United States Patent [19]

Van Stratum et al.

[11] **3,753,025**

[45] **Aug. 14, 1973**

[54] **INDIRECTLY HEATED SUPPLY CATHODE**

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[21] Appl. No.: **203,705**

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **313/270,** 313/337, 313/340, 313/346 R

[51] **Int. Cl.** **H01j 1/88,** H01j 19/42, H01j 1/26

[58] **Field of Search** 313/337, 340, 346, 313/351, 270

[56] **References Cited**

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Assistant Examiner—Paul A. Sacher
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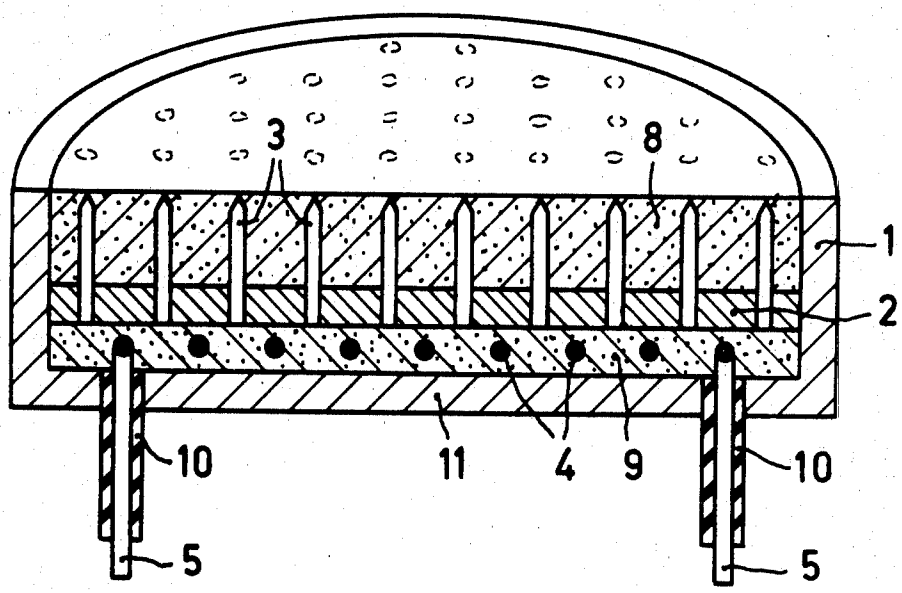
[57] **ABSTRACT**

A supply cathode having a large diameter in which the emissive body is supported by a metal base plate having metal pins which are embedded in the sintered emissive body.

3 Claims, 3 Drawing Figures



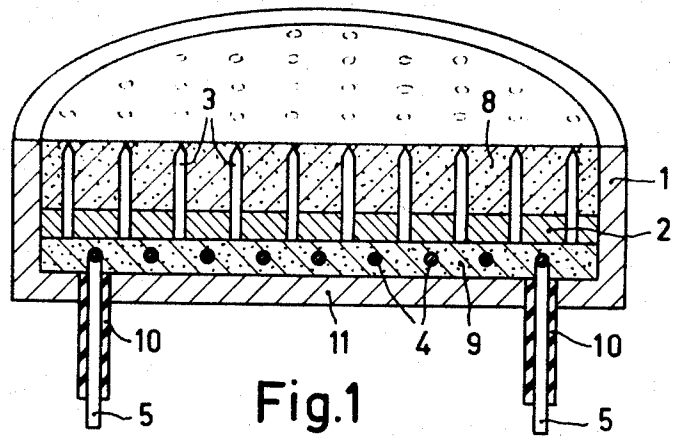


Fig.1

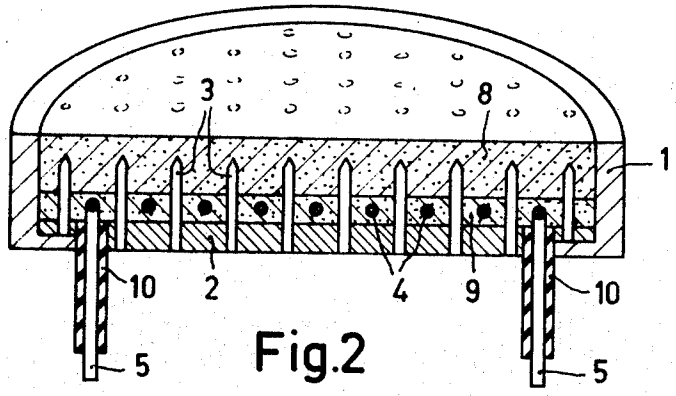


Fig.2

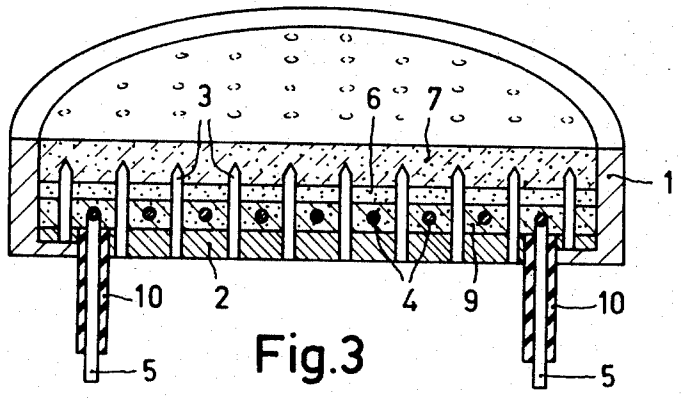


Fig.3

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INDIRECTLY HEATED SUPPLY CATHODE

The invention relates to an indirectly heated supply cathode consisting of a sintered emissive body which is surrounded by a metal jacket and is supported by a metal base plate. The invention relates in particular to a supply cathode having a large diameter and a comparatively small thickness.

In known supply cathodes, the emissive body consists, for example, of a layer of barium aluminate and tungsten and a porous tungsten body or consists entirely of such a mixture of barium aluminate power and tungsten powder. Such cathode which layers are compressed and sintered, have the drawback that it is not possible to increase the diameter without also increasing the thickness of the emissive body, since otherwise the mechanical rigidity of the cathode becomes too small since the sintered emissive body is brittle. A thin sintered disc-shaped emissive body therefore is very fragile. Moreover the possibility exists that the sintered disc does not remain flat but warps as a result of heating and cooling during operation and then becomes located loosely in the jacket as a result of which moreover the electric contact with the jacket is impaired.

These drawbacks are avoided entirely in an indirectly heated cathode consisting of a sintered emissive body which is surrounded by a jacket and is supported by a metal base plate if, according to the invention, the base plate is provided with a number of metal pins which are embedded at least for part of their length in the emissive body. The heating element may be provided in known manner on the other side of the base plate, but a cheaper construction is obtained if the heating element is positioned between the sintered emissive body and the base plate.

In order that the invention may be readily carried into effect, it will now be described in greater detail, by way of example, with reference to the drawing in which FIGS. **1, 2** and **3** show various embodiments of cathodes according to the invention.

Referring now to FIG. **1**, reference numeral **1** denotes a metal jacket which in this case comprises a base **11**. The jacket **1** with the base **11** consists, for example, of molybdenum and can be obtained by turning or pressing.

A heating wire **4** is provided in an insulated manner on the base **11** in that the wire **4** is embedded in a layer of aluminium oxide powder **9**. The ends **5** of the heating wire **4** are covered with an insulating layer **10** and pass through the bore **11**. The metal base plate **2**, which supports the emissive body **8**, is provided with a number of metal pins **3** which are secured in the base plate **2** and are embedded in the sintered emissive body **8**. In this manner it has proved to be possible to avoid deformation of the emissive body **8**. The cathode may have any large diameter without it being necessary to increase the thickness. The base plate **2** and the pins **3** may consist of molybdenum.

A cheaper construction is shown in FIG. **2**. In this embodiment, the base plate **2** with the pins **3** also form the bottom of the ring **1**. The base plate **2** is, for example, pressed in the turned ring **1** and clamped.

The heating wire **4** which is covered with a thin layer of alumina is laid between the pins **3**, for example, in a zig-zag manner or as a coiled coil and is covered with

alumina powder **9**. On this powder the preferably granulated powdered mixture of barium aluminate and tungsten is poured and the assembly is compressed until the layer has a density of from 75 to 90 percent and is then sintered. The pins **3** are embedded in the emissive body **8** and prevent warping of the emissive body.

Since the powders **8** and **9** are poured on each other in bulk and only one compression and sintering operation need be carried out, a cheap cathode is obtained. The thickness of the disc-shaped cathode is considerably smaller than that of the cathode shown in FIG. **1**. Since the cathode has a smaller mass, the heating time is comparatively short.

In the embodiment shown in FIG. **3**, first a layer **6** consisting of a mixture of tungsten and barium-calcium aluminate powder and on top of this a layer **7** consisting of tungsten powder is provided on the aluminium oxide layer **9** of the heating element. The layers are compressed and at the same time sintered, as in FIG. **2**.

The upper surface of the emissive body of the cathodes shown in FIGS. **1, 2** and **3** is covered, preferably prior to sintering, with an osmium layer, preferably by sputtering, which osmium layer is then also sintered.

The jacket **1**, the base plate **2** and the pins **3** preferably consist of molybdenum. However, the base plate **2** may also consist of compressed and sintered metal powder, in which compression and sintering can be carried out simultaneously with the compression and sintering of the remaining layers.

According to a particular embodiment, the outside diameter of the cathode is 2 cm, the thickness is 3 mm, and 80 pins are provided.

The thickness of the emissive body is substantially independent of the diameter.

Of course the thickness of the base plate **2** in the case of very large diameters will have to be slightly larger in order to obtain a sufficient rigidity to avoid warping of the emissive body. The jacket **1** need not consist of metal.

Cathodes according to the invention are particularly suitable for disc triodes and tubes which operate with large current densities.

We claim:

1. An indirectly heated supply cathode comprising

a. a metal base plate;

b. a sintered emissive body disposed over a face of said base plate;

c. a plurality of metal pins extending from said base plate face and having at least a portion thereof embedded in said emissive body;

d. a jacket element surrounding said emissive body; and

e. means for heating said emissive body.

2. A cathode as recited in claim **1**, wherein said heating means comprises a heating element located between said base plate face and said emissive body, said heating element being located between and electrically insulated from said pins.

3. A cathode as recited in claim **1**, wherein said base plate is a layer of compressed and sintered metal powder.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,753,025 Dated August 14, 1973

Inventor(s) ANTONIUS J. A. VAN STRATUM ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 49, change "bore" to --base--.

Signed and sealed this 27th day of November 1973.

(SEAL)
Attest

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents