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(54) Method of manufacturing a dispenser cathode.

(57) The invention relates to the manufacture of a dispenser cathode having a porous tungsten body incorporating scandium oxide in at least a layer adjacent the surface area intended for electron emission. It was surprisingly found that a scandium oxide-containing tungsten body can be mechanically processed satisfactorily if it incorporates copper prior to the processing operation.

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"Method of manufacturing a dispenser cathode"

The invention relates to a method of manufacturing a dispenser cathode comprising a porous tungsten body having a surface area intended for electron emission, which tungsten body incorporates scandium oxide at least in a layer adjacent the surface area intended for electron emission, and which tungsten body containing the scandium oxide is impregnated with an oxidic material after sintering.

In the manufacturing practice of dispenser cathodes the mechanical design of the hard and brittle tungsten body has often been found to be a problem.

In a known method for the mechanical design of porous tungsten bodies copper is therefore absorbed in the tungsten body prior to the mechanical design.

The tungsten body can then be given the required shape mechanically (US-A 26 69 008).

Subsequently the copper is removed from the tungsten body by evaporation in a vacuum.

According to US-A 29 86 799 the method using copper is time-consuming, costly and cumbersome. This patent describes the use of an oxidic barium-containing material instead of copper. This also simplifies processing of the tungsten body and this oxidic material does not have to be removed from the tungsten body because it is required anyway in the electron emission of the cathode.

In the further development of dispenser cathodes it has been found to be advantageous to incorporate scandium oxide in at least a layer adjacent a surface area of the tungsten body intended for electron emission during the manufacture of the tungsten body (NL-A 82 01 371).

It is found that the presence of scandium oxide in the tungsten body may reduce the absorption possibility of barium-containing oxidic material by the tungsten body. Moreover, the prospects for a satisfactory mechanical processing in the presence of scandium oxide are poor because sintered scandium oxide is much more difficult to process mechanically than sintered tungsten.

It is an object of the invention, inter alia, to obviate the described problem at least to a considerable extent.

According to the invention, the method described in the opening paragraph is therefore characterized in that molten copper is absorbed in the entire scandium oxide-containing sintered tungsten body prior to impregnation and in that the copper is removed from the tungsten body after a mechanical design treatment of the tungsten body which is effected at least on the side of the surface area intended for electron emission.

The method according to the invention is surprising because the processibility of the tungsten body, even if it contains a comparatively high percentage by volume of scandium oxide, is very satisfactory in the presence of copper. Furthermore, the copper can be removed in a comparatively simple manner after the mechanical operation so that there is certainly no question of an expensive, time-consuming and cumbersome method.

A scandium oxide content of preferably 2 to 10% by weight is used in the tungsten body.

A scandium oxide content of 3 to 7% by weight is used with special preference in the tungsten body.

The mechanical treatment preferably extends from the surface area intended for elecron emission throughout a scandium oxide-containing layer adjacent the surface area.

The invention will now be described in greater detail with reference to an example and the accompanying drawing.

The drawing diagrammatically shows in a cross-section a part of a dispenser cathode manufactured by means of the method according to the invention.

In a method of manufacturing a dispenser cathode which has a porous tungsten body 1 with a surface area 2 intended for electron emission scandium oxide is incorporated in a layer 3 adjacent the surface area 2 intended for electron emission. This is effected, for example, as follows. A 0.5 mm thick layer of tungsten powder is introduced into a mould having a circular opening with a diameter of 1.8 mm. A 0.1 mm thick layer of powder consisting of a mixture of tungsten and 5% by weight of scandium oxide is provided on the layer of tungsten powder.

After compression to a pellet the pellet is sintered in hydrogen at 1500°C for 1 hour. The total thickness of the sintered body is then approximately 0.6 mm and the thickness of the layer 3 is approximately 0.1 mm.

According to the invention, prior to impregnating the sintered tungsten body with an oxidic material, molten copper is absorbed in the entire scandium oxide-containing sintered tungsten body 1.

To this end the body is provided with oxygen-free copper as a plate or a pellet in a quantity which is at least equal to the free space in the sintered body (the free space in the sintered body is approximately 20%) and is absorbed as a melt in the tungsten body.

Subsequently the tungsten body 1 is subjected to a mechanical design treatment at least on the side of the surface area 2 intended for electron emission. The latter treatment may be a conventional treatment such as turning, drilling or milling.

In the case shown in the drawing, the design treatment extends throughout the layer 3 and the size of the scandium oxide-containing layer 3 is limited so that also the surface area 2 intended for electron emission is limited.

After the design treatment the copper is removed from the tungsten body. This is effected, for example, by means of nitric acid and water in a 1:1 ratio so that substantially all copper is removed. After cleaning and rinsing any possible last remainders of copper are removed by evaporation for several minutes at 1700°C in hydrogen. By burning the hydrogen flowing from the equipment the absence of copper can be established by the absence of a green colour. Subsequently the tungsten body is impregnated in a conventional manner with oxides of barium, calcium and aluminium (4:1:1), cleaned and welded to a shaft 4 provided with a heating element 5.

The dispenser cathode shown in the drawing is used, for example, as a component of a diode gun in a cathode ray tube. Such a gun accommodates above the cathode an anode 6 having a small aperture 7 (diameter, for example, 40 μm). The beam current passes through this aperture during operation while the anode potential is of course positive with respect to the cathode. Since the diameter of the electron emitting part is small (~0.3 mm) due to the processing operation, the thermal load of the anode may be sufficiently low.

It will be evident that the invention is not limited to the example described and that many variations within the scope of the invention are possible to those skilled in the art.

Claims

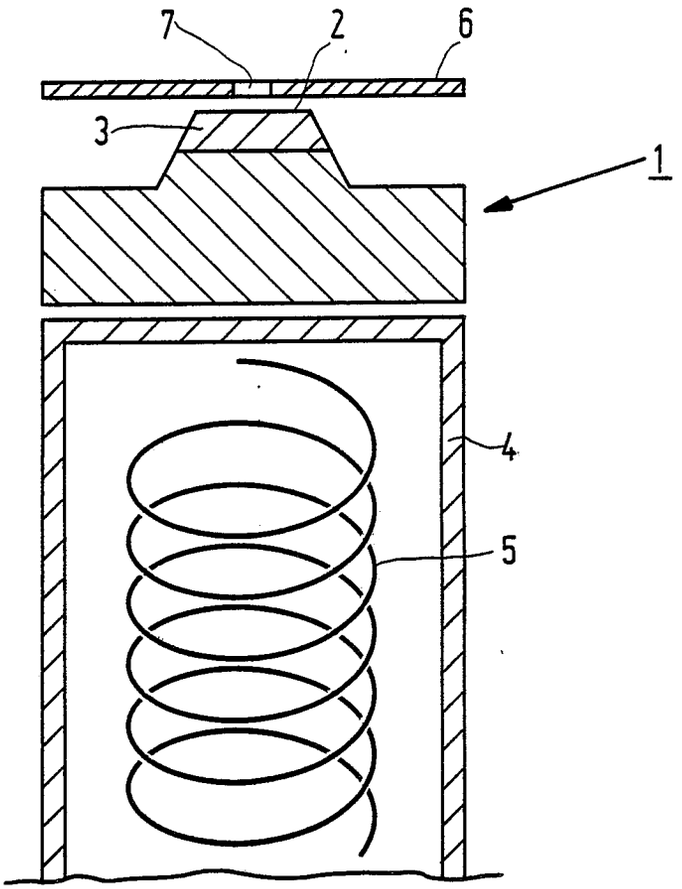
1. A method of manufacturing a dispenser cathode comprising a porous tungsten body having a surface area intended for electron emission, which tungsten body incorporates scandium oxide at least in a layer adjacent the surface area intended for electron emission and which tungsten body containing the scandium oxide is impregnated with an oxidic material after sintering, characterized in that molten copper is absorbed in the entire scandium oxide-containing sintered tungsten body prior to impregnation and in that the copper is removed from the tungsten body after a mechanical design treatment of the tungsten body which is effected at least on the side of the surface area intended for electron emission.

2. A method as claimed in Claim 1, characterized in that a scandium oxide content of 2 to 10% by weight is used in the tungsten body.

3. A method as claimed in Claim 2, characterized in that a scandium oxide content of 3 to 7% by weight is used in the tungsten body.

4. A method as claimed in any one of the preceding Claims, characterized in that the mechanical treatment extends from the surface area intended for electron emission throughout a scandium oxide-containing layer adjacent said surface area.

5. A cathode ray tube including a dispenser cathode manufactured by means of the method as claimed in any one of the preceding Claims.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EUROPEAN SEARCH REPORT

Application number

EP 87 20 0951

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	JOURNAL OF PHYSICS D, vol. 4, no. 1, January 1971, pages 39-46, Letchworth, Hertfordshire, GB; N.K. MITRA: "A small high current-density thermionic emitter" * Page 39, figure 1; page 40, paragraph 2.2 *	1	H 01 J 9/04 H 01 J 1/28
Y	EP-A-0 179 513 (PHILIPS) * Claims 1,14,15 *	1	
A		2,3,5	
A	US-A-4 236 287 (SMITH) * Claim 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 01 J 9/00
H 01 J 1/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-09-1987	SCHAUB G.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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