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D. D. KNOWLES

1,932,078

TELEVISION LAMP

Filed April 27, 1929

Fig. 1.

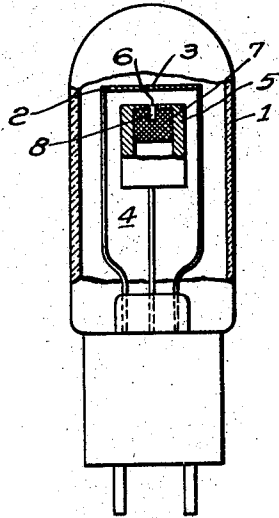


Fig. 2.

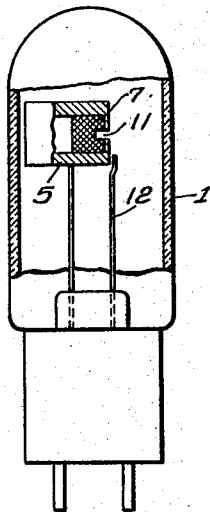
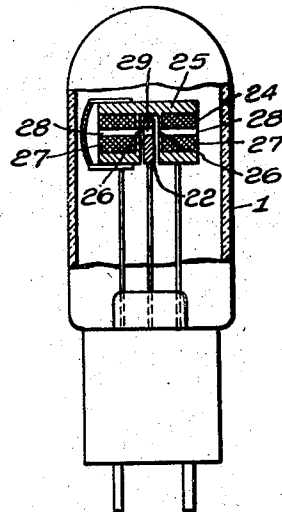


Fig. 3.



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TELEVISION LAMP

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Application April 27, 1929. Serial No. 358,611

10 Claims. (Cl. 176—122)

My invention relates to electrical-discharge de-
vices and particularly to discharge devices em-
ploying a luminous discharge as a source of light.

One object of my invention is to provide an
electrical-discharge device in which the current
discharge is confined at one electrode to a pre-
determined small area thereof.

Another object of my invention is to provide
a light source of small area and high intensity.

Another object of my invention is to provide
a light source of small area and high intensity
employing a glow discharge which shall have
a higher efficiency than light sources of similar
character and dimensions pertaining to the prior
art.

A further object of my invention is to provide
means for confining an electrical discharge to a
predetermined portion of the surface of at least
one electrode and without the necessity of em-
ploying solid insulating walls or barriers for this
purpose.

Other objects of my invention will become ap-
parent upon reading the following description,
taken in connection with the drawing, in which,

Figure 1 is a view, partially in elevation and
partially in section, of a glow-discharge tube
embodying my invention.

Figs. 2 and 3 are views, similar to Fig. 1, of
glow-discharge tubes of modified forms which
embody my invention.

For many purposes, notably in connection with
the arts of photographically recording sound
and of television, a light source which shall be
capable of instantaneously following fluctuations
of an electric current and which shall be of high
intensity but small dimensions is desirable. The
first of these conditions is best fulfilled by means
of a luminous electric glow discharge.

In my copending applications Serial No.
337,698 and Serial No. 310,738 I have described
structures in which a glow discharge is caused
to occur through a constricted passage, with the
result that the desired high intensity and small
area of source are attained. In the structures
shown in the applications just mentioned, the
glow discharge is confined to a small cross sec-
tion by means of barriers or enclosing walls of
insulating material.

One of the features of my present invention
consists of confining the glow discharge to a pre-
determined small area, or "crater", in the sur-
face of one electrode, by providing such electrode
with an external shell of material which has a
high cathode fall for electrical discharges ema-
nating from its surface and which covers an in-

terior substance having a relatively low cathode
fall for electrical discharges emanating there-
from.

Because of the difference between the cathode
falls above mentioned, an electrical discharge
emanating from the composite electrode will
concentrate almost entirely on any small ex-
posed area of the substance having a low cathode
fall.

By providing an aperture of the desired area
in the external shell, it is possible, accordingly,
to confine the electrical discharge to a small
"crater", the bottom of which comprises the ma-
terial of low cathode fall, and thus to confine
the cross section of the electrical discharge to a
cross section of any desired small area with-
out employing confining walls or barriers of in-
sulating material.

With the foregoing principles and objects in
view, my invention will best be understood by
reference to the drawing in Fig. 1 of which a
vacuum-tight enclosing tube 1 is provided with
an anode 2 having a small aperture 3 at some
desired point in its area. Cooperating with the
anode 2 is a cathode 4 in the form of a shell 5,
which may be of iron, open at one end and closed
at the other end, except for a small aperture 6. In
the interior of the shell 5 is a filling 7 which may
be of calcium or of the alloy commonly known as
misch metal. It will usually be found desirable,
although this is not absolutely essential, to pro-
vide a depression 8 in the filler 7 which registers
with the aperture 6 in the shell 5. It will also
usually be found desirable to have the aperture 3
in anode 2 in alinement with the aperture 6 and
depression 8.

The electrodes 2 and 4 are supported from the
walls of the enclosure 1 in a manner well known
in the art, and the enclosing tube may be ex-
hausted to a high degree of vacuum by methods
well-standardized in high-vacuum practice. It
will usually be found desirable to provide the en-
closure 1 with a gaseous atmosphere at a sub-
stantial pressure. For example, one of the noble
gases, such as neon, may be employed at a pres-
sure of approximately 2° millimeters of mercury.
It will also be found desirable particularly where
the filler 7 is not an alkali metal, to admix with
such gas about 10%, by volume, of pure hydrogen,
in the manner described in my copending appli-
cation Serial No. 337,699 filed February 5, 1929 for
Television receiving lamps.

Such being the structure of a glow-discharge
tube embodying my invention, it will be found,
upon impressing between the electrodes a suit-

able electromotive force, that a luminous discharge occurs which emanates almost entirely from the aperture 6 of the electrode 4. When the aforesaid electromotive force is of the direct-current type, the electrode 4 becomes the cathode. The concentration of the glow discharge within the aperture 6 provides an area of light of very high intrinsic brilliancy, and it has been found that, probably because of the decreased dissipation of energy incident to the low cathode fall of the filler 7, a much higher current density may be employed in the glow discharge than that to which cathode sputtering limited the glow discharge tubes of the prior art, the general dimensions of which were the same as those of tubes embodying the invention here disclosed. It has also been found that the luminous efficiency of glow discharges in the above-described tube is materially greater than that of glow discharges occurring in tubes of the prior art.

In the form of my invention, shown in Fig. 1, light is transmitted through the aperture 3 of the anode, and the latter functions as a light source having a diameter corresponding to that of the aperture last mentioned. Since there is substantially no limitation upon the sizes of the latter, the area of the light source may be made as small as desired.

In the modification of my invention, shown in Fig. 2, the light beam employed in auxiliary apparatus emanates from an aperture 11 on the side of the shell 5, instead of being transmitted through an aperture 3 in the anode in the tube shown in Fig. 2, a very simple cooperating electrode, namely, a rod 12 which may be of nickel, suffices. Otherwise, the structure, shown in Fig. 2, is the same as that already described in connection with Fig. 1.

The embodiment of my invention shown in Fig. 3 comprises a central plate electrode 22, which may be a plate of nickel or other suitable metal, and a cooperating electrode 24, which partly surrounds it. The electrode 24 comprises a shell 25 which may be of iron, and which presents a continuous surface, on all sides except those farthest removed from the electrode 22, except for a pair of apertures 26 in the faces opposite the plane faces of electrode 22. The interior of the shell 25 is provided with a filling 27 of material having a lower cathode fall than that comprising the shell, and provided with poles 28 alining with the apertures 26. The anode 22 may, likewise, if desired, be provided with a hole 29 alined with apertures 26.

The tube of Fig. 3 is otherwise like that described in connection with Fig. 1 and will be seen to be adapted to project light beams in opposite directions from the two ends of the holes 28.

While I have described the external shell of the electrode 4 as made of iron, and the filler material 7 as made of calcium or misch metal, it will be recognized that other materials than these may be employed if found more suitable for particular purposes.

The principal requisite is that the surface of the electrode shall be covered, except at those points from which it is desirable to have the discharge emanate, with a material which has a higher cathode fall than the material covering the other portions. It is also usually desirable that the material having the low cathode fall, which covers the electrode surface from which it is desired to have the discharge emanate, shall be a material not too readily volatile.

The cathode fall of iron in a neon atmosphere

is 153 volts, while the cathode fall of calcium in neon is 86 volts and that of misch metal is 90 volts. Accordingly, the difference in cathode fall between the preferred materials forming the surface and inner portion of the cathode is between 60 and 70 volts. With other materials, the difference in cathode fall may be less.

It will also be recognized that while I have described my invention as employed in a luminous glow-discharge lamp, it is utilizable for many other purposes; in fact, being utilizable wherever it may be desired to confine an electrical discharge to a predetermined area of an electrode surface, and that it may be applied to discharges in gases and vapors generally not being confined to the particular gases and pressures mentioned above.

In accordance with the patent statutes, I have described particular embodiments of my invention but it will be understood that they are merely given by way of illustration and that many other modifications embodying the principles may be evident to those skilled in the art. Accordingly, I desire that the appended claims shall be subject only to such limitations as are expressed in their terms or are imposed by the prior art.

I claim as my invention:

1. An electrical-discharge device comprising a vacuum-tight container having an atmosphere of gas, a first main electrode therein, and a second main electrode therein having a metallic surface coating of one material adjacent to said first electrode and a contiguous underlying interior portion of a material having a lower cathode fall than the first said material, and an aperture through said surface portion, exposing an area thereof which is small relative to the area of said surface coating.

2. An electrical-discharge device comprising a vacuum-tight container having a gaseous atmosphere, a first main electrode therein and a second main electrode therein having a surface portion of a material having a relatively high cathode fall and an interior portion having a relatively low cathode fall, the electrical path separating said electrodes being smaller than the breadth of the smaller thereof, and said first electrode being positioned substantially outside the path of light generated adjacent the surface of said interior portion.

3. An electrical-discharge device comprising a vacuum-tight container having an atmosphere of gas, a first electrode therein and a second electrode therein having a surface portion of one material adjacent to said first electrode and an interior portion of a material having a lower cathode fall than the first said material and an aperture through said surface portion extending into said interior portion, the electrical path between said electrodes being small relative to their superficial areas, and said first electrode being positioned and disposed to avoid intersection with the central axis of said aperture.

4. An electrical-discharge device comprising a vacuum-tight container having a gaseous atmosphere, a first electrode therein provided with an aperture, a second electrode therein having a surface portion of one material closely adjacent to said first electrode and an interior portion of a material having a lower cathode fall than the first said material and an aperture through said surface portion extending into said interior portion, said two apertures being substantially coaxial.

5. An electrical-discharge device comprising a vacuum-tight container having a first electrode therein and a second electrode having a surface portion of one material adjacent to said first electrode and an interior portion of a material having a low volatility and a lower cathode fall than the first said material and an aperture through said surface portion, said first electrode being disposed to avoid substantially obstructing light emerging through said aperture. 80
6. An electrical-discharge device comprising a vacuum-tight container, a first electrode therein provided with an aperture and a second electrode therein having a surface portion of one material adjacent to said first electrode and an interior portion of a material having a lower cathode fall than the first said material and an aperture through said surface portion, in operative alignment with the aperture in said first electrode. 85
7. An electrical-discharge device having an atmosphere of gas at a pressure of approximately 0.01 atmospheres, a first electrode having an aperture therein and a second electrode having a surface portion of one material adjacent to said first electrode and having a core of a material having a low volatility and having a lower cathode fall than the first said material and an aperture through said surface portion aligned with the aperture in said first electrode. 90
8. An electrical-discharge device comprising a vacuum-tight container having an atmosphere of gas at a pressure of approximately 0.01 atmospheres, a first electrode therein provided with an aperture and a second electrode having a surface portion of one material adjacent to said first electrode and an interior portion of a material having a lower cathode fall than the first said material, the difference in cathode fall of said materials being greater than 15 volts, a small aperture through said surface portion to said interior portion, and a cooperating electrode closely adjacent the first said electrode having an aperture axially aligned with said small aperture. 95
9. An electrical discharge device comprising an electrode having a surface portion of one material and an interior portion of a material having a lower cathode fall than said first material, the difference in cathode fall of said materials being greater than 15 volts, a small aperture through said surface portion into said interior portion, and a cooperating electrode closely adjacent the first said electrode having an aperture axially aligned with said small aperture. 100
10. An electrical discharge device comprising an electrode having a surface portion of one material and an interior portion of a material having a lower cathode fall than said first material, the difference in cathode fall of said materials being greater than 50 volts, a small aperture extending through said surface portion into said interior portion, and a cooperating electrode closely adjacent the first said electrode having an aperture axially aligned with said small aperture. 105

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