May 3, 1932. R. W. REITHERMAN 1,856,727

ELECTRODE

Filed April 5, 1929

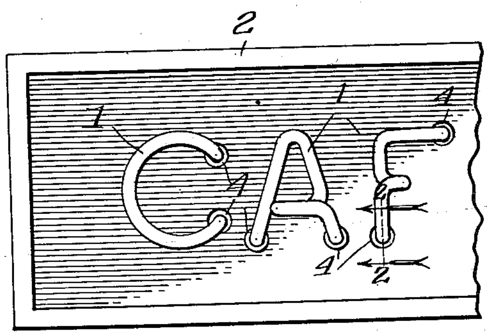


Fig.1.

Fig.2.

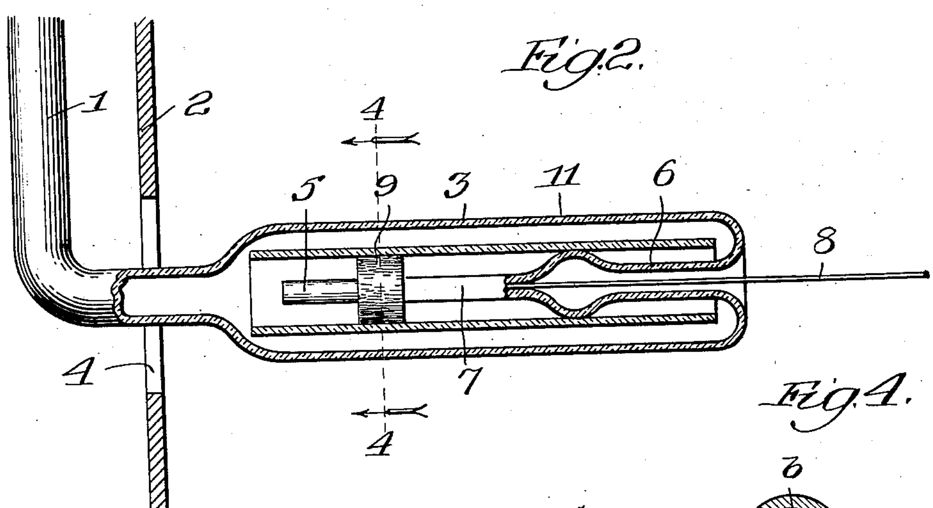


Fig.4.

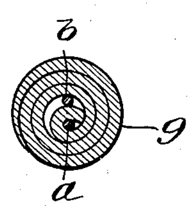
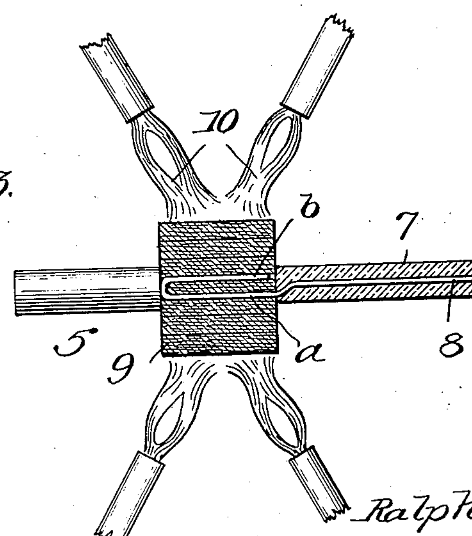


Fig.3.



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UNITED STATES PATENT OFFICE

RALPH W. REITHERMAN, OF OAK PARK, ILLINOIS, ASSIGNOR TO FLASHTRIC SIGN WORKS, A COPARTNERSHIP COMPOSED OF FRED PARKER AND HARRY S. PARKER, BOTH OF CHICAGO, ILLINOIS

ELECTRODE

Application filed April 5, 1929. Serial No. 352,706.

This invention relates to electrodes for luminescent gas discharge tubes, such as are used for electric advertising display signs and other purposes.

In the use of relatively small electrodes, such as have an area not exceeding 1.5 square decimeters per ampere, per electrode, the rate of vaporization or sputtering of the electrodes is very high due to the bombardment being distributed entirely over the electrodes. The gases with which the tubes are charged are imprisoned under the vaporized or sputtered material which is deposited on the walls of the electrode chambers in the vicinity of the electrodes. If the area which is subject to this deposit is large, the rate with which the gases are imprisoned thereunder is high. If this area is reduced in size, the rate of entrapment of the gas is slowed up to a negligible degree. To accomplish this result, a tubular glass shield is supported in the electrode chamber about the electrode as the deposit receiver. The inside diameter of this shield is a little larger than the outside diameter of the electrode so as to reduce to the minimum the area to receive the deposit from the electrode.

The soft glass from which the outer tube is made can not be used for this deposit receiver or shield because the shield being close to the electrode would melt and crack from the high temperatures developed at the electrode during the processing of the tube. One object of my invention is to overcome this. I do so by making the shield of a material which will withstand without cracking these high temperatures. Boro silica is a material which will withstand these temperatures and I accordingly make the shield of this material. With this material, the shield will not crack to expose the electrode to excessive bombardment or enlarge the deposit receiving area to increase the rate of entrapment of the gas to shorten the life of the tube.

The seal tube for closing the end of the electrode chamber is made of the same glass as the main outer tube so that the two may be joined by fusing. The boro silica shield has a lower expansion coefficient than the seal and the outer tubes and can not be joined to either. The shield must therefore be loose with respect to the seal and the outer tubes, and it is an object of my invention to provide a novel means of supporting the shield in the electrode chamber about the electrode and the seal tube. To accomplish this, I provide a packing fitting relatively tight in the shield tube at the base of the electrode to support the shield tube from the seal tube.

Another object of my invention is to employ this packing as a means for preventing electrical contact between the electrode and the deposited electrode material on the shield tube and thus prevent such deposited material from becoming a source of electrical emission to increase the area of the original electrode. I accomplish this result by making the packing of a material which will not conduct an electrical current and which will not take a plating of the sputtered material from the electrode.

The invention consists further in the structural features hereinafter described and claimed and also in the method of applying and treating the packing in the making of the electrode unit.

In the accompanying drawings—

Fig. 1 is a face view of an electric sign, the characters of which are in the form of luminescent gas discharge tubes provided with electrodes of my invention.

Fig. 2 is a longitudinal sectional view through the electrode end of one of the tubes, taken on line 2—2 of Fig. 1;

Fig. 3 shows one of the steps in treating the packing; and

Fig. 4 is a transverse sectional view through the packing.

In Fig. 1, 1, 1 indicate the luminescent gas discharge tube characters of the sign, and 2 indicates the sign body on which said tube characters are mounted for display. Each character 1 consists of a single length of appropriate glass tubing bent to the shape desired and having enlarged and elongated bulb-like end portions 3 which form the chambers for the internal electrodes of the characters. The bulbs 3 are at the opposite ends of the tube and are usually disposed at right angles thereto and extend into the sign body through openings 4 therein as shown in Fig. 2.

Located in each electrode chamber 3 is an electrode element 5 of a relative short piece or section of iron or other desired electrode material through which the electric current is discharged into the tube to ionize the gas confined therein. The gas employed may be neon or any other of the rare gases of the Noble gas group which are used in these tubes for illuminating them.

The electrode chambers 3 of each tube are sealed so that a high vacuum may be produced in the tube as required for tubes of this character. The seal at each end of a tube is made through the use of a seal tube 6 which is made separate from the main tube 1 and afterwards inserted therein. The seal tube 6 and the outer tube 1 are usually made of lead glass so that both tubes may be connected or joined together by fusing at the outer end of the seal tube. The inner end of the seal tube 6 is closed by fusing to provide a vacuum seal 7 for the outer tube 1. Electric current for the electrode element 5 is carried by a lead-in wire 8 which is sealed in the seal 7 and is connected by spot welding or otherwise to the element 5.

The wire 8 supports the electrode element 5 out of contact with the seal 7 so that the differences in expansion of the electrode material and of the glass seal 7 in the operation of the electrode will not crack or break the seal to allow the gas confined in the tube to escape and put out the tube. Supporting the element 5 in this way, the portions *a*, *b* of the wire are exposed between the element and the seal 7. To shield these portions of the wire from the bombardment to which the electrode element 5 is subject when in use and thus prevent cutting-off of the wire, I surround the wire with a packing 9 of a material which will not conduct an electrical current and which will also resist heat. Mica and asbestos will do this and when asbestos is employed, as shown in the drawings, I use it in flat strip form of a width to fill the space between the element 5 and the seal 7. The asbestos strip is first wetted and then wrapped in the form of a coil about the wire and has a sufficient number of convolutions or layers to completely enclose the wire and shield it from the bombardment referred to. The end of the wire 8 at the electrode element 5 is bent into the form of a loop to provide the prong *b* in which the starting end of the asbestos strip is engaged to hold the strip as it is wound about the wire. Wetting the strip makes it pliable for winding and also permits the wrapped layers to be pressed or squeezed together to bring the fibers of the strip into intimate contact. After the strip is wound, it is heated to incandescence by hydrogen flames 10, 10 to drive off the moisture and otherwise de-gasify the material to make a more or less solid integral mass which will not give off any deleterious gases or substance to mask the spectrum of the gas confined in the tube when the latter is put in use.

Arranged about the element 5 is a tubular glass shield 11 which is considerably smaller in diameter than the electrode chamber 3 so as to be relatively close to the electrode 5 and thus lessen the intensity of the bombardment to which the electrode is subject and also to reduce to the minimum the area exposed to receive the sputtered material from the electrode. This, therefore slows up the rate of entrapment of the gas in the tube in the sputtered electrode material and prolongs the life of the tube even when using small electrodes of the size heretofore referred to.

The shield 11 being close to the electrode element 5 is subject to the high temperature produced at the electrode when processing the tube, as well as when operating it in use. The soft lead glass shields heretofore employed melt and crack under these high temperatures, and to avoid this I make the shield of boro silica which will withstand these temperatures without cracking or breaking. A shield of this material has a lower co-efficient of expansion than the soft glass of the outer and the seal tubes 1 and 6 and can not be fused thereto. The shield 11 is therefore loose with respect to the outer and the seal tubes and I employ the packing 9 to support the loose shield in place. To accomplish this, I give the packing 9 an outside diameter sufficient to fit relatively tight in the shield to support it in place. When the packing is in the form of an asbestos strip, as shown, I have the number of layers of the wrapping sufficient to give the packing the outside diameter required. The shield tube 11 may be made relatively long so as to extend substantially the full length of the electrode chamber 3 from a point close to the outer end of the seal tube to the construction *y* where the chamber joins the main body of the tube 1, with this arrangement the shield tube is prevented from undue shifting in the main tube as the latter is handled.

The packing 9 fitting in the shield tube 11 provides a dead end for the gas in the shield tube and being a non-conductor of electrical current will prevent the deposited electrode material on the inner surface of the shield tube from becoming a source of electrical emission because the electrode is not in electrical contact with said material through the packing 9. The packing 9 will not take a plating of sputtered material from the electrode 5, because the packing has the dielectric property of absorbing a charge of the same polarity as the electrode with which the packing is used. This results in the induced charge on the packing repelling the vaporized particles omitted from the electrode and preventing plating of the electrode material on the exposed surface of the packing to establish electrical contact between the electrode and the deposited material on the surrounding wall of the shield 11. Manifestly the area of the electrode element 5 is not increased, beyond that as originally provided therefor, during the operation of the tube and the rate of gas entrapment is not increased. Thus, when using a relatively small electrode element, such as one having an area not exceeding 1.5 square decimeters per ampere, the packing 9 will not allow the area of such electrode being increased by the sputtered material deposited on the shield. This is an important feature because it reduces the rate of gas entrapment even with small electrodes which are subject to a more intense bombardment than the large electrodes.

The lead-in wires being in contact with the electrodes absorb heat, this heat being sufficient to destroy the union formed by the cupric and silica oxides between the glass and the lead-in wires. In accordance with my invention, I make the seals relatively long as shown at 7 in Figs. 2 and 3, so that a sufficiently long length of wire is enclosed in the seal that the latter will not be affected by the condition referred to and therefore will not allow the gas to leak through the seals about the wires, as heretofore.

With the shield 11 extending over the seal tube 6 beyond its seal 7, I provide the seal tube with an enlargement to fit against the adjacent portion of the shield and thus aid in supporting it in the outer tube.

The electrode unit of my invention is simple in construction, cheap and easy to make, and efficient in use. It is especially suitable for small electrodes, and effectively performs the functions for which it is designed.

The details of structure and arrangement of parts shown and described may be variously changed and modified without departing from the spirit and scope of my invention.

I claim as my invention:

1. An electrode unit for luminescent gas discharge tubes, comprising a seal tube having its inner end closed to form a seal, an electrode element at the inner end of said seal tube, a lead-in wire sealed in said seal and supporting the element out of contact therewith, and a packing of non-conducting material wrapped about and completely enclosing the portion of the wire between the element and the seal.

2. An electrode unit for luminescent gas discharge tubes, comprising a seal tube having its inner end closed to form a seal, an electrode element at the inner end of said seal tube, a lead-in wire sealed in said seal and supporting the element out of contact therewith, and a packing of non-conducting material wrapped about the portion of the wire between the element and the seal, said packing being in strip form of a width to completely fill the space between the element and the seal.

3. An electrode unit for luminescent gas discharge tubes, comprising a seal tube having its inner end closed to form a seal, an electrode element at the inner end of said seal tube, a lead-in wire sealed in said seal and looped at its inner end to support the element out of contact with the seal, and a strip of non-conducting material wrapped about and completely enclosing the portion of the wire between the element and the seal, said strip having its starting end engaged in the loop of said wire.

4. An electrode unit for luminescent gas discharge tubes, comprising a seal tube closed at its inner end to form a seal, an electrode element at the inner end of said seal tube, a lead-in wire sealed in said seal and supporting the element out of contact therewith, a shield tube about said element and extending along and beyond the ends of the same, and a packing of non-conducting material completely enclosing the portion of the wire between the element and the seal and extending out to the shield tube to support the same.

5. An electrode unit for luminescent gas discharge tubes, comprising a seal tube closed at its inner end to form a seal, an electrode element at the inner end of said seal and supporting the element out of contact therewith, a shield tube about said element and extending over the seal tube beyond the seal thereof, and a packing of non-conducting material enclosing the portion of the wire between the element and the seal and extending out to the shield tube to support the same at said element, said seal tube having an enlargement beyond its seal to provide a support for the portion of the shield tube thereover.

6. An electrode unit for luminescent gas discharge tubes, comprising a seal tube having its inner end closed to form a seal, an electrode element at the inner end of said seal tube, a lead-in wire sealed in said seal and supporting the element out of contact therewith, a shield tube about said element, and a de-gasified packing of asbestos enclosing the portion of the wire between the element and the seal and extending outward to said shield tube to support the same.

7. The method of making an electrode unit for luminescent gas discharge tubes, consisting in sealing a lead-in wire in a seal tube, connecting the wire to an electrode element at the inner end of said seal tube, wetting a strip of non-conducting fibrous material and then wrapping the same in the form of a coil about the portion of the wire between the element and the seal tube, then pressing the wet layers of the coil together to interlock the fibers of the strip, and finally heating the wrapped layers to incandescence to de-

gasify the layers and unite them in a relatively compact mass.

8. The method of making an electrode unit for luminescent gas discharge tubes, consisting in sealing a lead-in wire in a seal tube, connecting the wire to an electrode element at the inner end of said seal tube, wetting a strip of non-conducting fibrous material and then wrapping the same in the form of a coil about the portion of the wire between the element and the seal tube until the wrapping extends out beyond the base of the element, then pressing the wet layers together to interlock the fibers thereof, and finally heating the wrapped layers to incandescence to de-gasify the layers and unite them in a relatively compact mass.

9. The combination with an electrode chamber of a luminescent gas discharge tube, a seal tube extending into said chamber and joined thereto at its outer end, said seal tube having its inner end closed to provide a vacuum seal for said chamber, an electrode element in said chamber at the inner end of said seal tube, a lead-in wire for said element and sealed in said seal, a shield tube in said chamber about said element and extending substantially the full length of said chamber, said shield tube being loose with respect to said chamber and said seal tube, and means carried by the seal tube for supporting the shield tube in said chamber.

In testimony whereof I affix my signature.

RALPH W. REITHERMAN.