Sept. 13, 1960 L. C. MERRILL 2,952,793

GLOW LAMP

Filed Sept. 27, 1957

Fig. 1.

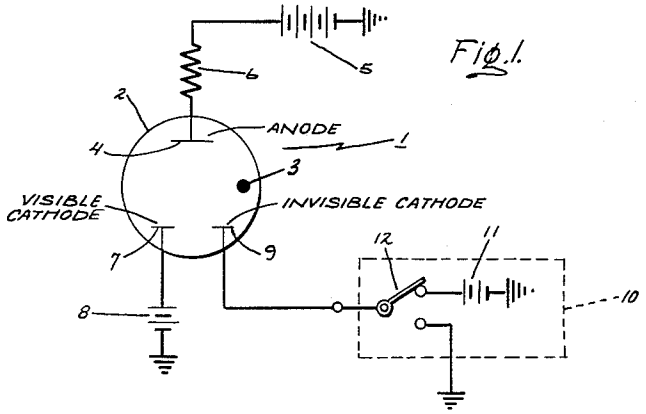


Fig. 2.

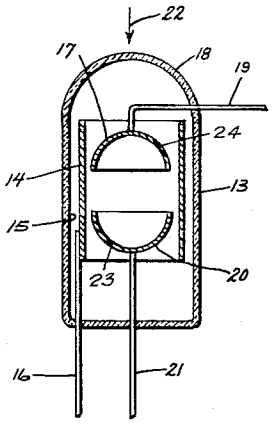


Fig. 3.

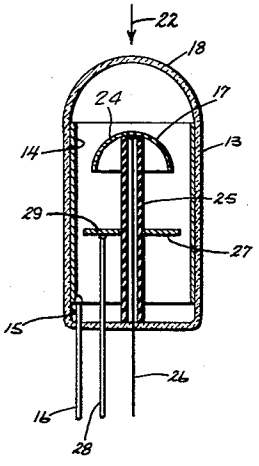
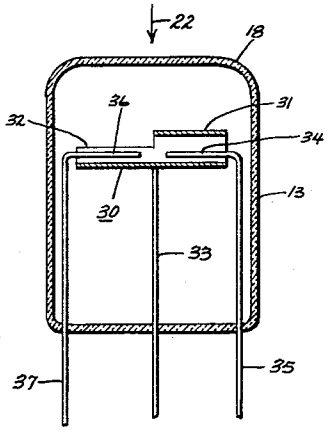


Fig. 4.



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GLOW LAMP

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3 Claims. (Cl. 313—217)

This invention relates to glow lamps, for example, low pressure neon glow lamps, and particularly to a glow lamp construction and circuit in which the glow can be made visible or invisible to external viewing.

There are many instances in the design of electrical circuits, for example, the "flip flop" circuits in computers, when it is desirable to provide means for indicating the condition of the circuit, i.e., whether the circuit is "on" or "off." When vacuum tubes are employed in such circuits, sufficiently large voltages are available to illuminate conventional glow indicating lamps. However, when transistors are employed, the voltages available are not sufficient to operate conventional indicating lamps and this fact has, in the past, necessitated the use of either relays, amplifying devices, or critical biasing arrangements for the operation of indicators. It is therefore desirable to provide an indicating lamp which can be operated on a low voltage circuit and more particularly with low voltage control.

Neon glow lamps are commonly used for indicating purposes. Such lamps conventionally have an anode and cathode positioned within a glass envelope filled with neon, argon, and sometimes other gases at low pressure. When the rated direct current potential (typically 65 volts) is applied across the anode and cathode of such lamps, ionization of the gas occurs around the cathode thereby causing the characteristic cathode glow in the region of the cathode; under these conditions, a very low space charge current flows between the cathode and anode. I have found that by providing a glow lamp with two cathodes, it is possible to cause the cathode glow to shift from one cathode to the other reliably and with a very low differential in voltage, i.e., as low as on the order of five volts. This invention, therefore, in its broader aspects, contemplates a glow lamp having two cathodes, one of which is visible from the exterior of the envelope and the other being invisible. Such a lamp may therefore be employed with an auxiliary means which will normally supply a sufficient biasing potential on the anode so that a cathode glow will be formed, while the circuit to be indicated will selectively apply a suitable voltage differential between the two cathodes thereby causing the cathode glow to shift or switch from the invisible to the visible cathode, or vice-versa, thus indicating the occurrence of specific conditions in the circuitry to which the lamp is connected.

It is therefore an object of this invention to provide a glow lamp having a visible cathode and an invisible cathode with a common region of ionization.

Another object of this invention is to provide a glow lamp having one cathode arranged so that its cathode glow is visible from the exterior of the envelope of the lamp and having another cathode arranged so that its cathode glow is invisible from the exterior of the envelope, the two cathodes having a region of common ionization.

A further object of this invention is to provide a glow lamp having a visible cathode and an invisible cathode

with circuit connections for applying a differential voltage to the cathodes so that the cathode glow may be selectively switched from one to the other cathode.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a schematic illustration showing my improved glow lamp indicator with typical circuit connections for causing the cathode glow to shift from the visible cathode to the invisible cathode;

Fig. 2 is a cross-sectional view of a glow lamp incorporating one form of my invention;

Fig. 3 is a cross-sectional view showing a modified form of my invention; and

Fig. 4 is a cross-sectional view showing yet another form of the improved glow lamp of my invention.

Referring now to Fig. 1, there is shown a glow lamp, generally identified as **1**, having an enclosing envelope **2** which may be filled with suitable gas at low pressure, such as neon, argon, helium, and possibly traces of other gasses, as is well known in the art, shown schematically at **3**. An anode **4** is positioned within the envelope **2** and may be connected to a suitable source of positive direct current biasing potential, such as 150 volts, shown here as a battery **5**, by a ballast resistor **6**, which may have, for example, 470,000 ohms. A first cathode **7** is provided which may be connected to a suitable source of direct current biasing potential, such as plus 5 volts, shown here as battery **8**. Cathode **7** is arranged so that its cathode glow is visible from the exterior of the envelope **2**. A second cathode **9** is provided which may be connected to external circuitry, such as a "flip-flop" circuit, as shown in the dashed lines **10**. The "flip-flop" circuit **10** may, for example, in its "off" position, impress a differential biasing potential, such as plus 10 volts direct current, shown here as being a battery **11**, on the cathode **9**, and in its "on" position impress zero volts on the cathode **9**. This selective impressing of either plus 10 volts or zero volts on the cathode **9** is shown here schematically by a switch **12**. Cathode **9** is arranged so that its cathode glow is invisible from the exterior of the envelope **2**.

I have found that when the two cathodes **7** and **9** are physically closely spaced so that they have a common ionization region, the cathode glow will slide from the visible cathode **7** to the invisible cathode **9** when the positive voltage differential **11** is applied to the invisible cathode **9**. Conversely, when the differential biasing potential **11** is removed from the invisible cathode **9**, the cathode glow will again slide or switch back to the visible cathode **7** under the influence of its biasing potential **8**. It will now be seen that the cathode glow of the glow lamp **1** can be made to shift or switch from its visible to its invisible condition in response to a very small differential voltage, this differential voltage being on the order of that available in transistor circuits.

Referring now to Fig. 2, there is shown a physical embodiment of the glow lamp **1** of Fig. 1, in which a glass envelope **13** is provided with a cylindrical metal anode **14** disposed therein as shown. It will be here readily understood that the anode **14** may be formed as a conductive coating on the inner wall **15** of the envelope **13**, as is well known in the art. An external lead **16** is connected to the anode **14**, as shown. A cup-shaped cathode **17** is disposed within the anode **14** facing away from the viewing end **18** of the envelope **13**, and having an external lead **19**. Another cup-shaped cathode **20** is positioned within the anode **14** spaced from and facing the open end of the cathode **17** and having an external lead

21. It will now be seen that when the envelope 13 is viewed from the end 18, as shown by the arrow 22, the cathode glow of the cathode 17 will form on the outer surface 24 and thus be visible while the cathode glow of the cathode 20 will form on its outer surface 23 and thus be invisible.

Referring now to Fig. 3 in which like parts are indicated by like reference numerals, here the anode 14 is shown as being deposited on the inner surface 15 of the envelope 18. Here, again, a cup-shaped cathode 17 is provided positioned within the anode 14 and facing away from the viewing end 18 of the envelope 13. Here, the cathode 17 is mounted on an insulating support 25 through which its external lead 26 extends. Also mounted upon the insulating support 25 is an annular planar cathode 27 having an external lead 28. It will now again be seen that when viewed from the end 18 of the envelope 13, as indicated by the arrow 22, the cathode glow of the cathode 27 will form on its surface 29 and thus be invisible from the exterior of the envelope 13, since cathode 27 is behind cathode 17 as viewed in the direction shown by the arrow 22, while the cathode glow of the cathode 17 will be formed on its outer surface 24 and thus be visible from the exterior of the envelope 13. In the case of both the embodiments of Figs. 2 and 3, it will be seen that the cathodes 17 and 20, and 17 and 27 respectively, are relatively closely spaced so that they have a common ionization region, thus permitting the cathode glow to shift or slide from one to the other responsive to a small change in the relative voltages applied thereto, as explained above in connection with Fig. 1.

Referring now to Fig. 4, here an anode 30 is provided having a first tubular portion 31 and a second portion 32 extending from the first portion 31 and having a semicircular cross-section with its open end facing toward the viewing end 18 of the envelope 13. Anode 30 has an external lead 33 extending out of the envelope 13, as shown. A first cathode 34 having external lead 35 is positioned within the tubular portion 31 of anode 30 while a second cathode 36 having an external lead 37 is positioned within the open anode portion 32. It will now be seen that the cathode glow of cathode 34 within the tubular anode portion 31 will be invisible from the exterior of the envelope 13 as viewed in the direction of the arrow 22 while the cathode glow of the cathode 36 will be visible from the exterior of the envelope 13 as viewed in the direction of the arrow 22. It will also be seen that the ends of the cathodes 34 and 36 are closely spaced together so that the two cathodes have a common ionization region thus facilitating shifting of the cathode glow from one to the other responsive to a small change in the voltages respectively applied thereto.

It will now be seen that I have provided a glow lamp usable to provide an indication of two different external conditions, i.e., for example, "on" and "off," the two conditions being indicated by the lamp in response to a differential signal voltage much lower than the total anode-cathode voltage drop of the lamp. This lamp may therefore be directly connected in such circuits as transistorized flip-flop circuits, thus eliminating the requirement for relays or amplifying devices for operation of conventional indicator lamps.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention.

What is claimed is:

1. A glow lamp comprising: an envelope; a cylindrical anode within said envelope; a cup-shaped cathode within said anode; said cup-shaped cathode facing toward one end of said anode and said envelope whereby its cathode glow is visible as viewed from the other end of said envelope; and a large area cathode within said anode spaced from and facing toward the open end of said cup-shaped cathode whereby its cathode glow is invisible as viewed from said other end of said envelope.

2. The glow lamp of claim 1 wherein said large area cathode is cup-shaped with its open end facing toward the open end of said first-named cup-shaped cathode.

3. The glow lamp of claim 1 wherein said large area cathode is planar and annular and disposed in a plane parallel with the open end of said cup-shaped cathode.

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