United States Patent

[11] **3,549,930**

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[21] Appl. No. **783,277**
[22] Filed **Dec. 12, 1968**
[45] Patented **Dec. 22, 1970**
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[32] Priority **Dec. 13, 1967**
[33] **Germany**
[31] **No. 1,614,679**

[54] **A COLLECTOR FOR TRAVELLING WAVE TUBES CONSTRUCTED OF PYROLYTIC**
4 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **313/44,** 313/311; 315/5.38
[51] **Int. Cl.** **H01j 1/38,** H01j 7/24, H01j 23/12
[50] **Field of Search** 313/44, 311; 315/5.38

[56] **References Cited**

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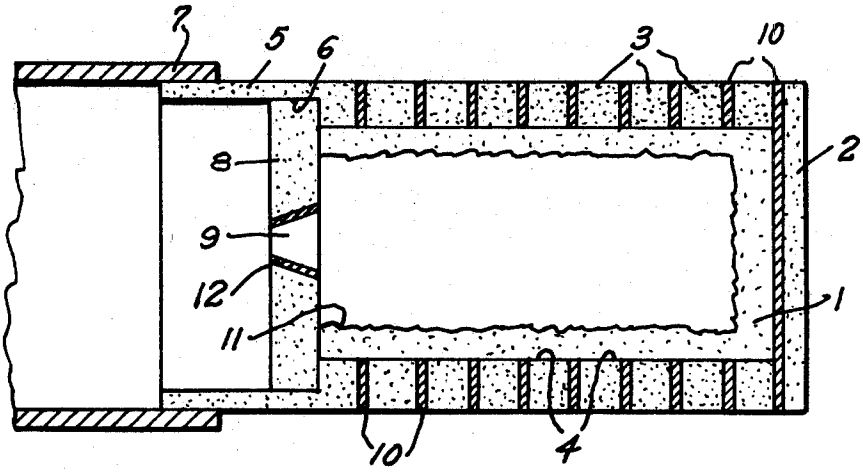
ABSTRACT: A collector for electrical discharge vessels, for example traveling wave tubes, is provided by a plurality of annular discs which range in thickness from 3 to 10 mm. and which are bonded together. The discs may be bonded vacuum tight with each other and with a wall of a discharge vessel as a continuation thereof so that the collector forms an integral part of the housing of the discharge vessel.



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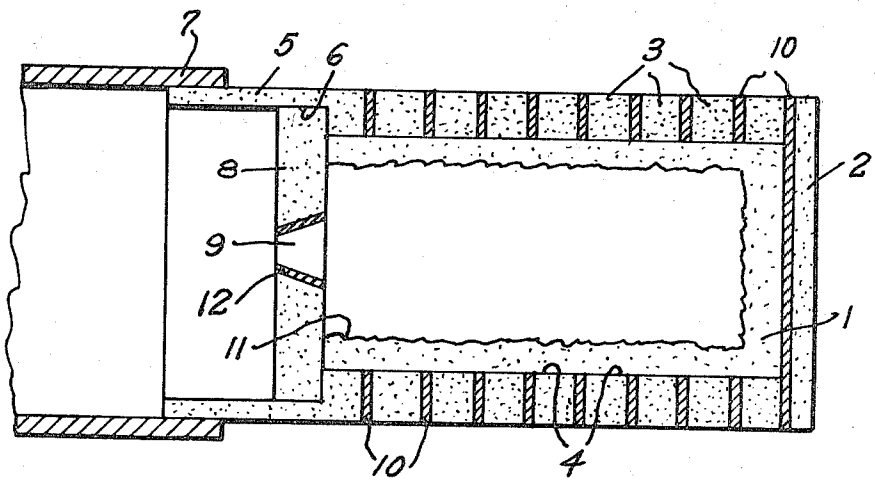

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A COLLECTOR FOR TRAVELLING WAVE TUBES CONSTRUCTED OF PYROLYTIC

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is related to electrical discharge vessels for electron tubes, and more particularly high-frequency power tubes in which the collector forms a part of the outer wall of the electron tube and serves to dissipate heat generated during the operation of the tube.

2. Description of the Prior Art

In high-frequency electron tubes for power applications it is important that the heat generated during the operation of electrodes, portions of electrodes and other parts of the tube, which is caused by greatly varying thermal loads be radiated outwardly as rapidly as possible. Heretofore, electron tubes have necessarily had to rely on the heat radiation and conduction from the operating elements to the tube walls, and upon the heat conductivity of the walls to an adjacent coolant in order that such tubes were cooled sufficiently during operation.

Carbon, a material which possess a high melting point and a low vapor pressure and which has a very high radiation capacity has been employed to dissipate heat to a neighboring region through radiation. It has been found however, that in the construction of collectors for power electron tubes, particularly those of large dimensions which have for instance axial lengths of greater than 10 mm., the formation of the collector components of carbon becomes difficult. It is therefore highly desirable to provide a discharge vessel structure which has a high rate of heat dissipation and which may be formed by relatively simple fabrication techniques.

SUMMARY OF THE INVENTION

According to the present invention, it has been discovered that it is expedient in collectors with large dimensions, and particularly in those having an axial length of more than 10 mm., to assemble the collector from individual discs, in that such discs can be provided from pyrolytic carbon. Generally, by pyrolytic carbon, according to the present invention is meant a carbon compound which may be deposited in layers by thermal heating on hot surfaces of suitable carbon compounds, particularly hydrocarbons. Pyrolytic carbon possesses a pronounced thermal anisotropy so that thermal conduction in one direction approximates the thermal conduction of copper while the thermal conduction in the other direction is significantly smaller. The extent of anisotropy for these two conditions approximates the value of 200. Pyrolytic carbon, according to the present invention, is preferably produced in layer form with dimensions limited in thickness in the range from 3 to 10 mm. The carbon discs are machined to the desired interior and exterior dimensions and bonded together and to the wall of the electron tube to form a vacuum-tight structure.

BRIEF DESCRIPTION OF THE DRAWING

The invention, its organization, construction and operation, will be best understood by reference to the following description taken in conjunction with the single drawing in which there is illustrated a sectional elevational view of a discharge vessel of an electron tube according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing there is represented a cylindrical pot-shaped collector for use in high-frequency electron tubes which operate with an electron pencil beam, for example, traveling

wave tubes, etc. A base body 1, preferably a carbon body such as can be produced by powder metallurgical manufacture or by mechanical machining from a solid material, is provided on its outer surfaces with a thick pyrolytic carbon layer comprising an end element 2 in the form of an annular disc and a plurality of ring-shaped pyrolytic carbon elements 3 each having an annular bore 4 therein. Each of the elements 3 is in the order of 3 to 10 mm. in thickness.

An annular pyrolytic carbon element 5 having a stepped bore 6 therein connects the structure formed by a aligned ring-shaped elements 3 and 5 to a metal wall 7 of the electron tube. Metal rings or discs 10, preferably of molybdenum or tantalum, are bonded to the facing surfaces of adjacent ones of elements 2, 3 and 5 to form a vacuum-tight structure. The pyrolytic carbon elements may be machined to provide different inner and outer dimensions so that a desired geometric internal and/or external shape can easily be provided.

At the open end of the collector there is provided an annular diaphragm 8 having a tapered conical bore 9 therein which becomes wider in the inward direction and on which there is a coating 12 of, for example, zirconium which becomes effective as a getter at an elevated temperature. The annular diaphragm 8 is preferably made from a carbon compound. The inside wall 11 of the collector is provided as a relatively rough surface (shown exaggerated in the drawing) so that in operation, particularly in the manner of a depressed collector, few secondary electrons or fast elastically reflected electrons can escape from the collector.

Briefly, there has been described herein an electrical discharge vessel for an electron tube having a collector formed of thin ring-shaped elements which provide excellent heat conductivity through the exterior of the electron tube, and which in a preferred embodiment of the invention forms a portion of the outer wall of the electron tube.

Although my invention has been described by reference to a particular embodiment thereof, many changes and modifications will become apparent to those skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A collector for an electric discharge vessel of an electron tube having an outer wall, said collector comprising a carbon body including a plurality of carbon discs each of which has an anisotropic thermal characteristic providing poor heat conductivity axially thereof and good heat conductivity normal to its axis, each of said discs having an axial dimension in the order of from 3 to 10 mm., and means for connecting said discs and the outer wall of the tube in vacuum-tight relation.

2. The collector set forth in claim 1, wherein said discs include pyrolytic carbon.

3. The collector set forth in claim 1, wherein said means for connecting said discs includes metal layers interposed between said discs and bonding said discs together.

4. In an electron tube including an outer wall and collector apparatus connected to said outer wall, said collector apparatus comprising: a cylindrical collector element including an open and a closed end; a diaphragm element at said open end having an aperture for passing the electron beam of the tube; a plurality of adjacent axially aligned pyrolytic carbon rings having thicknesses in a range from 3 to 10 mm. circumferentially disposed about said collector element and said diaphragm element; a pyrolytic carbon disc disposed adjacent the closed end of said cylindrical collector element, each of said rings and said discs having a thermal anisotropic characteristic which provides good heat conductivity perpendicular to their axes; and means connecting said disc, said rings and the wall of said tube to form a vacuum-tight structure.