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Katz

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[54] **VACUUM - TIGHT CARBON BODIES**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** **H01j 1/02;** H01j 1/14; H01j 1/38; H01j 19/30; H01j 19/06

[58] **Field of Search** ..... 29/472.7, 472.5, 220/2.1 T; 313/317, 352, 354, 355

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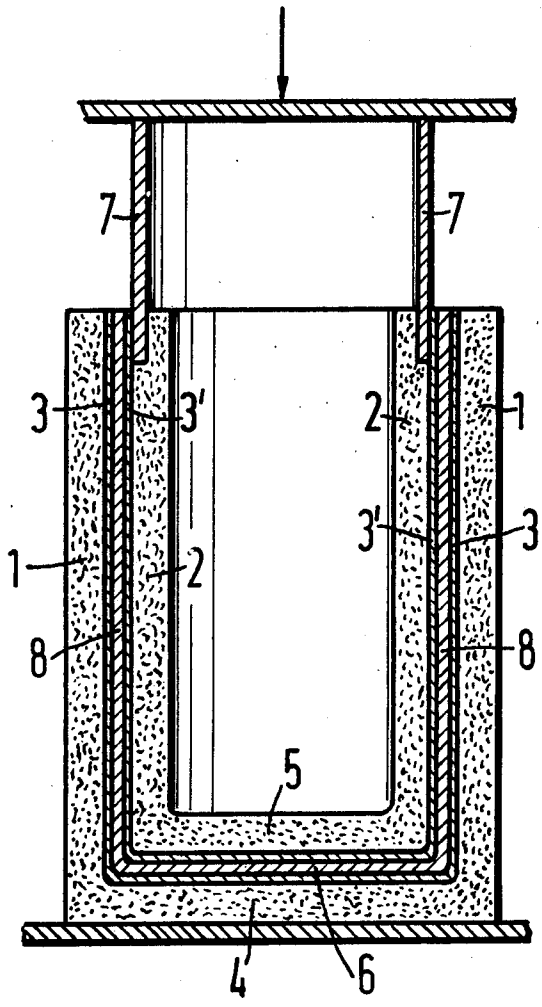
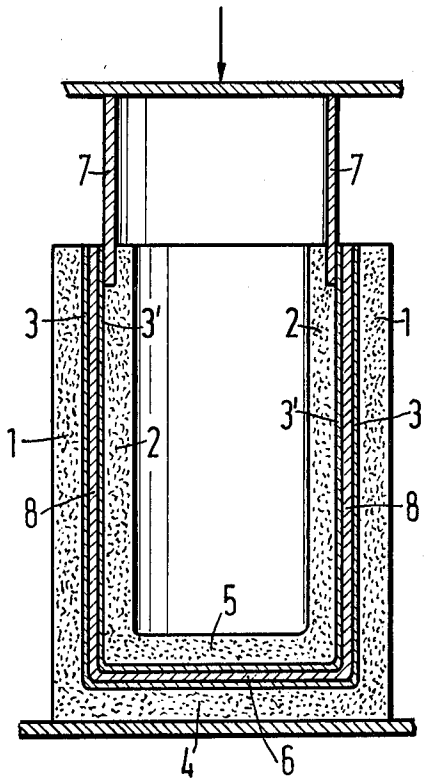
[57] **ABSTRACT**

A vacuum-tight body composed of at least two carbon members which are joined to one another with a layer of a gas-impermeable solder material selected from the group consisting of Cu, Ag, Au, and alloys thereof in direct contact with a rhenium layer on adjoining carbon surfaces. The body may form a collector which forms part of a vessel wall in a high capacity electric discharge vessel.

2 Claims, 1 Drawing Figure

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VACUUM - TIGHT CARBON BODIES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to vacuum-tight (gas-tight) carbon bodies, such as collectors in electric discharge vessels and to a process of producing such carbon bodies.

2. Prior Art

Carbon, especially in the form of molded graphite bodies, is capable of withstanding very high temperatures, is easily workable and has a high radiation ability. However, carbon is gas-permeable and is not a vacuum-tight material.

A coating of a metal, particularly copper, is an extraorindarily suitable material for obtaining gas-tightness for vacuum purposes. Copper is non-magnetic and thus does not interfere with magnetic fields, it is ductile so as to easily allow adjustment of parts thereof, etc. However, copper has a relatively low melting point of 1084° C. and is undesirably influenced when, for example, a highly focused electron beam impinges on a coating thereof positioned on a body of low thermal conductivity. For example, when a carbon body has its inner surface coated with copper and forms the inner wall of a collector, such as in a traveling wave tube, the inner surface is very sensitive to sudden and high localized rises in temperature. If, on the other hand, the carbon body has its outer surface coated with copper, such outer surface has such a low radiation ability in comparison with an uncovered carbon surface that only a fraction of the total power dissipation is obtained from that otherwise possible.

SUMMARY OF THE INVENTION

The invention provides a gas-impermeable carbon body which is characterized by a high reflection property and an insensitivity to high localized thermal stresses.

It is a novel feature of the invention to form a gas-impermeable (vacuum-tight) body from at least two carbon members joined together by a gas-impermeable metal layer between adjacent solderable surfaces of the carbon members.

It is another novel feature of the invention to place a layer of rhenium on adjacent surfaces of carbon members, place a disc or the like of a solder material selected from the group consisting of Cu, Ag, Au, and their alloys at a selected location of such rhenium-coated adjacent surfaces and subject the resultant structure to soldering conditions, such as in a vacuum or in a protective gas atmosphere, so that the disc melts and the solder material flows into contact with the adjacent surfaces and forms a gas-impermeable metal layer joining the carbon members to one another.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is an elevated cross-sectional view of an exemplary embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention provides a vacuum- or gas-impermeable body composed of at least two carbon body parts or members joined to one another along their adjacent solderable surfaces by a layer of gas-impermeable metal.

In the exemplary embodiment, a protective layer of rhenium is applied to the adjacent surfaces of the carbon members prior to soldering such surfaces together with a metal selected from the group consisting of Cu, Ag, Au, alloys thereof and similar metals.

The process embodiment of the invention is advantageously carried out in such a manner that the portions of the carbon members which form the joining or sealing surfaces are soldered together in a vacuum or protective gas atmosphere while having solder positioned therebetween. The process may also be carried out by combining the other portions of an electric discharge vessel at the same time the carbon members are sealed together.

In embodiments wherein the ultimately formed gas-tight body is composed of several body parts, solders having the same or different melting temperatures may be used at the various surfaces being soldered.

In the drawing, those parts which are not essential to the understanding of the principles of the invention have either been omitted or have not been provided with reference numerals. As shown, a carbon cylinder **1** is provided with a closed end, as at base **4**. The inner surface of the cylinder **1** is coated with a rhenium layer **3**, as by a reducing deposition process which provides a solid protective layer of rhenium on the carbon surface. A second carbon cylinder **2**, likewise having a closed end as at base **5** concentrically fits within the cylinder **1**. The outer surface of cylinder **2** is provided with a rhenium coating **3'**. The cylinder **2** fits fairly snugly within the cylinder **1** so that the adjacent surfaces of the cylinders are readily solderable. A solder supply, such as a relatively thick Cu-disc **6**, is placed at a select location (such as between the bases **4** and **5**) between adjacent surfaces of the cylinders. After alignment or adjustment of the cylinders with respect to one another and/or to a metal cylinder **7**, which forms a part of a discharge vessel wall, the two carbon cylinders are soldered together in a vacuum or a protective gas atmosphere by melting the solder, i.e. copper, and causing the molten solder, as by capillary forces and/or the pressure exerted by the inner cylinder **2**, to flow into contact with all adjacent solderable surfaces between the cylinders and form a gas-impermeable metal layer **8** joining such cylinders to one another via the rhenium layers.

In certain embodiments, fluidized solid material may be caused to flow from an outside reservoir arranged at a suitable height, for example, by its own weight, into the space or separating line between the cylinders or a portion of the solder may be provided from an outside source and a portion provided between the cylinders.

The solder is preferably a pure metal selected from the group consisting of copper, silver, gold, similar metals and their alloys. When forming bodies composed of a multiple of parts, select portions of solder are positioned at various solderable surfaces and each of the solder portions may be composed of different solder materials having differing soldering temperatures for joining or soldering the different surfaces. The plurality of solder portions may also be composed of identical solder materials or of solder materials having substantially identical soldering temperatures. In this manner, for example, a carbon body may be produced having a small cavity for the absorption of a beam current with an inner surface which can withstand a high temperature, above the melting point of the solder since a tem-

perature gradient occurs throughout the body wall and the temperature drops below the melting point of the solder, which in the case of Cu is 1084° C., before reaching the gas-impermeable metal layer and yet the body has a high radiation ability since its outer surface is uncoated carbon.

As is apparent from the foregoing specification, the present invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. For example, non-cylindrical carbon bodies may also be made gas- or vacuum-tight in accordance with the principles of the invention. For this reason, it is to be fully understood that all of the foregoing is intended to be merely illustrative and is not to be construed or interpreted as being restrictive or otherwise limiting of the present invention, excepting as it is set forth and defined in the hereto-appendant claims.

I claim as my invention:

1. A gas-impermeable member comprising a collector electrode which forms a housing wall portion in a high capacity electric discharge vessel, said member being comprised of at least two substantially permanently joined body members composed of carbon and having adjacent contacting surfaces;

a solid protective layer of rhenium or each of said contacting surfaces; and

a layer of a metal solder composed of a metal selected from the group consisting of Cu, Ag, Au and alloys thereof on said rhenium layers whereby a gas-impermeable seal is defined between said carbon body members.

2. A gas-impermeable member as defined in claim **1** wherein said solid protective layer of rhenium is positioned on the respective contacting surfaces of the carbon-body member by a reduction deposition process.

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