Aug. 27, 1940. A. ETZRODT 2,212,827

HOT CATHODE FOR HIGH POWER

Filed Oct. 22, 1938

Fig. 1.

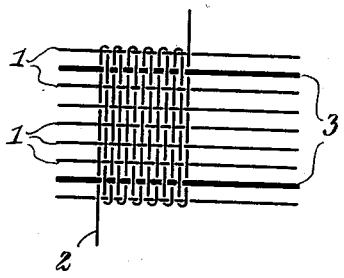


Fig. 2.

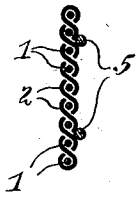


Fig. 3.

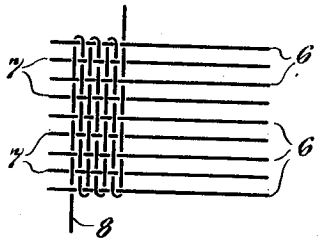


Fig. 4.

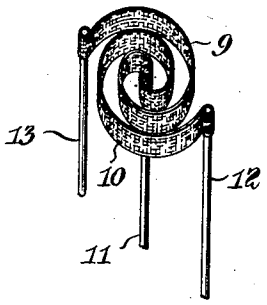


Fig. 5.

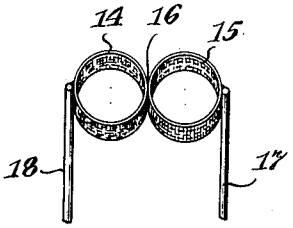
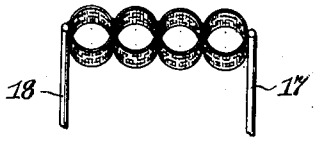


Fig. 6.



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2,212,827

HOT CATHODE FOR HIGH POWER

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Application October 22, 1938, Serial No. 236,438
In Germany December 29, 1937

6 Claims. (Cl. 250—27.5)

The invention relates to cathodes and particularly to the type of cathode comprising a conductor coated with an electron emissive body.

An object of the invention is to provide a large oxide coated cathode which will not be deformed in operation.

Other objects and advantages of the invention will be apparent from the following description and drawing in which:

Fig. 1 is an elevation of a supporting and conducting framework for an oxide coated cathode embodying the invention.

Fig. 2 is a cross-section through a supporting and conducting framework, embodying a modification of the invention.

Fig. 3 is an elevation of a supporting and conducting framework of a still further modification of the invention.

Figs. 4, 5, and 6, are perspective views illustrating modifications in the shape of the complete conducting and supporting framework of the cathode according to the invention.

In adapting hot cathodes for use in high power tubes, it is necessary to provide an extensive surface of the strontium, barium, and calcium oxide coating. Band shaped metal networks are utilized as carriers for the actual emission layer. These networks serve both as a supporting and a conductive structure for the coating thereon. The current of electricity is passed through the metal part and this current maintains the complete structure at the emission temperature of the active layer coating. Nickel or nickel compounds have been found to be particularly suitable for the support and conductivity of the heating current. Cathodes of high power, however, require an extended length of the cathode which may be in the order of 50 to 250 millimeters and a width of the order of 5 to 20 millimeters. When this metal network of nickel is in hot condition during operation, a jar or vibration may easily deform its original shape, causing a displacement in the distance between the cathode and the other electrodes.

According to the invention, the supporting and conductive network is strengthened by including therein wires of a material capable of withstanding high heat without deformation. These wires, as explained below in connection with the drawing, may be weaved or braided with the nickel or nickel compound wires or may be welded thereto to provide a strong supporting structure. Preferably these strengthening wires are of a material from the group of tungsten, tantalum, molybdenum, or alloys of these metals. It is preferred that these strengthening wires have a sufficiently large cross-section so that they avoid any deformation of the cathode and yet have an electric resistance several times that of the nickel or nickel composition wires so that these strengthening wires carry only approximately 10% of the total current. Preferably in cathodes of the above given dimensions of a length of 50 to 250 millimeters and a width of 5 to 20 millimeters, these strengthening wires are approximately .2 or .3 millimeter in diameter.

In Figs. 1 through 3, are disclosed certain preferred embodiments of the combination of the nickel and supporting wires. In Fig. 1, the network consists of nickel wires 1 extending longitudinally of the cathode which are held together with nickel wire 2 braided or weaved with the longitudinal wires 1. Extending longitudinally with the nickel wires are the strengthening wires 3 which, in this case, are two wires from the aforementioned group and preferably tungsten, having a diameter which is preferably somewhat greater than the diameter of the nickel wires 1. The coating is preferably that of strontium, barium, and calcium oxide, which may be placed thereon by dipping the network into the substance or by spraying the substance on the network and then activating the coating thereon in the usual manner.

In Fig. 2, the network is formed by the nickel or nickel composition wires extending longitudinally and braided vertically and then having band wires 5 from tungsten or molybdenum fastened at a plurality of points by welding. The supporting wires are indicated at 5 and the nickel wires at 1 and 2, corresponding to those of Fig. 1. While two supporting wires have been illustrated in connection with Figs. 1 and 2, it is, of course, understood that more or less may be utilized, depending upon the size of the cathode.

In place of working with a small number of supporting wires of large diameter, a large number of thin supporting wires may be utilized. Such a cathode body is illustrated in Fig. 3. In this case, the nickel wires 6 alternate with wires of tungsten, tantalum, or molybdenum, identified by 7. All the wires are held with reference to each other in proper position by the nickel wire 8 which is weaved or braided with the wires 6 and 7.

In the embodiment according to Fig. 3, it is desirable to make certain that the supporting wires themselves should carry a part of the active layer and in this manner add to the emission. In order to insure the suitable adhesion of the active layer

to the supporting wires, it may be desirable to cover the supporting wires 7 with an oxidized layer from the group of gold, platinum, or nickel. The supporting wires in Figs. 1 and 2 may also be treated in this manner.

If desired, such supporting wires of tungsten, tantalum, molybdenum, or alloys of these metals may be covered with this oxidized layer of gold, platinum or nickel and completely replace the nickel wires as a support for the emission layer. Nickel wires may or may not be used for braiding purposes in this construction.

The strength of the supporting network permits the use of many forms of cathodes which would otherwise be easily deformed in operating with high power. Fig. 4 discloses one such type made possible by the invention, in which the cathode body consists of two spirals 9 and 10 disposed within each other and having a central connecting and supporting standard 11. The ends of these spirals are supported by the connecting conductors and standards 12 and 13. 12 and 13 may be utilized as conductors for the heating current and 11 may be utilized as a conductor for the emission current.

In Fig. 5 the cathode consists of two bands of 14 and 15 bent into a ring form which are preferably welded to each other at 16. Other closed forms may be utilized. Conductors 17 and 18 form the supports for the cathode. The cathode is not necessarily limited to the two large rings disclosed in Fig. 5, but may be composed of a number of rings such as the four smaller rings illustrated in Fig. 6. This particular band shaped construction has the advantage of a large surface and high solidity for small weight, and therefore, after the heating current is connected thereto, very quickly attains its electron emitting temperature.

Many modifications may be made in the number, form and arrangement of the preferred embodiments disclosed. The central part of Fig. 5 at 16 may have a connection thereto similar to connection 11 in Fig. 4. Fig. 6 may be similarly modified. Accordingly, only such limitations are intended on the following claims as is necessitated by the prior art.

I claim:

1. A cathode for a discharge device comprising an electron emitting coating and supporting and heating wires therefor, some of said wires containing nickel and some of said wires containing a material from the group of tungsten, molybdenum, and tantalum.

2. A cathode for a discharge device comprising an electron emitting coating and supporting and heating wires therefor, some of said wires containing nickel and some of said wires containing a material from the group of tungsten, molybdenum, and tantalum, said last mentioned wires having an electrical resistance several times that of the first mentioned wires containing nickel whereby the major portion of the heating current passes through said first mentioned wires.

3. A cathode for a discharge device comprising an electron emitting coating and supporting and heating wires therefor, some of said wires containing nickel and some of said wires containing a material from the group of tungsten, molybdenum and tantalum, said last mentioned wires having an oxidation resisting protecting layer thereon.

4. A cathode for a discharge device comprising an electron emitting coating and supporting and heating wires therefor, some of said wires containing nickel and some of said wires containing a material from the group of tungsten, molybdenum, and tantalum, said last group of wires interspersed with said first group in a longitudinally extending band.

5. A cathode for a discharge device comprising an electron emitting coating and supporting and heating wires therefor, some of said wires containing nickel and some of said wires containing a material from the group of tungsten, molybdenum and tantalum, said last group of wires interspersed with said first group in a longitudinally extending band, and wires containing nickel woven crosswise of said longitudinally extending wires.

6. A cathode structure comprising a plurality of ringshaped bands of interwoven wire, said bands being welded together.

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