Instrument Lighting Rheostats

Many of us who drive LBCs have good reason to regard our parts suppliers with some ambivalence. On the one hand we applaud them for making sure there is a continuous supply of parts, so that our cars are easy to own and keep running; in fact our situation in this regard is enviable. On the other hand, some of the repro parts just aren't of the same quality as the originals, so much so that, as far as some electrical parts are concerned, I have heard the severest Lucas critic forced admit that maybe their products were actually pretty good quality after all

Fig. 1. Panel Lamp Rheostat

Not long ago I was asked to look at a rheostat that had apparently failed after a very short period of use. In my book *MGB Electrical Systems*, I describe the panel dimming device as a "cruel joke" because I can't see why MG and other car manufacturers thought anyone would need to further reduce the brightness of lamps which were so pathetically dim anyway. In spite of my disdain for the part, I agreed to look at it. Upon its receipt, a simple test with an ohm-meter confirmed it to be open circuit.

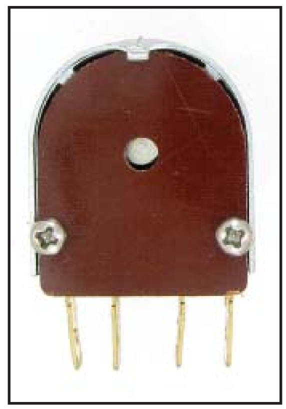

Fig. 2. New rheostat

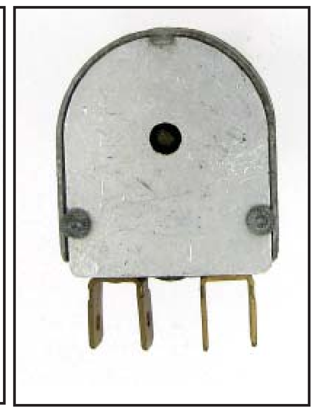

Fig. 3. NOS rheostat

The external appearance of the rheostat was similar to the original Lucas part. The most obvious differences were:
— The new part had been supplied without an operating knob.
— The back was of a fiber-board style material retained with screws (Figure 2), rather than a metal back retained with rivets (Figure 3).

The original Lucas panel lamp rheostat was constructed using a wire-wound resistor capable off dissipating relatively high power. One of the rheostat's 2 terminals was connected to one end of the wire-wound resistor and the other to a wiper that traveled the length of the resistor as the operating knob was turned. When the wiper was furthest from the terminated end of the resistor the rheostat would be at its maximum resistance of about 27Ω and when closest, the resistance would be as close to zero as measurable.

On opening the failed new rheostat it was found to contain 15, 1Ω 0603 format resistors, surface mounted on a printed circuit board (PCB) (Fig. 4). As the operating knob was turned, the PCB rotated with it under fixed wiper contacts so that any number between 0 and 15 resistors, mounted on the PCB, would be connected in series, providing a maximum of 15Ω resistance to dim the panel lamps. Once the knob and PCB was turned past the 15th resistor, one wiper would pass to unterminated circuit pads, opening the circuit completely; like a switch.

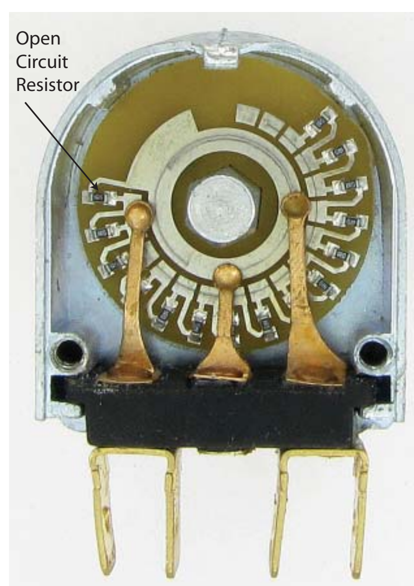

Fig. 4. New rheostat internal

The obvious electrical difference between the two is that the new type only has a maximum resistance of 15Ω against the original's 27Ω. Testing with 8.8 Watts of lighting (4 x 2.2W panel lamps) showed that the original 27Ω ohm device would reduce the voltage across the lamps to about 4V, which because of the 4^{th} power rule between incandescent lamp voltage and brightness, reduced their light output to only 0.8% of that at the design voltage of 13.5V. The new 15Ω maximum device would reduce the lamp voltage to about 6.5V, equating to a brightness reduction to 5%, which is probably adequate, especially since the panel lamps are so dim to start with.

The returned rheostat had failed because the first resistor in the string was open circuit. Since all other resistors are progressively joined in series with the first one, with it open, no others came into operation.

The first resistor takes the maximum wattage, The standard panel lamps are 2.2W @13,5V. There are 4 in most applications, making a total of 8.8W @ 13.5V, with an effective resistance of ~21Ω and a current draw of ~0.65A. With only the first resistor in circuit the current drops a little but not quite as per Ohms law because of the nonlinearity of the bulbs' resistance. In fact as the graph shows, with only the first resistance in circuit, it has to dissipate over 0.4W, more than 400% of its rated value The 0603 resistor is capable of dissipating only 0.1W max and so when operating at many times over its rated value, it will overheat and fail in a few minutes. Even if we consider that the car cabin is much cooler than some of the applications in which this resistor is found (it is mostly used for computers), and we re-rate it at 0.2W, only when all 15 resistors are in circuit, to share the load and cut the current to its minimum, does the dissipation of each resistor in circuit reach this value. Failure would be even more rapid if the device were used to control more bulbs or higher wattage bulbs, such as halogen types.

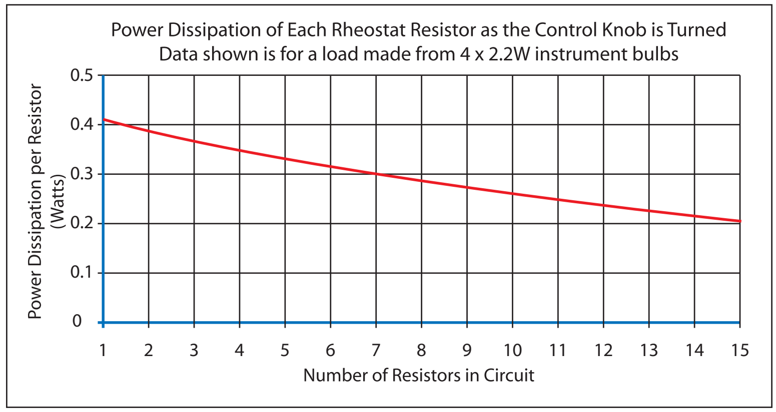

Fig. 5. Power dissipation of rheostat resistors

My conclusion is that this substitute for a rheostat it is not fit for the purpose for which it is intended.

Rick Astley
Author of MGB Electrical Systems and Classic British Car Electrical Systems.