July 17, 1956 C. B. STILES 2,755,400

ELECTROLUMINESCENT LAMP

Filed Nov. 22, 1952

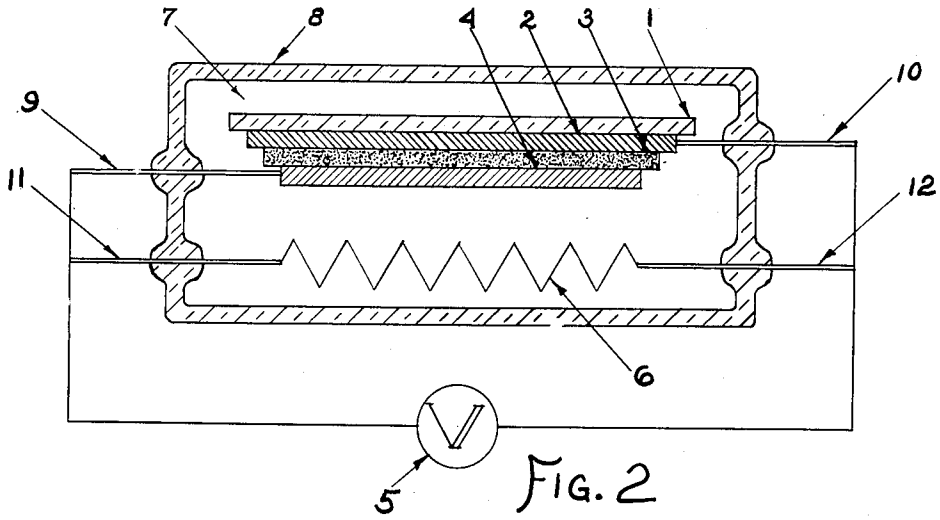


FIG. 2

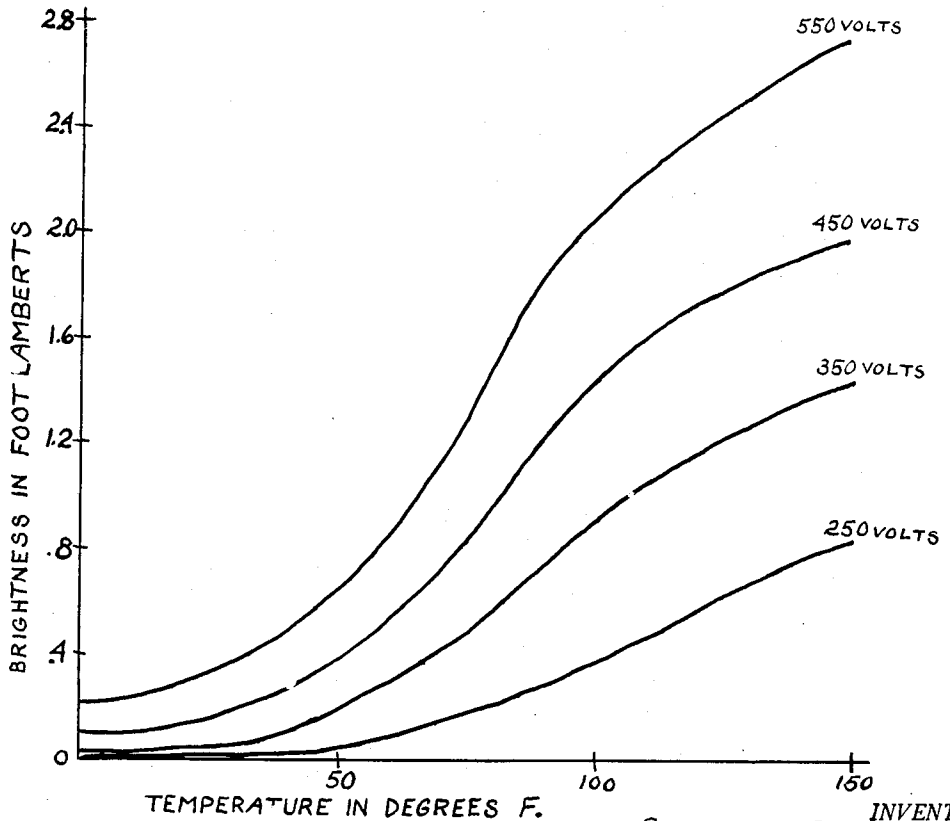


FIG. 1

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2,755,400
ELECTROLUMINESCENT LAMP

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Application November 22, 1952, Serial No. 322,007
6 Claims. (Cl. 313—15)

This invention relates to electroluminescent lamps, that is, to lamps in which an electroluminescent phosphor is excited by an electric field to emit light.

Such lamps have previously been operated at low temperatures, because the input at the voltages used was not sufficient to raise the temperature of the lamp more than a few degrees above ambient.

I have found, however, that the light output greatly increases as the temperature is raised above about 100° F. In some cases, the output is increased six times or more above that obtainable at room temperature.

An increase of temperature was formerly believed to be deleterious to the phosphor, since it would increase the speed of the blackening reaction which occurs in the presence of light and moisture. However, if the wattage available for heating the lamp is sufficient, the phosphor may in operation be dried quickly enough to reduce the amount of the reaction.

The desired increase in temperature can be obtained by heating the lamp with external means, such as a separate heater resistance, or by increasing the resistance of the lamp electrodes, for example, by increasing the resistance of the transparent conductive layer generally used as an electrode. The currents in the lamp are so small, however, that a series resistance such as that in the transparent conductive coating would not usually be sufficient in itself to raise the temperature sufficiently.

A further means of increasing the temperature is to increase the voltage across the lamp, and still another means is to increase the frequency sufficiently. At the same time, the thickness of the glass plate, generally associated with the lamp should be decreased to reduce its heat capacity, and the metal backing layer of the lamp should be thermally insulated to remain out of contact with any heat-conducting bodies to which energy might be lost. In some cases, it may even be desirable to enclose the unit in an outer envelope, spaced from the unit itself, to insure a higher temperature's being reached.

Figure 1 is a graph of the lamp brightness in footlamberts plotted against lamp temperature in degrees Fahrenheit, for several different voltages. Figure 2 is a view, partly in section of a lamp according to one embodiment of the invention. In Figure 2, the glass plate **1** has a transparent conductive coating **2** thereon, a layer **3** of an electroluminescent phosphor over that, and a layer **4** of conductive material over the phosphor layer **3**. The phosphor layer **3** can consist of a pressed layer of phosphor particles, as in co-pending U. S. application, Serial No. 305,400, filed August 20, 1952, by Laurence Burns, or of a layer comprising phosphor particles embedded in a solid dielectric material, as in copending application Serial No. 180,783 filed August 22, 1950, by Elmer C. Payne. A suitable thickness of dielectric material, can be about 0.002 inch, for example.

The transparent conductive coating **2** can be of stannous chloride or some other material, as shown, for example, in U. S. Patent application, Serial No. 120,398, now Patent No. 2,624,857, filed October 8, 1949, by Eric L. Mager, and the conductive layer **4** can be of aluminum or other metal as shown in that application. The phosphor itself can be, for example, of zinc sulfide activated with lead and copper, as shown in copending application Serial No. 230,711, filed June 8, 1951 by Keith H. Butler.

A voltage source **5**, which can be, for example, of 660 volts, 60 cycles per second A. C. is shown schematically in Figure 2, as is also a heating resistance **6**, which is shown connected in shunt to the lamp. However, it will generally be more efficient to let the lamp heat itself, by raising the voltage or frequency or both, and reducing the heat losses, for example by making the glass plate **1** and other parts of the lamp very thin so that not much energy will be required to heat them, and by enclosing the unit in an inverted outer envelope **8**, shown schematically in Figure 1. The conductive parts, being of large area, should be thoroughly insulated from any exposed metallic parts, if any are used.

Lead-in wires **9**, **10**, which may also act as supports, are sealed through the envelope **8** and attached to the conductive coatings **2** and **4** respectively, for example, in the manner shown in copending application Serial No. 230,596, filed June 8, 1951, by Keith H. Butler et al. Lead-in wires **11**, **12** are connected to opposite ends of the heating resistance **6**, which may conveniently be a tungsten filament, nichrome wire or the like.

The present electroluminescent lamps have a power loading of less than 1 watt per 25 square inches, which is not sufficient to produce a temperature rise of more than a few degrees. Loadings much higher than this are necessary to bring the lamp to temperatures of 100° F. and above with the present lamps. The amount of heat necessary can however be reduced by reducing the heat losses in the manner shown.

The electroluminescent lamp used can be made with the phosphor embedded in a ceramic material, if desired, with conductive coatings on each side, for example, as shown in an application Serial No. 282,003, filed April 12, 1952 by Richard M. Rulon.

The space **7** inside the envelope **8** may be evacuated or filled with a gas, preferably a gas inert with respect to the materials used.

What I claim is:

1. An electroluminescent lamp including an electroluminescent phosphor, and means for heating said lamp to a temperature above 100° F., and below any temperature deleterious to the phosphor quickly enough to prevent deterioration of the phosphor.

2. An electroluminescent lamp including an electroluminescent phosphor layer on a conductive coating of sufficient resistance to heat the lamp to a temperature of 100° F. with a predetermined current, at a sufficiently rapid rate to prevent deterioration of the phosphor.

3. An electroluminescent lamp including an electroluminescent phosphor, and means for operating said lamp at a loading above about 1 watt per square inch of surface area and below any loading sufficient to operate the lamp at a temperature deleterious to the phosphor.

4. An electroluminescent lamp including an electroluminescent phosphor, and means for operating said lamp at a frequency high enough to raise the temperature of said lamp above about 100° F., and below any temperature deleterious to the phosphor at a sufficiently rapid rate to prevent deterioration of the phosphor.

5. An electroluminescent lamp including an electroluminescent phosphor, and an enclosing envelope for said lamp to increase its operating temperature to a value above 100° F. but below any temperature deleterious to the phosphor, at a sufficiently rapid rate to prevent deterioration of said phosphor.

6. An electroluminescent lamp including an electroluminescent phosphor and means for heating said lamp to a temperature between 100° F. and 150° F., quickly enough to prevent deterioration of the phosphor.

References Cited in the file of this patent

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2,624,857 Mager ---------- Jan. 6, 1953