of the commutator.

The BTH dynamo is of the permanent-magnet field type and will do a lot better if remagnetized. Since there is no field winding, a Constant-Voltage Control (CVC) unit cannot normally be used because the CVC regulates the dynamo output by varying the field current. It must be remembered that in the early days of electric lighting, the lamps ran from a battery which was recharged periodically at the local garage. Early methods of recharging on the vehicle did not expect to cope with the lighting load, but merely to top up the battery during daylight running. The BTH machine is a likely example. After doing all we could with the dynamo, my brother had to settle for an 18-watt headlight and a 3-watt rear lamp.

Referring now to the use of a Lucas CVC unit and Switch. The CVC unit houses two relays, the first is the reverse current relay, the second is the voltage regulator. The job of the first relay is to sense when the dynamo output is high enough to start feeding current into the six-volt system and then to close it's contacts. It will stay closed until the dynamo output falls below six volts, whereupon current will flow backwards into the dynamo. This is sensed by the relay, (hence it's name), which will open it's contacts and disconnect the dynamo from the electrical system. The BTH dynamo needs only this relay.

The role of the second relay is to reduce the dynamo field current once the dynamo output reaches 6.8 volts, which is the on-charge voltage of a fully charged 6-volt battery. The output is now "constant-voltage" — hence the name. The battery will take a charging current depending on it's state of charge; the regulator does not control the charging current. Of course, if the voltage level is wrong, the charging will not be right either.

Now we return to our poor little BTH dynamo. I do not have diagrams to hand, but it seems quite likely that the Lucas CVC would operate OK using just it's "first" relay. For a neg ground system the dynamo output from the positive brush would be wired to the D terminal, the A terminal taken to the Ammeter "+", the E terminal would be taken to the frame and the F terminal left unconnected. The only problem

would be that the CVC relays draw about 0.25 amps which that dynamo can ill afford. The original control box contained only one relay which drew about 0.1 amps.

Referring now to the switch, which comes in two main types for magneto driven machines. For use with a CVC unit, there is no need to switch anything in the dynamo circuit. For non-CVC machines using a "third-brush" dynamo, switching is required in the dynamo field circuit. The positive field wire goes to the "third brush" which is positioned close to the positive brush, the negative field wire being taken to the switch. If the field circuit is left "open", ie, not connected to ground, the field current must be zero and the dynamo will not generate output. If the field wire is grounded, the dynamo output will be as high as it can be and commensurate with it's RPM and the setting of the "third brush".

The action of this third brush involves complex reaction between the armature and the field and depends upon load and RPM. It may be roughly summed up by saying that the brush position around the commutator adjusts the output current and is usually set to balance the lighting load at cruising speed. Properly set up, the system is remarkably reliable.

There is a snag to this simplicity however. On long daylight runs or when the headlight is not in use at night, the battery will experience overcharge. This is taken care of by inserting a resistance in series with the field except when the switch is set to "Head". Some switches had an "Off" position which left the field open, some had a "Chge" position for daylight charging if the battery was low. I am afraid I do not have details of specific installations, but the above comments may help to understand and adapt apparatus, working from schematic diagrams.

Returning to that BTH machine, I think that this could be left connected to the ammeter since you will be glad to extract any charge you can from it during daylight; if conscience pricks on a long run you could disconnect the battery or simply switch on the lights for a bit. Just one word of advice; with the battery disconnected, that puny little machine will make short work of your parking and rearlight bulb if you rev. up the engine.

I hope this belated letter sheds a little light on that little lighter-upper (a pun is intended).

All the best to Scotters everywhere.

Don Avis

*Ed: All together now: LUCAS MAGDYNO, BT-H MAG-GENERATOR,*

V18/4 June 1993

### BTH Mag-Generator

Dear Mr. Webb,

Just a short note in connection with John Kidd's article on the BTH Mag-Generator.

I have just fitted one on my 1929 Flyer with (so far) excellent results. Since I had no suitable cut-out unit I have used an encapsulated rectifier (from A.O. Services, £5.00 post free, advert in *Old Bike Mart*) under the saddle, which seems to be ideal. I get about 3 amps charge with no lights on, and for daylight running use pilot and rear lights, reducing the charging rate to 1-2 amps.

Plugs. I am at present using NGK B5ES as recommended by Ian Pearce. Has anyone experience of using the extended nose version — BP5ES? This type of plug is often used in chainsaw engines with good results.

Ted Jemmett,  
Petworth,  
West Sussex.

## MORE ON THE B.T.H. MAG-GENERATOR

John Kidd

Way back in February 1990 Brian Marshall published a photograph of a B.T.H. Mag-Generator. This was commented upon by 'Commode' in April, by B.M. himself in June (p.342), and finally Don Avis gave a pretty full account of it in April '91. After all that, you could be forgiven for thinking that there was little more to say about it. My own feelings, however, are that the little device has been given rather a bad press. The general opinion is that the magneto is very good, but that the dynamo is a disaster. I disagree with the latter judgement and think that if the unit is seen in its historical context it is as successful as the Scott itself.

If we consider that the B.T.H. Mag-Generator was a very early step in the history of electric lighting (it was introduced, c.1930, when carbide lighting was the norm) then I think it can be seen to be a useful step forward away from all the work involved in keeping an acetylene jet in good working condition. People's expectations were much less, too. Night journeys tended to be very local, roads narrow and twisty, and speeds much lower than we would contemplate today.

I have an interest in these machines, as they were fitted to early Vincent-HRDs, to JAP and Python-engined machines, as well as to 1935 machines with Vincent's own engines.

I got some very interesting information about the B.T.H. unit from Theo De Boer in Amsterdam. Theo bought a Vincent-HRD new in 1935 (one of the very first Vincent-engined bikes) and rode it all over Europe, including Eastern Europe, pre-WW II, covering well in excess of 100,000 kms. The unit never gave any bother, but he did need to keep two batteries, one on the bike and one on charge. This, as noted above, did not give rise to any sense of hardship; taken in context, the device offered reliable service and was as, or more, convenient than anything else on the market at that time. The unit has a 35mm spindle height as standard, but I have one mounted on a cast 10mm plinth, which brings it up to the more usual 45mm height of the Miller and Lucas versions.

The gearing to the dynamo is 3:1 for four-strokes (21t:63t) and 1½:1 for two-stroke engines. The headlamp bulb was 18/18 watt (tail lamp 3 watt) and, as the field strength is constant due to the permanent magnet field, the brightness of the filaments should remain constant regardless of speed.

The output of the machine is controlled inherently by field distortion with speed, after the maximum output has been reached. As a result of this 'self regulator' no auxiliary brushes or regulators are required.

There you are folks — a bit of additional information on this unique and, I think, excellent device. I think it is well worth the trouble of keeping them fitted to machines on which they appeared originally, especially when they have the gearing special to Scotts and as they are an important stage in the history of vehicle lighting.

## CURRENT TOPICS

By Potty

Much has recently been said in this and other journals about replacements for our magnetos, imported magnetos from Japan and dummy ML capacitor discharge units from Cheshire etc. all costing well in excess of £300, and all for items which are not ideal and somewhat untried. The Japanese magneto for instance has fixed ignition, and no doubt would require modification to fit our base plates and sprockets, the "ML" discharge unit has not proved reliable, in that I have heard of failures already, and whilst an electronic expert might be able to keep such a unit in good fettle it "does not" as my magneto man puts it, along with other such electronic systems "have a satisfactory wear-out pattern". This is the modern term for having no user serviceable parts.

I knew I was very lucky when in the early 1960's I found a superb magneto repairer, who over the period of 5 years repaired eight magnetos for me, - unfortunately (he then retired he used to do Baragwanath's record breakers). All of the magnetos he did for me have now had at least 25 years of hard service, some have covered many thousands of miles, and not one has ever left me stranded.

I can give you an exact rundown on the maintenance since. I have had one armature rewound, and one condenser replaced, both because of excessive damp internally, this caused verdigris and disintegration. I have replaced four slip-rings because they wore out with great big grooves in them, these also wore out numerous carbon brushes when they became really bad. Two pickups were replaced when they started tracking. Three B.T.H. contact arm pivot holes have been re-bushed because they worked loose and the drive side of a Lucas Magdyno was replaced as the spindle worked loose in the end plate, this I brazed in, but the heat annealed the brass so soft that when in assembly or use I could not keep the armature running true. On one Bosch and two B.T.H. magnetos I have had to adjust (bodge!) the advance and retard mechanism because wear made uneven opening of the points, (I soldered on a thin brass shim to the end boss). I have replaced no bearings and none have been re-magnetized, except by my present magneto repairer (condenser etc.).

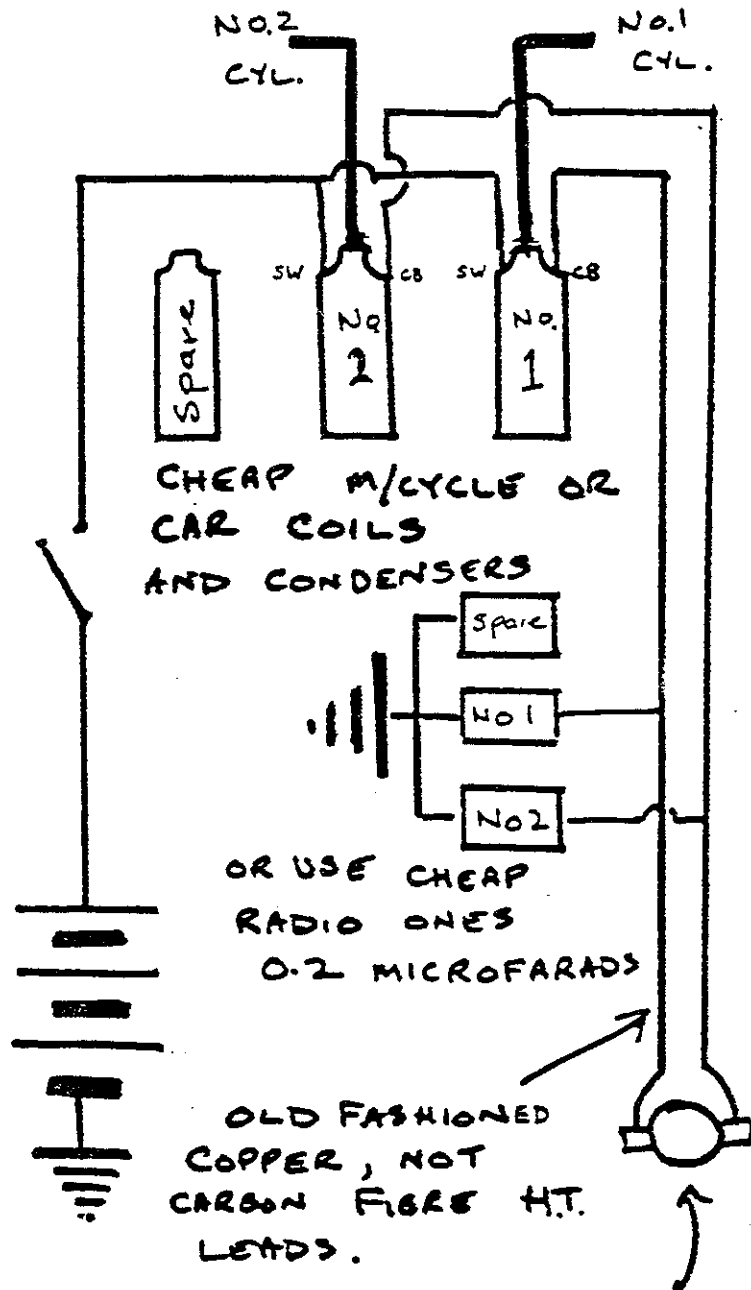
I have had various small dynamo problems but that is another matter. I see no reason to try alternatives given the reliability of a properly repaired and serviced magneto. Even if you take into account of possibly buying an auto-jumble wreck the total cost should never be more than £150 which is a fraction of an alternative unit.

However, any old magneto should be rewound regardless of how good it's spark, because of the dangers of "shellacitis" and other armature problems, but the work, of course, must be carried out by a really good repairer, and take the bike for a good two hour road test afterwards; Some of those who advertise in the Classic press are not very good!

It is with some trepidation that I mention the name of a man who has repaired my magnetos since 1970 as he is so overworked doing vintage cars, and aircraft as well as m/cycles (There are Spitfires up there with Tony Stairs magnetos in), and much of his work is in putting right work other so-called repairers fail to do. He winds his own armatures in batches (hence the waiting) and his prices start at about £65 for overhaul of magneto requiring just a rewind. But no complete magneto in good mechanical condition should cost more than £100. Broken or missing parts will of course put the price up. For those interested Tony's address is 51, Riverside, Hendon, London. NW4 Tel: 081 202-5194.

For those who cannot wait for Tony I submit a solution from the Morgan Three Wheeler Club. All the parts are "user serviceable" and by using HT wires in copper for LT and hiding type coils and condensers away it can be visually almost undetectable. I was worried about the LT resistance between the carbon brushes and slip ring, but having put my multi-meter on several magnetos I could not detect any resistance on a 10,000 ohm setting. One would of course have to have a good slip-ring and bushes with very light springs behind them. Ex-distributor carbon springs are far too heavy and cause rapid wear of the slip-ring. Apparently some Morgan owners have used this with success for some years now.

# CONVERSION OF MAGNETO TO COIL IGN.



WIRE LEADING FROM  
SLIP RING CUT. MAKE  
NEW WIRE DIRECT TO  
CONTACT BREAKER AVOIDING  
OTHER ELECTRICAL CONTACT

## OVERHAULING THE MAGDYN0

by Ian Robertson.

It is proposed to start with the magneto portion of this long-suffering, and horribly over-worked mechanism — the dynamo being the subject of a separate article.

Commence work by removing magdyno complete with mag platform. Condition of bolts holding platform to frame — lugs should be checked, and these must be renewed if the threads or hexagon heads are damaged. Remove mag from the platform, noting position of retaining bolts. Clean well with petrol and a stiff brush before proceeding further.

After wiping with clean, fluffless rag, test the bearings for up and down play. Remove H.T. pick-up brush-holders screws and pick-ups. Unscrew contact breaker centre-bolt and remove contact breaker. If stuck on taper, a levering motion of the re-inserted centre bolt will free.

Examine points for wear and pitting of contact faces. Check that point face surfaces meet evenly. Rectify by careful filing or renew. Note that contact breaker body is keyed to armature shaft, and must be replaced in this position in order to get maximum magnetic flux and a really strong spark. Check contact breaker fibre heel for wear; lubricate breaker arm pivot. The contact breaker spring should not be weak or rusted: check that you have an earthing brush. Replacements are cheap and can save much future inconvenience.

Remove advance/retard cam-ring and clean off any rust with fine emery cloth. The operating cable mechanism is removed by unscrewing the hexagon nut at adjuster base, when it will be possible to withdraw the whole unit.

It is assumed that the driving sprocket has been removed, but if this is not the case it should be taken off next. Working from the drive-side, remove drive cover screws, exposing clutch and pinions. In order to undo the large fibre gear retaining nut, the pinions must first be locked. A useful locking tool may be filed up from mild steel.

Bend back locking tab on small steel dyno pinion, and tap retaining screw squarely on end to break adhesion. Slacken screw, but before removing, unscrew clutch retaining nut on large fibre gear. Next remove dynamo complete with pinion by releasing strap.

With clutch parts and fibre gear removed, the backplate is exposed. This is keyed onto the shaft and must be drawn or carefully levered off, without bending the shaft. Before going any further, look for the safety-gap screw and possibly an earthing brush. Remove these. Behind the clutch backplate are the bearing end-plate retaining screws. After removal of these, the end-plate may be taken off, complete with bearing cup. From the contact breaker end unscrew bearing cap screws and remove end cap.

On late type magnetos the armature may be removed from its tunnel without risk, but on early type vintage magnetos it should be remembered that there is a strong risk of partial de-magnetization — unless a soft iron keeper is placed across the magnet.

Bearing may be carefully levered off the armature shaft and examined after washing in petrol. Check cups for pitting and wear. Replacements — obtainable from Lucas suppliers — are easily fitted if the endplate is first warmed over a gas ring. A bearing on which the cups are in good condition, but which shows slackness on test, may be improved by fitting a set of new ball bearings.

Examine the slip-ring for channelling by pick-up brushes. If severe it will be found that the brass H.T. pick-up segment stands proud of the insulation — and will eventually cause breakage of the brushes and holders. To rectify this condition cheaply and easily: First roughen groove with small coarse rat-tail file. Clean well with methylated spirit. Mix ARALDITE to manufacturers directions, and fill groove leaving level of filling slightly higher than brass segment. Allow to harden for 24 — 72 hours (depending on temperature) Then, gripping armature lightly in soft vice clamps, clean up with emery strip diablo fashion. If you are fortunate in having a lathe the job is even simpler, as the armature may then be spun between centres. Remove all traces of dust with a further wash in spirits, and you have a slip-ring that will out-wear a new one.

Examine armature pole pieces for signs of rubbing on magnet. This denotes badly worn bearings or a bent spindle. If the latter is suspected check between centres.

**TO RE-ASSEMBLE:** First pack bearing cups and bearings with HMP grease. Replace armature in mag tunnel. Re-fit both end caps, tightening screws evenly. Check for excessive end float, and make sure armature spins freely. Replace safety-gap screw and earthing brush. Working from the drive side replace clutch backplate, tapping lightly back on key with a tubular drift. Check for true running.

Re-fit large fibre gear, after cleaning and checking condition of teeth and clutch parts. Common sense must be used in judging the degree of tightness for the clutch nut. In Lucas service depots, a long, thin steel arm a foot in length is used by applying a spring balance to the end. The clutch nut is tightened to a point where the drive will just slip if a pull of 8lbs is applied to the spring balance. For this test — and for tightening the nut — the pinions are locked by the diamond shaped locking tool. The service depot test may be simulated by using a box spanner with a one foot tommy bar actuated by the spring balance.

Lock nut with tab washer, and after half filling gear casing with a medium grease, replace cover and screws. Next refit cam ring and operating mechanism, after lightly oiling cam ring lubricating wick. Ring must operate freely.

## OVERHAULING THE MAGDYN0 (part two)

by Ian Robertson

Various dynamos have been fitted to Scotts in the past three decades. This article will deal primarily with the Lucas Type E3HMAX — used on most 1937 to 1948 machines, and it will be assumed that the dynamo is not functioning.

After detaching dynamo from magdyno casing, by removing two end nuts and slackening strap, the dynamo casing should be wire brushed to remove rust and dirt.

Remove brush gear cover, and observe positions of brushes in their holders. Brushes that have worn down below the top edge of the holder, will tend to give intermittent contact with commutator, and should be renewed. Lift up brush springs, and remove brushes carefully. The end of a serviceable brush should present an evenly polished face, where it has made contact with the commutator.

Does the armature spin freely without noise? Test for wear in bearings before stripping.

Commence complete strip-down by removing drive pinion retaining screw. This is locked by a tab washer, which if treated carefully, may be used again. The pinion is keyed onto the shaft and may be easily levered off with a pair of small screwdrivers.

The next step is to remove the tab-washed locknuts on the two retaining screws at the drive end, permitting removal of the drive side end cap, bearing, and armature.

The armature should be cleaned and the commutator examined carefully. A worn commutator will prevent proper brush contact, and will severely limit dyno output. The only cure for serious wear, is to have the commutator skimmed up in a lathe, and the mica segments undercut. A friend with a lathe, or most small engineering works and well-equipped garages, will do this essential job for a small charge.

Examine armature pole pieces for signs of contact with the stator poles. Bright marks, caused by contact, denote either badly worn bearings, or a bent armature shaft. The most certain cure for the latter is an exchange armature!

To test armature electrically, use your battery and a six volt bulb. Contact should be shown between each of the commutator segments, but not between any segment and earth.

The drive side bearing is retained by a plate held by three small screws. Remove and wash out all the grease. Replace if in any doubt. The bearing at the commutator end is usually a bronze bush, which will normally be found in good condition.

To check stator windings again use battery and bulb. A circuit should be shown with bulb and battery in series with the stator coil, but not between either and of the coil and earth.

Faulty insulation of stator coil will be shown by a circuit to earth, and this will normally mean a new coil. It is not recommended that the coil be removed from its pole by other than an expert, as a special press is used at the factory when tightening the pole-piece retaining screws.

Providing that the armature and stator checks have shown these to be sound, the commutator, brush gear, and all electrical connections are in good order, and the bearings unworn, the dynamo must charge.

#### RE-ASSEMBLY.

First pack drive side bearing with HMP grease. Replace retaining plate and screws. Replace armature, oiling felt pad for bronze bearing at commutator end. Re-fit drive side end plate, and tighten locknuts. Replace brushes. If these have been renewed make sure that they are a free sliding fit in holders, and that electrical connections are replaced correctly. Brush springs should be in good condition and free from rust. With new brushes it is sometimes necessary to 'bed down' the ends onto the comm. For good output it is essential that all of the brush area is in good contact with the commutator segments.

**TO TEST.** Join terminals D and F. Run a wire from these to battery positive. Connect battery negative to dynamo casing. The dynamo should now motor slowly and evenly in the correct direction of rotation. This is a good indication that all is well, and may be verified by replacing the dynamo on machine and running engine. Do not yet replace plug to voltage control, but instead again join D and F, running a wire from these to a six volt 36 watt lamp, and the return lead from lamp to dynamo casing. At a fast tick-over the lamp should light brightly.

If there is still no sign of a charge, when voltage regulation or plug is replaced, then the fault must be in regulator, wiring system, or switch.

**REVERSED POLARITY.** It is possible during the overhaul or previous to same, that the polarity of the dynamo has become reversed. This will cause a discharge to be shown on the ammeter while running, and is puzzling but easily rectified. To rectify, make sure battery is connected correctly, and that leads D and F have not been crossed. Remove voltage control cover, and press cut-out points together for a moment. All should then be well.

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**MAINTENANCE INSTRUCTIONS FOR LUCAS "MAGDYN0"**

(From Lucas official instructions)

**EQUIPMENT**

The equipment consists of the 'Magdyno' itself, which is a combined unit incorporating the dynamo and magneto, the cut-out, and regulator unit, the battery, the headlamp with lighting switch and ammeter, the tail lamp and electric horn.

**BATTERY—Lead Acid Type**

About once a month, remove the battery lid, unscrew the filler caps and examine the level of acid in the cells. If necessary, add distilled water to bring the acid level with the tops of the separators. Do not use tap water as it contains impurities detrimental to the battery. When examining the cells, do not hold naked lights near the vent as there is a danger of igniting the gas coming from the plates.

Once a month examine the condition of the battery by taking hydrometer readings. There is no better way of ascertaining the state of the charge of the battery. The specific gravity readings and their indications are as follows:—

- 1. 250 — 1.300 — Battery fully charged.
- 1. 150 — 1.250 — Battery about half discharged.
- Below 1.150 — Battery fully discharged.

These figures are given assuming the temperature of the solution is about 60°F.

The readings for the three cells should be approximately the same. If one cell gives a reading very different from the rest, it may be that acid has spilled or leaked from this particular cell, or there may be a short circuit between the plates. In this case a replacement battery will be required.

Never leave a battery in a discharged condition for any length of time.

If the motor-cycle is to be out of use for any time, see that the battery is fully charged and about every fortnight give it a short freshening charge to prevent and tendency to permanent sulphation of the plates.

**DYNAMO**

The dynamo is of the compensated voltage control type and works in conjunction with a regulator unit which is mounted together with the cutout. The regulator and cut-out are accurately set and do not require adjustment.

The Regulator: Provides a completely automatic control, causing the dynamo to give an output which varies according to the load of the battery and its state of charge. When the battery is discharged the dynamo gives a high output, but if the battery is fully charged then the dynamo only gives a trickle charge so as to keep the battery in a good condition. In addition to controlling the output of the dynamo the regulator provides for an increase of output to balance the current taken by lamps when in use.

**AMMETER READINGS**

Normally during daytime running when the battery is in good condition, the dynamo gives only a trickle charge so that the ammeter readings will seldom be more than one or two amperes.

A discharge reading may be observed immediately after switching on the headlamp. This usually happens after a long run when the battery voltage is high. After a short time the battery voltage will drop and the regulator will respond, causing the dynamo output to balance the lamp load.

**LUBRICATION**

The lubricator at the commutator end bracket must be given a few drops of good thin grade oil every 4,000 - 5,000 miles. The bearing at the driving end is packed with grease and will last until the machine is taken down for overhaul.

**INSPECTION OF COMMUTATOR AND BRUSHGEAR**

About once every six months remove the dynamo cover for inspection of commutator and brushes.

The brushes must make firm contact with the commutator. The brushes are held in boxes by means of springs, remove the brush to see that it is free to slide in its holder, if it sticks, remove it and clean with a cloth moistened in petrol. Care must be taken to replace the brushes in their original position otherwise they will not bed properly on the commutator.

(To be continued)

V8/9 Jan. 1974

## **MAINTENANCE INSTRUCTIONS FOR LUCAS "MAGDYNO"**

(From Lucas official instructions) Part 2

If after long service the brushes have become worn to such an extent that they will not bear properly on the commutator they must be replaced. Always use genuine Lucas brushes. Now examine the commutator. It should be free from any trace of oil or dirt and should have an highly polished appearance. Clean a dirty or blackened commutator by pressing against it a fine dry duster while the engine is slowly turned over by hand. If the commutator is very dirty, moisten the duster with petrol.

### **DYNAMO OUTPUT**

The dynamo output is accurately set to suit the requirements of the motor-cycle and in normal service the battery will be kept in good condition. If due to special conditions you should find that the battery is not kept in a fully charged condition or is being overcharged, we advise you to have the regulator set by a competent mechanic who is provided with the necessary equipment. Do not attempt adjustment yourself.

(To be continued)

V8/10 March 1974

### **LAMPS. Headlamp checking alignment**

The best way to check the alignment is to take the motor-cycle on a straight level stretch of road at night and examine the beam of the main lamp. Adjust the lamp by slackening the two fixing screws and moving the lamp until the beam is straight ahead and parallel with the road surface. Tighten the fixing screws after adjustment.

### **FOCUSING**

In order for the headlamp to give the best results the driving light filament of the main bulb must be as near as possible to the focus of the reflector. Before the lamp is despatched from the works the bulb is correctly focused, and provided that the correct number genuine Lucas bulb is fitted as a replacement it should not be necessary to disturb the setting. If for any reason a Lucas bulb is not obtainable and an ordinary bulb has to be used, it may be necessary to refocus. To do this, remove the lamp front and reflector, slacken the clamping clip at the back of the reflector and remove the bulb holder backwards and forwards. After each adjustment note the effect with the reflector and front fitted.

When the best position for the bulb has been found see that the clamping screw is tightened.

### **REMOVING THE HEADLAMP FRONT & REFLECTOR**

To remove the lamp front and reflector slacken the fixing screw at the bottom of the lamp and swing it out of the slot in which it fits. When replacing the front locate the top of the rim first, then press on at the bottom and secure by means of the fixing screw.

To remove the bulb holder, press back the two securing springs.

### **REPLACEMENT OF BULBS**

It always pays to fit bulbs recommended by the lamp manufacturers.

When fitting a main headlamp bulb, care must be taken to insert it the correct way round, i.e, with the dipped beam filament above the centre filament.

### **LUCAS BULBS**

To assist in identification, Lucas bulbs are marked on the metal cap with a number.

Headlamp (main bulb) Lucas No. 70, 6 volts 24/24 watts. double filament.

Headlamp (pilot bulb) Lucas No. 200 6 volts 3 watts. (also for sidecar use when fitted).

### **CLEANING REFLECTORS**

All Lucas reflectors are protected by a fine transparent and colourless covering, which enable any finger marks to be removed by lightly polishing with a chamois leather and soft cloth. Never use metal polishes on Lucas reflectors.

### **DIPPER SWITCH**

Every 5,000 miles the moving parts must be lubricated with machine oil.

### **MAGNETO**

Cleaning: Dirty contacts can be cleaned with a fine carborundum stone, or if this is not available, fine emery cloth can be used. Wipe away any dirt or metal dust with a cloth moistened with petrol. Contact breaker springs should be examined and any rust wiped away.

To render the contacts accessible for cleaning, proceed as follows:—

#### **RING TYPE CAM**

Withdraw the contact breaker from its housing, by unscrewing the hexagon headed screws. The contact breaker can be pulled off the tapered shaft on which it fits. Push aside the locating spring and prise the rocker arm off its bearings, when it will be possible to begin cleaning the contacts. When replacing the contact breaker take care to ensure the projecting key, on the tapered portion of the contact breaker base, engages with the keyway cut in the armature spindle, otherwise, the timing of the magneto will be upset. Tighten the hexagon screw with care—it must not be too slack, nor must undue force be used.

(To be continued)

## MAINTENANCE INSTRUCTIONS FOR LUCAS "MAGDYNO"

(From Lucas official instructions). Part 4

### ADJUSTMENT

The gap to which the contact breaker points must be set when they are fully opened, is about 12 thousandths of an inch. Do not alter the setting unless the gap varies considerably from the gauge.

If the contacts need adjustment, turn the engine slowly round by hand until the contacts are fully opened. Then slacken the locknut and rotate the contact screw by its hexagon head until the gap is set to the thickness of the gauge. Fully tighten the locknut.

### LUBRICATION

The cam is lubricated by a length of felt contained in the contact breaker housing. A small hole in the cam, fitted with a wick, enables the oil to find its way on to the surface of the cam. Every 5,000 miles withdraw the cam ring, and add a few drops of thin machine oil to the cam. At the same time, push aside the locating spring, prise the rocker arm off its bearing and lightly smear the bearing with petroleum jelly.

### HIGH TENSION CABLES

When high tension cables show signs of cracking or perishing, they must be replaced. 7mm rubber covered ignition cable must be used for high tension leads.

**FITTING:** Thread the knurled moulded nut over the lead, bare the end of the cable for about  $\frac{1}{4}$ ", thread the wire through the metal washer provided and bend back the strands. Finally screw the nut into the terminal.

### MAGDYNO MODS.

V7/11 May 1972

Two problems presented themselves, on the decision being made to use a 1932 Magdyno on my rebuilt 1948 Scott: the direction of rotation was incorrect, and the dyno was one of the old 3 brush type, whereas the switch and wiring system called for a more modern two-brush type. It was decided to convert the dyno to two brush operation, and to then deal with the problem of reversing the direction of rotation.

Step one was to remove the dyno cover and the end-cap carrying the cut-out and brush gear. The regulating brush was removed and discarded, as was the cut-out complete. The Field lead running to terminal F1 was left untouched, and the other field lead disconnected from the cut-out, was connected to Pos terminal. The dyno was then tested by motoring on a 6 volt battery, and found to be working correctly but in the wrong direction to that which was desired.

Reversal of direction of rotation was finally accomplished by making the positive brush negative, and vice versa. To do this the earthed negative brush must be insulated from the dyno body, and the positive brush earthed.

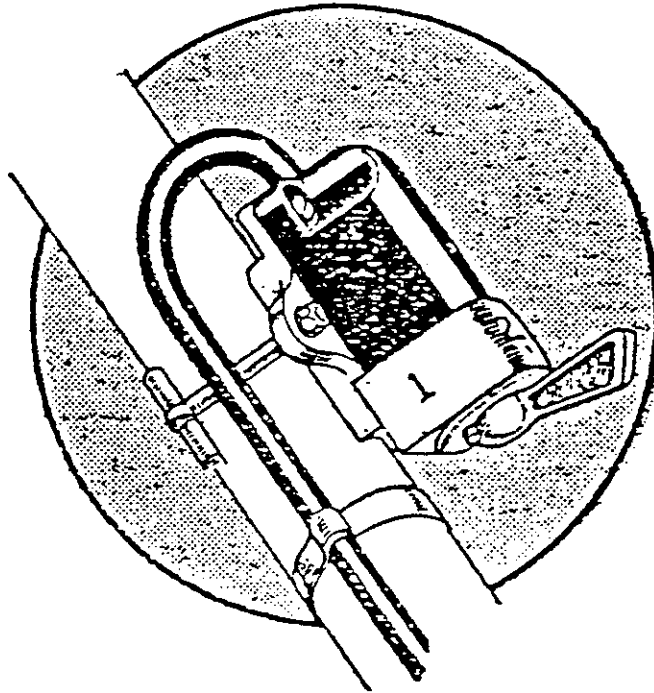
Insulating of the earthed negative brush is accomplished by removing the brush and filing out brush-box to a depth of approximately  $\frac{1}{32}$ nd all round. Care must be taken with this work. Next, pieces of  $\frac{1}{32}$ nd Fibre or Tufnol sheet are cut to line brush-box, and are securely affixed to sides of brush-box with Araldite. It is advisable to make sure that the brush is a free sliding fit in the box before Aralditing. Any easing down after Araldite has set will have to be done by reducing brush sides on emery cloth on a surface plate to give a good free fit in box. Check also that brush beds down well on commuator, and that connections are as follows:

- One side of Field coil direct to Term. F.
- Other side of Field coil to Pos. Term. D.
- Negative brush (old positive) earthed to dyno body.
- Positive brush to Pos. Term. D.

I. Robertson.

### SQUIRRLINGS

Some time ago Brian Scholes kindly sent me some photocopies of items from *The Autocycle* (1913 and 1914), one of which, about the 1913 TT winners, appeared in *Yowl* in June 1985. They also included a drawing of the switch shown here. The caption under the drawing is, to me at any rate, both interesting and puzzling. I knew the 1914 TT Scotts had two plugs per cylinder but I had no idea that they could be made to fire alternately. What would be the purpose of that? In his book, *The Yowling Two-Stroke*, Jeff Clew mentions the Bosch magneto's two armatures, four slip rings, and four pick-up brushes, and he also mentions the change-over switch but he only goes on to say that none of these could help the oil-soaked magneto to provide the necessary sparks for Tim Wood to continue in race — very sad after shattering the lap record on the first lap from a standing start. But why fire alternately?



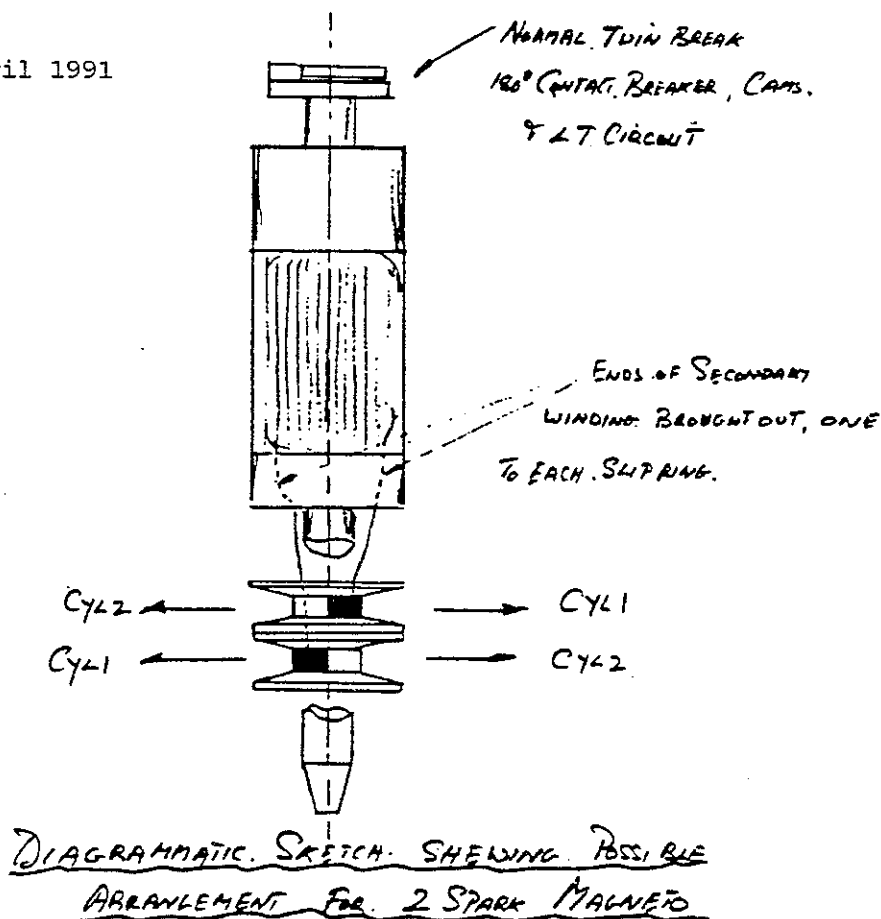
The change-over switch for the Bosch two-spark magneto, fitted to the T.T. Scotts, whereby the two plugs in each cylinder may be made to fire in synchronisation or alternately.

V17/1 Dec. 1990

### TOGETHER, STAGGERED, OR ALTERNATELY?

Did you read the article "Some Thoughts on Electrical Spark Ignition" by Keith Maddocks, BSc. (Eng.) in the August 1990 V.M.C.C. journal? It was concerned partly with the use of twin magnetos and twin plugs per cylinder, plus detailed description of the pros and cons of leaded fuel, unleaded fuel, the effects on sparks of increased compression, pinking, detonation, etc. All fascinating reading, and it made me wonder just how much Alfred Scott knew when he tried twin plug/duplex magneto ignition on the early T.T. machines (1913/1914). Did he really hope to achieve more power and r.p.m. or was it just to reduce stoppages due to oiled plugs? Now all this has been discussed before, but have we ever established just how the handlebar switch controlled that special Bosch magneto? Did they fire simultaneously, or with slightly staggered timing, or alternately, or did the rider have a choice? I know that Jack Frazer was contemplating reconstructing one of those special Bosch magnetos so perhaps he could tell us his thoughts on the matter..... I understand that Mr Les Langworthy has one of the original 1914 T.T. magnetos, so perhaps he could tell us the secret.....

BM



### TWO SPARKS PER CYLINDER

As far as I can ascertain, Scotts have used, or attempted to use, two sparking plugs in each cylinder on only four occasions. (Ed: Five, see below)

These were as follows:-

1913 TT where the expected special Bosch Magnetos necessary to do the job failed to arrive in time.

1914 TT where the 1913 Magnetos (2 armatures, 4 slip rings and 4 pickups) were used and in which Tim Wood led the race for some time until eliminated by a magneto problem.

1921 TT where Lucas special magnetos were used and only one out of five Works entries completed the course.

1922 TT where again Lucas Magnetos were used and all three Works entries completed the course to win the Manufacturers Team Prize. (Ed: Also the first Sociables, using an ML four spark Magneto)

In view of the somewhat discouraging nature of this record it is hardly surprising that for 1923 Scotts reverted to single plug ignition, and to the best of my knowledge, no further attempt was thereafter made to make use of two sparking plugs per cylinder.

These would appear to be the facts, but in order to try to fill in some detail I carried out a judicious trawl in the Indexes of this Journal as the most likely place to find some supplementary material. Vols. 1-5 and 6-10 yielded a nil return, but in Vol 14 No. 10 appeared a note from the then Editor, George Stevens, accompanied by a contemporary sketch showing the Bosch switch used in conjunction with the two-spark magneto used in 1914.

That this did not fall upon deaf ears is evidenced by a carefully reasoned response by D W Avis in Vol. 15 No.3 wherein he analysed the information available and, by inductive reasoning, put forward various alternative suggestions as to how the 1914 arrangement could have functioned. I have tried pretty hard with this thesis and every now and then, when I can catch it off its guard, I can get a glimmering of what he is driving at. Nevertheless I think discussion of this particular arrangement is more of an academic exercise than a practical possibility as it is difficult to contemplate an exposition of anything requiring two armatures, four slip rings never mind the change-over switch. What however, is of interest is his view that an effective twin-spark arrangement could improve the performance of the deflector type two-stroke engine, and this is reinforced by George Stevens' addendum to his article in which is cited the results of trials made by A.A.S. in the early days. Though qualitative rather than quantitative, the result of these trials seems to support Avis's view and

it would appear that a spark on both sides of the deflector could promote more rapid combustion and a more complete "burn" of the charge, thus to increase power output. This, despite the contrary view expressed by Keith Maddocks in the VMCC Journal of August 1990 as quoted by Brian Marshall.

The only other reference which I can find is in the reprint of Tom Ward's "Table Talk" in Vol.16 No.3, but this does not add anything of note to the foregoing.

All in all one could well take the view that the whole affair is for little more than academic consideration and relegate it once again to the archive were it not for one single fact. This is that quite a number of twin plug cylinder blocks of the 486cc Squirrel variety dating from the 1922/23 era, still exist. These, as far as can be seen, are as shown in the photograph of the 1922 TT entry on page 101 in J. Clew's "The Scott Motor Cycle". I have seen at least four of five at various Stanford Gatherings over the last ten years and, more significantly, such a block in very fair condition forms part of a 1923 engine No. 6380 which I am currently building up on the bench. For some years past this baneful object has been sending me messages to the effect that I will not engage it's full co-operation unless I make provision for two sparks in each cylinder.

Now it may well be that I am the only chap who actually *wants* to enhance the performance of his 486cc Squirrel engine and that others may be perfectly content that theirs should run in whatever way they do but, in my case, the possibility of a little more power to enable another tooth on the final drive sprocket is very attractive for the long haul such as Stranraer to Stanford/Banbury and *vice versa*. I have, therefore, given quite a lot of thought as to how it might be achieved.

First of all I discount all thoughts of the 1914 arrangement which, even if one knew how it originally worked, cannot but be unduly complicated. I also write off all attempts based upon Citroen 2 CV coils with both ends of the secondary windings brought out, batteries and twin contact breakers together with any solutions involving the ignition systems from four chainsaws amalgamated into some form of magneto: none of this would accord with the ethos of the early twenties. Furthermore, I don't see much future for a solution based upon a rotating magnet arrangement such as was reviewed in the Motor Cycle Press in 1959. This could provide a simple answer for a single cylinder engine but becomes much more complicated when one attempts to apply it to a twin as it necessitates two separate LT circuits for the two coils required and a special twin contact breaker to interrupt them.

What is required is some form of reasonably straightforward self-contained magneto which will provide the necessary facility, and as the result of some thought I have come forward with the idea shown in the accompanying sketch.

From this it will be seen that the proposal consists of a normal armature and contact breaker/cam assembly associated with two slip rings, the segments of which are 180°. Both ends of the secondary winding of the armature are brought out, one to each slip ring, and each slip ring is served by two HT pick-ups at 180°. The secondary winding on the armature would have it's number of turns increased to raise the induced voltage to a value sufficient to enable the two sparks in series via earth to be struck simultaneously and the leads to the plugs would be connected diagonally across the pick-ups so that at each break of the contact breaker points the two plugs in each cylinder would get the benefit of the induced discharge.

I discussed this arrangement with a magneto expert and his view was that, having regard to the improvements in insulation which are now available, it could be possible safely to get enough additional turns

on the secondary winding to raise the voltage to the required level (probably about 15000 v) but that the physical modifications to accommodate the additional slip ring and HT pick ups would not readily be made.

These modifications are, in essence, the extension of the drive side armature shaft by approximately 1" to accept the additional slip ring and the making of a new drive side end cover for the magneto body with accommodation for the aforementioned additional slip ring and provision for the 4 HT pick-ups, not to mention the housing of the drive side bearing on it's extended shaft.

It therefore seemed time to examine the problem in physical terms and accordingly, a scrap square type BTH magneto chosen for it's known satisfactory magnetic properties was obtained. This, regretfully, had to be discarded due to the fact that the drive side end cover and bearing housing was integral with the body and no means could be devised whereby it could be extended as necessary. There simply wasn't enough metal to form a seating for the extension piece required, short of gluing it on, a procedure which would hardly inspire confidence.

Attention was then turned to a more conventional type of magneto and a defective Bosch ZU2 instrument considered. This showed more promise and it was evident that by making a pattern and melting a few pistons, an alloy block could be cast to produce an extended drive side and cover which could be machined to mate with the existing register on the body, thus to secure correct alignment. The provision of the extended shaft didn't appear to present any insuperable difficulty.

So far so good, and at this stage, a welcome confirmation of my thinking arrived from John Kidd of Dundrum in the shape of an incomplete Bosch NU4 Magneto which had come from the vintage stock of no less a person than Stanley Woods. This magneto, which is labelled Bosch, New York, Patents 1905/1908 and is believed to have some connection with Rolls Royce 40/50 Silver Ghost cars, was found to be to the exact conformation described above i.e. both ends of the secondary winding brought out to two 180° slip rings + 4 HT pick ups. Obviously someone in 1905 was ahead of the game. Regrettably, in addition to being incomplete, it was much too large and massive (being largely constructed from G.M. castings) to consider it's use on a Scott.

There the affair at present rests, but I am only too well aware of what could lie ahead. The design of magnetos must be, not only a matter of understanding the technicalities of such matters as flux density, inductance, reluctance, distortion of magnetic field, head dissipation, output in watts and what have you, but also a considerable body of practical experience in making compromises to reconcile these various warring factors. Of such matters I have little knowledge and it would be foolhardy to embark upon a project involving considerable effort and, doubtless expense in such a state of ignorance.

Many questions can be asked. For instance, of what type were the special Lucas magnetos used in 1921 and 1922? Do any of them still exist? Are there any other instances of the use of dual-spark magnetos which we can call upon for guidance? Furthermore, if successful in so far as the magneto is concerned, would modern sparking plugs, admittedly greatly superior to those of the 'twenties, stand up to any additional heat release produced, bearing in mind that the head is air cooled?

In matters such as this, those who know least are frequently foremost in expressing their opinions. I have no doubt that I come within this category and I write this note in the hope that it may persuade those who actually **know** to put pen to paper and let us have the benefit of their knowledge and experience.

**JACK FRAZER**

Burnham  
Bucks.

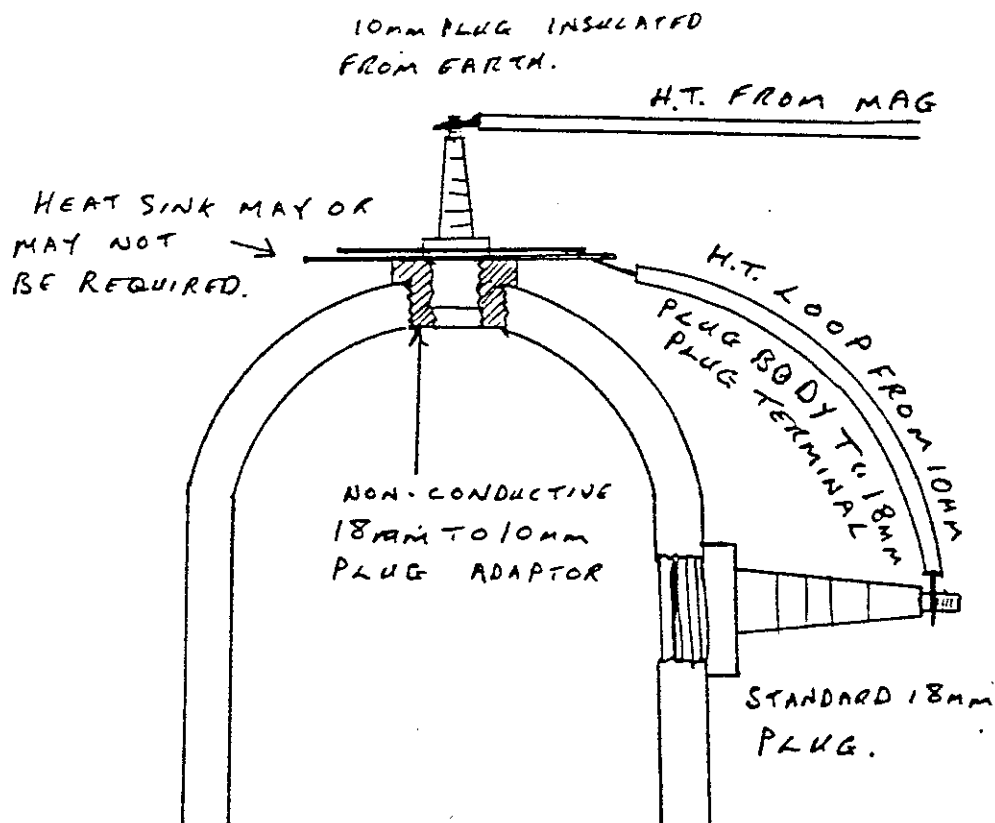
Dear Mr Editor,

In response to Jack Frazer's letter regarding dual ignition, may I relate my practical, but not expert, experience with the above system which I fitted to both of my Moto-Guzzi's. One a Le Mans, the other a G5.

It is imperative to have a good spark at both plugs in each cylinder. Two weak sparks per cylinder are no better, and possibly worse, than one good spark per cylinder.

When both plugs fire properly, it will be found necessary to retard the ignition considerably, to prevent detonation and promote proper running. With the Le Mans it was necessary to retard the ignition from a full advance figure of 34 degrees BTDC to 28 degrees BTDC, at which a measurable improvement was noticed. Similar improvements were found on the G5. Fuel consumption, acceleration, and tractability were all improved. Top speed remained about the same. The loss of a spark in one plug, could be felt as a slight drop in performance. Whilst sorting the system out various components were tried. Both Citroen 2CV and Japanese double-ended ignition coils were tried, and found to be lacking. The sparks were not good enough and the coils eventually failed. I believe this is due to the fact that these coils are designed to fire one plug under compression, and another plug, on another cylinder, off-load. When asked to fire two plugs under compression they cry 'enough'.

I eventually used American "Andrews" coils. These work. They are sold as high performance coils for use on Harley Davidson. Other makes of high performance double-wound coils are available from "Drag



racings" shops.

With regard to dual ignition on the "Scott", similar problems may be found. If both plugs per cylinder do not have a good spark, performance will not improve. Having to retard the ignition when compared to single plug ignition is indicative of good and quick fuel burn.

Have you ever noticed that a "Scott" with a poor or failing ignition system will accept more and more advance without protest? This is indicative of poor fuel burn.

I feel there is possible advantage in dual ignition on the "Scott", and suggest the following method may be worth a try. At least it would be easily achieved and quickly reversed leaving a good single plug system. It would be advisable to rewind the magneto, preferably with the extra secondary windings and modern insulation as Jack suggested, the rest of the magneto remaining standard. Two special 18mm to 10mm spark plug adapters would be required to be manufactured from a non-electrical conducting but fairly heat resistant material. Two heat sink/H.T.connectors may need to be manufactured to clamp between the 10mm plugs and the plug adapters. The grade of 10mm plug will need to be found by experiment, but this should be no problem. The main problem will be finding a suitable material for the plug adapters. Any experts out there?

I understand that in the late teens and early twenties, special insulated-from-earth spark plugs were sold to enable a similar system to be used. (*Ed: These were used on the first Sociables.*) I doubt if these are still available, but maybe it would be worth investigating? Marine, aircraft use? One further advantage is that the use of two plugs in series per cylinder will result in a much lower instance of "whiskering". Any formed will tend to be blown off due to the extra voltage induced as a result of the two series gaps.

Obviously — if a magneto is not going to be the H.T. source, then it would be more practical to use the previously mentioned "Andrews" double wound coils and conventional spark plugs.

Good luck — Dennis Wray.



"Dear Sir, In reply to your letter of the 15th inst. we can confirm. that the firing order of your 596cc Flying Squirrel is ONE-TWO".

## A CHEAP AND SURE CURE FOR "SHELLACITIS"

by Dennis Wray

I see that in the September Yowl, mention is made of my "shellacitis" problem.

This problem has now been solved for the grand sum of approximately 3/6d.

The method I used, I feel may be of some interest to other penniless Scott Owners.

Firstly the mag. armature was removed, not forgetting to remove the secondary air gap screws that protrude into the slip ring recess.

The driving end bearing race and slip ring were then removed. The screws that hold the drive shaft and brass end plate assembly to the coil former-cum-pole piece were removed and the assembly pulled off its dowel pins.

The screws that hold the contact breaker end brass plate to the coil-former were then removed.

The plate was then carefully eased off its dowel pins, care being taken to ensure that the coil leads were not damaged. These leads were then unsoldered. All of the insulation on the coil was then stripped from the coil right down to the actual windings which were then given a wash and brush up with methylated spirits left over from the booze up at the Olde New Inn at Laxey.

Extreme care must be taken when stripping this insulation as the coil windings are in three thou. wire.

With the coil prepared for reinsulation it was put aside whilst I searched for a suitable method of carrying out this task. After making enquiries at the local rewind shop it was found that Araldite impregnated cotton tape was used quite a lot in the insulation of hot running motors.

A six shilling pack of Araldite and some  $\frac{1}{4}$  in. cotton tape were then quickly procured (tape with the compliments of the Missus).

The tape was then cut into lengths of two quick laps of the coil. One piece of tape was taken and coated on one side only with Araldite. This was then wrapped round the coil, sticky side down, causing the Araldite to squeeze through the material. This tape was followed by a second and third piece and so on until the correct thickness of insulation was reached. The whole lot was then left to partially set for a few hours. When the mess was not so tacky, the coil was then placed in an oven at the lowest setting for a couple of hours. When removed from the heat and allowed to cool, it was found that Araldite had set like glass, but it was still possible to clean off any excess with a file.

The whole lot was then reassembled, and has proved so far, to be quite trouble-free.

V9/12 July 1976

## ANOTHER REEVES WRINKLE OVERHAULING THE MAGNETO

When overhauling a magneto, it is often found to have excessive wear in the end plate where the cam ring fits. This will cause unequal opening of the contact points and erratic running.

As new end plates are no longer obtainable for vintage magnetos, some other means must be found to cure it.

The usual method would be to bore out the end plate and re-bush it, however, I didn't have any suitable bronze, and local metal merchants do not supply small quantities.

I did have some steel tubing, so this was bored a light press fit for the cam ring. The outside was made approximately  $1/16$  in. bigger and the length was made equal to the distance from the bottom of the slot which limits the cam ring travel and the outside edge of the cam ring.

The sleeve was then pressed on to the cam ring and secured with a touch of loctite. Now the end plate had to be bored dead true.

A spigot turned on the lathe to suit the ball race housing in the end plate. This was slipped on and secured with a bolt and washer. The end plate bored a running fit without shake, and the job was done.

No doubt some of the purists will cry "It's not original", but I think a Scott on the road is worth two boxes of bits in the garage.

G. REEVES.

## BEVEL DRIVE FOR SCOTT MAGNETO

Colin J. K. Bradshaw

To those devoted to restoring Scotts to their original condition a bevel-driven magneto is clearly of no interest (unless of course the model is a Manx Grand Prix Scott!) and for serious, all-weather, all-year-round road use a directly driven generator and coil ignition is a far better proposition. But for those who, like myself, want only a light, elegant machine for fun riding and perhaps vintage competition, elimination of that awful magneto chain can be attractive. Val Ward's solution cannot be bettered for sheer functional simplicity, but having dropped my Scott twice on a twisty hill-climb without ill-effect... enough said?

For those still interested, here are details of the bevel-driven magneto I have contrived for OG 8778. The cornerstone of the device is a one-piece light alloy casting combining the crankcase door and bevel-box to which the magneto is flange-mounted. The pattern for this casting is freely available to any club members who wish to use it. No cores are involved, and use is very straightforward. I cast the prototype myself as an exercise at motor engineering evening classes.

### Dimensions:

The general arrangement sketch at Fig. 1 is sufficiently detailed to determine the locations of the main components. Where precise measurements are necessary they are determined by the dimensions of the components. The distance from the face of the driving disc to the centre line of the magneto is suitable as shown for "square" BTH or Lucas magnetos, but care must be taken to ensure that the magneto clears the side of the crankcase. The magneto is attached to the bevel box casting by four  $\frac{1}{8}$  inch BSF (or 2 BA) bolts or studs — two long and two short. Their precise locations are evident from inspection of the casting, and will be seen to be at the corners of a square with approx  $1\frac{1}{2}$  inch sides, although some latitude is permissible in locating the two short ones. Accuracy in drilling the holes in the casting both in relation to the magneto and input shaft centre lines, and to the fixing studs or bolt holes in the magneto, is important; oversize holes (as little oversize as initial accuracy permits) will then allow some fine tuning of bevel alignment.  $\frac{1}{4}$  inch silver steel location pegs fit in holes drilled through both bevel box and magneto castings when bevel alignment has been established.

### Machining:

All machining of the prototype was carried out in a 3 inch Adams bench lathe, with 6 inch lightweight Burnerds 4-jaw independent chuck and a vertical slide for milling. The vertical slide is probably not essential, given a slotted cross-slide, selective packing, and the use of fly-cutting technique to effect the facing of the magneto mounting. Some ingenuity is needed to chuck the casting for turning the flange and input bearing housings, etc. It goes without saying that all this should be completed at one chucking to ensure concentric running of the drive disc with the crankshaft. Face-plate mounting for this operation may be preferred. The facing for the cover plate on the  $45^\circ$  sloping face could well be hand filed, given the use of a cork compression gasket.

### Magnetos:

The prototype used an ex-R.A.F. BTH  $180^\circ$  twin magneto, originally used in an aircraft engine hand-starter. These mags are worth looking out for as it seems likely that quite a lot of brand new ones reached the surplus market some years ago. They do require a lot of modification, however. Firstly, a great deal of surplus alloy casting must be hacked or machined away; secondly, the input shaft consists of a spur gear which must be turned down to a suitable parallel or taper, then drilled and tapped since there is not really enough length for a threaded section and retaining nut; thirdly, no advance/retard mechanism is fitted. This omission

is not too difficult to overcome, however, as the appropriate parts from a motorcycle BTH are interchangeable. The other likely contender is one of the Lucas or BTH 180° twin mags with 3-hole flange, as fitted to most early 4-stroke vertical twins. These require only one modification: the three fixing lugs are cut away as neatly as possible and a square adaptor plate of  $\frac{1}{8}$  inch mild steel is secured by four countersunk  $\frac{1}{8}$  inch BSF setscrews.

#### **Lubrication:**

The housing is packed with grease and provided the oil seal is a good fit will require only infrequent attention.

#### **Location on engine:**

The prototype was mounted on L.H. side, and this seems almost obligatory. Apart from the long-standing priority of the oil-pump on the R.H. door, a L.H. location for the mag. goes some way to offset the weight of brakes and gearbox to the right of 'bike centre line. The design of the casting favours mounting at 90° to the cylinder block (see Fig. 2). This suits single down-tube frames but, depending on the length of the mag., with duplex frames the external frame lugs may dictate a more nearly horizontal position. To achieve this, the milled slots (Fig. 2) may be made some way from the "square-on" position with detriment to nothing but aesthetics. The lower slot is not essential, and the lower clamp may be one of the short straps used on the oil-pump door. A fully horizontal position (as on MGP Scott) dictates rear-set footrests.

#### **Rotation:**

Clockwise rotation of the magneto is required for L.H. mounting. The ex-R.A.F. BTH magneto is clockwise-rotating — ignore the anti-clock arrow on the casing, as this refers to the geared hand-cranking spindle which is of course discarded. Three-bolt flange-mounted mags. may be clock or anti-clock, but I believe most of them can be reversed in rotation fairly easily. Better advice than mine must surely be available in S.O.C. as to "whether" and "how".

#### **Bevels:**

The recommended bevels are designed for industrial sewing machines, and normally transmit the torque of a 3-phase  $\frac{1}{2}$  h.p. motor from nought to several thousand r.p.m. with a very "lumpy" load, and the more modest load of a magneto should ensure almost indefinite life. The bosses are each fitted with two robust grub-screws which may be used to secure the mag. bevel against rotation on its spindle, but this is not practicable with the input shaft bevel.

A parallel or Woodruff key is the "engineering" solution, but the prototype has a silver-steel  $\frac{1}{8}$  inch pin through the input shaft which just clears the ball-race inner bore, and engages a slot across the rear face of the bevel boss. The bevel bosses are tough but machinable and some facing-off will be required to ensure desired bevel engagement. The bevels should be available from Singer Agents, or from Bogod Machine Co. Ltd., 50-52 Gt. Sutton St., London EC1V 0DJ. I believe they may now cost as much as £25 per pair.

#### **Timing:**

Correct timing is obtained by finding the nearest tooth engagement of the bevels and "fine-tuning" by rotating the whole assembly in the crankcase before clamping. The few degrees — equivalent to not more than half one tooth of the bevels — is easily accommodated by the method of attachment described. Timing marks or even a scale for future reference are obvious refinements.

#### **Future Developments:**

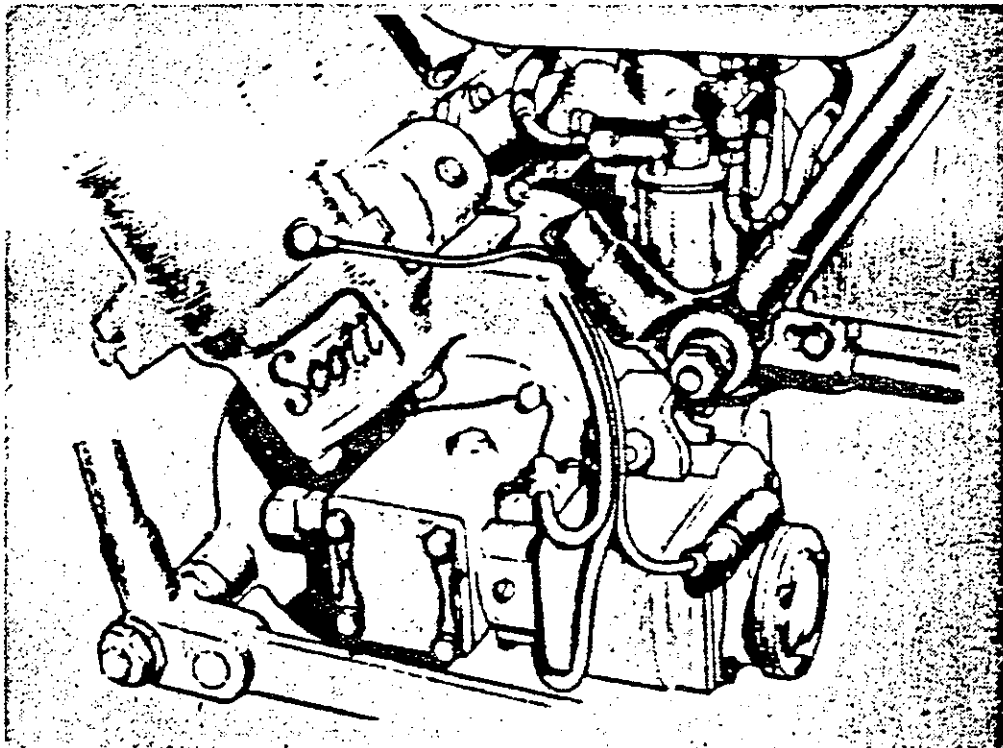
An obvious criticism is the close spacing of the two ball races. I can only say that it seems entirely adequate, and is a sure and simple way of

ensuring correct operating conditions for the ball races. If the races are spaced, and the casting will permit this with other appropriate adjustments, then either one of the four ball race tracks must be allowed to float, or the inner and outer spacers *must* be at least as accurately dimensioned as the races themselves. A possible way to achieve  $\frac{1}{4}$  inch spacing is to "fillet" a third ball race of the same pattern, then use the inner and outer tracks as spacers. "You pays yer money and you takes yer choice!" An alternative to the screwed retaining ring for the ball races is to use a dished retaining plate held by a ring of countersunk setscrews — the oil seal then seats in the dished section. A snug fit in the casting is essential to ensure concentricity of the oil-seal. This method, incidentally, requires less space axially and hence is more attractive if wider bearing spacing is described. One final point: a rev-counter take-off might be contrived to take the place of the cover plate.

#### Materials:

For those thinking of making their own castings — an old crankcase or two will provide the necessary material. (They don't have to be Scott crankcases!)

The drive disc and input shaft is shown as in one piece, but this is not a very practicable approach — the original was made by welding a  $\frac{1}{4}$  inch steel disc to a piece of  $1\frac{1}{2}$  inch steel bar, prior to machining. (At the time of going to press, Colin Bradshaw had a spare unmachined casting for sale at cost price. That might save a lucky enthusiast some work — Ed.)



The idea of putting the magneto on a bevel box, down on the crankcase, is over half a century old. Some of the last TT machines built at Shipley had them — the terrible 1930 vertical twin, which behaved so lamentably and sank without trace — and the 1933 machine which returned to more traditional Scott layout, whatever the name on the tank. This was the forerunner of the very few Manx Grand Prix Scotts, with large diameter crankcase doors, heavy cranks and a non-standard flywheel assembly. This particular 'one-off' had a twin-float carburettor with horizontal body and flanged adapting stub. Note the magneto body steadying bracket and the wired-on bolts.

(From *Motor Cycling*, June 1933).

Bevel drive for Scott magneto.

Figure 1. G.A. Input drive

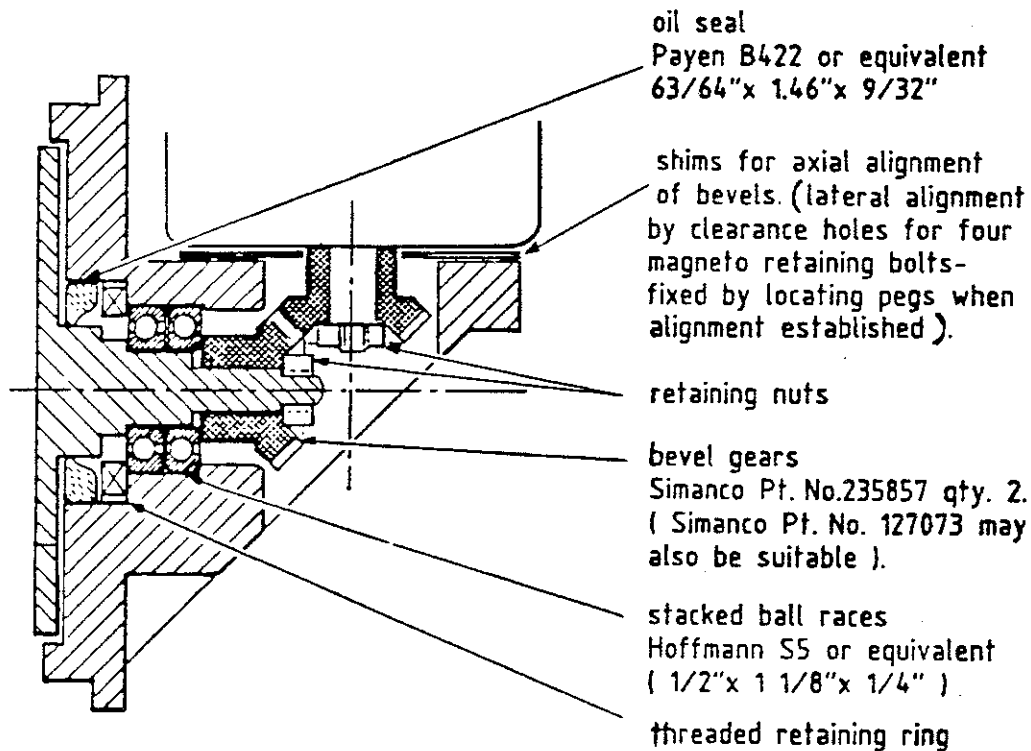
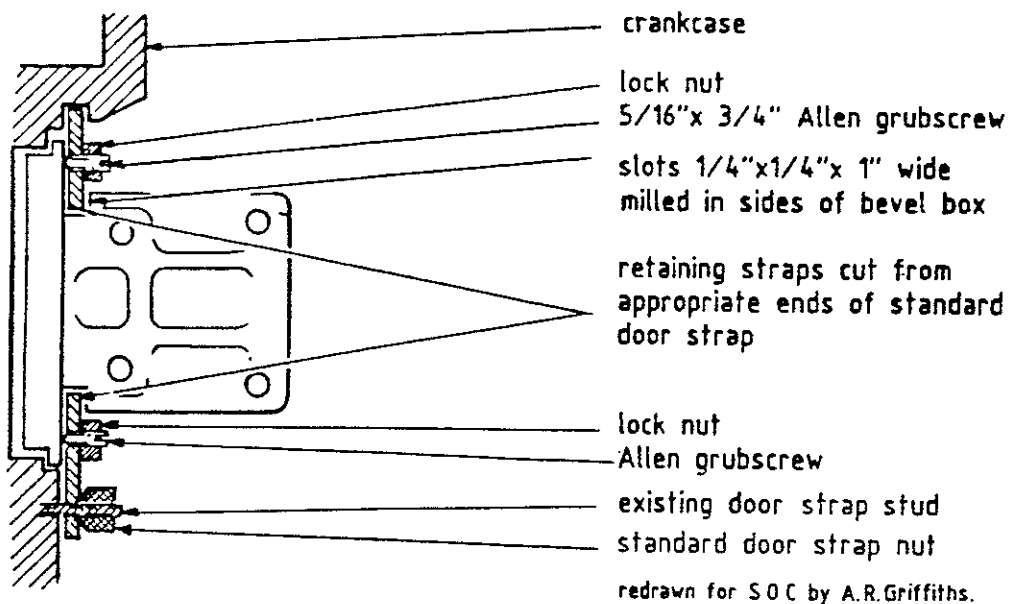
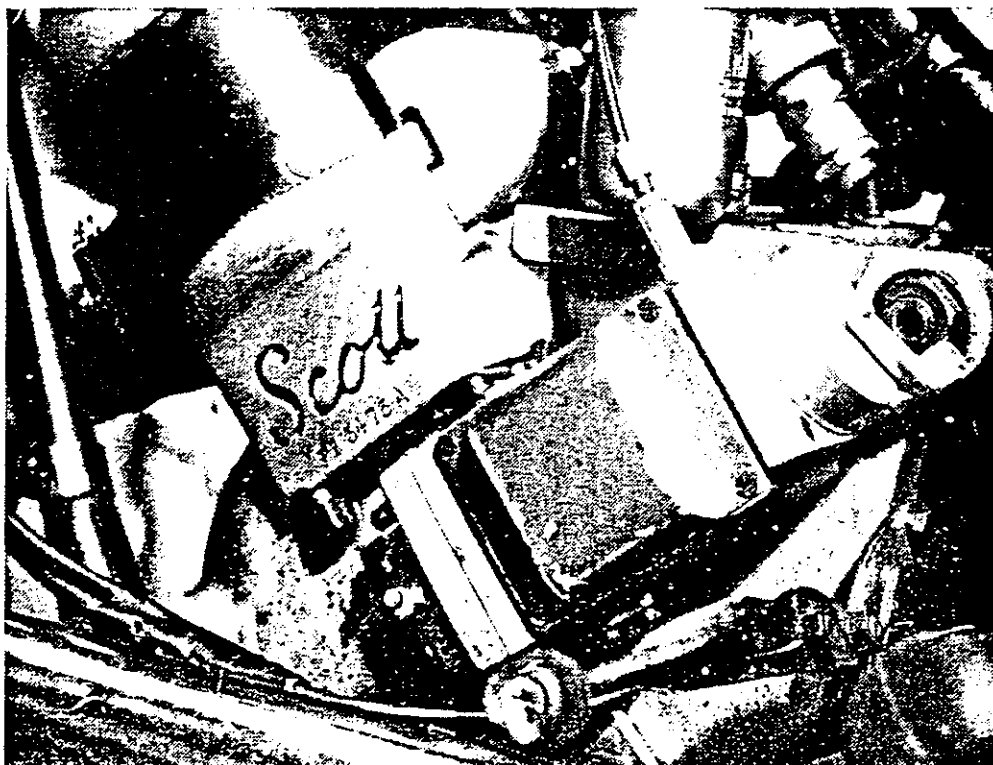
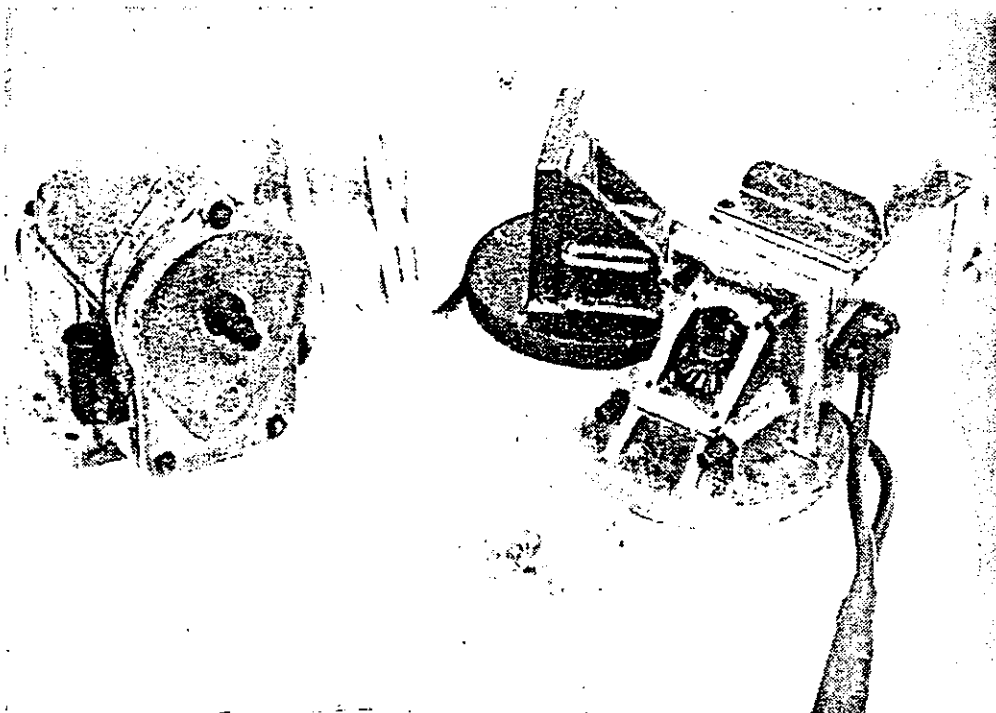


Figure 2. Attachment to crankcase





Colin Bradshaw's compact bevel-driven BTH on single down-tube Scott. Deep transfer port covers and remote float chambers are obvious additions to engine number FZ 3473A. Pick-up brushes and H.T. leads are neatly unobtrusive.



Ex-R.A.F. starter magneto, casting, pattern and complete assembly with inspection plate removed.

Those of you who subscribe to "Old Bike Mart" like myself will have seen the interesting article in the May issue concerning a very clever copy of the old ML square-bodied magneto, that contains a modern electronic ignition system, powered by a battery. The unit is produced by "Obsolete Engineering" of Cheshire, and was primarily aimed at Morgan Three-wheeler owners wishing to obtain pure vintage looks with a more reliable and powerful ignition system. The article said that any angle could be accommodated between the two firing points, simply by moving the electronic trigger units, and that it gave as good a spark when turned gently by hand as it did at full engine speed.

Well, you are there before me aren't you? I wondered if the unit could operate at 5000 magneto rpm and at 180°, and how much current did it consume. Now, none of my Scotts has a dynamo, lighting set or battery as I am firmly of the opinion that simplicity and minimum weight are top priorities for good Scott performance and handling. However, I would not mind hiding a little Japanese battery away in the toolbox if it was to feed a really powerful ignition system. After all, with no heavy magnet in the dummy magneto I would be saving the weight of a small battery!

Years of motorcycling by courtesy of Mr. Miller and Mr. Lucas left me with a rather jaundiced view of matters electrical, and as my father used to say "you can't normally feel it, see it or smell it, but if you do you've got big problems." The very words "motorcycle battery" immediately conjure up memories of evil, lifeless, sulphate-encrusted black containers, quietly dribbling sulphuric acid over the paintwork and chrome plate. However, the fast-dwindling supply of 1920's type magnetos, and prices charged for 'rebuilt' of doubtful quality could easily make me go modern and carry a battery; BUT, that battery would have to be sufficient to keep the system going for several hours of riding, whilst still fitting in a toolbox.

I therefore wrote to 'Obsolete Engineering' enquiring as to current consumption and ability to operate at 180° and at engine speed (instead of the half engine speed that it was designed for)

Their reply to me, and an explanatory leaflet that they enclosed follow:-

Dear Mr. Marshall,

Thank you for your letter in response to the article published in the May "Old Bike Mart" and the points you raised, you have certainly given us something to think about today!

Enclosed is a hand-out relating to our unit that restates some of the information given in O.B.M. along with a few more details relevant to setting the unit up. If you read through it you will understand that the unit is two separate "capacitor discharge systems" in a ML lookalike casing, although there is a bit more to it than that. The capacitors we have used are the maximum that we had space for within the casing but they are not quick enough to recharge 5000 times per min., only being good for around 3250/3500 mag. r.p.m. (well within Morgan engine rev range) however, this is mainly a problem of original looks and internal space which could be overcome by mounting some of the electronics remote, (along with the battery) and running one extra wire (about .1 dia) in through the "blind" side or base of the casing if this is acceptable. The current consumption at this output would be around 2a when running. With the ignition on but the engine stopped the unit goes onto standby and only keeps the capacitors topped up ready for the first spark.

You will appreciate that to modify the unit to the above will require some development work and costs at our end that we hope would be of mutual benefit to both sides given time. With this in mind we are prepared to modify a "test unit" (in advance of orders for around 30 units) at £335.00 plus carriage and VAT if it proves successful.

Hoping the above has been of interest and not too disappointing, we would appreciate your reply and comments whichever way you decide.

With our regards and best wishes,

Yours faithfully,

\* \* \* \*

Before getting too involved with the workings of our electronic magneto we must point out that unlike a conventional magneto, ours requires a +12v DC supply through a 10a fuse. Other than this difference it looks like the "Square" ML magneto and will supply a timed spark through its own HT lead/s to a single or twin cylinder engine as a normal magneto would.

Each cylinder is treated as a single cylinder and the spark is provided by its own HT coil, triggered through its own electronics by a magnet and proximity device which replace the points and points problems. 12v supply is through the cut-out wire on the end cap normally used to stop the engine. In cases of 6v only being available we can supply a 6v in, 12v out device to run our unit for about £30.00 extra incl. Our "Mag" will provide a full power spark when turned over in either direction, at the slowest speed so there is no need to "wind it up" to get a good enough spark to start an engine, however it is recommended to have a plug and H/T lead fitted with the plug resting on the engine etc. when power is switched on, to provide a path for the spark to earth. Direction of rotation (looking at pinion) is needed when ordering so that we can supply the correct badge on top of the unit along with the correct "points" casting for your advance/retard cable to fit into. In the case of twins, any angle can be set, so odd angles are no longer a problem.

To set timing on a single cylinder, position piston in bore as normal, engage bevel gear or chain drive to unit and tighten on mag but don't tighten the taper on the camshaft yet. Set advance/retard to correct setting. Rest HT onto engine preferably with a plug fitted. Switch on the unit by fitting a feed wire to the end cap. Slowly turn the unit in its direction of rotation until spark occurs, tighten camshaft taper and check timings. In the case of twins, set up the cylinder using the R.H. pickup as a single (resting both HTs this time), then rotate the engine to its next firing position. Taking care, look into the "points" area and note a locknut holding the magnet mounting onto the centre shaft. Making a temporary supply to input post, slacken locknut and rotate mounting in direction of rotation until spark occurs, tighten locknut and check timings etc.. For twin plugs per cylinder remove both magnet mounting from the shaft then carefully remove the two screws and spring post which retain the "points" casting. Solder a link across the two contacts shown then reassemble using only one magnet and time the unit as a single. this will give out two full power sparks simultaneously. The unit comes complete with pickup/s which have internal wiring and should NOT be removed to fit the H/T leads.

In event of any problems in use we ask you to contact ourselves rather than repair the unit. In return we will apply our common sense guarantee for 12 months providing the unit has been misused (incorrect voltage, impact damage etc.)

No original magneto parts are needed when ordering.

Cost of a single unit is £ Not available yet

Cost of a twin unit £359.00

Incl. carriage and VAT.

\* \* \* \*

Now the foregoing letter and leaflet have greatly interested me, because it is (I think) the first such system that actually looks Vintage, whilst not using a genuine vintage magneto as a base for conversion. I daresay that Jack Frazer will have taken note of the four spark potential too! — If that doesn't get IJ4934 cracking along nothing will!

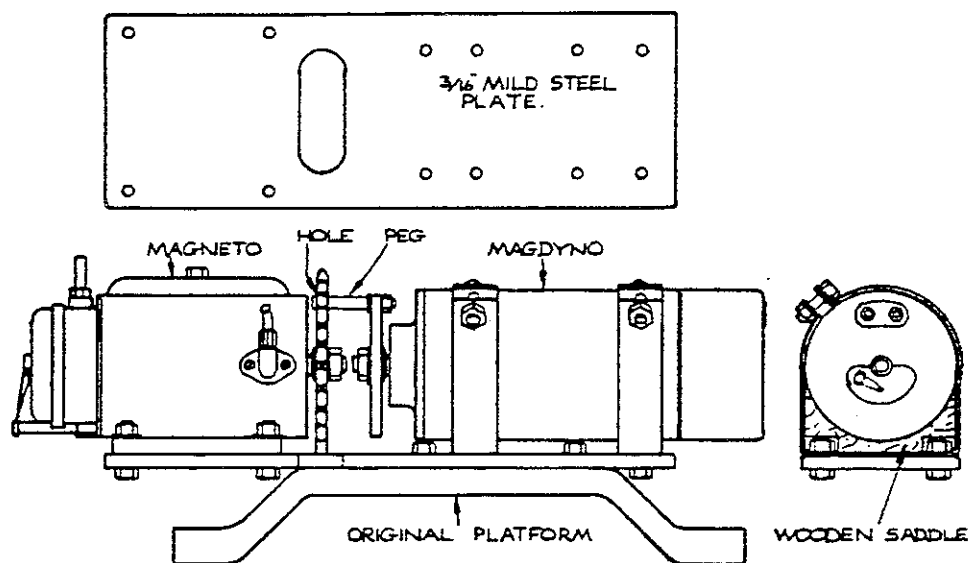
Would anyone interested please drop me a line, as I want to sound out if there is any demand (I doubt it!) before going any further.

B.M.

How a clockwise dynamo and anticlockwise magneto were mounted end-to-end, to replace a clockwise magneto unit.

Perhaps the following may be helpful in keeping a few Scotts on the road. After my Magdyno had been declared beyond repair by the makers, I dug into the piles of junk in my garage and found an anti-clock B.T.H. magneto and a clockwise Miller dynamo, which I fitted to my 1929 Scott Flyer.

From 3/16 in. thick mild steel plate I made up a platform long enough to take the magneto and dynamo placed end to end, and this was bolted to the original Magdyno platform. Being anti-clockwise, the magneto had to be mounted the opposite way round to the original clockwise instrument; it was bolted to one end of the new platform. At the other end the clockwise dynamo was mounted on wooden saddles and secured by metal straps. The driving ends of the magneto and dynamo thus faced, of course, and the coupling between the two was provided by a peg (protruding from a disc attached to the dynamo armature shaft) engaging with the hole in the magneto sprocket which was originally used for the oil pump drive. As the magneto runs at engine speed on a two-stroke,



How a clockwise magdyno on a Scott was replaced by an anti-clockwise magneto and a clockwise dynamo. A steel plate of sufficient length to accommodate the two instruments is hoisted to the original platform. The dynamo is peg-driven from the magneto sprocket.

it is not essential to gear up the dynamo.

The biggest job was fitting the original mag-driven oil pump on the off-side crankcase door. A scrap spindle with a left-hand thread was slotted at the threaded end to engage with the oil pump spindle, which itself was suitably reduced in size. At the other end of the scrap spindle is a boss to which is attached, by peening and soldering, a disc of 0.040 in. shim steel; near the outer edge of the disc is a peg (also peened over and soldered) to locate in the crankpin. In the crankcase door is a hole in which the spindle boss is a floating fit, protruding into the door for about a third of its thickness; beyond this point the hole is of larger diameter to receive the outer race of a journal ball bearing. About a third of the width of the bearing protrudes outside the door, and the remainder of its housing is provided by a piece of suitable scrap turned up for the purpose; this piece also locates the oil pump in position, and the two are secured by long screws screwed into holes drilled and tapped in the crankcase door. Incidentally, the door had to be faced off on the outside before this job could be carried out. As will be seen from the sketch, the shoulder formed by the boss on the spindle is pulled up against the inner journal of the bearing by a nut screwed up on the outside. In addition, of course, the spindle diameter is a comfortable push fit in the inner journal. The whole arrangement makes a very good gas seal.

All the extra parts for this job were made up from scrap, but the use of a lathe is required. These modifications have given complete reliability for about 1,000 miles so far.

(Courtesy, *The Motor Cycle*, 19th March, 1942).

## SOME NOTES ON DYNAMOS AND ALTERNATORS BY "TECHNICUS".

1. All electrical generators (i.e. dynamos and alternators), produce an output which increases with speed of rotation and tend to produce less voltage with increasing load.

a) Permanent magnet dynamos and alternators generate a proportional *voltage*.

b) Third brush dynamos produce a proportional output *current* Which is adjustable by the position of the third brush. This applies *only* if the RPM is high enough and it is connected to a battery.

Without the battery, the output will "run-away" and blow all your bulbs if the lights are switched on. A "half-charged" resistor is attached to the switch and is placed in the field ground return wire to reduce output when the headlamp is not lit.

c) Dynamos and alternators which have a field winding require a Constant Voltage Unit, (CVC), to regulate their output voltage. A second relay in the control box performs this function. If this relay gets out of adjustment, the voltage may be too high or too low. An open circuit or high resistance soldered joint will allow the voltage to rise which will boil the battery dry and possibly burn up the generator. The regulator contacts are closed fully until the controlled voltage level is reached. At this point the relay operates like a buzzer; the ratio of closed time to open time determining the average value of the field current and hence the output voltage.

The normal output voltage required is 6.8 to 7.0 volts and the relay is adjusted to deliver this, since it is the voltage of a fully charged 6V battery *whilst on charge*. As the contacts burn away, the regulated voltage will fall; when it gets as low as 6.2V the battery will not take charge and may appear defective. You can drive all night with the lights on, but when you stop, they will fade down. Coil ignition bikes may fail to start next morning.

If there is a third relay in the box, it is probably a *current* regulator. Its purpose is to *limit* the output current. Its main function is to restrict the charging of a discharged or defective battery. It will also save the generator if the voltage regulator has lost control. This relay is usually only found in car CVCs.

2. Polarity is a factor which most people understand. Negative to negative and positive to positive: what could be simpler? As a general rule this works fine, but those familiar (+) and (-) symbols do not always have the same meaning. Electrical systems usually have one pole grounded to the vehicle frame. The side not connected to the ground is often referred to as the "hot" side and might be either the positive or the negative. You *must know* which it is; just look to see which terminal of the battery goes to the frame.

a) For an "active" device such as a battery or a generator which puts current OUT, the (+) sign means "current will come out here". Of course, when being charged, current is going IN, but the battery is now a *passive* device since it is *receiving* energy.

b) The Ammeter is wired in series with the battery and indicates whether current is flowing into or out of the battery and how much. Its (+) terminal means "current goes IN here to show CHARGE". For a negative-ground system, the (+) side goes to the system "hot" side, which is positive and the (-) side goes to the battery positive. Surprised? For a positive-ground system, its (-) terminal goes to the system "hot" side, which is negative, and its (+) side goes to the battery negative; the battery positive going to ground.

3. When we come to generators, (dynamos or alternators), the polarity

question becomes somewhat treacherous, because it can change and you won't know it until things don't work or just burn up. Let's see how.

a) Alternators generate alternating current which is cycling positive and negative. This is "rectified", that is, made unidirectional. If the rectifier is built-in, the output polarity is guaranteed. If one output terminal of the rectifier is connected to the case, the polarity cannot be changed unless you rewire it internally. If an external rectifier is used, the alternator output wires go to the rectifier and the system polarity is determined by which rectifier output terminal is taken to ground.

b) In the case of permanent-magnet dynamos, one terminal is usually connected to the case. The polarity is then determined solely by which direction the dynamo is *driven*. You can check the polarity by connecting a battery across the brushes; the dynamo should revolve *in the direction it must be driven*. Surprised again? In order to output current, the dynamo must be driven *at a higher rate* than it runs as a motor. Such machines are usually designed for one polarity and one direction.

c) Dynamos having a field winding are clearly designed for maximum grief. It is a common belief that they are best left alone because things seem to go from bad to worse when they are subjected to interference. Unfortunately, those old machines have already been tampered with by the time we get them. The following may be of help here.

When this type of dynamo is rotated, the residual magnetism in the field iron causes a voltage to be generated across the brushes. Its polarity will be determined by the direction of rotation and the North/South polarity of the residual magnetism. Since the field winding is across the brushes, this voltage will pass current through the field. For the output to build up, this current must *increase* the strength of the residual field, otherwise, the dynamo will appear "dead". To make it build up, either the rotation or the field connections must be reversed. The required rotation is therefore determined by the polarity of the field connections.

What then determines the polarity of its output? Now here is the treacherous bit: it is determined by the residual magnetism and therefore in which polarity it was last run. Many people have overhauled their dynamo and tested it by motoring it across a battery with the field wire to the case. It works fine and is installed on the machine and run-up, whereupon all hell breaks loose. It was "motored" with the wrong polarity for the machine and is now ramming current the wrong way into the system. The cure is simple: disconnect one battery terminal, hold the reverse current relay closed (the one with the most "thick" wire on it, if you have a CVC) and touch the wire momentarily on the battery. This will reverse the residual field and reverse the output polarity.

I know of one Scotter who ran into this problem and solved it by reversing the battery. He could never understand why his ammeter showed "charge" when he had the lights on and the engine wasn't even running! If you can figure out why, you've about got this subject beaten.

4. This paragraph will be a catch-all for things that could not be introduced before without confusing the issue.

a) Previous references have been to 6V systems, but still apply in principle to 12V systems; the on-charge voltage of a 12V battery being 13.6 to 14V. The 12V system has been adopted because of the use of self-starters since the wiring gauge may be reduced to one-quarter of that for a 6V system of equal power.

b) The early alternators appearing on British machines, including the Birmingham Scotts, were of the permanent-magnet type. Control by a CVC unit was impossible since they did not have a field winding. A form of "open-loop" type of control was used, as with the third-brush

dynamo. In this case however, the number of coils on the alternator was selected to match the load. The circuits were complex and confusing. These systems, like the third-brush dynamo, rather relied on a tough battery to bridge the gap between what was generated and what was actually required.

Like their DC counterpart, they were comparatively reliable if left alone, but if the battery were accidentally reversed, the rectifier could be burned out and the alternator partially demagnetised. Those systems employing external selenium rectifiers suffered from gradual deterioration of the rectifier. (A selenium rectifier comprises several discs on a threaded rod). Later, silicon diodes were used and were usually inside the alternator.

c) With the arrival of cheap semiconductor devices, the Zener diode appeared on British machines. This device is wired across the poles of the system, (+) to (-). It had the characteristic of drawing negligible current below 6.8 volts, but above this, the current through it increased rapidly. It worked by simply soaking up all the excess current and had to be mounted in the airstream to dissipate the large amount of heat it generated at cruising speed. It may have operated in conjunction with coil-switching, but the writer cannot be sure.

d) It is not possible here to fully explore the subject of voltage regulators, but here are two observations which might help out. The Miller system placed the reverse-current relay in the end of the dynamo, where it had always been in the days of third-brush machines. The Voltage regulator took the form of a cylindrical cartridge which plugged into a holder. It had two sets of contacts; one pair at each end. The first pair opens the field circuit when the voltage reaches the "set-point" of 6.8V and the other pair at the other end seem to short the field to dissipate the stored magnetic energy. The writer has never been able to prove the last point, but it is certain that the Miller regulator has a very tight control over the voltage. Unfortunately, when the contacts wear, the voltage level is *precisely too low* with the result described in para 1c.

e) The Lucas CVC contains the two relays, as previously described. The writer has fixed many of these which were burning up the battery, by resoldering the voltage coil lead-out wire. The poleface of this relay (the one with the lesser amount of "thick" wire on it), is "D" shaped and the lead-out wire from the centre of the coil emerges in the middle of the circular portion. After soldering, the manufacturer grinds off the solder on the poleface and cracks the solder joint, which eventually goes "high-resistance". The relay core is not at ground as one would expect, but is connected to the system "HOT" side.

To effect a repair, pick at the lead-out, which is a cadmium-plated thin strip of brass, until it separates. Now scrape off the cadmium and solder on a small-gauge copper wire. Solder this to the edge of the poleface.

Note that the Lucas CVC has a surge suppressor wired across the voltage control contacts, which does the same job as the second contact set in the Miller system. It takes the form of a thick black washer on the back of the relay block.

f) Before ending, I would offer one parting comment with respect to the alternators on the Birmingham Scotts. Riders used to be puzzled by the chronic "butchered bigend" noise emitted by the engine when idling. The noise was not present on machines equipped with the large crankcase-mounted dynamo. It was due to chatter between the driving peg on the bigend and the slot in the disc driving the alternator. The alternator had a strong disc driving the alternator. The alternator had a strong permanent magnet as a rotor and the torque required varied greatly as this rotated past the poles of the stationary coil assembly. At higher speeds the effect disappeared.

V17/4 June 1991

Solihull  
West Midlands.

Dear Brian,

I am always interested in people's writings on dynamos and alternators — particularly as I was responsible for car generator design for some 10 years!

The "Technicus" article in April *Yowl* was very sound — my comments may be rather "nit — picking", but for what they are worth they follow:-

Firstly, I am not sure that regulator contact wear will cause a reduction of regulated voltage; as they wear, the airgap in the relay will increase, which should increase the required voltage. It is more likely that the leaf springs settle with use, and weaken because of corrosion, so reducing the force needed to open the contacts.

Secondly, The Miller regulator of ill — repute. This is a device which is rather too clever for its own good. (Or, more realistically, was designed down to too low a cost to be reliable, as was so much motorcycle electrical equipment.) This device is often referred to as a carbon pile which it is not. I'm not sure why this idea started. It is a vibrating contact unit, but there are two sets of contacts, arranged so that field current is regulated in two stages, theoretically giving a better control than the single — stage Lucas system.

The Field winding is connected in series with a resistance. At low voltage, the first pair of contacts short the resistance, so full Field current flows, as the voltage increases, the contacts start vibrating and reduce the mean field current. If the conditions are such that the voltage is still higher than the set value, then the increased pull on the coil causes the second pair of contacts to start operating. When they open these cut off the field current completely. (I believe this is done by shorting the winding, but I don't have a unit in front of me to check).

Unfortunately, the whole thing depends on very small airgaps and accurately set springs. As it ages, all sorts of things can go adrift, with unfortunate results!

Yours sincerely — David Thomas.

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V16/6 Oct. 1989

### **BIRMINGHAM SCOTT ALTERNATORS**

If you could do with some more "juice" from the Miller alternator on your Birmingham Scott there is a very easy trick to boost output, which is just the job if you feel the need to do a lot of night riding, or to use your headlight in daylight so as to make yourself slightly more noticeable to the average myopic car/van/truck/bus driver.

Put a lead between terminal 3 (red) and terminal 4 (yellow) of the light/ignition switch. If you put a switch in the cable it's use can be optional.

This very cheap dodge should give a much better charging rate.

**B.M.**

# **RESTORING A SOCIABLE DYNAMO** **ML (MAGLITA) NO. 170, PAT. NO. 176032**

**J. M. Chapman**

Bradford Industrial Museum had only been able to obtain a dynamo in very poor condition for the Scott Sociable which they were restoring; in fact, they thought it almost past repair. As I had already restored a number of ancient electrical machines for the Museum, they asked me if I could help.

Preliminary external examination of the dynamo showed that one corner of the nameplate and the corresponding corner of the commutator endplate had been burned away with battery acid. The same endplate was also cracked round one of the fixing holes. The earthed brushgear was incomplete and badly corroded; the live brushgear missing. Turning the rotor revealed a bearing problem.

Dismantling the dynamo revealed that the commutator was missing and that all that was left of the commutator end bearing was the cracked outer race.

The drive end bearing was complete and in good condition. The rotor winding was intact and undamaged.

Measurement of the cracked outer race and the shaft showed that an angular thrust race 28mm OD 10mm bore and 8mm wide was required.

A telephone call to a local bearing stockist supplied the information that this was an E10 magneto bearing, and a few days later they produced a bearing.

Having obtained a bearing, restoring the dynamo appeared possible, so the first problem tackled was the damaged endplate. I decided that it was impractical to repair this, so a replica was machined from  $\frac{1}{2}$ in. aluminium plate. Some care was needed, as the register for the bearing housing had to be accurately located with respect to register pins in the laminations.

Two new pins were made to locate the end cover. (The end cover will be made by the Museum). The next problem was the nameplate. Making a replica was ruled out owing to the difficulty of reproducing the raised lettering in the "ML" trademark. The damaged corner was cut off and the plate machined to half its thickness for a  $\frac{1}{2}$ in. from the cut edge. A piece of sheet aluminium was similarly machined and the two "half jointed" together, the joint being secured with Araldite and  $\frac{1}{2}$ in. aluminium rivets.

At this stage I realised that further restoration would be guesswork without more information, so the rotor and brushgear were borrowed from another dynamo. A new brushbox was fabricated from sheet brass using the borrowed parts as a model; brush springs were made from clock springs; the special rivets securing the brush springs were turned from a 4in. nail. The brass clips for the brush springs were made from a cable clip with the tinning removed. Two paxolin bushes were made for the live brushgear and a replacement brass bush for the earthed brushgear, new insulating fibre sheet was cut for the live brushgear.

The new brushbox was nickel plated and the original brushbox and both bearing housings replated. Carbon brushes were cut from Lucas dynamo brushes (Lucas Part No. BS3).

Attention was now turned to the rotor where it was found that the screw thread both on the shaft and on the commutator securing nut was stripped. The shaft was turned down and threaded 26 T.P.I. (the original pitch). A bush was silver soldered into the nut and threaded to match the new, undersize thread on the shaft.

The commutator was made by turning a copper ring and cutting it into four. The segments were insulated from the shaft with glass tape impregnated with Araldite and from each other with mica. The assembly was clamped between insulating washers and connections made with  $\frac{1}{2}$ in. diameter brass rods screwed into the two live segments.

It is interesting that the dynamo has two isolated commutator segments, their purpose is to ensure that the battery does not discharge into the dynamo when at rest. To achieve this the dynamo is driven from the magneto and since the engine will always stop at the start of a compression stroke the rotor is arranged so that the brushes are on the dead segments at this point.

Brass shim washers were made to space the new bearing and the missing retaining bolt replaced.

The dynamo was assembled, the bearings being secured with Loctite. (originally solder had been used). The original screws were used, except on the new endplate where most of the original screws were either missing or damaged.

On testing the dynamo, it was found that the output was only  $\frac{1}{2}$  amp into a 6 volt battery at about 1000 rpm: after remagnetising the output was over  $\frac{1}{2}$  an amp. Two features of this dynamo which are not on the borrowed dynamo are the face cam at the commutator end of the rotor and the cut out at the bottom of the commutator end bearing cap. These parts originally came from a MAGLITA combined dynamo and magneto, so the machine is partly original, partly dynamo/magneto and partly a restoration.

Restoration of this dynamo completes the Bradford Scott Sociable, one of only five remaining out of 120 built between 1919 and 1924.

I hope that this account will encourage others to tackle apparently impossible restoration jobs and bring them to a successful conclusion.

#### **Parts List For Scott Sociable Maglita Dynamo**

Drive end plate: Original - polished  
Drive end plate cap: Original - replated  
Drive end bearing: Original - 35mm OD, 15mm ID, 8mm wide  
Magnets: Original - cleaned and remagnetised  
Laminations: Original - cleaned  
Com end endplate: Replica  
Com end bearing cap: Original - replated  
Com end bearing: New E10 28mm OD, 10mm ID, 8mm wide  
Rotor: Original - cleaned shaft rethreaded  
Commutator: Replica  
Commutator insulation: Replica  
Commutator securing nut: Bushed and threaded  
Earthed brushbox: Original replated  
Brush Springs: Replicas  
Live brushbox: Replica  
Brush spring clips: Replicas  
Brush spring rivets: Replicas  
Brass brushbox fixing bushes: 1 original - 1 replica replated  
Paxolin brushbox fixing bushes: Replicas  
Brushbox insulation: Replica  
Brushes: Replica - cut from Lucas BS3  
End cover locating pins: Replicas  
Nameplate: Original - repaired  
Screws: 9 original - 10 new  
Washers: 5 new

V8/1 Sept 1972

#### **POTTY MOD. 2    Cost — Nil    Time — 2 mins.**

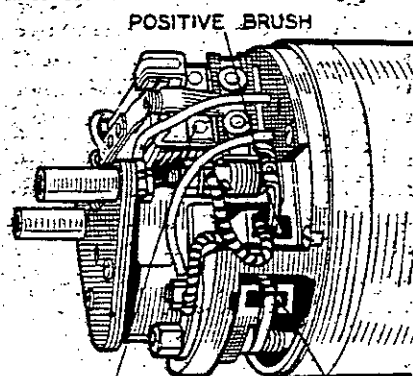
To increase charging rate in the pilot position as the generator output only just balances the load and continual use of stop light, horn etc., runs down a battery quickly, especially if it's a bit "dicky". Take a piece of wire (about 3") connect at the switch terminals 3 and 4 between the red and yellow wires. This will give a 2 amp charge in the pilot position.

To follow — Potty Mods 3, 4 and 5. Better braking on Supers and Webb forked models and how to avoid bending your forks if you make the brakes better.

## PRACTICAL POINT OF VIEW

**SURPRISINGLY**, despite the grouching and grumbling which goes on now, and I think always has, about items of motorcycle electrical equipment, it seems that many dynamos manufactured in the early 1930s are still in use and, indeed, have a further long spell of duty ahead of them. I say that because from time to time we get letters from readers suggesting that while the old Lucas three-brush instrument is giving good service it would be nice to modify it to the two-brush pattern for use in conjunction with a modern MCR2 compensated voltage control unit. Is such a thing possible?

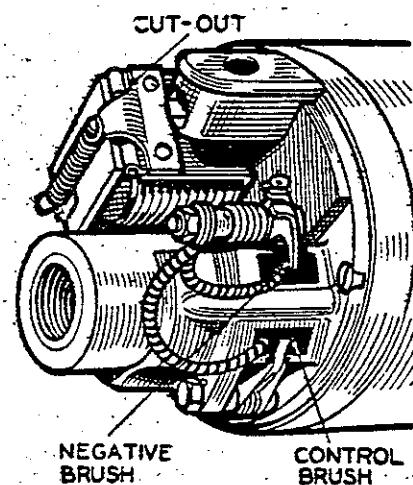
It certainly is, but, at the outset, it should be stressed that the voltage regulator suitable for the "short" pre-war



Lucas E3B, E3D and E3MD dynamos had this end-bracket arrangement and an adjustable third brush.

dynamo is, of course, the MCR1, which is no longer manufactured. Often you can pick up a good second-hand c.v.c. of that type but, failing such a course, it is essential that you have a specific type of MCR2 unit, part number 37144A.

Three main types of three-brush instrument can be modified and the first to



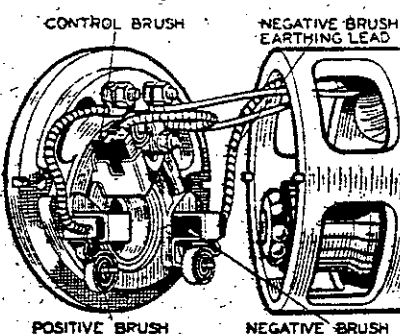
## How to Modify the "Electrics" of a Near-Vintage Machine

consider are those in the E3 series—E3B, E3D or E3MD—in which the control brush is adjustable and the cut-out mounted on the end bracket. The preliminary work involves disconnecting the leads from the Pos and F1 terminals, lifting out the brushes and removing the terminal strip, which is secured by two screws. Three more screws retain the end bracket which must be taken off the body of the dynamo. The next stage is to slacken the two securing screws which retain the control brush and its holder. Remove the field lead from its terminal—the position of which can usually be located by the appropriate letter stamped on the outer dynamo cover.

The two cut-out leads must now be disconnected from the positive brush box—the one which is insulated—and the earth lead, usually green in colour, cut as near to its eyelet as possible. Take off the complete cut-out.

The field lead which you previously disconnected from the "F" terminal should now be taken to the negative brush box. The remaining field lead, originally connected to the control brush, should have its eyelet suitably modified to fit the field terminal. Refit the commutator end-bracket and terminal strip.

The E3C and E3M dynamos have a fixed control brush and the modification commences with the initial work previously described. The control brush is



(Above) Modern except for a third brush, the E3A or E3E Lucas patterns were fitted to pre-war A.M.C. machines.

(Left) A fixed third brush was used on the E3C and E3M Lucas dynamos.

(Right) How to wire up the modified end-bracket with an MCR2 control unit.

## IS YOUR DYNAMO UP TO DATE?

removed by disconnecting its flexible lead from the earthed brush terminal. The red field lead should be taken from the positive brush and connected to the F1 field terminal in place of the yellow lead, the last-mentioned being transferred to the negative brush.

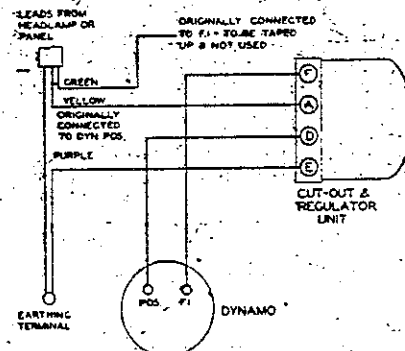
Green- and red-covered leads go to the cut-out; they should be severed and the cut-out removed. Remove the brass strip which serves to connect the cut-out fixing nut and the positive terminal; this is done by slackening the screw at the rear of the terminal. The red-covered lead is now attached to the terminal and the screw tightened again. The connection must be secure, and in such a position that there is no danger of contact with the end-bracket.

A few pre-war machines, notably those from the A.M.C., Ltd., factory, were equipped with type E3A and E3E dynamos with the cut-out mounted in the headlamp or instrument panel. The conversion in this case is easier.

First disconnect the dynamo leads and remove the cover band and brushes. Take off the moulded commutator end-bracket and the control brush plate and brush.

Disconnect the field lead from the "F" terminal and take it to the dynamo yoke, utilizing the screw which already secures the end of the lead from the negative brush. Connect the field lead, originally running to the control brush, to the field terminal. Reassemble the commutator end-bracket and replace the two brushes. Disconnect all leads to the cut-out which, of course, can be discarded.

The sketches show the brush and cut-out arrangement as it will be seen on the three dynamos in question before conversion. When the work is done, the main leads from the terminals marked F1 and Pos. should be regarded as field and dynamo connections.



### OVERHAULING THE 1949 DYNAMOS.

The one bit of kit on my '49 Flyer that had not revealed its all to me was the dynamo. I had made a rather half hearted attempt to strip it when the machine was in pieces but, "discretion being the better part" etc. etc., and my ability to break valuable parts being proven I had rather funk'd it and put it back with external clean, paint and polish. The fruits of this cowardly deed came the other night when my worst suspicions aroused by dimming lights I noticed that what little charge I had on the ammeter had gone altogether. I put a 6 volt bulb across the dynamo terminals and this failed to produce a glimmer. I resolved to strip or bust and, having removed the two set bolts I tapped around the aluminium rim with a hammer and wood drift. It does come off albeit I had a need to get a bit violent before it gradually moved. I think some gentle heat would pay dividends. This end cap is a push fit over the outer track of a ball race on the end of the armature shaft. Greatly relieved, I examined the exposed brush gear (four brushes) and found all brushes worn, one out of contact altogether and the commutator dirty and a bit worn. Next problem was getting at the brushes. Two of them mount directly on the visible face plate and are removable by extracting their holding screws. This is the trick, for these two screws also hold the face plate in position and, once removed, the plate comes off. You will notice that it is located by slotting over a peg in the housing. This leaves the face plate with brushes hanging from the last two brush wires which go up to the terminal block through the outer case. On the front of this block, the outermost plug socket has a grub screw head visible on the forward side, unscrew this and the face plate comes away complete.

Next problem is obtaining spares. Lucas claimed that the brushes were long since gone. Someone somewhere had told me that they were the same as some of the Sunbeam ones, so I rang and called at Stewart Engineering, Bective Road, Putney, London SW15 01-874 7708 where I bought a set of brushes for £1.38. While there I was shewn other spares, such as complete armature assemblies which looked mightily the same, face plates etc. lying around the floor. In short they are keen to get Scott enquiries and, if someway away I would suggest you send your tatty bits for appraisal. I had to take off and re-solder the terminal block tag which was easily accomplished, face the brushes to the commutator by turning it surrounded by a strip of fine emery paper, clean the commutator with fine emery, put the fragile end cap back on, having re-packed the bearing with grease, plugged in the two wires, fired up, and heigh presto, a glorious 8 amps! I ought to add that I have no qualifications for this article other than experience, so that if I have written anything that makes a mechanical or electrical nonsense—better write quick!!

Keith Brettell.

## A GOOD SPARK

Titch Allen

As long as I have had anything to do with Scotts I have known that more than anything they need a good magneto. In the really early days we used to seek a Bosch because the word was that they were the best and so it seemed in use, but they were all pre-first war ones, of course. There were those tales about our despatch riders secretly swapping our tyres for their magnetos in 'no man's land' in dead of night, but they were single cylinder mags., not twins. In the early 20s we had to make do with Fellowes mags which I always found quite OK. All our post war horseshoe mags were, of course, government inspired copies of the Bosch mag. But later we swore by B.T.H. mags. and I still do. I've always found it paid to ditch the standard Lucas magdyno and fit a B.T.H. (there were a lot about after the war, ex-charging engines and such). Of course, not having to spin a crude dynamo round saved a lot of power (five miles per hour in speed, I swear) and the lights weren't much use anyway. Better get home before lighting-up time.

I've had a little B.T.H. on for 20 or 30 years now and it's never given any trouble. I have, over the years, had the odd spot of plug trouble, though only when pushing it hard. A change of plugs, preferably to a harder grade, would always cure the odd misfire and cough. After fitting a sidecar the trouble became more frequent. Sidecars need a lot more throttle. I wondered if the 50-year-old mag. might be a little tired, so I took it to my magneto expert, to whom an old mag. is a challenge and a delight after run-of-the-mill stuff. He ran it on his test rig and said he could find nothing wrong with it. "Never mind," I said, "rewind it to make sure". He did. Believe it or not I swear the old girl goes better than I can remember. The 'plug trouble' has gone and altogether she feels more 'joyful'. I can't think of any other word to explain the improvement. One thing, though, it does not seem to need any use of the advance and retard lever. One setting seems to do for all conditions. I seem to remember a friend who a long time ago, replaced his mag. with a car coil set-up, and found he could manage with one setting. Is there, I wonder, something subtle about the strength or length of the spark which suits a Scott best?

Sparks do come in different lengths. I found that out the hard way when I was a teenager, but as it's a story about a four-stroke, I dare not tell it in these pages.

## TECHNICAL TOPICS

### Potty

#### Magnetos (Potty's Polarisation Problem)

I am not an expert on magnetos — but I know a man who is!

Last year was not the Year of the Magneto as far as I was concerned. I had three fail on bikes, two Scotts and one vee-twin. The symptoms were all the same — weak spark and difficulty starting and running when hot. I surmised (wrongly) condenser problems.

I took the magnetos to my expert who put them all on test. "Nothing wrong with these apart from a bit of polarisation, and one with slightly advanced internal timing, which exacerbates this. Your problem is HT leads and pick-ups". Now, I was given a roll of lovely rubber HT lead a couple of years ago. It does not harden with age or cold and does not vibrate off the plugs like plastic, and it does look right. However, leaking sparks could be seen on the test rig and one was tested to destruction. "It's like the handicap of a resistance in each lead" he said. When the pick-ups were placed on the rig the resulting pyrotechnical display showed that all was not well.

It would seem that early ebonite pick-ups and more modern ones made out of superior plastic are OK, but brown ones made in the late vintage and early post-vintage eras are the ones to avoid.

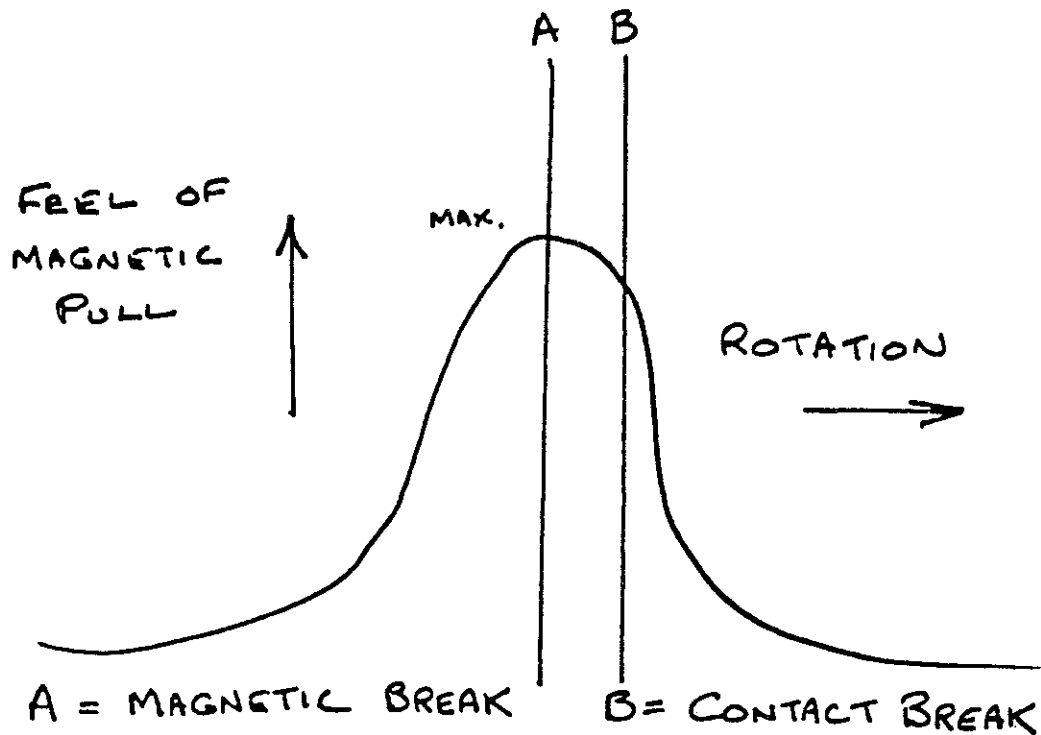
Internal timing of the magneto I will cover under polarisation as it is very relevant.

**Polarisation.** I had no idea I suffered from this, but my man said: "Polarisation is a sort of disease of the metal of old magnetos". It seems that it is the reluctance of metal in our armatures to cope with reversals of magnetic polarity which occur twice every revolution; the faster the r.p.m. the weaker the spark when at full internal advance. The older the metal the worse it becomes. Mags on Scotts are particularly prone to this, running at engine speed. However, all is not lost and special attention to the internal timing will improve matters. BTH magnetos seem to be worst affected, but are the easiest to fix, having moveable stops.

To check your internal timing all you need is a steady hand to feel the pull of the magnetic flux. The diagram shows how the timing ought to be. If your Scott has the correct ratio of contact-breaker opening (full advance) to piston position ( $\frac{1}{4}$ " to  $\frac{5}{16}$ " before TDC) but runs better at speed when you slightly retard the ignition you may have a polarisation problem.

I have retimed one magneto, changed five pick-ups and all their HT leads. I now have good sparks in all the *right* places and all seems well (says he, crossing his fingers).

# CORRECT INTERNAL TIMING FOR OLD MAGNETOS



(WITH CONTACT BREAKER SET AT 12 THOU  
"B" MUST NOT BE ON OR BEFORE "A")

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## THE INTERNAL TIMING OF MAGNETOS

Don Hewitt

It often happens that we vintage bike enthusiasts find it necessary to refurbish an old magneto, or even to build one up from individual parts that have been obtained from various sources. We may wish to investigate the cause of a weak spark, or to change the direction of rotation of the armature.

It is not difficult to change the direction of rotation; the following steps are required:

- fit a contact breaker of the other 'hand',
- in the case of a twin magneto, it will often be necessary to change the slip ring of the armature; the brass segment is usually circumferentially offset, relative to the brush boxes,
- check whether the cam ring is suited to either direction of rotation; some are, some are not, dependent upon how the ramps have been ground,
- alter the internal timing.

In all cases it is advisable to check and, if necessary, to adjust the internal timing, since timing which is incorrect by only a few degrees can result in quite poor performance. Whilst many Club members will be familiar with both the technique and the theory of internal timing, the following notes will perhaps be useful to those who are less certain.

In order to understand the theory of internal timing, it is important to appreciate that it is the *change* in magnetic flux flowing in the core of the armature, and not the absolute level of the flux, which induces an electromotive force in the magneto windings. The greater the change, and the faster that it takes place, the greater is the induced e.m.f. It follows, therefore, that a complete reversal of the magnetic flux in the armature core, rather than a simple collapse from maximum to zero, will induce a greater e.m.f. in the windings.

Figure 1 shows the magnetic flux at its maximum, with the armature core at 90 degrees to the magnet pole faces. There is no *change* in flux and therefore no e.m.f. is induced in the windings.

If the primary winding on the armature core is not closed by the contact-breaker points when the armature reaches the position which is shown in Figure 2, there will be no magnetic flux flowing through the core — the flux will have been diverted through the teeth of the laminations. There has been a change of flux in the core. However, if the primary winding is closed by the contact-breaker points during this part of the rotational cycle, there will be an e.m.f. induced in the winding, and the current will be approaching its maximum at this point. This current will try to maintain the magnetic flux in its original direction in the armature core, and will continue to do so until it is interrupted. the armature is allowed to continue to rotate, for about eight to ten degrees past 'top dead centre'. Figure 3 shows the condition of the magnetic flux at this time.

If at this point the contact points are opened — just broken — the current in the primary winding will cease to flow and its restraining influence on the magnetic flux will be removed. The flux in the armature core not only collapses but, because the armature poles are entering the other and opposite poles of the permanent magnet, it reverses completely. the very rapid and extensive change of flux in the armature

core induces a very high e.m.f. in the H.T. winding on the core. Figure 4 shows this changed condition, and it is easy to appreciate that the break point is quite critical.

The condenser, which is usually fitted inside one of the brass end-plates of the armature, is connected across the contact breaker points and suppresses most of the arcing and assists in the collapse and reversal of the flux in the core. It is important that the contact breaker points are maintained in a clean condition, so as not to offer any undue resistance to the passage of the current in the primary winding.

Because the position of the advance/retard mechanism affects the relationship of the opening of the points to the magnet poles, it also affects the internal timing of the magneto. The internal timing should be set so that the points open at eight to ten degrees past the 'top dead centre' position of the armature core, with the advance/retard mechanism at the full advance position.

Having got the internal timing correct, sometimes involving alteration to the 'stops' which govern the movement of the cam ring and/or its housing, it may be necessary to have the magneto re-magnetised, a simple operation. It is advisable to re-magnetise so that the field is in the same direction as before, i.e. that the original polarity of the magnet is preserved, otherwise the magnet may start with a small handicap to its performance!

Modern materials that are used for permanent magnets develop directional characteristics when they are magnetised, and can be magnetised to very high strengths. They retain their magnetism, even when knocked or when stored without a 'keeper', far better than do the older materials such as the tungsten and the chromium steels which were used for the magnets of many of our vintage magnetos.

When these older materials are magnetised, the phenomenon of 'magnetostriction' occurs and this causes a small dimensional change in the magnet, primarily in the direction of its length (this effect forms the basis of some types of transducers). Consequently, magnetostrictive strains will be set up within the magnet, and the attempt of the material to return to its original dimensions and so relieve these strains, over a period of time, leads to a gradual decay in the magnetism.

The magnetic field decay is increased if the magnet is subjected to physical shock (don't bash the magneto shaft to release the sprocket — use a puller!), or stored without a keeper (when removing the armature, follow it with a few lumps of iron or steel), or is heated; many of us will have encountered these effects at some time or other.

The magnetostriction effect also occurs in many of the modern alloys which are used for permanent magnets, but the composition of these materials is such that the magnetic decay is largely resisted.

In the June 1995 issue *Yowl*, 'Potty's' magneto man's comment about 'polarisation' of magneto armature cores was reported. It is likely that the greater part of any deterioration of the magnetic properties of the core material is the result of a diminution of the 'permeability' of it. Permeability is a measure of the readiness with which a material responds to a magnetic flux.

Relatively soft iron (so-called 'Swedish iron') and some low-silicon irons were, and still are, used for armature laminations, although more modern alloys, differently heat-treated, are often used now. However, in the event of a higher level of certain impurities being present in the older materials than is the case these days, or of inadequate annealing

of the material, it is possible for the internal grain structure to change gradually, over the years. This may lead to a reduction in permeability, and the reduction of this quality will reduce the strength of the magnetic field which is set up in the armature core, leading in turn to the generation of lower e.m.f.s.

Additionally, the residual magnetism at the end of each of the flux changes (which the magneto man may have called 'polarisation'), may be increased as a result of the changes in the core material structure, especially those which result from 'ageing' following the cold-working by shearing of the edges of the laminations when these are blanked. This leads to an increase in the loss of magnetic energy, dissipated as heat ('hysteresis loss'), thus reducing the e.m.f. which is generated in the windings.

Armatures which are used in high quality rotating electrical machines nowadays are usually machined or ground after assembly, to the finished diameter, thus removing the sheared edge material and also giving greater accuracy of the air gap dimensions. Generally speaking, the smaller the air gap, the greater will be the efficiency of the machine.

The diminutions in electrical performance of old magnetos which result from changes in the core materials over time, are relatively small by comparison with those which are caused by reduction in the permanent magnet strength and by unsuitable internal timing, so after making sure that the armature windings are in good order and that there are no problems with the contact breaker, those two factors should be investigated before worrying about core material problems.

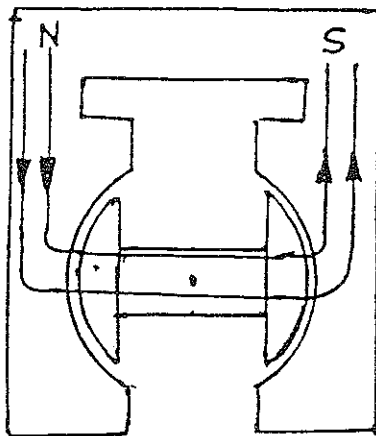


FIG 1

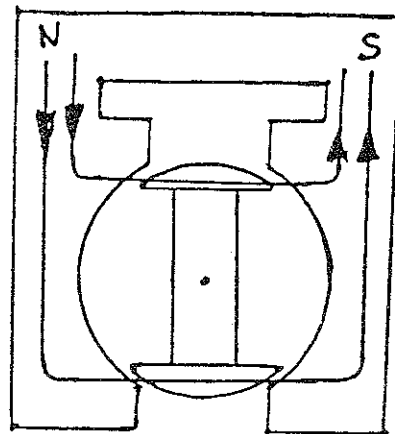


FIG 2

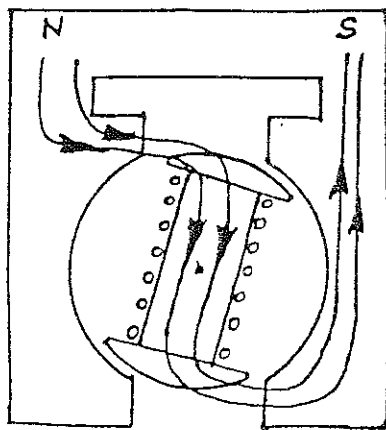


FIG 3

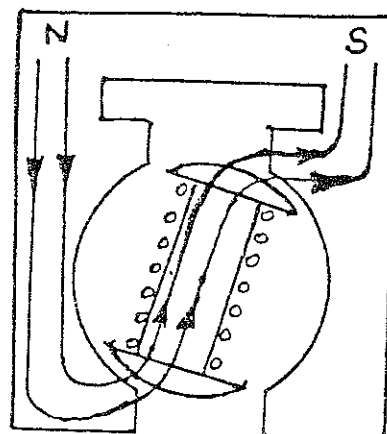


FIG 4

## SPARKS!

Titch Allen

No component of a Scott is more important than the magneto. A mag. which gives a healthy spark when you kick it over ... two sparks actually because you should test both, does not mean it works properly under compression and what you may consider as the quality of the spark can affect the overall running of the engine from start to maximum revs or when pulling hard. My 'Old Faithful' ex-Banks 1929 Flyer, for instance, never showed much enthusiasm with a Lucas Magdyno fitted, yet rejoiced when a little old square B.T.H., probably off a WD charging plant was fitted. I know the Magdyno soaks up quite a bit of power, five m.p.h. was usually reckoned to be the penalty. When using the lighting set I usually slid the dynamo out of mesh, it was the later type, for I saw no point in boiling the electrolyte away during daylight, but there was a detectable difference in the general feel of the motor between the two makes.

Before accepting this was one of the facts of life with magnetos I realise I should have carried out a test that I have been advising owners of twins to carry out for many years. That is to make sure by means of a timing disc that the points open at the time they are supposed to, in our case 180 degrees apart. It's no good setting the timing spot on on one cylinder if it's way out on the other and an average discrepancy for a rocking arm type contact breaker is 4-5 degrees. Scotts are not too fussy about mag timing, unlike modern two-strokes where two or three degrees out can result in a holed piston, but you should find the error if there is one and divide it between the two cylinders. On high performance four-stroke twins it is often worth stoning the cam ramps to achieve more equal fire points, but I do not think it should be worth it on a Scott.

Splitting the difference should be enough to secure even running. Another possibility is that one spark is stronger than the other and providing the pick-up and its brush and the lead of the weaker is OK, there's nothing you can do about it and it may not matter. It's often caused by the contact gap being different on each pole, which is often due to wear in the cam ring housing. I shouldn't worry about this or about the fact that the polarity of one spark is opposite to the other.

In a lifetime with magnetos I thought I had encountered all the possible troubles, but I am still learning. I had a Magdyno cut out suddenly without warning and first aid, like removing the contact breaker and cleaning the points filed to produce a glimmer of a spark. I took the mag part to my friendly mag man (he had rewound the armature not long before). He twiddled it, pursed his lips, and then removed the long screw that holds the contact breaker to the armature and gave the threaded end a quick going over with a little wire brush. Replaced the spark was back with a real crack.

Now, that screw had been out twice and I saw nothing wrong with it. It seems he had had the fault before with mags that had been left in damp sheds over the winter (mine had). There was no visible sign of corrosion, I swear, but of course the voltage is very low at this point in the circuit. Now, would you believe it, a friend rang me to say the Magdyno on his vee-twin had packed up on a run and he had been trailered home. Could I get his mag fixed pronto. So, with my experience fresh in my mind, I said before he parcelled it off to me he should take out this screw and give it a going over. Worked like a charm it did.

Before I leave you to ponder, here is a new source of trouble which my mag man has tracked down. On the after-market is a supply of brushes for pick-ups which look perfect, but are, it seems, made of graphite, not the carbon they should be. Fit them on a twin and they leave a smear on the slip ring which soon causes the spark to track from one segment to the other. The effect is that a twin misses on one cylinder. You clean the slip ring and it's OK for a short distance and then happens again. It doesn't seem to matter if you use them on a single. Testing is simple; if they mark a piece of paper like a pencil, don't use them. The proper thing is much harder.

A final thought about sparks. A long gone friend, a Scott man through and through, got fed up with mags (this was in wartime.) and converted to a decent car dynamo with a Jowett contact breaker driven off its shaft with an inch of rubber canvas hose acting as a flexible drive. Thereafter he had good lights, instant starting and an engine which ran with wonderful smoothness. I've often threatened to fit two single cylinder mags (B.T.H. for preference) end to end on a long plate bolted to the platform with the sprocket between them. An even better idea, if I could do the engineering, would be to mount a B.T.H. direct on each crankcase door. Then I could get the sparks spot on, but I don't think I shall bother.

V19/11 Aug. 1999

## SELF-HELP OR THE MAKING OF HANDED PICK-UPS FOR MAGNETOS

Jack Frazer

Some time ago a kind friend presented me with the remains of a Bosch ZA2 magneto which, from its serial number, first saw the light of day in 1913. It looked like the wreck of the Hesperus. I cleaned it up in a vague way, stuck a piece of HT wire in the single remaining defective HT pick-up and more in sadness than in hope, gave it a tentative twiddle. Much to my surprise it emitted a cheerful spark.

Magnetos of this quality and seniority are in short supply nowadays so I decided that full recovery should be attempted and set about doing all those things which one does to derelict magnetos: these I need not enumerate. At the end of the day I was left with what appeared to be a respectable article, but no HT pick-ups.

I rang up several magneto experts. One said that he knew that he had Bosch pick-ups (not much in demand these days) but couldn't remember where he had stored them. Another said that he could make them (but was very busy on other work). There was nothing for it but to have a go myself and from here read on.

The making of things which are similar dimensionally but to 'opposite hands' is for me always fraught with difficulty; a false move in the procedures can quickly return you to square one with consequent loss of time, material, effort and temper, and I write these notes with the possibility in mind that others may be similarly afflicted.

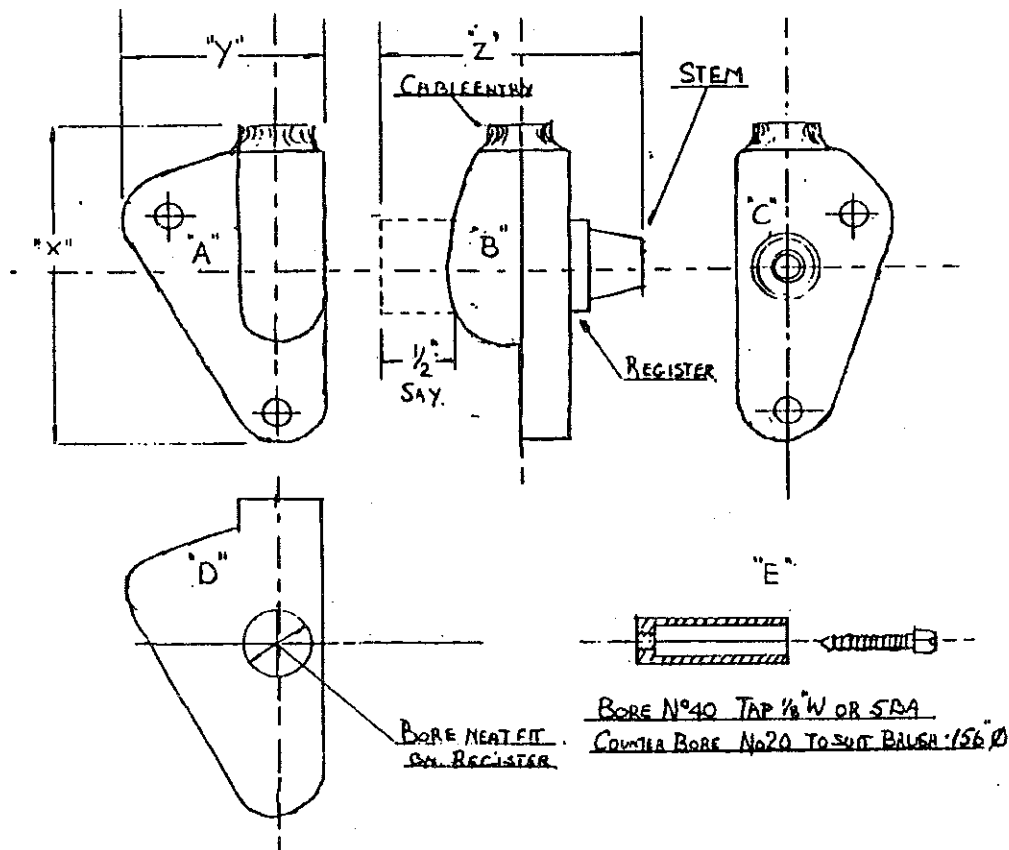
Before I get down to detail, there are one or two general points to cover as follows:

**The accompanying sketch.** On this I have shown the physical outlines of the Bosch pick-ups as made, but have (with minor exceptions) given no dimensions as you may well be dealing with a different magneto. The sketch is for general application and hopefully will enable you to see the sequence of the various operations involved. It may be helpful to know that all these operations were carried out (a) by hand or (b) in an ancient Drummond lathe which cost me £10 sixty

years ago or (c) in an equally ancient pillar drill which made .303 tracer sleeves in World War 2. You may be able to do without the drill, but the lathe is essential.

**Fixings.** Most HT pick-ups are held to the magneto body by two set screws. (Thompson Bennett is an exception: he used a form of spring clip.) In the case of the Bosch magneto these screws were of conical form to mate with metal inserts cast into the material from which the pick-up was moulded. They were also of indeterminate thread, somewhere just under 3BA. I tapped them out to this size and made four plain set screws with hex. heads (so that they can, if necessary, be removed with the magneto on the platform). I wish someone would enlighten us as to what system of thread/screws Bosch employed — nothing seems quite what it appears to be.

**Material.** In my scrap box I found a substantial Tufnol gear of unknown origin in pristine condition other than it was missing four teeth. This was large enough to cut out two blocks of adequate size to make the pick-ups. If I were doing it again, I would get new material of a heigher grade cut from the correct thickness to minimise preliminary work. Electrically and mechanically, however, this old material appears to be entirely satisfactory.



A.B.C.	3 ELEVATIONS RH PICKUP (FROM DRIVE END)
'x'y'z'	MINIMUM DIMENSIONS OF EACH BLOCK
"D"	TEMPLATE
"E"	BRASS SLEEVE & SCREW 2 OF EACH

N.T.S

- HANDED HT PICKUPS -

9.1.96

JWF

I now come to the Child's Guide part of the business which I carried out more or less in the sequence described.

*Step 1* Cut out the basic Tufnol (or other) blocks amply large to cover the minimum dimensions as shown on sketch. Square all six faces of each reasonably accurately. Blocks should be cut so that the cotton insertion in the Tufnol is parallel with the flange of the pick-up flange face.

*Step 2* Make a template from sheet metal (I used zinc about  $\frac{20}{1000}$  in. — easy to handle). See Sketch D. First step is to bore the hole for the pick-up stem (or register) as accurately as possible. (I faced off a piece of wood in the lathe and fixed the piece of zinc thereto by carpet tacks; then bored out accurately.) Put it onto your sample pick-up and mark all round the flange. Cut out with shears and finish to scribed line by hand. DO NOT attempt to bore the holes for the two set screws at this stage. If you turn this template round on a vertical axis you will see that, when used in both aspects, it will give flange profiles for both 'hands'.

*Step 3* Using this template, mark out your two Tufnol blocks at the same time to ensure that you get one to each hand and mark the centre line of the stem with a small centre drill. DO NOT cut out the flange at this stage. The important thing is to get the centre line of the stem marked.

*Step 4* Set up blocks in a four-jaw chuck or on faceplate with centre of stem (as in 3) running true and turn back the face of each block to give correct stem length. If a register is incorporated, turn down to this diameter (your template will act as a gauge). DO NOT attempt to bore the stem for the brass insert or to profile the stem at this stage.

*Stage 5* Remove from four-jaw chuck, reverse end for end, chuck in three-jaw chuck and turn down the opposite face for about  $\frac{1}{2}$  in. (axially) and to the same diameter as the other end to form a 'chucking piece' (subsequently to be removed). See Sketch B — dotted line.

*Stage 6* Remove from lathe, place template on register and scribe round to show profile of flange (do both blocks, turning the template to obtain 'other hand'). Reduce to this shape with hacksaw and file.

*Step 7* Using jenny leg-callipers (or otherwise), set out the thickness of the flange on the surfaces produced by 6, taking the dimension from the mating face of the flange (i.e. the stem end). *Do not overlook* (or consider removing at this stage) the projecting portion which is necessary for the cable entry. See 'B'. Again reduce to shape with hacksaw and file.

*Step 8* If you have got as far as this you should have a roughly square rectangular surface where the HT cable will enter. Mark off a centre line on this and set up vertically in drill (hopefully, as in my case, one side of the flange will be obviously vertical to enable a square to be used). Centre drill and thereafter drill down with a suitable drill to accept cable of your choice to a depth which will meet the drilling of the stem which follows in due course. This is best done by drilling down to slightly below the level of the centre of the chucking piece which you have not yet removed. This centre is, of course, in line with that of the stem.

*Step 9* Make a stub mandrel in the lathe onto which you may push the workpiece by the cable hole (do both pick-ups at the same time to avoid having to make a second mandrel). Turn down (from left to right) to give cylindrical mouth to cable entry (as shaded in 'A').

*Step 10* Make two brass inserts and screws as 'E' to appropriate dimensions.  $5BA\frac{1}{8}$  in. Whit. screws are best made from silver steel hardened and tempered to deep blue. Ordinary M.S. is not good enough to ensure that screwdriver slots will survive. If you twist the slot out you really have a problem; this I have encountered on another occasion.

*Step 11* With three-jaw chuck in lathe, grip chucking piece so that stem runs true and bore it, initially  $\frac{1}{8}$  in. to meet the cable entry hole and, thereafter, counter bore to suit brass insert as in 10. Use a drill slightly larger than the O.D. of the insert. *Drill only* to within  $\frac{3}{16}$  in., say, of the cable entry wall. Push the sleeves in with a smear of Araldite. Then, supporting the stem with tailstock, profile stem as necessary on the outside, making sure you have the register (not less than  $\frac{1}{8}$  in. deep).

*Step 12* Remove from lathe and cut off chucking piece. Finish with file. Then fit each pick-up carefully to the magneto body with file and w.h.y. to ensure that it beds down on the mating surface only.

*Step 13* Cut two short pieces of screw each about  $\frac{1}{2}$  inch long and of the same size and pitch as the securing set screws are to be. Turn off one end of each to clear thread for about  $\frac{1}{16}$  in. and face end. Screw these into magneto body, leaving cleaned end protruding just above jointing face. 'Blue' these ends with blue marking. Then put on pick-up, adjust to suit and hit the back of the pick-up with a light blow. The blue marking will transfer to the face of the pick-up flange and show precise location of the holes for the fixing screws. Mark centre of each hole, start with a small centre drill and follow up, boring through with clearance hole for whatever size of screw you are using (clearance for 3BA is a No. 19 drill). Doing it this way will avoid sloppy holes and general inaccuracy. Throw away the two marking screws!

*Step 14* Finish to taste with a scrap of wet and dry paper and give two coats of electrical varnish on the exterior surfaces. If you are still with me, you should now have two reasonable looking and serviceable pick-ups.

The cry may well go up "What if I haven't got a pattern?". Even in this extreme case, all is not lost. It should be possible to get a marking for the template from one side or another of the magneto body and a little careful cardboard engineering will enable you to transfer this to the piece of sheet metal together with the exact location of the hole for the pick-up stem. the only other thing to watch is the length of the stem and its profile. The length should be such as to bring the open end about  $\frac{1}{8}$  in. from the slip ring and the profile should be such as to clear the insulated sides of the slip ring freely and should be decided on *before* you cut off the chucking piece for obvious reasons.