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CATHODE FOR ELECTRON DISCHARGE DEVICES

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FIG. 1 FIG. 2 FIG. 4 FIG. 5

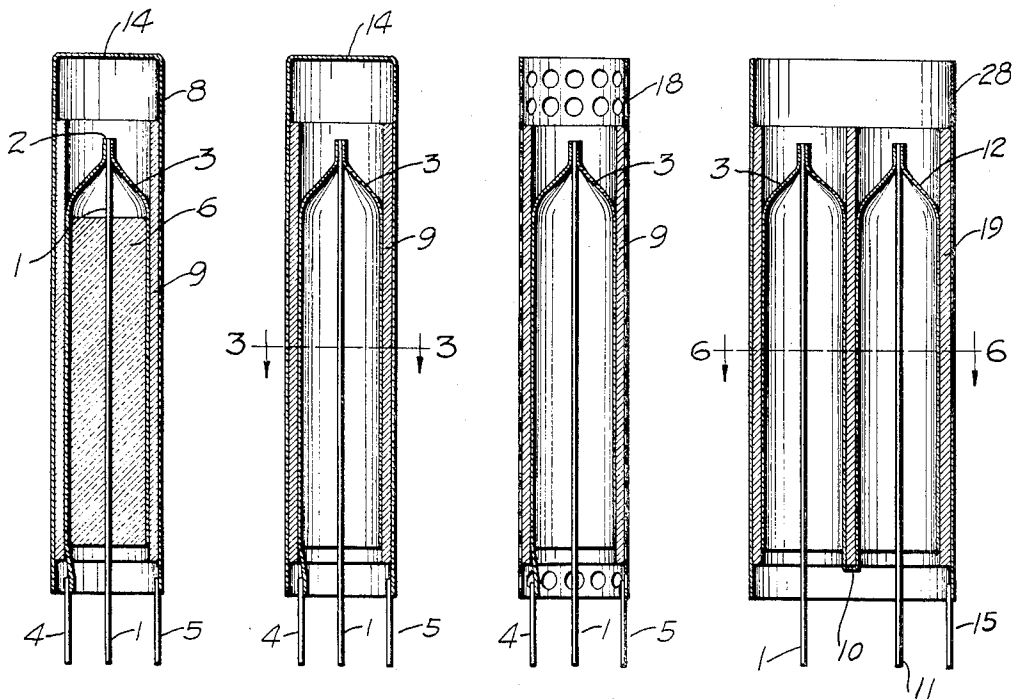
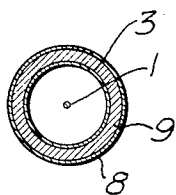
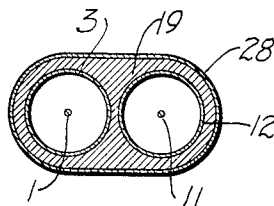


Fig. 3



11-6



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CATHODE FOR ELECTRON DISCHARGE DEVICES

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3 Claims. (Cl. 250—27.5)

My invention pertains to electron discharge devices and relates in particular to the cathodes of such devices.

There are two general types of cathodes used with that class of electron discharge devices known as thermionic tubes; those in which the electron emitting substance is heated directly by the passage of current therethrough or through a conductor bearing the emissive substance, and those in which the electron emitting substance or member is heated by the proximity of a separate heating element.

My invention contemplates an improvement especially in the latter type of such cathodes and has as one of its objects to produce a cathode in which the efficiency of electron emission is very materially increased over that now known.

Another object contemplated by my invention comprises producing a cathode in which the thermal emission is lowered to effect a corresponding increase in the electronic emission.

A further object of my invention is to produce a cathode having a low thermal emissivity and a correspondingly high electronic emissivity.

It is well known that a highly polished surface has a relatively low thermal radiation or emissivity, while a surface such as that presented by the oxide coating of the cathode of a modern thermionic tube has a relatively high thermal emissivity. It is further known that a surface having a low thermal emissivity has a high electron emissivity and vice versa. It follows therefore that if an electron emitting surface with a low thermal emissivity can be provided, a cathode having a greatly increased cathode efficiency over that hitherto known can be produced. My experiments with my novel cathode indicate that an efficiency, that is milliamps of electron current per watt of heating energy, approximately four times that of the ordinary oxide coated cathode can be achieved.

In my improved cathode, I interpose an electron emitting element between the heater and a metallic member which is highly polished on the outer surface to present an emitting surface of low thermal and high electron emissivity.

The electron emitting element in my improved cathode is in the form of a refractory cylinder maintained between the heater and a metallic sleeve provided with a highly polished and thus low thermal emissive surface. The refractory cylinder is preferably formed of an alkaline earth oxide or oxides such as barium or strontium or a combination of these earths and by

a process of electrothermal dissociation, the alkaline earth oxides are broken down to, by electrolytic conduction, diffuse the alkaline elements through the wall of the metallic sleeve to effect electron emission from the highly polished surface thereof.

In the drawing accompanying and forming a part of this specification illustrating several embodiments of my device and in which like reference numerals designate corresponding parts throughout:

Fig. 1 is an enlarged sectional elevation of one embodiment of my improved cathode.

Fig. 2 is an enlarged sectional elevation of an alternative form of my cathode.

Fig. 3 is a cross-section taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional elevation of a still further embodiment of my cathode.

Fig. 5 is an enlarged sectional elevation of an embodiment of my cathode applicable for use with standard thermionic tubes and standard circuits for the use of the same.

Fig. 6 is a cross-section taken on the line 6—6 of Fig. 5.

Referring now to the figures, which are shown with greatly exaggerated relative diameters in order to more clearly bring out the structural features of my invention, I have illustrated my new cathode in conjunction with the type of heater disclosed in my Patent No. 1,852,023, issued April 5, 1932, as I have found by experiment that such type of heater is admirably adapted for use in conjunction with my improved emitter, although any other efficient type of heater may be utilized.

Fig. 1 illustrates an embodiment of my idea in which the heater wire, composed of tungsten or other material which is rendered incandescent by the passage of electric current therethrough, is co-axially disposed within preferably a nickel cylinder or tube 3, the upper extremity of which is tapered to a point 2 as shown. The heater wire 1 is welded or otherwise conductively connected to the tapered point 2 and a terminal 4 is provided for the tube 3 to serve as the connecting terminal therefor. A cylinder 6 of refractory material serves to maintain the heater wire in co-axial relation with the tube 3. The tube 3, as explained in my co-pending application hereinbefore noted, functions as a portion of the return circuit for the heating current. A cylinder 9 composed of the alkaline earth oxides hereinbefore noted encircles the tube 3 and is in turn encircled by a metallic cylinder 8

which may be of nickel and preferably provided with a very thin wall, the outer surface of which is highly polished. The upper extremity of this cylinder may be provided with a top 14 or may be left open as desired. The cylinder 8 is provided with a connecting terminal 5 as indicated which serves as the cathode connection of the thermionic tube utilizing my improved type of cathode.

With the construction shown, as ordinarily used, there will be maintained a small current through the material of the cylinder 9 because in all modern thermionic tube use the heater is biased by a potential with respect to the cathode sleeve. I utilize this small leakage current to, by electrolytic conduction and thermal dissociation, bring the alkaline elements or active material to the surface of the emitting cylinder or sleeve 8 and to steadily during the operation of the cathode re-supply active material lost by evaporation. This action is similar to that in common use for reactivating thoriated tungsten filaments wherein the thorium or more active material is dissociated from the tungsten and brought to the surface to provide efficient electron emission. The highly polished surface of the cylinder 8 provides a surface having a low thermal emissivity and consequently high electron emissivity. Therefore a gain in efficiency is achieved through an increase in the milliamps of electron current per watts of heating current emitted.

Referring now particularly to Figs. 2 and 3, I have shown embodiments of my device in which the refractory material maintaining the heater wire 1 in co-axial relation with the tube 3 is dispensed with. In all other respects this embodiment corresponds with the embodiment disclosed in Fig. 1.

Referring now to Fig. 4, I have illustrated a still further embodiment which differs from that shown in Fig. 2 in that the metallic emitting surface 18 is not only highly polished on the outer surface, but is provided with perforations. While these of course reduce the area of the polished surface, they permit of more efficient heat transfer and the combined effect of direct emission from the oxide cylinder 9 and the polished surface of the cylinder 18 is thus achieved.

Referring now to Figs. 5 and 6, I have illustrated an embodiment of my cathode employing a type of heater designed for use with standard tubes and standard tube circuits. As explained in my Patent No. 1,852,023 hereinbefore referred to, the length of the present day heater is governed by the alternating current voltages used and the physical constants of the tungsten heater wire and it is therefore not possible to use the standard heater wire lengths with my co-axial cylinder construction, although I prefer to use this type of heater in conjunction with my novel emitter. In order therefore to obtain the same length of heater wire as is now common in standard thermionic tubes that my new type of emitter may be used in thermionic tubes suitable for use with standard circuits, it is necessary to use two heaters 1, 3 and 11, 12, con-

nected in series by conductor 10 as shown in Fig. 5. The twin heaters thus formed are surrounded by the active material 19 which is in turn enclosed in the thin wall tube 28, the outer surface of which is highly polished and to which there is connected a conducting terminal 15. This embodiment of my device in respect to the efficient emission of electrons functions in the same manner as hitherto described herein.

It will be noted that, contrary to accepted practice, I provide the active material within a metallic cylinder rather than on the outside thereof and that by thermal dissociation and electrolytic conduction amalgamate the active materials through the wall of the metallic cylinder that electrons may be emitted from the highly polished surface thereof to thus increase the cathode efficiency. It should be noted that the active material may be in the form of a coating attached to the inner wall of a metallic cylinder, the outer surface of which is highly polished.

As stated hereinbefore, I have purposely exaggerated the diameter of the heater tubes, the electron emissive cylinder and the emitting surface in order that the construction may be more clearly shown. It is obvious that the diameters of the elements of my cathode must be so properly proportioned that the optimum activation temperature may be obtained. Such relative diameters depend upon the thermal emissivity of the outer surface and the physical ratios of the diameters of the elements will be readily apparent to those skilled in the art.

Having thus completely described my invention by illustration and description of several embodiments thereof, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. A cathode comprising, a conductive cylinder, a heater maintained within said cylinder and comprising a plurality of cylindrical conductors conductively connected to each other at one of the extremities thereof, a heating element disposed within each of said conductors and conductively connected thereto, and an electron emitting element maintained between said conductive cylinder and said cylindrical conductors forming a part of said heater.

2. A cathode comprising, a metallic member, a plurality of hollow conductors within said member, a heater within each of said conductors, said heaters being interconnected by said conductors, and an electron emitting substance disposed between said conductors and said metallic member.

3. A cathode comprising, a metallic member, a plurality of conducting members within said metallic member, a heater within each of said conducting members, said heaters being serially connected by said conducting members and an electron emitting substance disposed between said conducting members and said metallic member.

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