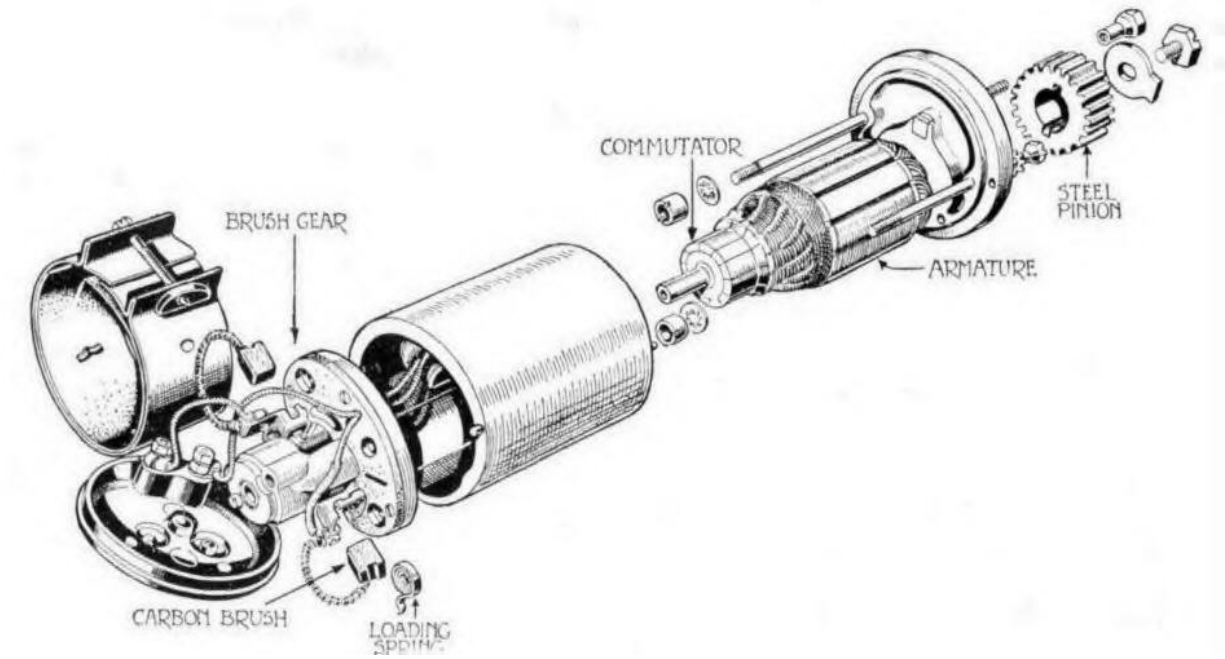
LUCAS GENERATOR



LUCAS GENERATOR

(a.k.a. DYNAMO)

It has been said many times that, when Joseph Lucas & Sons. designed the DC dynamo, they did so with neither an excess of copper nor steel.

Just after the turn of the century as motorized transportation was developing, motorists became aware of the dangers of driving about after dark. (The quotation "A gentleman does not motor about after dark." has been attributed to Joseph Lucas, but I cannot confirm if this is true.) Acetylene lamps were mounted on vehicles and served more to warn other motorists of your approaching, and of limited value to see where you were going.

As maximum speeds increased it became necessary to have more efficient lighting. By this time, Thomas Edison (an American) had already invented the electric light bulb which could be powered by a lead/acid battery. The battery was a DC (direct current) device, so now we need a DC generating device to keep the battery charged. No problem says Lucas, and they began manufacturing DC dynamos for the British transportation industry.

The DC voltage generated by a DC dynamo is governed by three factors, and each factor has limitations.

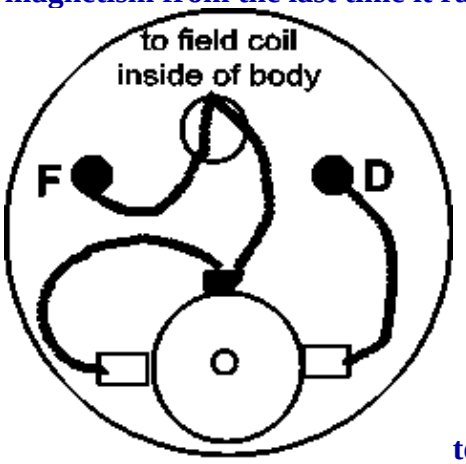
1) Number of turns of wire on the armature. This value is fixed by the physical size of the armature, and by the size of the wire. The more turns, the higher the voltage. The larger the wire, the higher the current.
2) Magnetic field developed in the field coil. This depends upon the number of turns of wire and the current passing through the wire. The output voltage will rise until the magnetic saturation of the pole piece is reached.
3) The rotational speed of the armature, which is governed by the engine speed.

Generator styles

Although there were a myriad of variations, the most common styles of generators are as follows-
E3H (short) Rated at 48 watts. Recognized by having only one screw holding field coil pole shoe.
E3L (long) Rated at 60 watts. Recognized by having two screws holding field coil pole shoe.
Keep in mind that Lucas generators were designed and built in England, which has a rather cool climate, and that power output ratings are nominal. Output ratings might be de-rated 10% for applications where the generator is mounted to the rear of engine, used in southern temperate climates, or south of the Mason Dixon line.

What's wrong with my generator ?

Each time the generator begins rotation, it generates a small voltage using the residual magnetism from the last time it ran. This small voltage is then fed



to the field coil, which induces more magnetism. The increased magnetism then creates a higher voltage in the armature. Thus the generators literally lifts itself by it's own boot straps. When the desired voltage is reached, the voltage regulator kicks in to control the maximum voltage output.

Possible problems

Although the DC generator is a relatively simple instrument, there are several things that can go wrong.

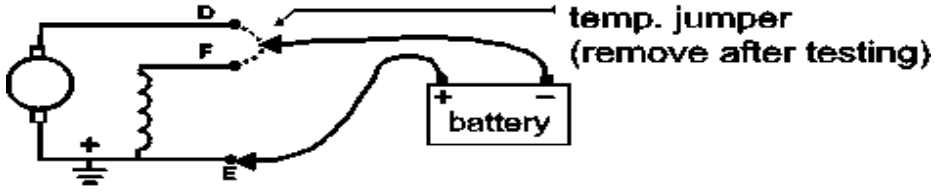
- **Open winding in armature. This test will require a DVM (digital volt meter). Because the windings are connected in series, you must measure the resistance between each adjacent commutator copper. And because this is a**

relatively small coil of large diameter wire, you can expect only a fraction of an ohm resistance. You must find the same resistance between each adjacent pair of commutator coppers. If you have an open coil, you will read to total resistance of the remaining coils in series. Look for evidence of overheating and/or thrown solder, as a wire may have become unsoldered from the commutator copper. This is most often caused by overloading the generator, or a defective regulator.

- **Armature coil shorted to ground. Check for continuity between the commutator copper to armature body. Continuity will indicate a shorted coil. Most commonly caused by overheating and charring of insulation.**
- **Armature coil shorted internally to itself. This can only be detected by a "growler" so you might have to take it to a local armature shop.**
- **Defective field coil. Common problem is overheating due to sticking points on the regulator. The insulation becomes charred and flakes off with time and vibration. Nominal resistance should be around 2.8-3.2 ohms. A visual inspection is a good idea and will require unwrapping some of the fabric wrapping. If there is any visual indication of charring, the field coil should be replaced.**
- **Note- all tests below are done assuming your electrical system is Positive Earth (ground).**

Testing the generator

1. **Remove the generator from the bike.**
2. **Connect a temp. jumper between "D" and "F" terminals.**
3. **Connect one end of another wire to the hot terminal of a battery. Touch the other end to the D-F terminal jumper. The generator should motor smoothly, and in the direction of the arrow on the case. (assuming you have the correct generator for the bike). If the armature rotates in a jerky motion, then you most likely have an open armature winding and the armature must be either replaced or rewound If it rotates very slow, you may have a defective field coil.**
4. **By doing the above test, you will have determined if the generator is healthy, and you will have polarized it for positive earth. Be sure to remove the D-F jumper.**



Another test **(this can be performed with generator mounted on bike)**

1. **Disconnect the regulator from the generator.**
2. **Connect a temp. jumper between "D" and "F" terminals.**
3. **Connect an analog volt meter between this jumper (negative) and earth (positive).**
4. **Start the bike, but do NOT rev the motor higher than a fast idle.**
5. **Because the output is unregulated, voltage will depend on rpm. You should read maybe 5-10 volts. Do not run over 10 volts for more than a minute or you can burn out the generator.**

Flashing the field (this can be performed with generator mounted on bike)

Because the pole shoe is soft iron, it won't hold the magnetism for an indefinite amount of time. This is especially important when using a solid state regulator because they require a generator output of 0.7 volts in order to initialize.

1. **Disconnect the voltage regulator from the generator.**
2. **Connect a temp. jumper to the "hot" terminal of the battery.**
3. **Touch the other end of this jumper to the "F" terminal on the generator. Maybe touch it several times holding no more than a second. This should be enough to re-establish the field magnetism.**

6 volts or 12 volts ?

Early cycles used the short E3H generator which was rated at 48 watts (or 8 amps). Around 1950 most manufacturers upgraded to the longer E3L generator rated at 60 watts (or 10 amps). These instruments were designed to give full output at approx. 20-25 mph and are certainly adequate for putting around town. And considering that the majority of vintage Brit bikes are ridden during daylight hours, lighting is seldom needed except perhaps for annual safety inspections.

Should I convert to a 12 volt electrical system? The first question I must ask is.... why? Most of the time the reason is to have brighter lights, which I can certainly understand. The standard 6v. tungsten headlight bulb provided by Lucas is 24/36 watts. This means your low beam is 24 watts. In this case we offer an easy solution. We stock a 6v. halogen 36/36 watt bulb that fits into the existing Lucas bulb holder without any modification. Cost is a mere $15.

Most Brit bikes with DC generators are 50's vintage, or earlier. Most are not suitable for high speed highway cruising (except Vincent, of course). If you do a lot of night riding and feel the overwhelming desire to have a 12 volt electrical system, there are two ways to do it-

1. **Use a 6-to-12 volt conversion regulator. This is the most economical way to achieve 12 volts, but there is one caveat to this method. As mentioned above, the output voltage depends upon three factors, one of which is the number of turns of wire on the armature. The 6 v. dynamo was designed to give full output at normal road speed. (Notice chronometric speedos have a mark at 30 mph, which was usually the speed limit back then.) If you want it to put out 12 volts, you must spin it twice as fast. Not a problem if you ride a Vincent and plan to cruise the Interstate, but don't plan on putting around town in high gear at 30 mph and maintain a charged battery. But one advantage will be increased efficiency, thus increasing safe output to maybe 90 watts. Running a higher powered halogen headlamp should be no problem, if this is your goal.**
    - **Advantages - Low cost and higher power output for halogen headlamp.**
    - **Disadvantages - You must maintain higher rpm in order to maintain full output.**
2. **Convert the generator to 12 volt specifications. This involves replacing both the armature and field coil with special units designed for 12 volt operation. The specially wound 12v armature will give you full output at lower rpm. The special**

field coil will give maximum magnetic flux whilst drawing a minimum amount of current. You must also use a special ELEKTRONIC-DATA-KLEIBER 12v solid state regulator (06000D/1 or 01600C/1) that is designed for this purpose. The only drawback, if you can call it that, is you still have a 60 watt instrument. It will be adequate for normal 12v. 45 watt bulbs, but don't attempt to run the high powered ones.

- **Advantages - Full 12v output at lower rpm.**
- **Disadvantages - Higher cost for special 12v armature and 12v field coil. You are still limited to 60 watts output (12v @ 5 amps)**