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Van Stratum et al.

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[54] **METHOD OF MANUFACTURING A LANTHANUM HEXABORIDE-ACTIVATED CATHODE FOR AN ELECTRIC DISCHARGE TUBE**

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[58] **Field of Search** ..... 204/181; 313/346 R

[56] **References Cited**

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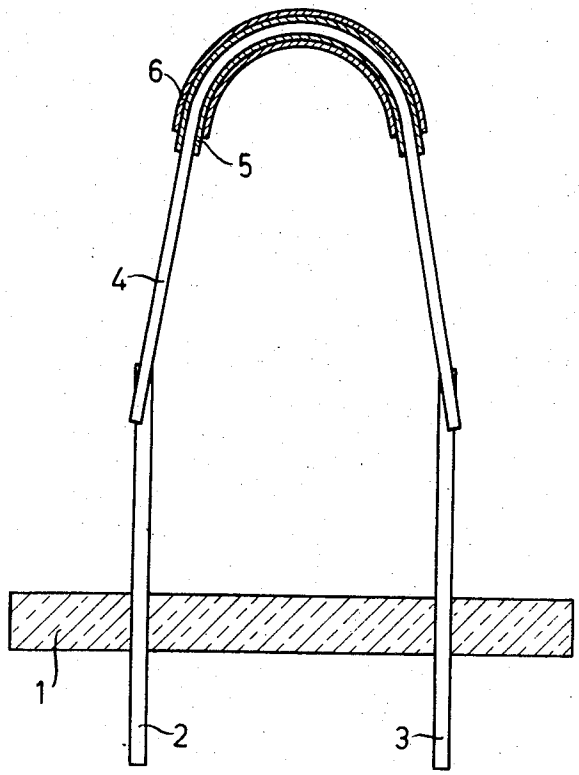
[57] **ABSTRACT**

A layer of lanthanum hexaboride is applied cataphoretically to a rhenium wire and then sintered. The process is repeated. In this manner a cathode with small evaporation and long life is obtained.

1 Claim, 1 Drawing Figure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METHOD OF MANUFACTURING A LANTHANUM HEXABORIDE-ACTIVATED CATHODE FOR AN ELECTRIC DISCHARGE TUBE

The invention relates to a method of manufacturing a cathode for an electric discharge tube in which a layer of lanthanum hexaboride is cataphoretically provided on a rhenium support and is sintered. The invention furthermore relates to a cathode manufactured in this manner.

The method described above is known from Rev.Sci. Inst. 36, 856–7, 1965.

It is found in practice that lives of only approximately 1,000 hours are obtained with such cathodes. The rhenium wire on which the lanthanum hexaboride is sintered then usually breaks. If the boride is not yet very pure, that is to say free from free boron and boron oxide, the life is still considerably shorter. This is the result of the fact that in the presence of the said contaminations borides of rhenium are formed in an uncontrollable manner. The reaction between the rhenium and the lanthanum hexaboride is then subject to considerable fluctuations and the operation of the cathode is not satisfactory. Should lanthanum tetraboride also be present in the lanthanum hexaboride, a considerable evaporation of lanthanum occurs because the tetraboride first decomposes to hexaboride rather rapidly. The hexaboride reacts slowly with the rhenium and evaporates only slowly. Perhaps the lanthanum released from the tetraboride could also react with the rhenium.

It is the object of the invention to provide a method by which cathodes of the indicated composition can be obtained with a long life.

According to the invention, in a method of manufacturing a cathode for an electric discharge tube in which a layer of lanthanum hexaboride is cataphoretically provided on a rhenium support and is sintered, the cataphoretically provided layer is slowly heated to a temperature of 1,500° to 1,550°C and maintained at said final temperature for maximum 30 seconds until a smooth and shining surface is obtained, after which a second layer of lanthanum hexaboride is cataphoretically provided and also heated to a temperature of 1,500 to 1,550°C and maintained at said temperature for maximum 2 minutes.

Upon heating the first layer of hexaboride which need not be very pure, a layer of rhenium boride is formed all over the surface of the rhenium wire and forms a barrier against the reaction of the remaining hexaboride from the first layer with the rhenium and with the hexaboride from the second layer. Consequently, too rapid a depletion and hence fracture of the rhenium wire as a result of excessive boride formation is prevented and a long life of many thousands of hours can be achieved. At the normal operating temperature of the lanthanum hexaboride cathodes, good emission densities are achieved. If the second layer contains no lanthanum tetraboride, little evaporation occurs.

The invention will be described in greater detail, also with reference to the FIGURE, by means of the following example.

In the FIGURE, **1** denotes a part of a hard glass bottom in which two wires **2** and **3** of an iron-nickel-cobalt alloy are present.

A rhenium wire **4** of 0.18 mm diameter is welded to the lead-in wires **2** and **3.** After firing the rhenium wire in hydrogen gas at 1,600°C for 2 minutes, it is covered from a lanthanum boride suspension (unpurified LaB_6) with a 50 μ thick layer. Said layer is heated for 5 minutes and sintered in hydrogen at 1,530°C for 15 seconds. The layer becomes smooth and shining. A 20 microns thick layer of lanthanum hexaboride is then cataphoretically provided, said layer being sintered in hydrogen at 1,550°C for 2 minutes.

After sealing the bottom **1** in a tube and after evacuation thereof, the cathode is degassed at 1,600°C for a few seconds. The cathode is then activated at 1,500°C for 5 to 30 minutes.

At a temperature of 1,400°C the saturation emission (measured with pulses) is 10 A/cm^2. The life at said temperature is more than 8,000 hours.

Like all the hexaboride cathodes, the cathodes according to the invention are suitable for use in high voltage apparatus such as X-ray tubes, rectifier tubes and also in electron beam welding apparatus, electron microscopes and the like, in which comparatively poor vacuum conditions occur and which cathodes are exposed to air repeated times. In apparatus in which layers have to be locally activated by means of electron beams or be worked differently, said cathodes are also suitable.

What is claimed is:

1. A method of manufacturing a cathode for an electric discharge tube in which a layer of lanthanum hexaboride is cataphoretically provided on a rhenium support and sintered, characterized in that the cataphoretically provided layer is slowly heated to a temperature of 1,500° to 1,550°C and maintained at said final temperature for maximum 30 seconds until a smooth and shining surface is obtained, after which a second layer of lanthanum hexaboride is cataphoretically provided and also heated to a temperature of 1,500° to 1,550°C and maintained at said temperature for maximum 2 minutes.

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