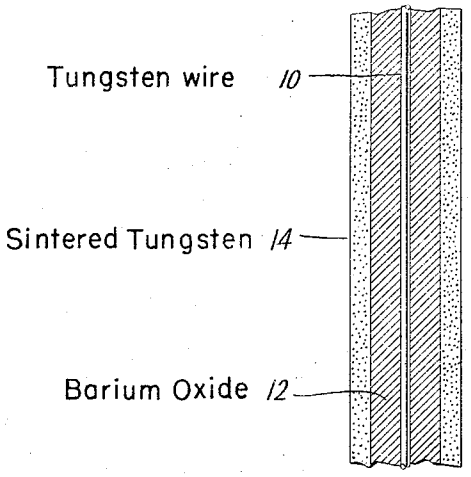
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FILAMENTARY CATHODE AND METHOD OF MAKING SAME

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FILAMENTARY CATHODE AND METHOD OF MAKING SAME

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This invention relates to a filamentary type cathode. More particularly it relates to a so-called L-type cathode.

In recent years Lemmens, Jansen and Loosjes have developed in Holland a cathode of the planar type which has been referred to in the literature as an L-type cathode. These cathodes have been described as giving high emission densities, possessing good mechanical strength and having good temperature emission characteristics, excellent resistance to high voltage and high speed gas ions. The structure furthermore contains a reservoir of barium, strontium carbonate emitting material. The Lemmens type cathodes of the prior art having been made by forming a molybdenum cup and filling it with the emissive material. The interior of this cup acts as a storage space or reservoir for the barium strontium carbonate mixture which is then capped with a porous wall of tungsten. The molybdenum member is further designed so as to permit a filamentary heater to be used to heat up the material in the cup member. Cathode bodies of this type are, for the most part, fairly large since there is a spacial distance between the filamentary heating element and the molybdenum cup. These cathodes are therefore also relatively slow in heating up.

It is, accordingly, an object of this invention to develop an L-type cathode which can be made in a very small form.

It is a further object of this invention to develop an L-type cathode which can be brought to temperature very rapidly.

It is still another object of this invention to provide a method of making an L-type cathode in very simple and inexpensive manner.

These objects and other advantages incidental thereto can be attained by coating a filamentary wire with an emission material, subsequently coating the emission material with a fine molybdenum or tungsten powder and then sintering the final coating.

In the drawings, which illustrate an embodiment of this invention, Figure 1 is a cross-sectional view of a filamentary type L-cathode showing the relative position of its component parts.

In the drawing, 10 illustrates a tungsten wire filament coated with barium oxide 12 which has in turn been coated with a fine tungsten powder 14 which has subsequently been sintered.

The method of preparation of this filamentary type cathode is pretty much straight forward. The tungsten wire can be coated with emission material, such as barium and strontium carbonates, by either the electrophoretic or bench coating techniques, as well as by any other methods known to the prior art. There is nothing particularly critical in its method of application. It is merely desirable that a good coherent coating be formed on the wire 10.

The tungsten powder 14 or molybdenum powder which is to be used to form the sintered porous coating over the emissive material is, however, preferably placed thereon in a very finely divided state. In fact, the tungsten

powder might even be referred to as being ultra-fine. They can, of course, be brought onto the emissive coating 12 in any number of ways. The preferred method is one in which the metallic powder is brought on by the usual bench coating technique from a nitro-cellulose bath containing acetone as a binder. The degree of fineness of the powder will affect the sintering temperatures which can be used for this purpose. When the powder is in a very fine state a radically lower sintering temperature can be used.

During the actual sintering, the emission coating will also break down and thus give a product in which the porous sintered outer coating will contain impregnated therein some of the emissive material, with a layer of the emissive material directly in back of it to act as a reservoir.

In view of the fact that the tungsten wire is in direct contact with the emissive material, it can readily be seen that the resulting cathode structure is of the quick heating type. This is true since the heat can be transmitted directly by conduction and need not depend upon radiation.

When the powdered tungsten or molybdenum powders are sintered, a porous mechanically tight jacket is formed around the emission material. The sintering should be carried out at those temperatures and conditions that will lead it to a sintered mass which is porous, but strong enough not to crumble.

The finished L-type cathode is composed of three parts; a tungsten filament 10, an inner core of barium oxide 12 and an outer sleeve of mechanically tight porous tungsten or molybdenum 14. This cathode is made by electrophoretically coating a tungsten filament wire with a barium carbonate emission material by a standard cataphoretic method in which the barium carbonate is suspended in a solution made up, for example, of 10.4 grams of nitro-cellulose (900–1300 sec.) dissolved in a liter of amyl acetate. The coating is carried out under such conditions that a coating thickness of about 1 mil is obtained. The resulting material is a standard filamentary coated cathode. This coated wire is then bench coated with a fine tungsten powder. The suspension which is used for this purpose is similar to that used for the suspension of the barium carbonate, namely a nitro-cellulose lacquer suspension formed by dissolving 10.4 grams of nitro-cellulose in a liter of amyl acetate. The tungsten powder suspended in this solution is one which has a very fine particle size. Sufficient tungsten powder is added to make the suspension slightly thick. After the tungsten powder has been deposited on the carbonate coating the entire structure is brought up to the sintering temperature of the metal powder to produce a reasonably strong mechanically tight sleeve. This temperature is usually in the neighborhood of about 1200° C. For best results at this temperature the particle size of tungsten, if tungsten is to be used as the outer metal coating, is about $\frac{1}{10}$ of a micron; whereas if molybdenum is used as the outer coating, the particle size is preferably in the neighborhood of .5 micron. In order to get the best results the thickness of the metal powder coating obtained as a result of the bench coating thickness should be about 1 to 2 mils.

When filamentary cathodes of this type are tested it has been observed that emission comes at about 970° C. and then follows a normal curve. It has been further noted that in those cases in which tubes gassed at too high a voltage and flashed over, the emission will build up again upon reducing the voltage to zero and raising it again. This phenomenon is characteristically peculiar to L-type cathodes.

While the above-described manner of preparing the filamentary cathode is preferred, it has been found possible to mix the metal powder and the emission material

and form a single suspension of the two. This double suspension can then be simultaneously applied to the wire core by either a cataphoretic or bench type coating technique which is then followed by the normal sintering technique. This latter will tend to break down the carbonate to form the desired oxide and a porous tight sleeve of metal. While this technique results in a cathode coating in which the barium oxide is dispersed throughout the sintered tungsten or molybdenum, whichever is used as the metallic sheath forming metal, the structural appearance of the two forms is somewhat different since the form shown in the drawing has a separate and distinct reservoir of emissive material which can filter up through the porous metal sheath.

While the above description and drawing submitted herewith discloses a preferred and practical embodiment of the filamentary cathode of this invention it will be understood that the specific details of construction and arrangement of parts as shown and described are by way of illustration and are not to be construed as limiting the scope of the invention.

What is claimed is:

1. A filamentary cathode suitable for use in an electron discharge device consisting essentially of a tungsten filament coated with an emissive material, the composite being sheathed within a porous refractory metal body.

2. A filamentary cathode suitable for use in an electron discharge device consisting essentially of a tungsten filament coated with an emissive material, the composite being sheathed within a porous tungsten metal sheath.

3. A filamentary cathode suitable for use in an electron discharge device consisting essentially of a tungsten filament coated with an emissive material, the composite being sheathed within a porous molybdenum metal sheath.

4. A filamentary cathode suitable for use in an electron discharge device consisting essentially of a tungsten filament coated with barium oxide, the composite being sheathed within a porous tungsten metal sheath.

5. In the method of making a filamentary cathode the steps comprising coating a tungsten filament with an emissive material, applying a coating containing a finely divided refractory metal and sintering the outer metal coating to form a porous metal sheath.

6. In the method of making a filamentary cathode the steps comprising coating a tungsten filament with barium carbonate, applying a coating containing a finely divided refractory metal and sintering the outer metal coating to form a porous metal sheath.

7. In the method of making a filamentary cathode the steps comprising coating a tungsten filament with barium carbonate, applying a coating of finely divided tungsten particles and sintering the tungsten particles to form a tight porous sheath.

8. In the method of making a filamentary cathode the steps comprising coating a tungsten filament with barium carbonate, applying a coating of tungsten powder having a particle size of about $\frac{1}{10}$ of a micron and sintering the composite at a temperature of about 1200° C.

9. In the method of making a filamentary cathode the steps comprising coating a tungsten filament with barium carbonate, applying a coating of molybdenum powder having a particle size of about .5 micron and sintering the composite at a temperature of about 1200° C.

10. In the method of making a filamentary cathode, the steps comprising coating a tungsten wire with a mixture of barium carbonate and a refractory metal powder and heating the coated wire to the sintering temperature of the metal powder.

11. In the method of making a filamentary cathode, the steps comprising coating a tungsten wire with a mixture of barium carbonate and tungsten metal powder and heating the coated wire to the sintering temperature of the metal powder.

12. In the method of making a filamentary cathode, the steps comprising coating a tungsten wire with a mixture of barium carbonate and molybdenum metal powder and heating the coated wire to the sintering temperature of the metal powder.

13. A filamentary cathode suitable for use in an electron discharge device comprising a filament, a coating of emissive material cohered to said filament, and a porous refractory body sheathing said coating, said body being formed by sintering whereby some of said emissive material of said coating impregnates said body, and said coating serves as a reservoir of emissive material for impregnation into said body.

14. A filamentary cathode suitable for use in an electron discharge device comprising a filament, a coating of emissive material cohered to said filament, and a porous refractory body of tungsten powder sheathing said coating, said body being formed by sintering whereby some of said emissive material of said coating impregnates said body.

15. A filamentary cathode suitable for use in an electron discharge device comprising a filament, a coating of emissive material cohered to said filament, and a porous refractory body of molybdenum sheathing said coating, said body being formed by sintering whereby some of said emissive material of said coating impregnates said body, and said coating serving as a reservoir of emissive material for impregnation into said body.

16. A quick-heating cathode for an electron tube comprising a filament, a coating of emissive material in direct contact with said filament, a sintered and mechanically-rigid metallic body sheathing said coating, said metallic body being porous and having diffused therein emissive material of said coating.

17. A quick-heating cathode for an electron tube comprising a tungsten filament, a coating of emissive material in direct contact with said filament, a sintered and mechanically-rigid body of tungsten sheathing said coating, said metallic body being porous and having diffused therein emissive material of said coating.

18. A quick-heating cathode for an electron tube comprising a tungsten filament, a coating of emissive material in direct contact with said filament, a sintered and mechanically-rigid body of molybdenum sheathing said coating, said metallic body being porous and having diffused therein emissive material of said coating.

19. A cathode comprising a heatable body, a coating of emissive material cohered to said heatable body, and a porous refractory body of metal powder sheathing said coating, said porous refractory body being formed by sintering whereby some of said emissive material of said coating impregnates said porous refractory body.

20. A cathode comprising a heatable body, a coating of emissive material in direct contact with said heatable body, and a sintered and mechanically-rigid metallic body sheathing said coating, said metallic body being porous and having diffused therein emissive material of said coating, said coating serving as a reservoir of emissive material for further diffusion into said metallic body.

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