STEWART ENGINEERING

***THE* SUNBEAM SPECIALISTS**

Data Sheet No. 13

Subject: Voltage Control (Servicing and Setting Up)
Date: November 1992

Small wonder that electrics overwhelm the amateur mechanic. Given a pushrod-operated valve most of us can see the relationship between the movement of a cam at one end and the opening of a valve at the other. Electricity is less transparent in its habits, but persevere. Remember. Your wobbly efforts on that first bicycle. It was worth it wasn't it?

Every dynamo has two output wires: positive (+) and negative (-). Confusingly, one of the 'wires' is the metal body, and it's connected to earth by being bolted to the crank case, either directly or through the magneto in combined systems. The other output is the wire connected to the D terminal.

Good contact with the fabric of the machine is essential, and if anything but the end cap has been painted, put function before beauty and strip it to its original electroplate. A pretty dynamo is no consolation when you're stranded by the pitch-black roadside.

Dynamo voltage is raised by feeding a portion of the output back to the field coil. The problem is that output varies with demand depends on the riding conditions.

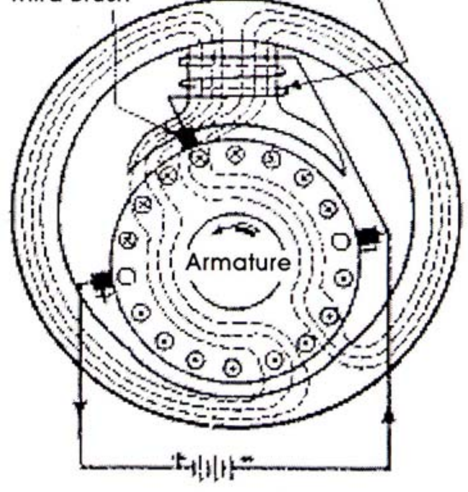
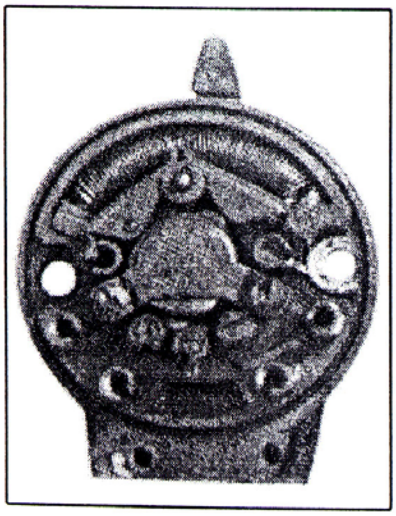


Diagram 1: Third brush dynamos make use of magnetic field distortion to limit output as revs rise.

Consider a dynamo running flat out and feeding a well-charged battery. *(See Diagram 2 next page.)* Compare that with a machine which is trickling along in top with its lights on full beam while attempting to charge a flat battery. It is clear that we need something more flexible: Enter stage left the third brush dynamo.



A coil resistor like the one fitted to this Lucas headlamp switch restricts output from the three-brush dynamo when the lights are off.

This was sometimes known as the constant current system, and instead of drawing its field coil input from the main brushes, fed it from a separate brush, making use of a phenomenon known as armature reaction.

As a dynamo's speed increases so its magnetic field distorts. By careful placing of the third brush the voltage available could be made to drop as the magnetic field moved away from it.

Of course that only takes into account part of the problem; variations in dynamo speed. The demand for power will still depend on the state of the battery, and whether lights are in use. So the other side of the field coil was connected to the dynamo brush via the headlamp switch.

The photo of a Lucas switch from the 30's shows a resistance coil which was switched in circuit when the charge or 'C' position was selected. Thus the input was reduced when lights were not in use, with the coil bypassed for night time riding.

And in the off position the field coil was taken out of circuit altogether. This was essential, because one of the drawbacks of the system is that it will burn out the field coil if run with no load. For that reason when the battery is disconnected the switch must be set to **off.**

Adjustment of the third brush dynamo's output is achieved by moving the brush and holder sideways.

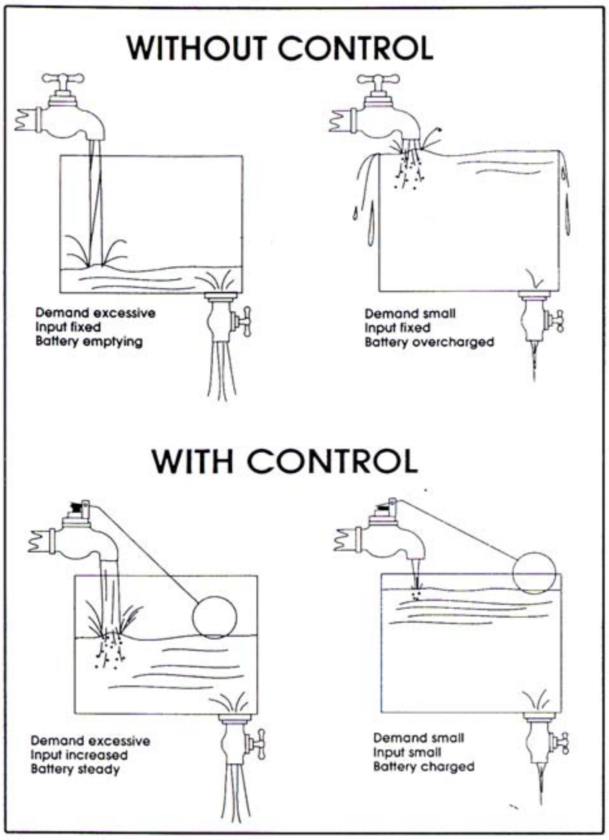
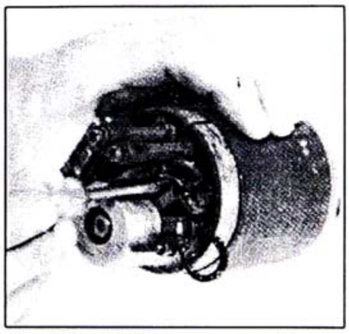


Diagram 2: The advantages of compensated voltage control are similar to those of a cistern ball valve.



The Miller D3MG dynamo requires average conditions to give its best. Output can be varied by minor adjustments to the third brush.

With a fully charged battery and the switch set to 'C' a reading of two amps should be registered on the machine's ammeter.

The third brush is the offset one, and it has no partner on the opposite side of the commutator. Slacken the screw in the brush holder and move the assembly to vary output. The main brush sits in the best position for collecting volts, so move the brush closer to increase output, away to reduce it.

But the third brush system was still not perfect. The resistance in series with the field coil meant that higher speeds were needed to maintain a charge, which often led to batteries going flat during prolonged slow speed riding.

The problem was that output catered for average conditions. Some manufacturers experimented with additional switch positions, with resistances allowing summer charge, winter charge and full charge rates, but none were really successful.

Then came a solution which could adjust itself to any conditions: constant voltage control or CVC. Sometimes referred to as automatic voltage control, this was the familiar regulator, that mysterious little black box attached to the frame tube or tucked under the saddle of so many machines.

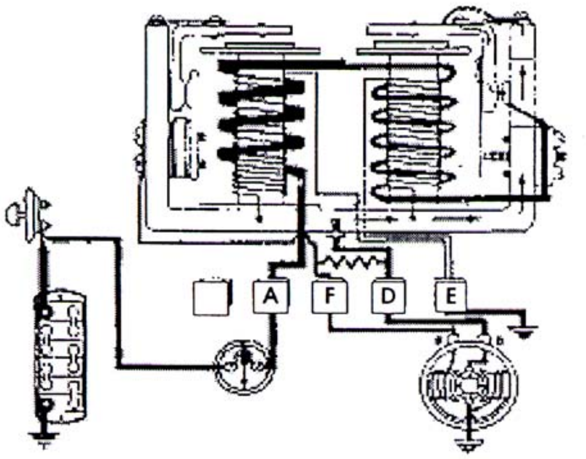


Diagram 3: The Lucas Compensated Voltage Control, with regulator (left) and cut-out coils. Output (A) feeds battery through ammeter.

The CVC does the same job as the third brush, but does it better. More intelligent than the switched resistance system, it samples the voltage between earth and dynamo output terminals (the E and D connections), and feeds a proportion of that output back to the field coil (F). The fourth terminal on the underside of the box is the output, (A), which connects to the ammeter, *Diagram 3.*

Unlike the cut-out, the regulator contacts are normally closed, feeding the full output of the dynamo back to the field coil as soon as the engine turns over. The dynamo output is also connected to a coil around an iron core, and as the voltage increases so the magnet pulls at the armature. At a pre-set voltage the magnetic field overcomes the pressure holding the contacts together, and separates them.

As soon as the circuit to the field coil is broken the magnetic field in the dynamo collapses and voltage is reduced in the regulator coil. This allows the points to close again, feeding the field coil until the process repeats. By varying the spring pressure, we can decide at what voltage it all happens.

The main coils are hidden from view, wrapped in insulation but there are two additional coils, added to clear up a couple of problems with the system.

A heavy winding on the cut-out bobbin helps to make cut-out operation more positive, preventing the points chattering. And a flat wire coil connected to the output ensures that the dynamo won't try to supply more than its windings can stand. If you add a couple of spotlights and a pair of heated handlebar grips, the compensated voltage control system will call a halt before the armature starts throwing off goblets of molten solder.

That at least is the theory of CVC operation but moisture, corrosion and fiddling fingers all take their toll.
The Lucas MCR1, which was introduced in 1935 for the 45 watt dynamo, and MCR2 which appeared after the war, are most plentiful and also easiest to service. Their brass covers are retained by a spring clip.
Later units like the RB108 are encased in a tamper-proof aluminium case, with two linked rubber bungs giving access to the cut-out and regulator adjusting screws. It is worth opening the case of an old unit to check contact condition. Prise the alloy tags carefully away and lift the cover from its sponge gasket.

Setting of the regulator is not difficult provided it is tackled methodically. Of the two coils, the regulator is on the left - the one with its points normally closed. Unlike the cut-out, it has no restricting tag above the armature.

Turn the unit round and you will see a pair of screws which attach the fixed contact to the back. Remove the upper one completely, slacken the lower, and swing the contact sideways.

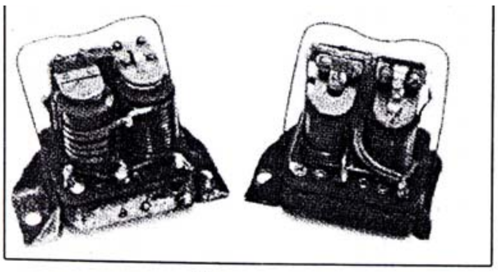
This will reveal both contact faces, which can be cleaned up with a fine oilstone or emery stick. Get rid of pitting, and degrease thoroughly before reassembly.

Now set air gaps (refer to ***LH** coil, Diagram 3),* beginning with the one between the armature and the regulator frame. This should be between .018" and .020" which allows for any tapering of the gap. Adjustment is made after slackening the armature fixing screws.

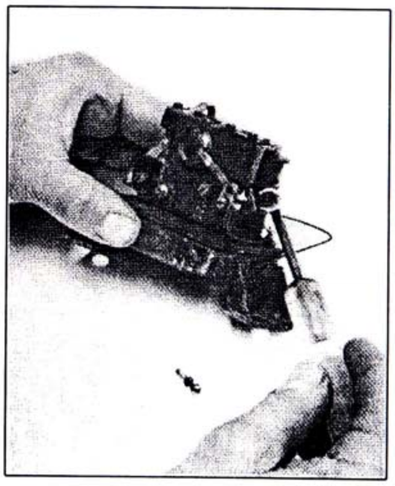
The gap between the armature and the coil core should measure between .012" and .020", with a feeler gauge beneath the brass shim.

Finally, with the armature pressed down to the core, the contacts point gap should open to between .006" to .017". It can be adjusted by careful bending of the fixed contact support.

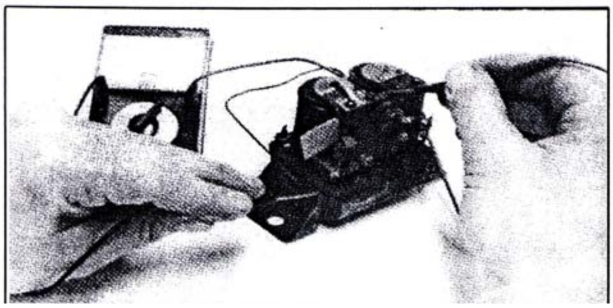
RB107 and RB108 regulators with adjustable points above the armature should be set so that the points just touch when a .021" gauge is placed between armature and core.
On the back of the upright frame is a 38 ohm carbon resistor, attached to the fixed contact screws by a metal strap. It is riveted to the regulator frame and its function is to reduce sparking between the points as they open.



Setting the output of Lucas MCR2 (left) and RB107 control boxes shares the same technique, but points adjustment differs (see text).



After removing the top fixing screw and slackening the lower, the points of this Lucas MCR regulator have been swivelled aside for cleaning.

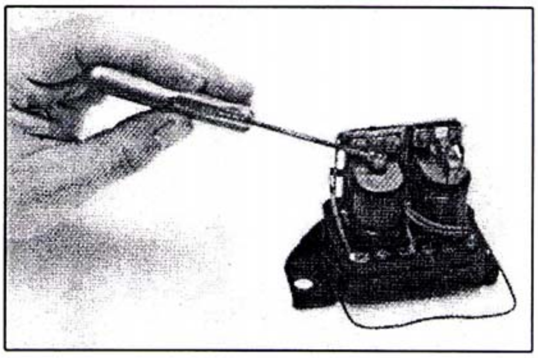


Left: Output of the MCR2 should be checked between earth and the regulator backplate, as shown. Note the paper insulation between cut-out points.

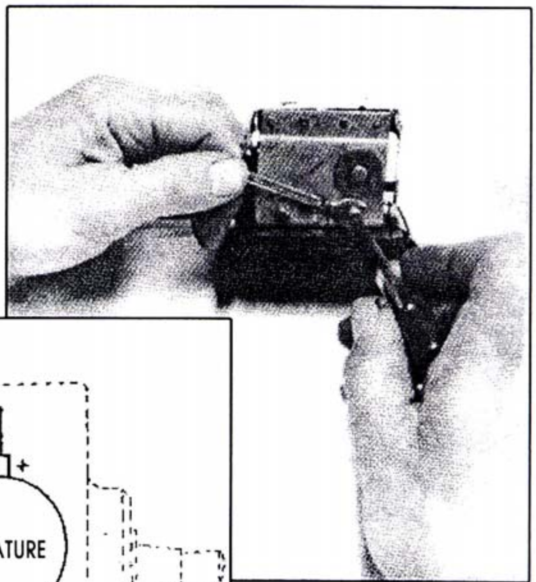
If the resistor has been damaged, or if the points show severe pitting, obtain a replacement rated at four watts or above. Cut the strap which connects the carbon pellet, fit a tag under one of the armature fixing screws and solder the replacement resistor between it and the contact screws.

When the gaps are set the output can be adjusted. Slip a piece of paper between the cut-out points to avoid variations in load, and run the engine. Some adjusters use a locknut, which should be slackened.
With a voltmeter connected between earth and the regulator frame, rev the engine and adjust screw pressure to give between 7.6 and 8 volts. Tighten the screw to increase voltage, slacken to reduce.
Some riders prefer to switch the headlights on and set output by using the ammeter. If you have no voltmeter, this can be a solution, although no ideal. With a good battery and the engine revs set to the equivalent of 30 mph in top gear, aim to balance the meter between charge and discharge. Resist the temptation to give it a bit more. When adjusted tighten the locknut and prevent engine vibrations from undoing your good work. Lucas RB tpe regulators were rubber mounted and less prone to interference by stray crankshaft frequencies.
Miller dynamos continued to use a cut-out mounted on the dynamo faceplate, but the third brush was superseded by a remote regulator. Although this is similar to the Lucas CVC, Miller offered a three-state device which should have been better, but wasn't *(Diagram 4, below).*

Below: RB107 regulator points must be set with this screw and locknut before output is adjusted.



Below: Adjusting regulator output after slackening the locknut. Points resistor can be seen behind star washer.



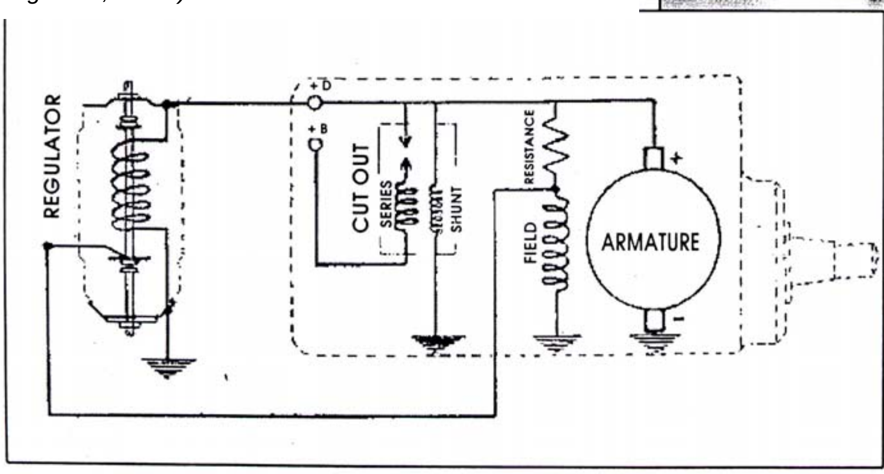


Diagram 4, left: Miller's control system superseded their third brush dynamo but was tricky to adjust.

Stage 1 shorts the dynamo field coil, stage two supplies it via a resistance and stage three feeds direct. if you were paying attention earlier you'll recognise that the Miller system is little more than an automatic version of the manually switched set-up in early headlamps.

Even hardened motor cycle electricians, who cut their teeth on the Miller regulator, admit that setting it up properly takes at least three hours. If you are one of those people who happily have tacked the Gordian Knot without so much as a blunt pen-knife, go ahead. Fortunately for the rest of us the problem has an electronic solution, and it's available off the shelf.

On the subject of electronics, there are some excellent devices on sale which convert six volt systems to 12 volts. Fitting them requires simple substitution of the regulator.

Conversions have also been made by using a 12 volt car regulator, or even adjusting the 6 volt system to double its output. A word of warning here, because while such systems may work successfully they can provide the dynamo with a life-threatening challenge.

Until the output reaches 12 volts the regulator will continue to feed the dynamo product back into the field winding, regardless of the fact that doing so generates no more power. Field coils have a fragile disposition, and will burn out after relatively little of this treatment. If you must have a 12 volt system - and there is little doubt about its superiority - be kind to your dynamo and fit an electronic device which restricts field current to a safe level.

But the standard six volt system can work well providing it is harnessed to a good wiring loom. Field coils are greedy. They just don't know when they've had enough, but restrict their input to a reasonable level, and there's no cause to be afraid of the dark ever again. Go on. Get in there and give it a try.