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GASEOUS SEAL AND METHOD

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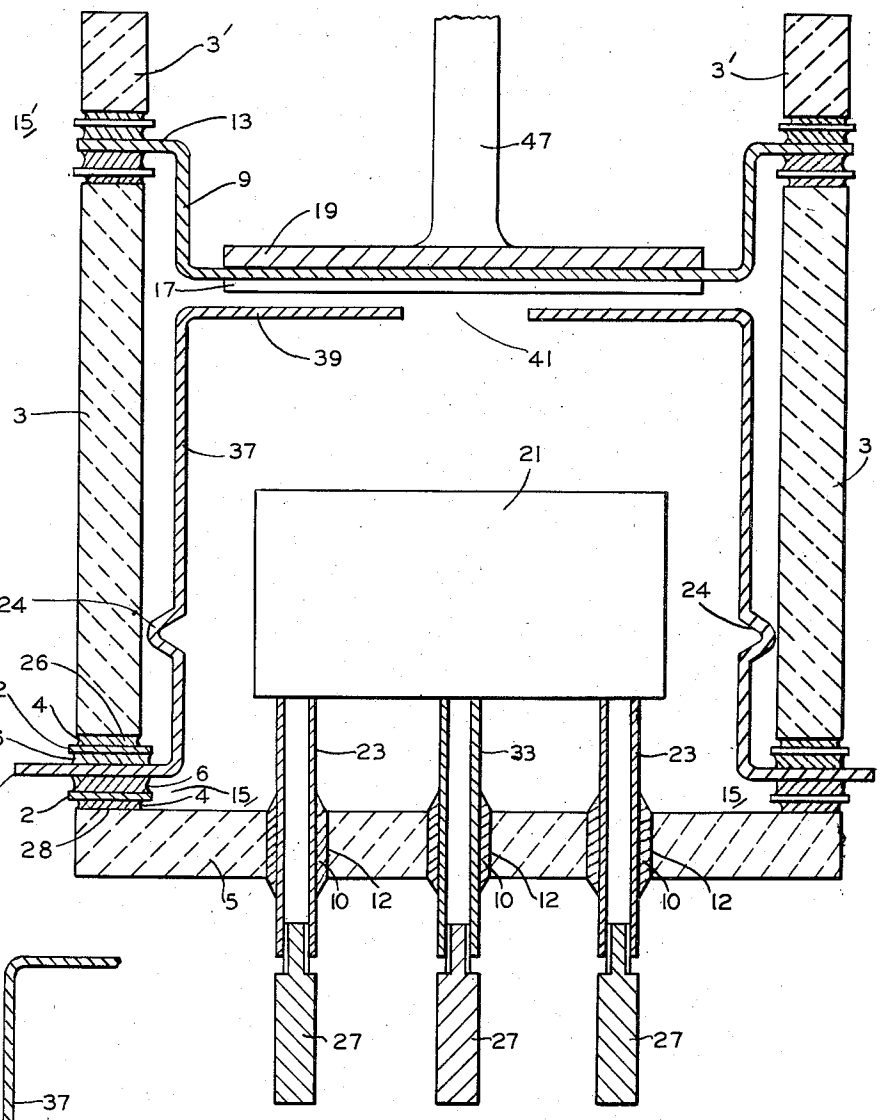


FIG. 1

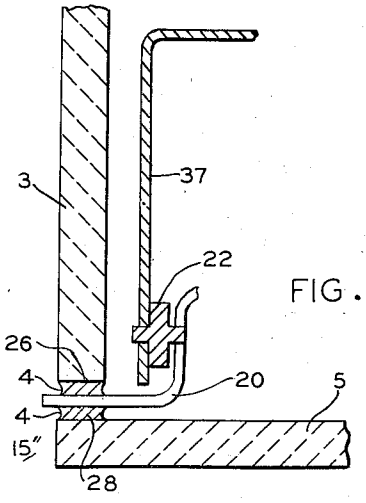


FIG. 2

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GASEOUS SEAL AND METHOD

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3 Claims. (Cl. 313—193)

The present invention relates to conductor-to-ceramic seals and methods of sealing and, more particularly, to seals between gaseous-discharge-tube electrodes or electrode structures and ceramic-tube walls.

As described in a copending application of Kenneth J. Germeshausen, Serial No. 598,425, filed July 17, 1956 entitled Gaseous-Discharge Device, gaseous-discharge tubes of the hydrogen thyratron type have been constructed with ceramic envelopes and cup-shaped anodes and control electrodes to permit the dissipation of heat generated during the high-voltage, high-current, high repetition-rate pulsing or switching of such tubes in stroboscope, flash-photography or radar circuits and the like. Included in such circuits are those disclosed in United States Letters Patent Nos. 2,518,879 and 2,592,556, issued, respectively, on August 15, 1950 and April 15, 1952 to the said Kenneth J. Germeshausen. The electrodes or electrode supports must be sealed or secured to the dielectric ceramic envelope walls or to predetermined regions thereof at which the electrodes or electrode supports are passed through the envelope walls to the exterior in order to permit of heat-conduction and cooling.

It is an object of the present invention to provide a new and improved method of effecting such sealing and a new and improved conductor-to-ceramic seal.

A further object is to provide a novel conductor-to-ceramic seal of more general utility, though, for purposes of illustration, the invention is described as applied to gaseous-discharge-device seals to which it is particularly adaptable. In summary, the ceramic-conductor seal comprises silver and titanium hydride coated upon the ceramic and bonded to a nickel member connected to the conductor.

An additional object is to provide a new and improved gaseous-discharge device.

Other and further objects will be explained hereinafter and will be more particularly pointed out in the appended claims.

The invention will now be explained in connection with the accompanying drawing, Fig. 1 of which is a longitudinal section of a gaseous-discharge device embodying the conductor-to-ceramic seals of the present invention; and

Fig. 2 is a similar, though fragmentary, view of a modification.

A gaseous-discharge device, such as a hydrogen-filled thyratron tube of the type disclosed in the said co-pending application is shown in Fig. 1 provided with a heat-dissipating cup-shaped anode 9, as of copper, having a substantially planar preferably molybdenum lower anode electrode surface 17 and an external preferably Kovar surface 19, and enclosing the top of the device. An inverted heat-dissipating cup-shape control electrode 37 is disposed with its upper substantially planar surface 39, provided with one or more apertures 41, in close proximity to the anode cup 9. The lateral walls of the control-electrode cup 37, like those of the anode cup 9 are disposed close to the preferably substantially cylindrical

side walls 3 of the device to avoid any long-path arc discharges between the control electrode 37 and the anode 9 along the walls 3. A centering dimple 24 may be provided in the lateral sides of the control-electrode cup 37. The walls 3 are preferably of ceramic material. Ceramic walls not only possess superior dielectric properties, particularly at high temperatures such as those that develop at the electrodes in repetitively pulsed thyratrons of this character, and which eliminate the leakage or high-voltage puncturing problems encountered with glass and similar walls, but they provide for improved ruggedness and dimensional accuracy. The ceramic walls 3 may be, for example, of alumina with small percentages of silica and other constituents. A satisfactory ceramic material is the type AI–200 ceramic manufactured by the Coors Porcelain Company of Colorado.

A cathode 21 that may be of any desired type, such as the types disclosed in the said Letters Patent and in the said copending application, including those of the heated oxide-coated vane variety, or the type employed in the 4C35-type hydrogen-thyratron, is supported by hollow pins 23, as of Kovar, that extend through the ceramic bottom wall 5 of the device to conductor lead-in plugs 27. A heater pin 33 may also be employed to conduct heater current to the cathode 21.

It remains to explain how the anode cup 9, the control-electrode cup 37 and the cathode pins 23 are connected and sealed to the ceramic walls 3 and 5.

Referring, first, to the control-electrode cup 37, it will be observed that flanges 43 are provided that extend outward between the inner and outer surfaces of the ceramic side walls 3 between the lower edges 26 thereof and the outer edges 28 of the ceramic bottom wall 5. Heat developed upon the control electrode is not only conducted to the anode cup 9 and radiated thereby into space, but it is radiated to the ceramic side walls 3 by the lateral walls of the control-electrode cup 37 and it is conducted outside by the flange 43. The external portion of the flange 43 also serves for permitting electrical connection to the grid in circuits of, for example, the type disclosed in the said Letters Patent. The region between the lower edge 26 of the side walls 3 and the outer edge 28 of the bottom wall 5 through which the control electrode conductive flange 43 extends must be sealed, as at 15. The seal 15 must not only be mechanically rigid, but it must be gas tight for high pressures and it must be relatively insensitive to temperature variations. The material of the seal, moreover, must not produce contaminating effects.

In accordance with the present invention, the lower edge 26 of the ceramic side wall 3 and the outer edge 28 of the ceramic bottom wall 5 are sprayed with a controlled layer of titanium hydride which may be about 0.001 inch thick. To this, an annealed nickel washer or other nickel member, preferably about 0.005 inch thick, is brazed or bonded in vacuum using a pure silver solder washer, say of 0.003 inch thickness. The thusly metallized portions of the ceramic walls are then brazed to the copper or other conductive flange 43, using an RT silver-copper-tin or BT silver-copper eutectic solder, the former of which flows at about 700° C. The solder layer is preferably about 0.003 inch thick. This last step may also be carried out in vacuum. At such temperature, the vapor pressure of the silver and copper parts is sufficiently low and little carbon dioxide is released from the cathode to poison the titanium hydride. At high temperatures, such as the brazing temperature of silver solder, such poisoning does take place and, in addition, the cathode becomes coated, reducing its emission. The final assembly step for the tube is therefore preferably the RT or BT tin-solder brazing step.

The vacuum furnace may comprise a conventional

metal diffusion pump, not shown, using a high-vacuum clapper valve and inert gas cooling for accelerating the cooling process. Induction heating may be employed with the device enclosed in a tantalum muffle in a Vycor bell jar. Other vacuum metallizing and sealing apparatus may also, of course, be employed.

The seal 15 thus comprises sections on each side of the flange 43 each having a nickel member 2 brazed on one side to a silver-titanium hydride coating 4 upon the ceramic wall material and brazed with the above-mentioned solder 6 to the copper conductive flange 43 of the control electrode 37. Even though the coefficients of expansion of the materials are not matched, the use of such ductile materials in the seal has been found to permit the same to stand up under wide temperature variations. Had the copper flange 43 been silver-brazed directed to the ceramic wall, since the coefficients of expansion of the materials are not matched, the resultant extremely hard seal material would tend to crack the ceramic walls. The use of nickel, moreover, has been found to prevent the RT or BT tin solder from penetrating into the silver-titanium hydride coating and destroying the metallized bond to the ceramic material.

The anode-cup 9 is provided with similar seals 15' at its outwardly extending flanges 13 to the top edge of the ceramic side walls 3 and the bottom edge of an upper ceramic-side-wall extension 3', the use of which insures greater integrity for the seal 15' than if no upper side-wall extension were employed. While the cathode 21 could similarly be supported upon members similarly sealed to the ceramic walls, in the tube of Fig. 1, the preferably Kovar tubular pin supports 23 and 33 are silver-soldered, as at 19 to titanium-hydride-coated apertures 12 through the bottom ceramic wall 5.

The tube may be filled with gas at the desired pressures, as explained in the said Letters Patent, through an inlet 47 that communicates with the interior of the tube through an opening, not shown, in the anode cup 9. The inlet 47 may be sealed off when the desired pressure and gas concentration is obtained.

In the modification of Fig. 2, the ceramic-wall edges 26 and 28 are shown provided with the silver-titanium hydride coatings 4, but these coatings are brazed to a nickel conductor 20. This provides a single-step brazing seal 15''. The conductor 20 is secured to the control electrode 37 within the envelope by a member 22. If the member 22 were of insulating material, the nickel conductor 20 could, indeed, serve to support both the cathode and the control electrode cup, as well. This would provide an excellent low-inductance conductor connection.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A method of providing a connection between a conductor and a ceramic member that comprises coating the member at the connecting region with silver and titanium hydride, bonding nickel to the said coating, and securing the conductor to the nickel.

2. A ceramic-conductor seal comprising silver and titanium hydride coated upon the ceramic and bonded to a nickel member soldered to the conductor.

3. A ceramic-walled gas-filled device having an electrode disposed in the gas of the device and secured to a wall thereof with a seal comprising silver and titanium hydride coated upon the ceramic wall and bonded to a nickel conductor secured to the electrode.

4. A ceramic-walled gas-filled device having an electrode disposed in the gas of the device provided with a conductive extension passing at a predetermined region of a wall of the device between the inner and outer surfaces of the wall, the said extension being secured to the predetermined region by a seal comprising a silver and titanium-hydride coating disposed upon the ceramic-wall material at the said predetermined region bonded to a nickel member and soldered to the said extension.

5. A ceramic-walled gas-filled device having an electrode disposed in the gas of the device and a nickel conductor connected to the electrode and extending at a predetermined region of a wall of the device between the inner and outer surfaces of the wall, the nickel conductor being secured to the predetermined region by a seal comprising a silver and titanium-hydride coating disposed upon the ceramic-wall material at the said predetermined region bonded to the nickel conductor.

6. A gaseous-discharge device having a ceramic-walled envelope for containing the gas of the device, an anode electrode, a cathode electrode spaced in the gas of the device from the anode electrode, and a control electrode disposed in the space between the anode and cathode electrodes provided with an apertured surface adjacent the anode electrode and extending substantially to the walls of the envelope and, at a predetermined region of the walls, extending between the inner and outer surfaces thereof, the control electrode being secured to the predetermined region by a seal comprising silver and titanium-hydride coated upon the ceramic-wall material at the said predetermined region and bonded to a nickel member connected to the electrode.

7. A gaseous-discharge device as claimed in claim 6 and in which the said gas comprises hydrogen, the said envelope is substantially cylindrical, the said control electrode is a substantially cylindrical inverted cup and the said predetermined region is of substantially circular contour.

8. A gaseous-discharge device having a ceramic-walled envelope for containing the gas of the device, an anode electrode provided with a surface extending substantially to the walls of the envelope and having means for securing the anode electrode to a first predetermined region of the envelope wall to enclose the envelope, a cathode electrode spaced in the gas of the device from the anode electrode, and a control electrode disposed in the space between the anode and cathode electrodes provided with an apertured surface adjacent the anode electrode and extending substantially to the walls of the envelope and having means for securing the cathode electrode to a second predetermined region of the envelope wall, the said anode and cathode-electrode securing means each comprising a seal including silver and titanium hydride coated upon the ceramic wall of the envelope at the corresponding predetermined region bonded to a nickel member connected to the corresponding electrode.

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