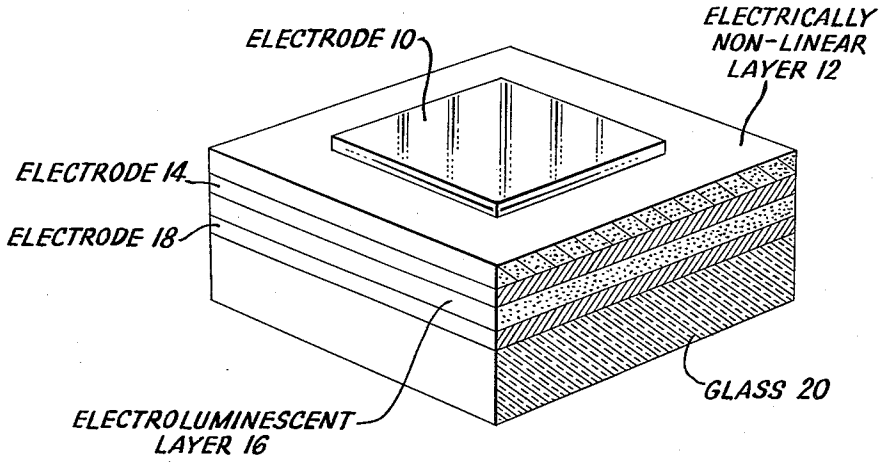
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ELECTROLUMINESCENT LIGHT SOURCE

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ELECTROLUMINESCENT LIGHT SOURCE

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My invention is directed toward electroluminescent light sources.

Electroluminescent light sources normally comprise a solid electroluminescent layer subtended between and electrically connected to first and second spaced apart electrodes, at least one of which permits the passage of light therethrough. When a voltage is applied between the two electrodes, light is produced, the amount of light being determined by the magnitude or amplitude of the applied voltage.

In many applications, as for example wherein electroluminescent light sources are used in combination with photo-conductors as switches, it is highly desirable to utilize an electroluminescent light source which has a threshold response to applied voltages. A threshold response is required, for example, when the source is to produce light for an applied voltage which equals or exceeds a predetermined value and is to produce no light when the applied voltage falls below this value.

I have invenied a new type of electroluminescent light source which has such a threshold response. In particular, my source has such a sharp threshold response that as the ampiitude or magnitude of the applied voltage is increased by a factor of two for a specified level, the light output of my source can be increased by a factor substantially in excess of 10,000.

In accordance with the principles of my invention, my electroluminescent light sources comprise first, second and third electrodes, at least the third electrode permitting the passage of light therethrough. An electroluminescent layer is interposed between the second and third electrodes, and a layer of electrically non-linear material is interposed between the first and second electrodes. (This non-linear layer, in response to a voltage applied thereto, exhibits an electrical impedance which decreases as the voltage is increased.) The first electrode is smaller in area than the second electrode. The surface of the non-linear layer is substantially equal to the surface area of the electroluminescent layer.

When an alternating voltage is applied between the first and third electrodes, it will be found that, at low voltage values, the impedance of the non-linear layer is high relative to that of the electroluminescent layer, and there will be substantially no light emitted from the electroluminescent layer. As the amplitude of the voltage is increased, the impedance of the non-linear layer, relative to that of the electroluminescent layer decreases very rapidly. As a consequence, light is emitted from the electroluminescent layer, the total light emitted increasing very rapidly with relatively small increases in the amplitude of the applied voltage.

The electroluminescent layer, together with the second and third electrodes, acts electrically as a luminous capacitor. The non-linear layer, together with the first and second electrodes, acts electrically as a network constituted by a non-linear resistor shunted by a capacitor.

The use of the first and second electrodes of differing areas permits the capacitance of the non-linear layer to be adjusted with respect to the capacitance of the electroluminescent section of my source so as to produce tne threshold effect described above. In the absence of the third electrode, I have found that the impedances of the non-linear layer and the electroluminescent layer cannot

be adjusted properly relative to each other and my source will not function in the manner desired.

An illustrative embodiment of my invention will now be described with reference to the accompanying figure.

Referring to the figure, there is shown an electroluminescent device having a first electrode **10**, a second electrode **14** and a third transparent electrode **18**. An electrically non-linear layer **12** is interposed between electrodes **10** and **14**. An electroluminescent layer **16** is interposed between electrodes **14** and **18**. The entire structure including electrode **18** is supported on a glass substrate **20**.

The electrode **18** can be formed from transparent tin oxide films. Electrodes **10** and **14** can be formed from the same material, or alternatively can be formed from an opaque metal, such as gold. The non-linear layer can be composed of cadmium sulfide particles (which are either free from copper or contain a small amount of copper), embedded in a glass enamel, as disclosed, for example, in my copending patent application Serial No. 827,111, filed July 14, 1959. The electroluminescent layer can comprise a dispersion of electroluminescent (copper activated zinc sulfide) particles also embedded in a glass enamel. Typically, the electroluminescent layer can be 1.5–2.5 mils thick. The non-linear layer typically can be about four times as thick as the electroluminescent layer.

As shown in the FIGURE, the area of the first electrode is smaller than the area of the second electrode. By adjusting the ratio of the area of the first electrode to that of the second electrode, the relative impedance values of the non-linear and electroluminescent portions of my device can be suitably adjusted in the manner previously indicated. Typically, this ratio can fall within the range 0.25–0.50.

When a 6000 c.p.s. voltage having a R.M.S. value of 250 volts was applied to a device as described above, the light output was found to be about 20 foot lamberts. As the R.M.S. value was reduced to 125 volts, the light output dropped below 0.001 foot lamberts.

What is claimed is:

1. An electroluminescent device comprising first, second and third electrodes, the second electrode being interposed between the first and third electrodes, the third electrode permitting the passage of light therethrough, the area of the first electrode being less than that of said second electrode; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel, the surface areas of both of said layers being substantially equal.

2. An electroluminescent device comprising first, second and third electrodes, the second electrode being interposed between the first and third electrodes, the third electrode being transparent, the first and second electrodes being opaque, the area of the first electrode being less than that of said second electrode; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel, the surface areas of both of said layers being substantially equal.

3. An electroluminescent device comprising first, second and third transparent electrodes, the second electrode being interposed between the first and third electrodes, the area of the first electrode being less than that of said second electrode; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and

second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel, the surface areas of both of said layers being substantially equal.

4. An electroluminescent device comprising first, second and third electrodes, the second electrode being interposed between the first and third electrodes, the third electrode permitting the passage of light therethrough, the area of the first electrode being less than that of said second electrode; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel, the surface areas of both of said layers being substantially equal, the ratio of the surface area of the first electrode to the surface area of the second electrode falling within the range 0.25-0.50.

5. An electroluminescent device comprising first, second and third electrodes, the second electrode being interposed between the first and third electrodes, the third electrode permitting the passage of light therethrough, the area of the first electrode being less than that of said second electrodes; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel, the surface areas of both of said layers being substantially equal, the ratio of the surface area of the first electrode to the surface area of the second electrode falling within the range 0.25–0.50, the ratio of the thickness of the non-linear layer to that of the electroluminescent layer being approximately 4:1.

6. An electroluminescent device comprising first, second and third electrodes, the second electrode being interposed between the first and third electrodes, the third electrode permitting the passage of light therethrough, the area of the first electrode being less than that of said second electrode; an electroluminescent layer interposed between said second and third electrodes; and an electrically non-linear layer interposed between said first and second electrodes, said non-linear layer consisting of cadmium sulfide particles embedded in a glass enamel.

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