March 4, 1941. M. FLETCHER 2,233,476

ELECTRODE FOR GASEOUS TUBES

Filed Aug. 24, 1939

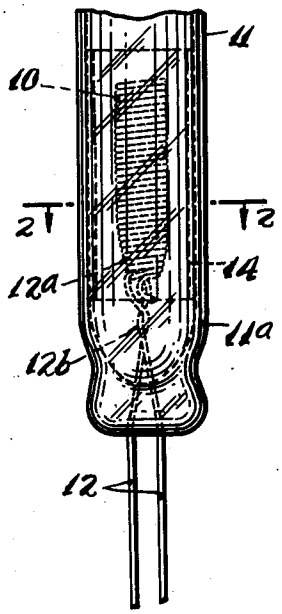


Fig. 1.

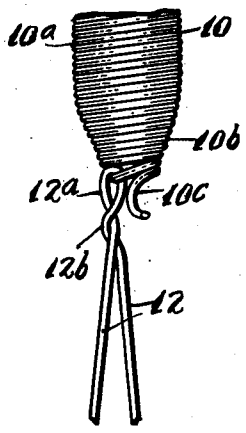


Fig. 3.

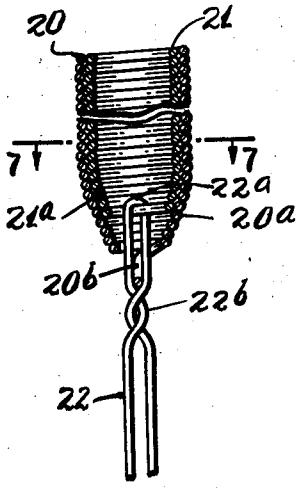


Fig. 6.

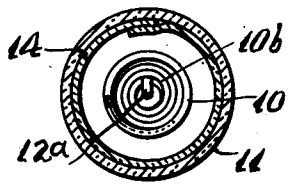


Fig. 2.

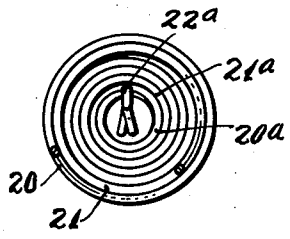


Fig. 7.

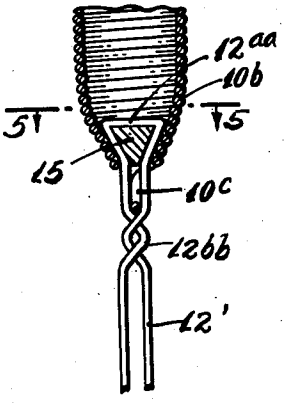


Fig. 4.

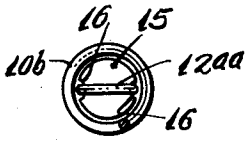


Fig. 5.

INVENTOR
Milton Fletcher
BY Zoltan A. Polachek
ATTORNEY

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ELECTRODE FOR GASEOUS TUBES

Milton Fletcher, New York, N. Y.

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5 Claims. (Cl. 176—126)

This invention relates to new and useful improvements in an electrode for gaseous tubes.

Heretofore it has been customary to construct the electrodes in vacuum tubes of solid or hollow cylindrical forms in order to provide sufficient area for the emission of electrons. It has been known that the greatest potential gradient occurs at the ends of these cylinders (or discs) and it has been a matter of common observation that sputtering of the electrode material occurs principally at such places. It is also generally known that such sputtering is highly undesirable, since it has the property of absorbing the chemically active gases contained in the vacuum tubes and so reducing their life. This sputtering is known to occur during the manufacture of the vacuum tube as well as during its use, especially when an excess local potential gradient develops, on or in the vicinity of the electrodes.

Numerous attempts have been made to so construct the electrodes, or the material of the tube surrounding it, to eliminate or reduce this sputtering. Such attempts have met with little success.

This invention particularly proposes a novel construction of the electrode so as to reduce, and very often completely eliminate the sputtering complained of. Particularly the invention proposes the use of wire coiled into hollow cylindrical or hollow conical form, or other forms, to form the main body of the electrode. It is proposed that the turns of these coils be closely wound. When the electrode is thus made it will be found that the ends are round due to the curvature of the wire, and moreover the side walls of the electrodes are formed with small rounded ridges, or areas, which comprise the round shape of the wire forming the coil. It has been found that the electrode so constructed will have a relatively lower flux density and a lower distribution of the dielectric flux which avoids disruption of the metal forming the electrode and so avoids sputtering.

Still further the invention proposes a novel means for supporting the new electrode in a vacuum tube.

Still further the invention proposes the construction of an electrode as mentioned which is simple and durable and which may be manufactured and sold at a reasonable cost.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawing, and to the appended claims in which the various novel features of the invention are more particularl set forth.

Fig. 1 is a fragmentary elevational view of a portion of a vacuum tube with an electrode constructed in accordance with this invention.

Fig. 2 is an enlarged horizontal sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary side elevational view of an electrode constructed in accordance with this invention.

Fig. 4 is a fragmentary vertical sectional view of an electrode constructed according to a modified form of this invention.

Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is a fragmentary vertical sectional view of an electrode constructed in accordance with a still further modification of this invention.

Fig. 7 is a horizontal sectional view taken on the line 7—7 of Fig. 6.

The electrode for gaseous tubes in accordance with this invention includes a wire coil 10 for engagement within a gaseous tube 11, and provided with a terminal wire 12 attached to its rear end, and extending from the tube 11. The coil 10 is formed from a length of rounded wire which is closely wound. The bottom portion 10^a of the coil, and at its rear end, has its coils tapering forming a tapered rear end portion 10^b. This rear end portion terminates in the wire end 10^c which is coaxial with the coil.

The terminal 12 comprises a length of wire which is bent at its center 12^a and which is mounted on one of the turns of the rear end 10^b of the coil. This wire 12 is formed with several turns 12^b constructed by twisting an area thereof, immediately adjacent the bent end 12^a. The terminal may be engaged upon the turns of the rear end 10^b by engaging the bent end 12^a over the free end 10^c and then moving the bent end 12^a around and around to move it along the turns of the wire forming the rear end 10^b.

The electrode may be engaged into the end 11^a of the tube 11 and may be supported by the terminal wire 12, and then the tube 11^a may be sealed in the regular way. A sheet of insulating material 14 of such dielectric strength and high permittivity is rolled into a hollow cylindrical form and is disposed within the end of the tube 11, and encases the electrode 10. This insulation material 14 assists in lowering the maximum potential gradient occurring between the electrode and the wall of the tube and so assist in preventing the disruption and sputtering previously explained.

In Figs. 4 and 5 a modified form of the invention has been disclosed which distinguishes from the prior form in the way in which the terminal 12' is mounted in position. According to this form of the invention the terminal 12' has a loop end 12^{aa} which is engaged transversely across a solid conical member 15 mounted within the conical rear end 10^{b} of the electrode. This conical member 15 has longitudinally extending grooves 16 along the diametrically opposite sides. The side portions of the loop 12^{aa} extended through these grooves. The side portions of the loop 12^{aa} continue downwards and out from the open rear end of the electrode, and extend past the sides of the end 10^{c} of the wire which forms the electrode. The terminal 12' has a twisted area 12^{b} immediately adjacent the end 10^{c} for assisting in holding the terminal in position.

In Figs. 6 and 7 another form of the invention has been disclosed which distinguishes from the prior form in the fact that the electrode is made from two coils of wire, one set into the other. Specifically the electrode comprises an outer coil 20 and an inner coil 21. The outer coil 20 has its rear end 20^{a} formed into frusto-conical form. The inner coil has its rear end 20^{a} in similar form. A wire terminal 22 has a central loop portion 22^{a} engaging over one of the turns of the inner coil 21. This loop portion 22^{a} extends downwards out through the opening of the coil 20, and engages against the tail end 20^{b} formed by bending the free rear end of the coil 20 centrally.

The terminal wire 22 also has a twisted portion 22^{b} arranged immediately adjacent the end 20^{b} so that the parts are somewhat rigidly connected. The coils 20 and 21 contact each other. The flux density at the front end of the coil will be distributed to the ends of both of the coils, and will distribute and reduce the dielectric flux and thus avoid disruption of the metal forming the coils.

It is proposed that the electrode be made from stainless steel wire such as nichrome wire which is especially good for high intensity and fluorescent tubing, but may also be made of nickel, chromium, or Monel metal, or other wire found suitable for this purpose.

While I have illustrated and described the preferred embodiments of my invention, it is to be understood that I do not limit myself to the precise constructions herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new, and desire to secure by United States Letters Patent is:

1. An electrode for gaseous tubes, comprising a wire coil for engagement with a gaseous tube having its rear turns progressively reduced in diameter to present a frusto-conical shape, said wire coil having the rear end of the wire from which it was formed extended from the rear end of said coil and bent at right angles to the axis of said coil, and a U-shaped terminal wire having the junction of its arms disposed within the frusto-conical portion of said coil, said terminal wire having its arms extended from the rear end of said coil and along opposite sides of the right angular end of said coil wire and twisted about each other adjacent the face of said right angular end of said coil wire disposed from said coil.

2. An electrode for gaseous tubes, comprising a wire coil for engagement with a gaseous tube having its rear turns progressively reduced in diameter to present a frusto-conical shape, said wire coil having the rear end of the wire from which it was formed extended from the rear end of said coil and bent at right angles to the axis of said coil, and a U-shaped terminal wire having the junction of its arms disposed within the frusto-conical portion of said coil, said terminal wire having its arms extended from the rear end of said coil and along opposite sides of the right angular end of said coil wire and twisted about each other adjacent the face of said right angular end of said coil wire disposed from said coil, and a conical shaped member set into the frusto-conical shaped rear end of said coil, said terminal wire having the junction of its arms engaged over said conical shaped member.

3. An electrode for gaseous tubes, comprising a wire coil for engagement with a gaseous tube having its rear turns progressively reduced in diameter to present a frusto-conical shape, said wire coil having the rear end of the wire from which it was formed extended from the rear end of said coil and bent at right angles to the axis of said coil, and a U-shaped terminal wire having the junction of its arms disposed within the frusto-conical portion of said coil, said terminal wire having its arms extended from the rear end of said coil and along opposite sides of the right angular end of said coil wire and twisted about each other adjacent the face of said right angular end of said coil wire disposed from said coil, and a conical shaped member set into the frusto-conical shaped rear end of said coil, said terminal wire having the junction of its arms engaged over said conical shaped member, said conical shaped member being formed with longitudinal grooves on diametrically opposite sides thereof forming passages between the adjacent faces of said conical member and said coil through which the arms of said terminal wire extend.

4. An electrode for gaseous tubes, comprising a wire coil for engagement with a gaseous tube having its rear turns progressively reduced in diameter to present a frusto-conical shape, said wire coil having the rear end of the wire from which it was formed extended from the rear end of said coil and bent at right angles to the axis of said coil, and a U-shaped terminal wire having the junction of its arms disposed within the frusto-conical portion of said coil, said terminal wire having its arms extended from the rear end of said coil and along opposite sides of the right angular end of said coil wire and twisted about each other adjacent the face of said right angular end of said coil wire disposed from said coil, said coil, comprising an outer coil and a complementary inner coil disposed within said outer coil, said right-angular end portion being extended from the rearmost turn of said outer coil.

5. An electrode for gaseous tubes, comprising a wire coil for engagement with a gaseous tube having its rear turns progressively reduced in diameter to present a frusto-conical shape, said wire coil having the rear end of the wire from which it was formed extended from the rear end of said coil and bent at right angles to the axis of said coil, and a U-shaped terminal wire having the junction of its arms disposed within the frusto-conical portion of said coil, said terminal wire having its arms extended from the rear end of said coil and along opposite sides of the right angular end of said coil wire and twisted about each other adjacent the face of said right

angular end of said coil wire disposed from said coil, said coil, comprising an outer coil and a complementary inner coil disposed within said outer coil, said right-angular end portion being extended from the rearmost turn of said outer coil, said terminal wire having the junction of its arms looped over a turn of the frusto-conical portion of said inner coil to cooperate with the turned portion of the arms of said terminal wire in locking said coils together.

MILTON FLETCHER.