Aug. 11, 1936. D. D. KNOWLES 2,050,341

GLOW LAMP

Filed Oct. 6, 1928

Fig. 3.

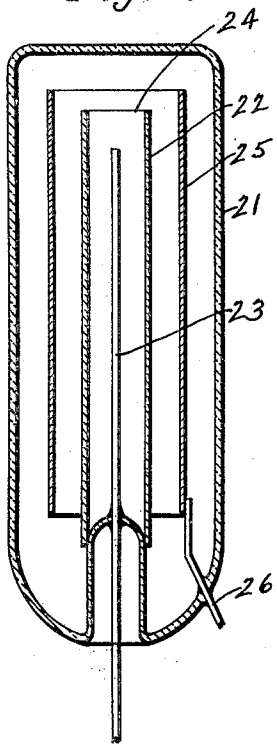


Fig. 1.

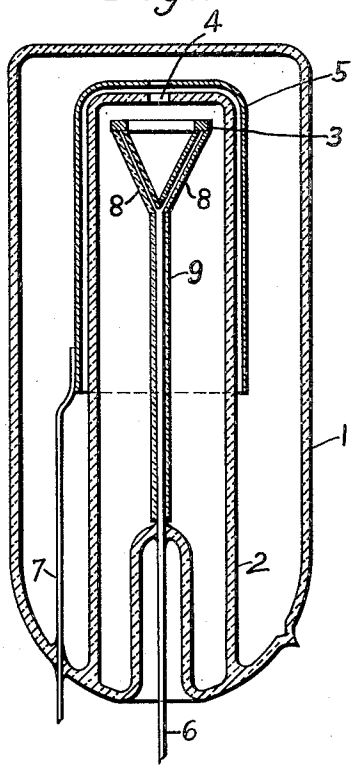
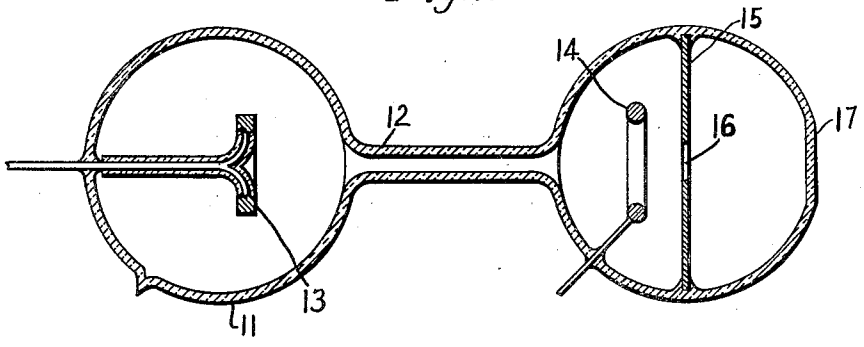


Fig. 2.



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GLOW LAMP

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Application October 6, 1928, Serial No. 310,738

12 Claims. (Cl. 176—122)

My invention relates to glow-discharge lamps and particularly to glow-discharge lamps adapted for use in television and other devices where rapid variation of light intensity is necessary.

One object of my invention is to provide a light source combining high intensity, small dimensions, and ability to respond instantaneously to variations of the electric current supply thereto.

Another object of my invention is to provide a light source combining high intensity with small dimensions and ability to respond rapidly to variations of current supply and having a long operative life devoid of changes in luminous efficiency.

Another object of my invention is to provide a light source of high intensity and capable of rapid response to variations of current supply and in which the major portion of the emitted light is projected in a predetermined direction.

Another object of my invention is to provide a glow-discharge lamp adapted to provide a light source of high intensity and small dimensions which avoids deterioration of the transparency of the walls of the containing vessel through cathode sputtering of the metals constituting the electrodes.

A further object of my invention is to provide a light source of high intensity and capable of rapid response to variations of exciting current in which the luminous area has the form of a relatively long and narrow line.

Other objects of my invention will be apparent upon reading the following specification, in which

Figure 1 is a view, partly in section and partly in elevation, of a glow-discharge lamp embodying one form of my invention, and

Fig. 2 is a view, partly in section and partly in elevation, of another form of glow-discharge lamp embodying the principles of my invention.

Fig. 3 is a view, partly in section and partly in elevation, of another but, simpler, form of glow-discharge lamp embodying principles of my invention.

For many purposes, such as television or photo-film work, a light source is desired which has a high intensity but which is capable of accurate and instantaneous response to rapid fluctuations of some electrical controlling quantity. One of the best devices of this character comprises an electrical-discharge tube in which a glow discharge takes place between a pair of cold electrodes immersed in a gas at a substantial pressure. For many such devices, it is essential that the light source shall be concentrated into a relatively small area, but that the luminous intensity of this area shall be relatively high.

In accordance with one feature of my invention, I provide a light source of the above-described character by producing an electrical discharge between two electrodes, one of which is positioned in the interior of a chamber of insulating material having a single opening in its walls of the size and shape of the luminous source desired. The cooperating electrode is positioned outside this chamber, preferably, closely encircling the opening aforesaid. Electrical discharge produced through a low-pressure gas between these two electrodes is concentrated in the opening aforesaid which thereby provides a luminous source of very high intensity, capable of substantially instantaneous response to fluctuations of the supply voltage.

It is a defect of many glow-discharge lamps of the prior art that the electrical discharge causes what is known as cathode sputtering; that is to say, the surface metal of the cathode being bombarded by the positive ions carrying current through the tube is projected on to the surrounding walls of the container and ultimately renders them opaque to light. The luminous efficiency of the tube, accordingly, rapidly deteriorates with use. In accordance with a feature of my invention, this deterioration of the transparency of the tube walls is substantially prevented by employing an annular cathode within a hollow anode, the only opening in the wall of which, constituting the path of the electrical discharge, is of such small dimensions that virtually no sputtered metal finds its way thereto. Such small amounts as are projected through this small window can scatter over a portion of wall space outside the anode but the amount deposited on the particular spot in the wall through which useful light is projected is negligible.

In accordance with another embodiment of my invention, the anode is separated from the cathode by a tube of insulating material through which the luminous discharge is compelled to pass; and the light emitted by this discharge is compelled to pass, in turn, through a relatively small perforation in an opaque screen, this perforation, accordingly, acting as the luminous source of small area. The cathode is then made in the form of a ring having its center on the line connecting the insulating tube and the perforation in the screen, and of such diameter that any sputtered metal emanating from this ring and passing through the aperture in the screen cannot lodge on that portion of the tube wall

through which the useful light beam is projected.

With the foregoing purposes and principles in mind, my invention may be understood by reference to the accompanying drawing, in Fig. 1 of which 1 designates a tube of glass or other transparent vacuum-tight material. Within the tube 1, and, if desired, continuous with the walls thereof, are the walls 2 of an internal chamber enclosing an annular electrode 3 except for an aperture 4 of the size and shape of the desired luminous source. The electrode 3 may be of any suitable metal such as tungsten or tantalum. I have found the latter material to permit the flow of discharge current of much greater density than is possible with other cold solids without substantial sputtering of metal and other deterioration. Covering the exterior of the chamber 3 from the edge of the aperture 4 to a point well behind the electrode is a sheath of metal 5, such as nickel, tungsten or tantalum, which constitutes a second electrode. Both of the foregoing electrodes are provided with suitable inleading wires 6, 7 in forms well known in glass-blowing art, those to the electrode 3 being provided with sleeves 8, 9 of insulation, for instance, glass or quartz. The diameter of aperture 4 and of annular electrode 3 are so related that any particle of metal projected from the latter through the former does not impinge on the central area of the tube wall through which the light emanating from aperture 4 is projected through the aperture in electrode 5.

The discharge tube so constructed is evacuated to a high degree by processes too well known in the vacuum-tube art to require description here and is then filled with some gas, preferably helium, mercury vapor, or neon, at a pressure which may be substantially 1—1/100 of an atmosphere. The precise pressure and the gas to be employed depend upon the color and the quality of the light desired, but the foregoing will be found suitable for many purposes.

By connecting the electrodes above described to a suitable source, the current in which it is controlled is in accordance with any modulating quantity, the variations of which it is desired to reproduce in a beam of light. It will be found that the aperture in the chamber 2 acts as a luminous source of high intensity and instantaneous response of the character desired.

It will likewise be found that the major portion of the light emitted from this source coincides, in direction, with the line connecting the center of the aperture 4 with the central axis of the electrode 3, and that, correspondingly, there is produced, in effect, a concentrated light beam.

For certain purposes, it may be found desirable to give the form of the aperture 4 that of a long narrow rectangle. In such cases, a ready method of producing such an aperture consists in forming the walls of the chamber 2 of a boro-silicate glass, known in the art as G—702—P, sealing a piece of molybdenum, having the dimensions of the seal desired, into the end of the chamber where the aperture is intended to be, permitting the glass to cool, and pulling the molybdenum out. When this is done, a long thin slit or aperture will be left in the chamber wall.

While there are numerous ways of forming the metallic sheath 5 constituting the external electrode surrounding the chamber 2, it will be found that this may be conveniently done by coating the exterior of the glass with a silver mirror, or by depositing metal thereon, by the Schoop spray process. These methods are particularly applicable where the narrow form of aperture is produced by employing molybdenum in the manner just described.

In the embodiment of my invention shown in Fig. 2, 11 designates a tube of glass or other insulating material consisting of two bulbs connected by a relatively narrow tubular neck 12. In one of these bulbs is sealed an electrode 13 which may be in the form of a ring shaped plate, while, in the other bulb, is sealed a cooperating electrode in the form of a ring 14. On the side of electrode 14 remote from the tube 12 is positioned a screen 15 which may be of metal and is provided with an orifice 16 aligned with the axes of the tube 12 and the electrode 14. The aperture 16 is made of the size and shape of the luminous source desired.

A tube, constructed as indicated in Fig. 2, is evacuated and filled with a suitable atmosphere of gas. As stated in connection with Fig. 1, the precise gas and its pressure depend somewhat upon the use to which the glow lamp is to be put, but substantially 1—1/100 of an atmosphere of neon, mercury vapor or helium will be found suitable for many purposes.

When the electrodes 13 and 14 are connected to a suitable control source of electric current, a glow discharge occurs between them which is concentrated to a high intensity along the narrow tube 12. Light emanating from this portion of the glow discharge is projected through the aperture 16, thence through the end wall 17 of the tube and out to any desired point. It will be found that the major portion of the emitted light is concentrated in the axis connecting the tube 12 and the aperture 16 and that, accordingly, a relatively concentrated beam of parallel rays results.

By reason of the relative positions of the aperture 16 and the periphery of the ring electrode 14, it will be seen that any particles sputtered from the surface of the latter by the electrical discharge and projected through the aperture 16 will strike portions of the tube wall other than that traversed by the light beam. In consequence of this, the transparency of the portion 17 of the tube wall remains practically undeteriorated throughout the life of the glow lamp.

Another yet simpler structure embodying my invention is illustrated in Fig. 3 in which a vacuum-tight envelope 21 is filled with gas in the same manner as the tubes shown in Figs. 1 and 2. A tube 22, which may be of quartz, contains an anode 23 which may be a tungsten or tantalum rod, and has an end opening 24 of the size and shape desired for the light source. The tube 22 may be of opaque quartz or have its surface etched or covered with an opaque substance. A cathode 25 of metal, such as tantalum, which may be a cylinder of sheet metal, surrounds the tube 22 and may be supported from a lead 26 sealed into the wall of envelope 21. The method of construction and mode of operation of this embodiment of my invention are similar to those already described in connection with Figs. 1 and 2.

While, in accordance with the patent statutes, I have described in detail two particular embodiments of my invention, it will be evident that the principles thereof may be embodied in numerous other structures which will be readily devised by those skilled in the art. Accordingly, I desire that the following claims be limited only in accordance with their express terms and in view of the prior art.

I claim as my invention:

1. An electrical-discharge device comprising a vacuum-tight container, a cathode having an

opening therein, an anode adjacent to said cathode and having an opening therein in alignment with the opening in said cathode, and an insulating member positioned between said cathode and said anode and intersecting all straight line discharge paths between said anode and cathode, said member having an opening in alignment with said first-named openings.

2. In a device of the class described, a bulb including a substantially flat optical window, a pair of spaced electrodes within the bulb, and a member interposed between one of said electrodes and said window and formed with a narrow elongated slit through which light may pass.

3. A source of light for producing a photographic record of light wave variations comprising a bulb having a substantially flat optical window, a cathode within the bulb, an anode within the bulb, an ionizable gas within the bulb, and a member interposed between the cathode and said window and formed with a slit permitting the passage of light rays.

4. A source of light for producing a photographic record of light wave variations comprising a bulb having a substantially flat optical window, a cathode within the bulb, an anode within the bulb, an ionizable gas within the bulb, and a member interposed between the cathode and said window and formed with a slit aligned with the cathode.

5. A source of light for producing a photographic record of light wave variations comprising a bulb, a cathode within the bulb, an anode within the bulb, a metallic disc between the cathode and the wall of the bulb, and said disc formed with a narrow elongated slit positioned in front of the cathode.

6. A source of light for producing a photographic record of light wave variations comprising a bulb including a substantially flat optical window, an anode within the bulb, a cathode within the bulb, an ionizable gas within the bulb at such a pressure that at operating voltage a concentrated glow is produced about the cathode, an opaque member positioned between the cathode and said window and formed with a narrow elongated slit.

7. A source of light for producing a photographic record of light wave variations comprising a bulb including a substantially flat optical window, an anode within the bulb, a cathode within the bulb, an ionizable gas within the bulb at such a pressure that at operating voltage a concentrated glow is produced about the cathode, an opaque member positioned between the cathode and said window and formed with a narrow elongated slit extending substantially parallel with the cathode.

8. A source of light for producing a photographic record of light wave variations comprising a bulb having a substantially flat transparent optical end, means for producing a glow within the bulb, and a member within the bulb provided with a narrow elongated slit.

9. An electrical-discharge device comprising a first electrode, walls of insulating material surrounding said electrode, said walls having an aperture at one point therein and a second electrode comprising a hollow member outside said walls and having an opening registering with said aperture, said walls of insulating material intersecting all straight line discharge paths between said two electrodes.

10. An electrical-discharge device comprising a first electrode, walls of insulating material surrounding said electrode, said walls having an aperture at one point therein and a second electrode comprising a hollow member closely surrounding said aperture and covering an extended area thereabout and intersecting all straight line discharge paths between said electrodes.

11. An electrical discharge device comprising a container having an optical window, two electrodes in said container, a gaseous medium providing a luminous discharge path between said electrodes, an insulating wall intersecting all straight line discharge paths between said electrodes, said insulating wall having an opening aligned with said optical window.

12. An electrical discharge device comprising a container having an optical window, two electrodes in said container, at least one of said electrodes having an aperture therein, a gaseous medium providing a luminous discharge path between said electrodes, an insulating wall intersecting all straight line discharge paths between said electrodes, said insulating wall having an opening aligned with said optical window.

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