5.5 Lighting Systems and 12-Volt Conversions

LET THERE BE LIGHT

12-Volt Conversion for a Scott

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Several people have expressed interest in the fact that our 1931/38 Scott "Kitty" boasts a powerful halogen headlamp. Others may be interested to know how it was done.

When we bought the Scott "kit" in 1978, the electrics consisted of a Lucas Magdyno, new 6-volt control unit, 12-volt horn and a 7-inch headlamp complete with switch and ammeter and with a reflector in the usual doubtful condition. Having learnt as a "night owl" youth just how ineffective motorcycle headlamps tend to be, and knowing that I should need to buy a suitable battery, I opted for a 12-volt system as the best way of using the bits that I had.

The headlamp was the easy part, as "Cibie" produce an excellent 12-volt halogen conversion light unit to fit the Lucas 7-inch rim. The battery also was no problem, as the Lucas 12N5.5A-3B fitted the magneto platform nicely and is usefully an inch or so lower than the "correct" 6-volt battery.

Although 12-volt conversion control boxes for 6-volt dynamos were available, I did not wish to fork out even more money when, for the cost of a few resistors, I could use the brand-new Lucas MCR2 6-volt unit. Because it was new, I did not wish to change the adjustment of the unit, so I had to make it "think" it was in a 6-volt system. Since the voltage coils of the voltage regulator and cut-out (see circuit) are connected across the dynamo output between the D and E terminals of the control unit, it was straightforward to connect a resistor R2 in the earth lead to the E terminal, equal in value to the measured resistance (13 ohms) between the D and E terminals. In this way, exactly half of the dynamo output voltage is applied across the voltage detecting elements of the control unit. The control unit "sees" 6.5 volts when the dynamo output is 13 volts and acts accordingly to close the cut-out contacts. At 16 volts dynamo output, the control unit "sees" 8 volts and opens the voltage regulator contacts to reduce the dynamo output.

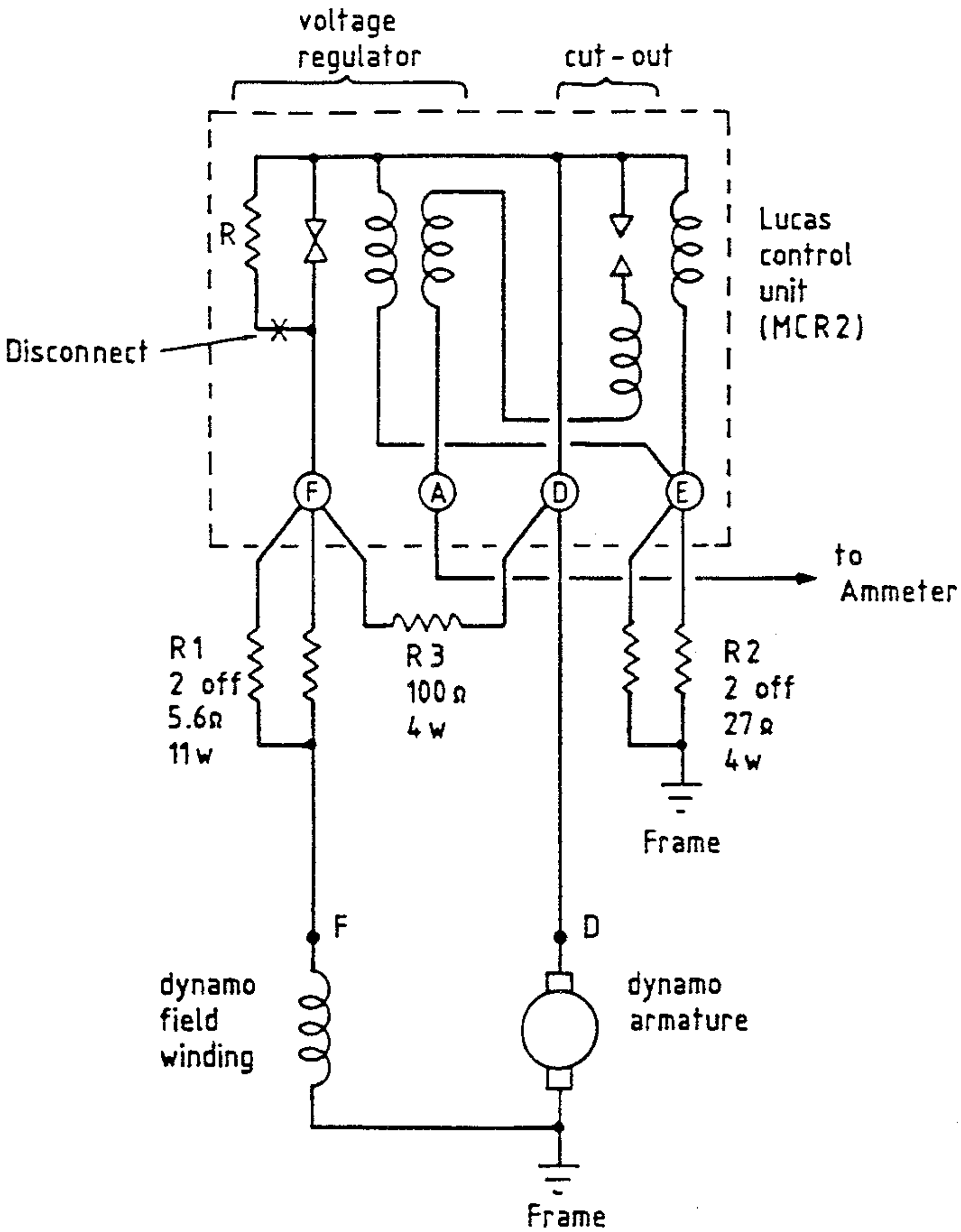
How about the 6-volt dynamo? Well, for a given current in the field winding, the dynamo output voltage is roughly proportional to armature speed. Since the field winding is connected across the dynamo output, via the initially closed voltage regulator contacts, the field current increases with dynamo output. Thus, the dynamo output voltage rises faster than the armature speed and reaches the 13-volt cut-in voltage at, perhaps, 50% higher engine speed than the normal 6.5-volt cut-in level.

It is tempting to take full advantage of this feature, as some conversions do. However, with double the voltage across the field winding (before the regulator contacts open), the field current is also doubled. This means that the dynamo field winding has to dissipate four times the wattage as heat. I did not fancy risking burning out the field winding and in any case had the advantage of a Magdyno with geared up dynamo (probably off a Douglas), instead of the normal Scott engine-speed one.

As a result, I applied the same principle as for the control unit conversion. I measured the field winding resistance (3 ohms) and connected a resistor R1 of equal value in series, i.e. between the control unit and dynamo F terminals. Thus, the field winding "sees" 6 volts, when the dynamo output is 12 volts.

This was the extent of my initial conversion, apart from ensuring that all bulbs were 12 volt and of similar wattage to the standard ones, with the exception of the 55/55W H4 halogen "bobby dazzler".

The first ride in daylight produced a healthy positive ammeter reading as expected, but instead of settling down to a trickle as anticipated with a new, fully-charged battery, the current continued at a couple of amps or so. After some thought and measurement, I realised that the voltage regulator spark quench resistor R (46 ohms) permitted a significant field current to flow on 12 volts, when the regulator contracts



were open. Unfortunately, I now realised that there was no alternative to a minor internal modification to the control unit. This consisted of disconnecting one end of resistor R, as indicated by X in the diagram, and insulating the floating lead. A substitute resistor R3, twice the value of the original, was connected externally between the F and D terminals.

The result has been six-and-a-half years of trouble-free and very effective lighting. The twice engine-speed dynamo balances the full lighting load at about 25 m.p.h. and has not yet burst nor stripped the fibre gear. Mind you, we don't make a habit of using the 5000 r.p.m. peak of the "Power-Plus" engine.

A Lucas-Scott engine-speed Magdyno conversion would balance the full lighting load at about 50 m.p.h. (A pancake dynamo should do rather better.) O.K. for the fast guys but I would suggest a compromise value for R1 of say one-third that shown in the diagram, so that the dynamo field receives 9 volts nominal.

The power rating of the resistors is easily calculated from:

$$\text{power (watts)} = \frac{V \times V}{R}$$

where R is the resistance of the resistor in ohms and V is the maximum voltage applied across the resistor, say 8 volts for R1 and R2 (about 4 volts for the "compromise" ⅓R1) and 16 volts for R3. Your radio and TV repairer should be able to supply suitable wire-wound resistors.

	R1	R1	R2	R3	
Resistance					
calculated	3	1	13	92	ohms
practical	2×5.6 parallel	2×2.2 parallel	2×27 parallel	100	ohms
Rating					
calculated	2×11.4	2×7.3	2×2.4	2.6	watts
practical	2×11	2×11	2×4	4	watts

By the way, don't worry about overloading the armature. The doubled voltage will do no harm and for a given wattage loading the current will be halved. Thus the safe output of the dynamo is doubled, from 45 or 60 watts to 90 or 120 watts. Note that at 12 volts, the dynamo is more efficient than at 6 volts, since the power loss in the armature and brush resistance (not to mention that of the motorcycle wiring) is dependent only on the output current and not on the output voltage, so it's not going to overheat. The voltage regulator current coil will protect the dynamo against overload at about 8 or 10 amps, in the normal manner.

ON LIGHTING

I have been helping a friend rewire a 1946 Squirrel, we wired for a voltage control unit although I knew the Mag'dyno was not a 1946 model, but an earlier 3 brush type. Leaving an inspection till last I realized I had dropped a clanger, just removing the third brush was not on. A look at the following diagrams shows why.

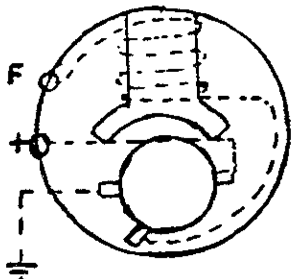


FIG 1

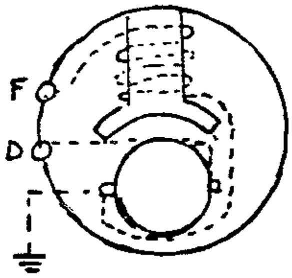


FIG 2

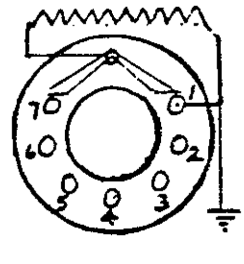


FIG 3.

Fig. 2 is of course, the usual two brush dynamo, with earthed neg. brush coupled to one end of field winding. The other end of the field being brought out at terminal F.

Fig. 1 Shows details of the earlier three brush model. note field is fed from armature via the third brush, the other end of field goes to terminal F. This dyno has the cutout incorporated in the end, I have ommitted for clarity. The correct headlamp switch for Fig. 1 is as shown in Fig. 3. Terminal F being connected to terminal 7, and is either switch direct to earth or through the half charge resistance to earth. However, not possessing one of these switches we simply removed the voltage control unit, putting the field wire to frame and joining wires A and D. On these three brush dynos the ends of the field winding are accessable, so there seems to be no difficulty in altering to work with a VC unit, so before experimenting with someone eles's dynamo, has anyone made the conversion?

FINAL NOTE . . . On looking through my back copies of *Yowl*, I find three excellent wiring diagrams supplied by H. C. Harrison, dated 12.5.68.

CONVERTING A BIRMINGHAM SCOTT TO 12 VOLT ELECTRICS

Converting an existing 6 volt a.c. equipped Scott to 12 volts is a comparatively easy modification and well worthwhile since there are a number of advantages to be gained from the higher voltage system. The zener diode used in the 12 volts system ensures that the battery is charged at the correct rate. When the battery is fully charged the zener diode bleeds off the current from the alternator and rectifier to heat energy, thus making battery boiling a thing of the pasts. This may not be the most efficient method of current control but it is relatively simple, and ensures a reasonable service life from the battery. Higher wattage car type headlamp bulbs can be used for improved night riding, and, of course, replacement bulbs can be obtained from any service station, which is not now true of 6 volt bulbs. For high speed night "Yowlers" who do "L Castle" or better there is the opportunity to fit a quartz halogen or iodene headlamp.

The following parts are required for the conversion:—

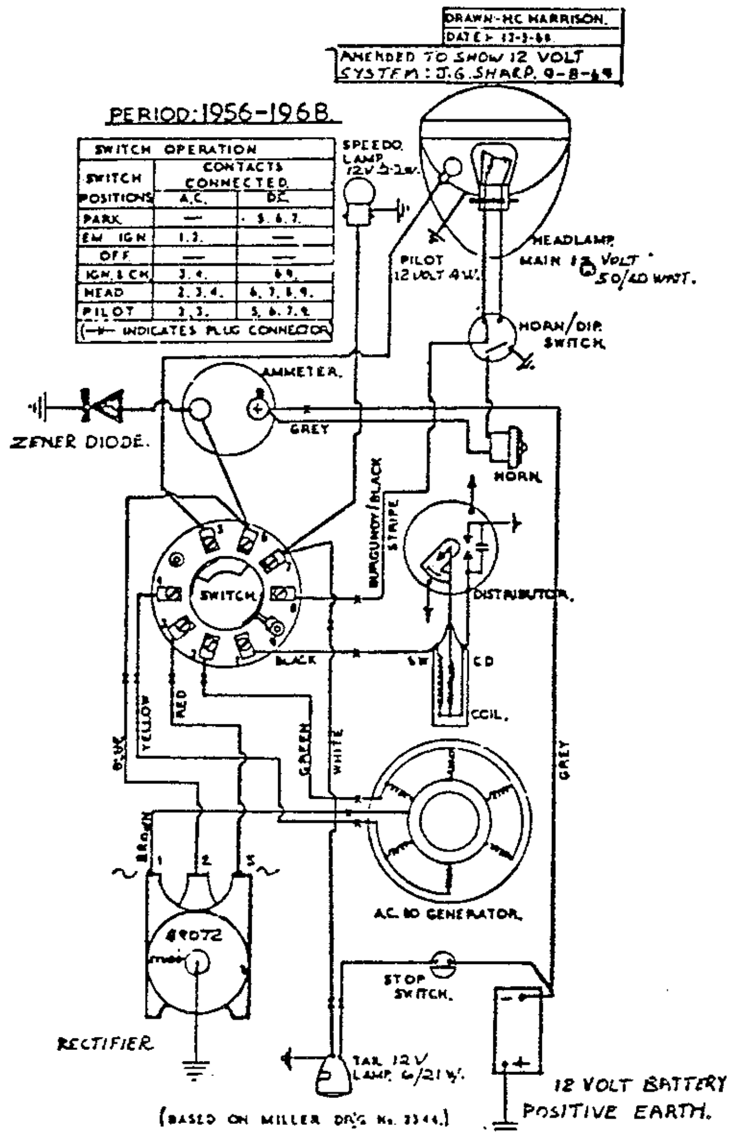
- One PUZ5A or JB 1B Lucas 12 volts battery, or similar type of different manufacture.
- One Lucas zener diode, part number 49345.
- One Lucas silicone rectifier, part number 49072.
- One 12 volt ignition coil, Lucas type 45101, or similar car type 12 volt coil.
- Distributor capacitor, Lucas type 54441582.
- Complete set of 12 volt light and instrument bulbs.
- One packet of Lucar connectors (standard size), plus one large Lucar connector to suit zener diode connection. Also packet of Lucar insulating sleeves.

Conversion

The new 12 volt battery will not fit in the existing 6 volt battery carrier. A new carrier can easily be made up and installed under the seat in the original position, or a 12 volt battery carrier can be purchased from a local Triumph or Norton agent and be modified to suit the Scott location.

The zener diode has to be mounted in a heat sink. I used one of the Triumph finned type and mounted it at the front of the Scott. B.S.A. also have a suitable heat sink. For "do-it-yourselfers" (show me a Scott addict who isn't) a suitable heat sink can be made from a piece of 16 swg aluminium or copper approximately 6 inches by 4½ inches, with a ½ inch hole in the centre for fixing the diode. The heat sink should be mounted in a position where it will benefit from a reasonable airflow passing over it. I prefer to mount it at the front of the machine, but it can also be fitted under the saddle with good results. Where ever the heat sink is mounted, it is important to ensure that is is properly earthed back to the battery either through the frame or by a separate earth wire. If the diode is mounted on the front forks the earth through the frame may not be good enough due to loss of conductivity through the steering head ball races, caused by the grease. Although the Miller wiring diagram does not show a separate earth wire to the headlamp assembly, my Scott is equipped with an earth wire direct from the battery to the headlamp. If your machineis similarly equipped, no extra wires will be required should you wish to mount the diode on the front forks. On my machine, I welded a small bracket on one of the front down tubes just below the radiator to accommodate the diode and heat sink.

While on the subject of welding, it is imperative that the diode, and both the positive and negative battery connections be disconnected before



any electric welding is undertaken, otherwise the diode will most likely be damaged. It is also a good idea to disconnect the rectifier as well, to prevent possible damage. With Lucar connectors, disconnecting the diode and rectifier is no trouble.

The new rectifier will fit in the same place as the original Miller unit, with plenty of room to spare, as it is only about half the size. A good earth should be made for the mounting stud, and care should be taken to ensure that the mounting stud does not turn within the rectifier when tightening up, as the whole unit is mounted on one bolt. The hexagon head of the bolt can be held with a spanner on the opposite side of the rectifier from the mounting stud. Late model rectifiers also have an earthing tag, and it is a good idea to run a wire from the tag to a good earth, just for safety, if you have one of these units.

The ignition coil will clip in place in the same position as the original 6 volt unit. My Scott is equipped with a Judson transistorised "hot" coil, which has given very good service to date, but, obviously, this is not a necessity. The coil chosen should not be much larger in diameter than the original, since space is limited in the gap between the two halves of the petrol tank.

The new capacitor can easily be fitted on the distributor in place of the existing unit. No problems here.

It is not necessary to fit a new horn, as I find that the original Miller horn is improved no end by the added surge of 12 volts running through its vitals.

Like the horn, one can use the original Miller alternator, which is very much up to the job, giving adequate charging rates, etc. For those who wish to gild the lily, one of the latest Lucas resin encapsulated alternators can be fitted, but I don't know if there is an advantage to be gained on normal Scotts, although the higher wattage available could be used for additional spot lights etc.

All the light bulbs will have to be changed, but the existing ammeter can safetly be used with 12 volts.

Connecting Up.

The battery should be connectetd with a positive earth, the same as the previous 6 volt unit. Depending on the type of connecting tags fitted to your Scott, you may have to *solder* new ones on to the battery wires to suit the 12 volt battery. At this point it should be stressed, that for reliability, all connecting tags, especially the Lucar terminals should be soldered, and not just crimped. Use resin core solder.

The zener diode should be connected to terminal No. 6 of the lighting switch or the switch side of the ammeter. I connected mine to the switch side of the ammeter, since it was easier than disturbing the already crowded No. 6 terminal on the lighting switch. The wire from the switch side of the ammeter runs to terminal No. 6 anyway. to it is 6 in half a dozen (Volts!). Ouch! That pun hurt.

The silicon rectifier should be connected up as shown in the diagram. In fact the connections are the same as for the original rectifier, though Lucar terminals will have to be fitted to the leads.

The ignition coil should be connected in the same way as the old one, likewise the new capacitor which is fitted to the side of the distributor.

As you will see from the above there is no great trick to the conversion, however a word of warning on the diode might be in order. Firstly ensure that the diode has a good flat seat on the heat sink, to ensure adequate heat conducion away from the diode. Secondly, the mounting stud of the diode is made of copper to ensure maximum heat conductivity. Therefore, due to the low tensile strength of copper, the nut should not be tightened to more than 17 lb. ins. torque, otherwise the stud may snap off.

For reference, the Lucas bulletin No. 2380 is very helpful as it covers all the ins and outs of the conversion. The bulletin is available from all Lucas Service Depots, or Lucas in Birmingham.

I have now done over 1,000 mies since I converted my Scott, and everything works with no trouble. I haven't even needed to top up the battery, which due to its clear plastic sides, is easily checked without removing the saddle. The emergency ignition does not work at all, but I don't think this has very much to do with the conversion as it never worked very well in 6 volt days, even when the Scott was new. In fact, I had better success on the one occasion that I needed emergency ignition by jump starting the Scott with the ignition switch at "normal". The battery is always fully charged which makes for easy starting. If all goes well, my next project for modernising Scott electrics is a Q.I. headlamp and twin contact breakers, which will do away with the need for the distributor. How about somebody beating me to it, and then I can read the instructions in "Yowl"!