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COMPENSATION CIRCUIT FOR ELECTROLUMINESCENT LAMPS

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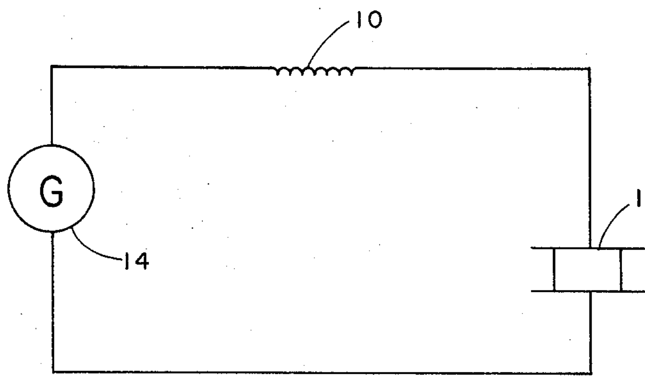

FIG. 1

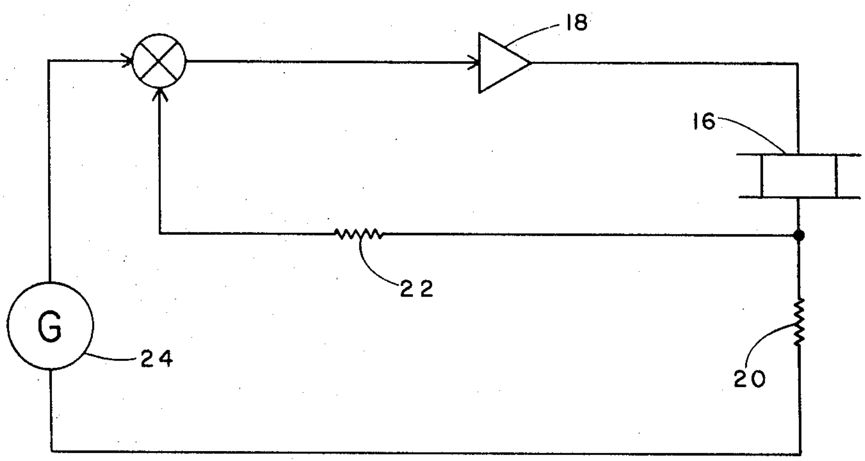

FIG. 2

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COMPENSATION CIRCUIT FOR ELECTRO-LUMINESCENT LAMPS

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U.S. Cl. 315—283 **6 Claims**

This invention pertains to a compensating circuit for electroluminescent lamps. More particularly the device of this invention is a means for maintaining a substantially constant light intensity from an electroluminescent lamp.

Present known electroluminescent lamps utilize crystalline phosphors which fluoresce upon application of an alternating current. It is commonly observed that such lamps change light intensity over a continued period of operation. Under continued operation, an aging process produces changes in the crystalline phosphor grains. These changes are evidenced by steadily decreasing photo-conductivity and dark conductivity in the phosphor grains. The decrease in light intensity (lumen output) has been found to be proportional to the decrease in current through the electroluminescent material when operated at a constant voltage and constant frequency. This decrease in lumen output under such operation is approximately 40 percent in the first 1000 hours of operation.

It has been discovered that the impedance of an electroluminescent lamp varies over the life of the lamp. Further measurements verify that, with the frequency constant, the intensity of the lamp is dependent upon the current flow through the lamp rather than the voltage across it.

In accordance with this invention a constant current device is used to drive an electroluminescent lamp. One means for maintaining the current flow substantially constant through electroluminescent lamps is to insert in series with the lamp an impedance device whose impedance at a predetermined frequency of excitation voltage is substantially greater than the impedance of the lamp at that frequency.

It has also been observed that the intensity of the luminescence of the lamp varies directly with frequency. If the impedance noted above which is inserted in series with the electroluminescent device is inductive in nature, the current which flows through the electroluminescent device not only is maintained at a substantially constant value at the operating frequency of excitation originally chosen, but also this current is decreased in the event that the frequency increases thereby causing the actual intensity of luminescence emitted by the lamp to remain substantially the same over a band of frequencies. By the use of the inductive impedance in series with the electroluminescent lamp, the decrease in light intensity has been reduced to less than 3 percent in the first 1000 hours.

It is thus an object of this invention to provide a means for maintaining substantially constant the light intensity output of an electroluminescent lamp.

It is another object of this invention to provide a means for maintaining substantially constant with varying frequency, and for extended life the light intensity output of an electroluminescent lamp.

Other objects will become apparent from the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is a schematic diagram of a first embodiment of the device of this invention; and

FIGURE 2 is a schematic diagram of a second embodiment of the device of this invention.

The circuit of FIGURE 1 shows an inductor **10** connected in series with an electroluminescent lamp **12** in series with a voltage source **14**. It is to be stressed that a resistive or capacitive impedance could be used in place of the inductive impedance **10**. A resistive impedance would have the defect that it would utilize additional power. An inductive impedance **10** has the additional advantage that if the frequency of the voltage of generator **14** increases, the impedance of the inductor **10** also increases, thereby decreasing the current flow through the electroluminescent lamp **12** and maintaining the light intensity of lamp **12** at a substantially constant level. The inductor **10** must have an impedance at the desired frequency of excitation which is very high compared to the impedance of lamp **12** at that frequency (for example ten times the value) so that changes in the internal impedance of lamp **12** do not substantially vary the current flowing through it.

Second means for maintaining constant current through a lamp **16** is shown in FIGURE 2. In FIGURE 2, amplifier **18** is connected in series with electroluminescent lamp **16** which, in turn, is in series with resistor **20**. This combination of circuit components is connected across a source of operating voltage **24** which may be similar to generator **14** of FIG. 1. Resistor **22** provides a current feedback path to the input of amplifier **18**. Amplifier **18** may be made frequency sensitive, by known techniques, to cause its output current to decrease as the frequency increases, thereby to maintain substantially constant illumination intensity.

In operation, excitation current from source **24** will flow through amplifier **18**, electroluminescent device **16**, and resistance **20** of FIG. 2, thereby causing the device **16** to luminesce, and also producing a voltage drop across resistor **20**. The voltage developed across this resistance is also impressed upon resistor **22**, which with it connecting circuitry comprises a feedback loop **26**. The feedback voltage from loop **26** is imposed upon the input of amplifier **18** by way of a summing matrix, which may be one of several suitable known designs and which is designated by the conventional mixing-point symbol **30** used by some text writers (particularly, Prof. Ryder at page 614 of his text "Engineering Electronics") to symbolically indicate a matrix which algebraically sums different voltages into a single resultant voltage. As shown in the figure, the matrix **30** receives excitation voltage from source **24** (note arrow **32**) and also the feedback voltage from loop **26** (note arrow **28**). As is indicated by the direction of arrow **34**, the excitation and feedback voltages are mixed or summed by matrix **30** in a manner well-known to those skilled in the art, and the resultant of these two voltages is the input supplied to amplifier **18**.

As may be deduced from examining the circuit of FIG. 2, in the event that the total current flowing through electroluminescent device **16** is decreased due to the increased internal impedance of the device resulting from the aging process noted, the voltage developed across resistor **20** and present in feedback loop **26** will be reduced accordingly. Thus, the resultant voltage from the source **24** and the feedback loop will be changed, and amplifier **18** will be supplied an input which is different from that previously present at this point. When this occurs, the output from the amplifier is of necessity altered accordingly, and this produces a current flow through the device **16** of the same magnitude as that originally present there, thereby returning the circuit to its orginal operating condition, and maintaining the luminescence from device **16** at the same level as before.

The device of this invention then maintains the light intensity of an electroluminescent lamp substantially constant with variable applied voltage and variable applied frequency.

Although the device of this invention has been described in detail above it is not intended that the invention should be limited thereby but only in accordance with the spirit and scope of the appended claims.

We claim:

1. A control circuit for maintaining a constant intensity of luminescence from electroluminescent devices, comprising: a source of excitation voltage having a predetermined frequency, an electroluminescent device in series with said source; and means interposed in circuit between said source and said device for maintaining the current flowing through said device at a value which is not affected by changes in the impedance of said device, said means including a component which, at the operating frequency of said source, has an impedance much larger than that of said electroluminescent device such that said current is substantially determined solely by said component.

2. A constant lumen output circuit for electroluminescent devices as defined in claim **1**, wherein said circuit component increases its impedance with increases in the frequency of the voltage supplied by said source.

3. The constant lumen output circuit for electroluminescent devices as defined in claim **2**, wherein said circuit component comprises an inductor placed in series with said source and said device.

4. A control circuit for maintaining a constant intensity of luminescence from electroluminescent devices, comprising: a source of excitation voltage having a predetermined frequency, an electroluminescent device in series with said source; and means interposed in said circuit between said source and said device for maintaining the current flowing through said device at a value which is not affected by changes in the impedance of said device, wherein said means includes an amplifier coupled between said electroluminescent device and said source, and also includes a feedback system for providing a signal to said amplifier representative of current flow through said electroluminescent device; said feedback system and said amplifier being arranged so that the latter maintains the current flowing from it to said electroluminescent device at a predetermined value in response to changes in the internal impedance of said device.

5. A device as recited in claim **4** wherein the said amplifier is frequency sensitive to cause its output current to decrease as its input frequency increases.

6. An electroluminescent device combination which displays a light output of predetermined maintenance characteristics throughout a prolonged period of operation, said combination comprising: electroluminescent means operable to produce light when an alternating potential is applied thereto and also possessing inherent capacitance of predetermined value which decreases in value during operation, and said electroluminescent means displaying a light output which decreases during normal operation under energization by a constant alternating potential; inductor and resistance means of predetermined value connected in series with said electroluminescent means; a series circuit, having a predetermined value of Q, formed by said electroluminescent means and said series-connected inductor and resistance means; potential source means adapted to deliver a predetermined potential of predetermined frequency and connected across said series circuit; and the said means comprising said series circuit having such relative values of resistance and reactance that when initially energized by said potential source means, the potential developed across said inductor and resistor means differs by a predetermined amount from the potential developed across scaid electroluminescent means, and during operation the normal decrease in light output from said electroluminescent means is modified in predetermined fashion by the change in effective energizing potential developed thereacross as the operation of said series circuit is shifted with respect to a condition of resonance.

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