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G. DIEMER
ELECTRIC DISCHARGE TUBE COMPRISING
AN INDIRECTLY HEATED CATHODE
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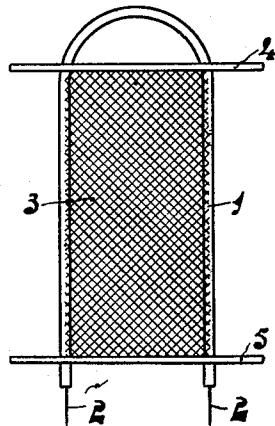


Fig. 1

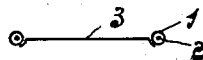


Fig. 2

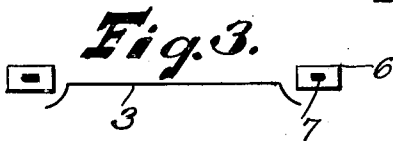


Fig. 3

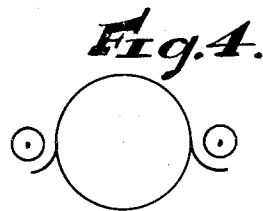


Fig. 4

GESINUS DIEMER
INVENTOR

BY *Wm M Vogel*
AGENT

UNITED STATES PATENT OFFICE

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AN INDIRECTLY HEATED CATHODEGesinus Diemer, Eindhoven, Netherlands, as-
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9 Claims. (Cl. 250—27.5)

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This invention relates to electric discharge tubes and more particularly to the structure of the cathode of such tubes. It is a known phenomenon that electron emission from very thin cathode wires is comparatively better than that of thicker wires. This applies to both wires consisting of a substance having itself the capacity of readily emitting electrons and wires which are coated with an electron-emitting substance or mixture. Consequently, a directly heated cathode, which consists of a very thin wire, yields comparatively a greater emission than a cathode comprising a thick electron-emitting body, for example an indirectly heated cathode.

It is an object of this invention to provide an indirectly heated cathode which attains a high thermal yield, that is a large number of milliamps of emission current per watt of heating energy.

In an electric discharge tube according to the invention, an indirectly heated cathode is built up from a tubular metallic body bent once or several times and which constitutes the envelope for a heating wire provided in an insulated manner inside the metallic body the envelope having secured to it a number of wires of a thickness of 50 microns at the most, with a spacing of the wire parts of at least three times the thickness of the wire. The thin wires may be braided to form a network, the apertures of which have a width of preferably four times the thickness of the wire or more. The said wires may either consist of a substance, having the capacity of readily emitting electrons, such as tungsten, tungsten-thorium or the like, or be coated with electron-emitting substances such as oxides of the alkaline or alkaline-earth metals.

The advantageous action of a cathode provided in accordance with the invention is probably attributable to several factors. Firstly, the curvature of the sectional area of thin wires is great, so that the field at the surface is strong and a comparatively high emission per unit of surface may be obtained. Furthermore, a highly uniform distribution of temperature may occur if the envelope containing the heating wire is U-shaped and the limbs are connected by the thin wires. It appears that in this case the cooling of the limbs resulting from radiation by the thin wires is approximately equal to the cooling at the points of support of the envelope. It is also possible to bend the heating wire in a zig-zag manner, or to compose the envelope of two or more cylindrical bodies, indirectly heated and substantially parallel, which are connected by the thin electron-emitting wires. It is very advantageous

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to utilize for this purpose two or more bodies of conventional indirectly heated cathodes. In one form of construction of a discharge tube according to the invention the supporting body for the thin wires is constituted by a plurality of conductors drawn out to a small diameter, which surround one another and are insulated with respect to each other. In this case the transfer of heat from the heating wire to the metal envelope is very advantageous, while the mass is small so that a short heating-up time may be obtained. Furthermore such a supporting body may be flattened without taking particular precautions. The spacing of the parallel parts of the envelope containing the heating wire must preferably not be greater than 200 times the diameter of the thin electron-emitting wires, since otherwise the decrease in temperature along these wires becomes excessive. The said distance is preferably 60 times the said wire thickness, in which case the temperature difference at different areas of the cathode will not be greater than about 10° C.

It was known per se to arrange a heating body in an insulating manner in a channel formed by grooves provided in two superposed plates. The plates could in this case be substituted, if desired, by metal gauze. There were, however, no data about the thickness of the wires of the metal gauze and the size of the apertures and no mention was made of the possibility of obtaining more satisfactory emission by the use of very thin wires.

The invention will now be explained more fully by reference to the accompanying drawing in which

Fig. 1 is a side view and

Fig. 2 is a cross-sectional view of a cathode according to the invention; and Fig. 3 is a cross-sectional view showing another embodiment in which the supporting body is flattened and Fig. 4 is a cross-sectional view in which the electron emitting part of the cathode is shown curved.

In the figures, reference numeral 1 designates a heating body of 250 microns in diameter which is constituted by a plurality of drawn conductors and in which a heating wire 2 is housed in an insulated manner. To the U-shaped body 1 is secured a network 3 consisting of wires of a thickness of 15 microns and having a width of the apertures which is about four times the thickness of the material. The thin wires may consist of nickel or any other material suitable as a support for electron-emitting substances and the wires are coated with the electron-emitting material by the spraying process or by cataphoretic

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means. The thin wires may be welded to the heating body with the aid of supports 4 and 5 as shown, but may alternatively be secured to this body by fusion whilst heating under pressure. The distribution of temperature has been found to be very advantageous. Since the heating body is arranged at the edge of the electron-emissive portion in form of wire or gauze, the distribution of temperature at right angles to the limbs may be highly uniform. For this purpose the distance between the limbs of the heating body is chosen to be not greater than 200 times the diameter of the thin electron-emitting wires. Also in the longitudinal direction of the cathode the distribution of temperature is more advantageous than in conventional indirectly heated cathodes since the cooling brought about by the attachment members is about equal to the cooling of the remaining part of the limbs caused by the electron-emitting thin wires. A particular advantage of a heating body consisting of drawn wires is furthermore that such a body is adapted to be flattened in a direction normal to the surface of the cathode as shown at 6 in Fig. 3, so that the dimensions of the cathode in this direction may be small. It is thus possible in a tube according to the invention to obtain a small distance between the cathode and the first grid without utilizing a shaped grid.

It is evident that the cathode may also exhibit other shapes within the scope of the invention. Thus, the heating body may be bent several times, and hence comprise more than two parallel limbs and need not be constituted by a plurality of drawn wires. Furthermore, the surface of the cathode may be curved or exhibit the shape of a cylinder as shown at 8 in Fig. 4.

What I claim is:

1. An indirectly heated cathode structure for an electron discharge tube comprising a tubular metal body having bent-back portions for supporting the electron-emitting part of said cathode, a heating wire arranged within said tubular body, insulating means provided between said heating wire and said tubular body, and a plurality of thin wires secured to said supporting portions of the tubular body and adapted to be indirectly heated by said heating wire, said wires having a thickness of 50 microns at the utmost and being spaced from each other at a distance which is at least three times the diameter of said wires.

2. An indirectly heated cathode structure for an electron discharge tube comprising a tubular metal body having bent-back portions for supporting the electron emitting part of the indirectly heated cathode said body having a flattened profile in a direction at right angles to the surface of the cathode, a heating wire arranged within the tubular body, insulating means between said body and the heating wire, and a plurality of thin wires secured to said supporting portions and forming said electron emitting part of said cathode, said wires having a thickness of 50 microns at the utmost and being spaced from each other at a distance at least three times the diameter of said wires.

3. An indirectly heated cathode structure for an electron discharge tube comprising a tubular metal body having bent-back portions shaped to form a frame for supporting the indirectly heated cathode proper, a heating wire arranged within said tubular body, insulating means provided

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between said heating wire and said tubular body, and a plurality of thin wires braided to form a network between said supporting portions of the tubular body and adapted to be indirectly heated by said heating wire, said wires having a thickness of 50 microns at the utmost and forming apertures having a size which is at least four times the diameter of said wires.

4. An indirectly heated cathode structure for an electron discharge tube comprising a drawn tubular metal body having bent-back portions forming substantially parallel limbs for supporting the electron emitting part of the indirectly heated cathode, a heating wire arranged within the tubular body, insulating means between said body and the heating wire, and a plurality of thin wires secured to said supporting portions and forming said electron emitting part of said cathode, said wires having a thickness of 50 microns at the utmost and being spaced from each other at a distance at least three times the diameter of said wires.

5. An indirectly heated cathode structure as claimed in claim 4, wherein the spacing of said substantially parallel limbs of the tubular body is less than 200 times the diameter of said thin electron emitting wires.

6. An indirectly heated cathode structure for an electron discharge tube comprising two tubular metal bodies placed substantially in parallel, for supporting the electron emitting part of the indirectly heated cathode, a heating wire arranged within each tubular body, insulating means between the heating wires and said bodies so that the bodies will be indirectly heated, and a plurality of thin wires secured to said supporting bodies and forming said electron emitting part of said cathode, said wires having a thickness of 50 microns at the utmost and being spaced from each other at a distance at least three times the diameter of said electron emitting wires.

7. An indirectly heated cathode structure as claimed in claim 1, wherein the surface of the electron emitting part of the cathode is curved.

8. An indirectly heated cathode structure as claimed in claim 1, wherein the surface of the electron emitting part of the cathode is cylindrical in shape.

9. An indirectly heated cathode structure for an electron discharge tube, said cathode structure comprising a tubular body having bent-back portions forming substantially parallel limbs for supporting the electron emitting part of the cathode, a heating wire arranged within the tubular body, insulating means between said body and the heating wire, and a plurality of thin electron emitting wires secured to said supporting limbs and braided to form a network therebetween, said wires having a thickness of 50 microns at the utmost and forming apertures having a size which is at least four times the diameter of said electron emitting wires.

GESINUS DIEMER.

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The following references are of record in the file of this patent:

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