

[54] **OXIDE CATHODE FOR AN ELECTRIC DISCHARGE DEVICE**

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[58] Field of Search ..313/317, 352, 222, 238, 346 R, 313/318

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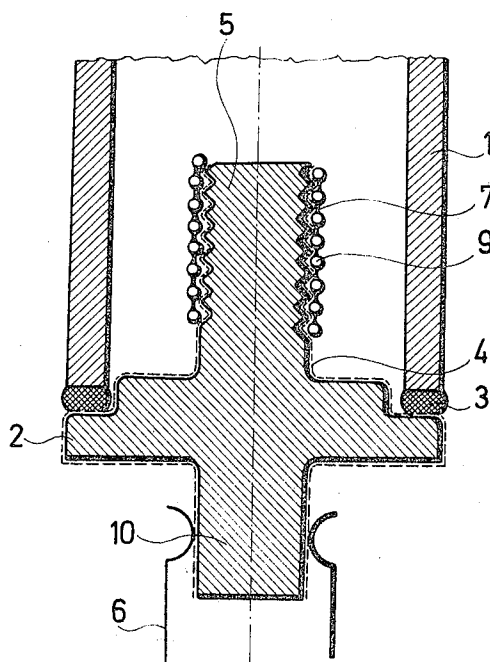
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[57] **ABSTRACT**

Gas discharge device having a ceramic bulb or body at least one end of which carries a cathode comprising a closure member made of ceramic material, silica or glass, which is at least partly covered by at least one metallic layer, an electron emitting layer, formed by at least one alkaline earth metal oxide, being provided on the surface of at least a portion of the metallic layer. The closure member is united with the bulb or body in a vacuum-tight manner so that a part thereof is inside the bulb or body, the metallic layer extending to that part of the closure member which is inside the device, to that which is outside the body, the electron emitting layer being provided on at least a part of the metallic layer within the bulb or body.

3 Claims, 4 Drawing Figures



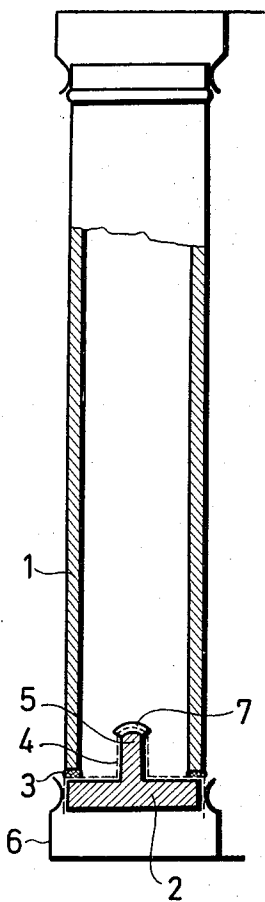


Fig.1

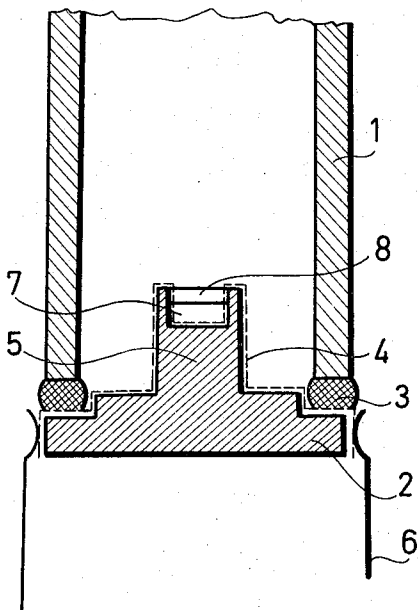


Fig.2

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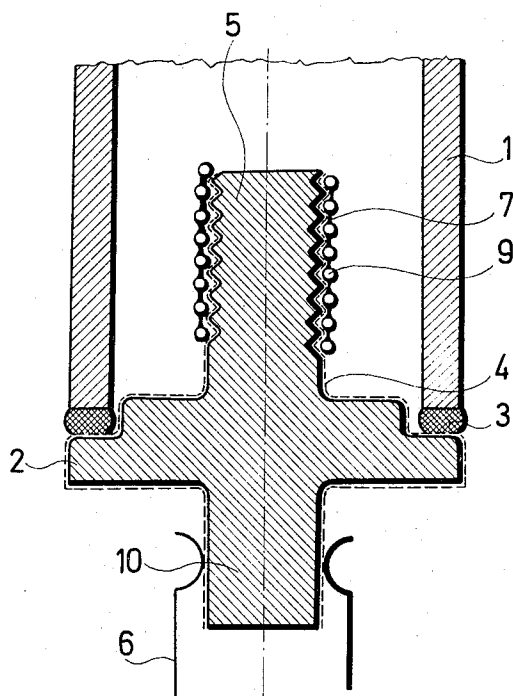


Fig.3

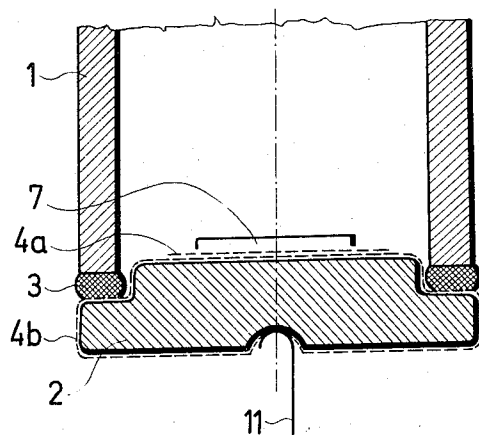


Fig.4

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OXIDE CATHODE FOR AN ELECTRIC DISCHARGE DEVICE

The present invention relates to a new oxide cathode construction for electric discharge devices mainly for gas discharge lamps as well as to the discharge devices having such cathodes themselves.

Oxide cathodes of different electric discharge devices such as vacuum tubes, fluorescent lamps, high pressure gas discharge lamps, etc., consist in a known manner of a self-supporting metal body (tungsten or nickel) and an electron emitting layer (a mixture of different alkaline earth metal oxides, in different ratios, e.g., a 1:1 mixture of BaO and SrO). There are strict specifications in practice for the composition of said metal body (the core metal), the shape of same can be however various, it can be e.g., a tube, a wire helix, etc.

Such cathodes are described in more detail in the literature (e.g., Espe: Werkstoffe der Hochvakuumtechnik, VEB Deutsches Verlag der Wissenschaften, Berlin 1960. Bd. 1. S 234-241).

Although such oxide cathodes have been used for a long time, the easy peeling off of their electron emitting layer could not be eliminated. This property is partly due to the smoothness of the surface of their metal core (which is a necessity for manufacturing them) and partly to the difference of the thermal expansion coefficient of said emitting layer and the core metal (this coefficient is in case of W smaller, in case of Ni larger than that of the emitting oxide). The temperature variation of the cathode (while switching it on or off) can hence help peeling off, of the layer. Expensive ulterior roughening of the surface of the metal core only partly helped to eliminate the peeling off.

When built into a discharge device a current leading band has to be welded to the said cathode bodies in order to secure the electric contact of the same with the lead-ins and through them towards the external part of the tube.

Electric discharge devices made out of ceramics are well known. In case of such devices their vacuum-tight sealing as well as the securing of vacuum tightness of their electric lead-ins causes difficulties in practice. To eliminate these problems ceramic discharge devices with niobium closure members (caps) have been developed. Such devices are however expensive because of said niobium cap.

One object of the invention was to have a new oxide cathode construction without the mentioned drawbacks of said known ones.

Another object of the invention is to eliminate the current leading bands for said cathode.

A further object of the invention is to have a simple, secure and cheap solution for leading electric current into discharge devices first of all for discharge devices having ceramic bulbs.

Other objects and features of the invention will become clear from the specification.

The invention is based on substituting the self-supporting metal body (core metal) of oxide cathodes by a metallized surface of a ceramic (preferably of an oxide ceramic), silica or glass body which forms at the same time a closure member of the discharge device. The electron emitting layer is positioned on at least a part of said metallized surface. The metal surface extends also to that part of the said closure member which will be

united with the bulb as well as at least partly to that part of it which is at the outside part of the discharge device. This gives the possibility of leading electric current via the metallized surface into said device, to the emitting layer.

The new cathode constitutes hence at the same time a discharge device closure member, an electrode coated with an emitting layer (cathode), as well as current leading means.

The metallized surface on said closure member can be a single metallic layer made — according to the nature of the metal used — by sintering (e.g., W), by evaporating (f.i. by cathode sputtering) (e.g., Ag), galvanization (e.g., Ni) painting (Mo), etc. One can also use however more than one layer on each other, or a single layer having portions made out of different metals which are however in contact with each other.

The thickness of the layer or in case of more layer of each layer should be about 10 – 50 μ .

W is preferable under the emitting layer, Mo is best at that part which is to be united with the bulb, Ag or Au are preferred at the outer portion of said closure member for securing electric contact. It is however only for special cases necessary to use a multilayer, a single layer out of Ni (a Ni-Mg alloy normally used for cathode cores) is mostly doing the job.

The closure member can be united with a bulb by heat of diffusion sealing although it is better to use a cementing material (such as a soldering frit or glass). If Mo is used as the metallic layer this can also serve to form after heat treatment the vacuum-tight seal.

The bulb can be a glass, ceramic or silica one. Should the discharge device be a tube having a closure member at both ends, a closure member according to the invention can be used only at one end and a conventional one at the other, or at both ends that according to the invention.

It can be preferable to form a nose part towards the inside of the bulb on said closure member and to put the emitting layer on the metallized nose. A container can also be formed in said nose, which — after metallizing it — is filled with the emitting material and thereafter closed by a porous body. An other type of cathode can be formed, by giving a thread like surface to said nose, forming a metallic layer on the closure member and the nose, positioning a metallic (e.g., tungsten) helix on said thread and putting said emitting layer on the surface of said thread filling also out the intervals of said helix.

The best way of securing electric contact towards the inside of said device is to fix a metallic spring or cap onto the outside portion of said closure member after having united it with the bulb in a manner that this shall be in contact with the external portion of the metallic layer.

Should the metallic layer extend to the whole or a large part of the external surface of the closure member (i.e., to that portion which is outside the discharge device) a good electrical contact can be secured even without fixing any metallic means to the external part of the discharge device by contacting said metallic layer of the device with a pin.

The advantages of the new cathode and discharge device resp. according to the present invention are — among others — the following:

a. as mentioned the known oxide cathodes shown a peeling-off property of their emitting layer. Due to the fact that the surface of the preferably ceramic closure member is more or less coarse, the surface of the superposed relatively thin metallic layer will also be rather coarse than smooth. This decreases to a large extent the peeling-off of the emitting layer. Further on the thermal expansion coefficient of the metallized ceramic closure member is very near to that of the emitting oxide layer which fact works again in the direction of having less frequently the peeling-off occurrence of the emitting layer.

b. Materials to be used for and the manufacturing process itself is less expensive in case of the invention as in that of conventional cathodes.

c. The vacuum-tight sealing of some gas discharge lamps, mainly high pressure sodium discharge tubes was a constant problem. Due to the fact that the thermal expansion of the metallized closure member is nearly the same as that of the bulb of such lamps, the vacuum-tight sealing of these two parts can in case of the present invention easily be carried out.

The invention will now be described, by way of four examples, with reference to the accompanying drawings wherein:

FIG. 1 shows an electric discharge device having a closure member according to the invention with a nose part, a single metallic layer and a metallic cap at the external portion of the device.

FIG. 2 shows another embodiment of the cathode according to which a container is formed in the nose part, of the closure member which contains the emitting layer and is closed by a porous metal body.

FIG. 3 shows a further embodiment according to which the nose part has a thread-like surface, and an emitting layer on said surface and a helix surrounding said thread-like surface.

FIG. 4 shows a nose-less closure member having two superimposed metallic layers, an external surface having on its whole a metallic layer and thus eliminating the necessity of fixing metallic means to the external part of said surface.

The gas discharge lamp illustrated in FIG. 1 comprises a tubular body 1 made of glass or ceramic material, which is closed at both ends by a closure member 2 with the aid of a vacuum sealing soldering frit 3. The closure member 2 is made of ceramic material, silica or glass, and is formed with a nose part 5 projecting towards the inside of said discharge device. Broken lines represent a metallic layer 4 on the surface of said closure member 2 and its nose part 5. As can be seen from the drawing the nickel layer 4 extends below the frit 3 to a part of the external surface of the discharge device. The said nickel layer 4 is produced in a manner known per se by electro-plating on the surface of said closure member 2. A metallic spring 6 is fastened to the external part of the lamp contacting the external metallized part of the closure member 2 thus ensuring electrical connection. An electron emitting layer 7 (e.g., of a 1:1 mixture of BaO + SrO) covers the metallized top of the nose part 5 of the said closure member 2. The discharge lamp is filled in a manner per se with an initiating gas and discharging material (e.g., Xe, Na, Hg, etc.) as known per se.

Due to the presence of the nose 5 of the closure member 2 an additional advantage of the cathode occurs, namely that the nose part 5 has a smaller cross-section than the closure member 2, hence its thermal conductivity is lower and thus the correct operating temperature of the cathode can be set more easily.

FIG. 2 shows an embodiment in which the cathode is provided with a recess in the top part of the nose 5 and the emitting layer 7 is not positioned on the surface of the nose but in the said recess which forms a container for the layer 7. The emitting layer 7 is closed towards the inside of the discharge device by a porous body 8, which serves which serves — as it is known in the case of dispenser cathodes for protection of the emitting material against ion bombardment. The emitting layer 7 can be made of a mixture 50—50 percent BaO and SrO, while the porous body can be made of tungsten. This mixture is pressed into the container and sintered thereafter. Other parts of the discharge device are similar to those shown in FIG. 1. The device can be filled with Xe, Na, Hg, as known per se.

In the embodiment of the cathode illustrated in FIG. 3 the nose part 5 has a thread-like surface. A helix 9 preferably made of tungsten is screwed onto said surface. This helix 9 does not serve as the core metal of the cathode due to the fact that the metallic layer 4 of nickel extends also to the thread-like surface of the nose part 5. An emitting layer 7 is provided on the surface of said nickel layer 4 at the thread-like nose part 5 so as to span the spaces between the coils of said helix 9 or surrounding the said helix 9. The helix 9 serves in the present case as an auxiliary anode. Other details of the cathode construction are substantially the same as those in FIG. 1 with the exception that the closure member 2 has also a nose part 10 directed towards the outside of the discharge device. The nose part 10 is partly covered by the nickel surface 4, and the metallic spring 6 is fastened to said metallized nose part 10 of the closure member.

The cathode construction according to FIG. 3 can be utilized e.g., in a discharge device having a filling of Xe, Na, Hg, and the emitting layer is formed of BaO + SrO (50—50 percent). The tubular member 1 and the closure member 2 are made of a ceramic material, and frit is used as a cement bonding the two elements together.

FIG. 4 shows an embodiment in which the closure member 2 has no nose part but is provided with a layer 4b made of molybdenum or niobium, and surrounding practically the whole closure member. A second layer 4a made of nickel, covers a portion of the inner part of the layer 4b on the closure member 2. The emitting layer 7 is supported by said metallic layer 4a. The molybdenum or niobium layer 4b is made by painting of the surface of the closure member 2 and thereafter heat-treating it, while the nickel layer 4a electro-plated onto said first layer 4b. Other parts of and materials used for the device are similar to those described in connection with FIG. 1 with the exception that no metallic spring is needed to be fixed on the surface of said closure member but electrical contact is ensured by a pin 11 contacting the metallized external surface of said closure member 2.

What we claim is:

1. A ceramic discharge device comprising
 - a. a hollow, cylindrical ceramic envelope containing a discharge sustaining gaseous atmosphere,

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- b. ceramic closure members hermetically sealing off each end of said ceramic envelope,
- c. at least one metallic layer at least partly covering the closure member, the metallic layer extending to that part of the closure member which is inside the envelope and at least partly to that which is outside the envelope,
- d. sealing means interposed between said closure member and its associated end of said envelope to form a hermetic seal, and
- e. a pair of discharge sustaining electrodes within said envelope electrically connected to that part of

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the said closure member which is inside the said envelope.

2. A ceramic discharge device according to claim 1, wherein the closure member has a nose part which has a thread-like surface and at least one metallic layer which extends at least to the thread-like surface, a metallic helix being positioned on the thread-like surface, the electron emitting layer spanning the spaces between the coils of the helix.

3. A ceramic discharge device according to claim 2 wherein the helix is made of tungsten.

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