June 9, 1931. H. W. HOWARD 1,809,447

LUMINOUS TUBE

Filed March 16, 1929

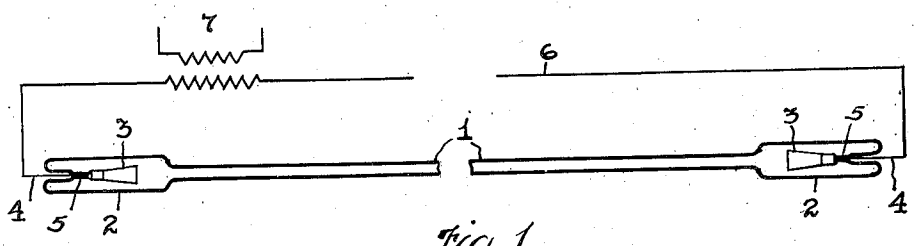


Fig. 1.

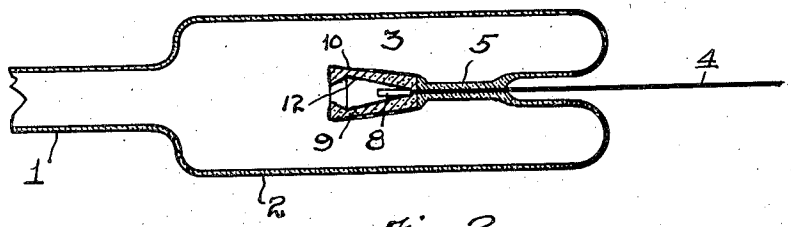


Fig. 2

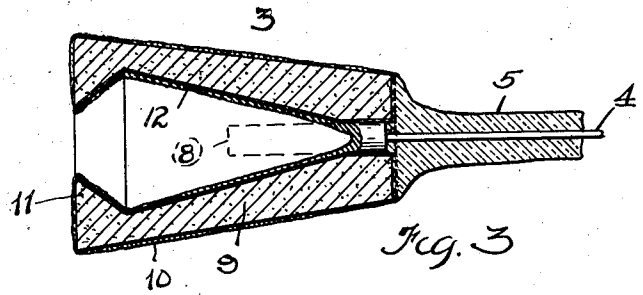


Fig. 3

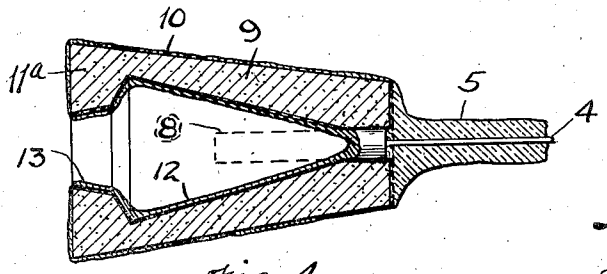


Fig. 4

INVENTOR.
Harold W. Howard
BY
Fay, Oberlin & Fay
ATTORNEYS.

Patented June 9, 1931 1,809,447

UNITED STATES PATENT OFFICE

HAROLD W. HOWARD, OF CLEVELAND, OHIO, ASSIGNOR TO NEON PROCESS, INCORPORATED, OF CLEVELAND, OHIO, A CORPORATION OF OHIO

LUMINOUS TUBE

Application filed March 16, 1929. Serial No. 347,506.

The present improvements relating, as indicated, to luminous tubes have more particular regard to neon tubes such as are extensively utilized for display and advertising purposes due to the distinctive spectral color of the neon when excited by the passage of a suitable electric current therethrough. One principal object of the invention is to provide an electrode assembly for use in such neon and like luminous tubes which will make it possible to employ an electrode of relatively small surface area as well as one which will be lasting in service and not subject to any detrimental changes in its character.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:—

Fig. 1 illustrates a typical neon or like luminous tube in which the present improved electrode assembly is incorporated; Fig. 2 is a sectional view, on a larger scale, of one end of such tube and the corresponding electrode assembly; Fig. 3 is a similar sectional view, but on a still larger scale, of the electrode by itself; and Fig. 4 is a view corresponding to Fig. 3, but showing a modified form of the electrode.

Referring to the structural features of the tube, the body 1 thereof is shown in the several figures of the drawings in conventional form, it being understood that such body will be of suitable diameter and length and will ordinarily be bent in the outline of a letter or ornamental design where the tube is used for advertising purposes. The ends 2 of the tube are, as shown, preferably of larger diameter than such body 1 so as to form chambers for the corresponding electrode assemblies 3. The latter are connected with and supported by lead-in wires 4 which conduct the necessary current to the electrodes, each such wire being sealed vacuum tight at the inwardly directed neck 5 where it passes through the end of the electrode chamber 2, and the circuit 6, wherewith said lead-in wires are thus connected, also including the high tension secondary of a suitable transformer 7.

Referring more particularly to the electrode assembly as illustrated in the sectional views of Figs. 2 and 3, the electrode 8 proper consists of a short cylindrical piece of metal, ordinarily iron, to the inner end of which the corresponding end of the lead-in wire 4 is firmly brazed or welded. Surrounding such electrode is a sheath 9 of general cup shape, the closed end of the sheath being mounted on and secured to the end of the inwardly directed neck 5 through which the lead-in wire passes, as explained above. The sheath 9 may be made of any suitable dielectric material. For example, it may be made of glass, in which event it will constitute in effect an extension of the neck to which it is attached, but preferably a more refractory dielectric material will be used. Thus a preferred material is that known as "lava," through its use in the manufacture of gas tips and burners, particularly where properly prepared by glazing the surface, inside and out, with a fused coating 10 of an alkali metal silicate or such a silicate mixed with a borate or fluoride, or both, such mixtures yielding a boro-silicate or fluo-silicate.

Independently of the particular dielectric material thus used, attention is directed to the shape of the inner surface of the sheath, this surface being designed to take advantage of the fact that spraying or sputtering of the electrode material is always in a line normal to the surface from which such spraying or sputtering takes place. Thus such surface, in the first place is of a contour such that only particles that are sputtered off at right angles to the end of the metal electrode 8 directly towards the opposite electrode can escape from such sheath. In the second place the shape of the surface in question is such that particles that are subsequently sputtered from any point on such surface itself, where they have initially lodged, will again be deposited at some other point inside of

the sheath and practically none will be deposited outside of the latter, as for example, on the adjacent side walls of the tube 1 or its enlarged end 2.

To accomplish the foregoing result, in the form illustrated in Figs. 2 and 3, the inner surface of the sheath is made of substantially conical form with the apex at the point where the metal electrode 8 projects therethrough. The outer, larger end of the sheath is partially closed by an inwardly directed circumferentially extending flange 11, the inner face of which is beveled. As a result of the surface conformation just described, the metal particles sprayed from the electrode 8 are substantially all collected, and form in the course of a short period of operation a coating, on the inner surface of the sheath. In other words, the projecting electrode 8 will disappear and be replaced by such metal deposit or coating 12 that now constitutes in effect the electrode.

In the modified construction of electrode shown in Fig. 4, the flange 11^a is beveled at a somewhat more acute angle to the conical inner surface of the sheath and in addition the opening remaining at the center of such flange has a beveled edge 13. The angularly related surfaces thus provided are adapted not only to retain the sputtered electrode material within the sheath but cause the deposit or coating 12 thereof to remain of substantially uniform thickness.

Moreover, the area of the electrode thus formed by the deposit of metal on the inner wall or surface of the sheath will be defined by the area of such surface and any desired limit may accordingly be imposed without danger of its being exceeded. There is a distinct advantage in such limitation of electrode area, for the reason that the gases within the tube tend to be absorbed by the deposited coating, and while such absorption is desirable up to a certain point, i. e. the elimination of so-called impurities admixed with the conducting gas as to which impurities a preferential absorption occurs, this action if carried too far will reduce the vapor pressure of the conducting gas itself to a value below that required for proper operation.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. An illuminating device of the character described, comprising a glass tube, a metallic electrode supported within said tube in spaced relation to the surrounding wall thereof, and a sheath of dielectric material surrounding and extending from said electrode and having a conical cavity almost closed at its free end to confine the metal sputtered from said electrode.

2. An illuminating device of the character described, comprising a glass tube, a metallic electrode supported within said tube in spaced relation to the surrounding wall thereof, and a sheath of dielectric material surrounding and extending from said electrode and having a conical cavity almost closed at its free end by an inversely coned flange.

3. An illuminating device of the character described, comprising a glass tube, a metallic electrode supported within said tube in spaced relation to the surrounding wall thereof, and a sheath of dielectric material surrounding and extending from said electrode and having its inner surface presenting a conical contour narrowly diverging from the electrode and then converging by successive truncated cone faces.

4. An illuminating device of the character described, comprising a glass tube, a metallic electrode supported within said tube in spaced relation to the surrounding wall thereof, and a sheath of dielectric material surrounding and extending from said electrode and having its inner surface presenting a conical contour narrowly diverging from the electrode and then converging by a sharply inturned truncated cone face with a less sharply inturned truncated cone face extension.

5. An electrode element for an illuminating device of the character described, comprising a member of dielectric material having its inner face coated with metal and presenting a conical cavity almost closed at its free end to confine the metal sputtered within the same.

6. An electrode element for an illuminating device of the character described, comprising a member of dielectric material having its inner face coated with metal and presenting a conical cavity almost closed at its free end by an inversely coned flange.

7. An electrode element for an illuminating device of the character described, comprising a member of dielectric material having its inner surface coated with metal and presenting a conical contour narrowly diverging from its inner end and then converging by successive truncated cone faces.

8. An electrode element for an illuminating device of the character described, comprising a member of dielectric material having its inner surface coated with metal and presenting a conical contour narrowly diverging from its inner end and then converging by a sharply inturned truncated cone face with a less sharply inturned truncated cone face extension.

Signed by me this 13th day of March, 1929.

HAROLD W. HOWARD.