June 6, 1933. G. V. RYLSKY 1,912,919

EXTERNAL ANODE DISCHARGE DEVICE

Filed Oct. 20, 1927

Fig. 1.

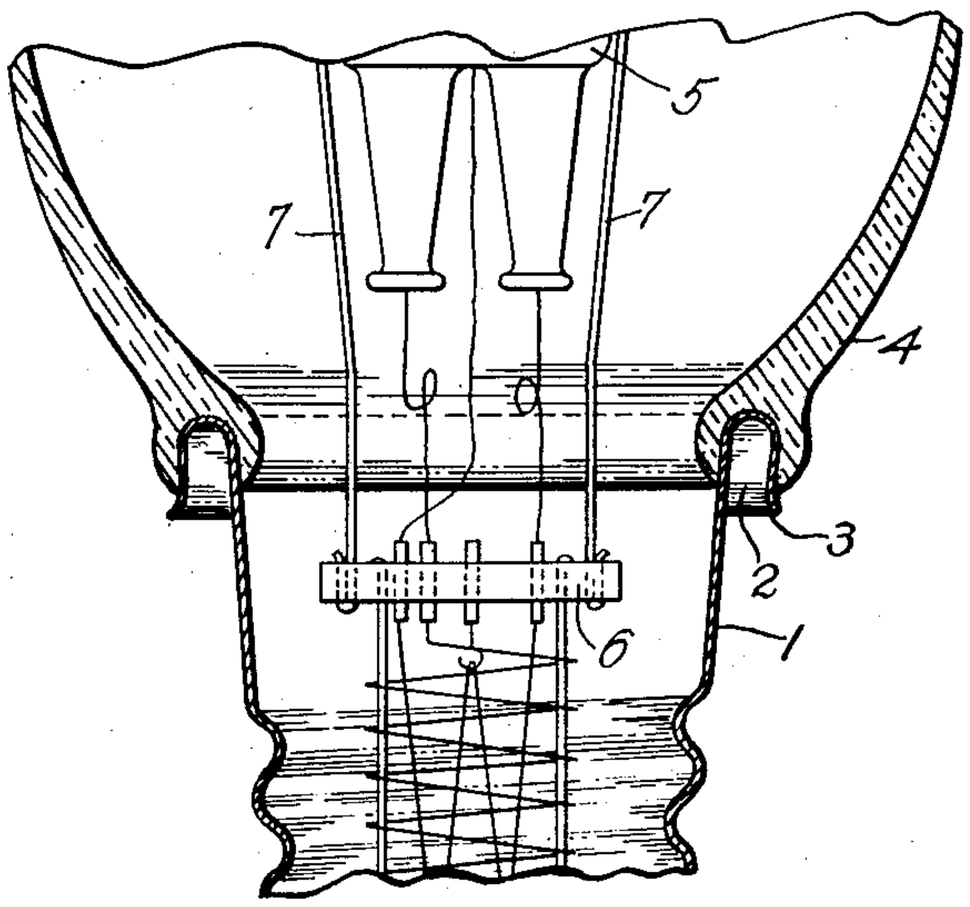


Fig. 2.

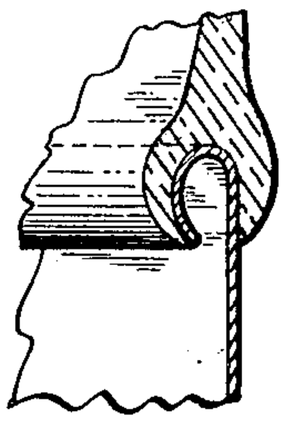


Fig. 3.

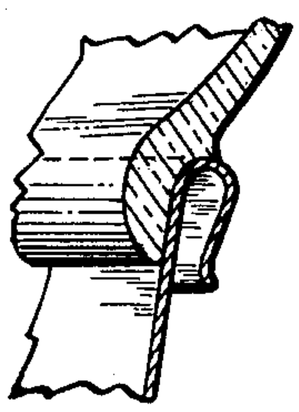
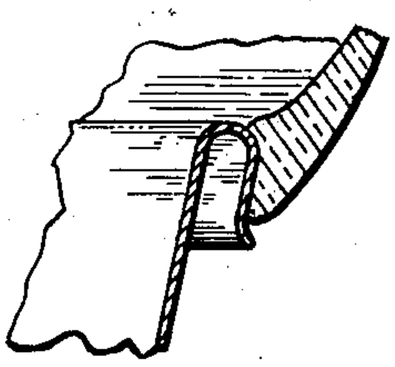


Fig. 4.



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UNITED STATES PATENT OFFICE

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EXTERNAL ANODE DISCHARGE DEVICE

Application filed October 20, 1927. Serial No. 227,588.

My invention relates to a method of making vacuum-tight seals between glass and metal and particularly to methods of making vacuum-tight seals between the external anodes of high-power radio tubes and the glass-wall portions thereof.

One object of my invention is to provide means for making vacuum-tight seals between metal and glass which shall be relatively strong and durable.

Another object of my invention is to provide means for making a vacuum-tight seal between a thin-edge metal member and glass in which the thin edge is not enclosed within the glass.

A further object of my invention is to provide means for making a vacuum-tight seal between a thin-wall metallic electrode of an electrical discharge tube and the glass wall thereof in which a portion of said thin-wall electrode acts to screen the thin edge thereof from the electrical field between said electrode and the other electrodes within said tube.

Other objects of my invention will be apparent from reading the following specification taken in connection with the drawing wherein:

Figure 1 is a sectional view showing one form of a joint between the glass wall of an electrical discharge tube and a metallic wall portion thereof,

Fig. 2 is a sectional and perspective detail view of a joint between a glass wall portion and a metallic wall portion of a vacuum-tight container, embodying a modification of my invention,

Fig. 3 is a similar view of a similar joint embodying another modification of my invention,

Fig. 4 is a similar view of a similar joint embodying still another modification of my invention.

It is current practice in the manufacture of high-power radio-transmitting tubes to make a portion of the wall of the vacuum-tight enclosing vessel of thin metal, such as copper, and to form a vacuum-tight joint between the metallic portion and the glass portion of the tube wall by fusing the glass around a thin edge of the metallic wall portion so as to completely enclose this edge of glass. In the case of tubes operating at relatively high voltages, the electric field between the electrodes tends, in accordance with well known principles, to concentrate in the neighborhood of this thin edge. As a result, the glass seal is subjected to large electric stresses, and the alternating field produces considerable heating on account of dielectric losses in the glass of the seal. In consequence of these effects, the glass seal frequently is punctured.

To overcome this difficulty, use has been made of metal shields projecting from the anode within a tube and intercepting the electric field which would otherwise concentrate about this thin metallic edge. A shield of this character is described and claimed in application Serial No. 188,420, of I. E. Mouromtseff and F. Deak filed May 3, 1927, and assigned to the Westinghouse Electric and Manufacturing Co.

My invention relates to a method of making seals for power tubes which avoids the necessity for providing internal shields of the character described in the aforesaid application, through the expedient of so forming the metallic wall portion as to intercept the electric field which would otherwise concentrate about the thin edge of the metal and in so fusing the glass wall thereto that the thin edge is not enclosed within the glass.

My invention also provides, in an electrical discharge device, a seal between the glass portion of the container and the copper anode forming the other part of the container whereby there is uniform stress on the seal due to the greater thermal expansion of the copper and also there is no wedging action by the edge of the copper tending to split the glass.

Referring particularly to Fig. 1 of the drawing, a cylindrical anode of thin-wall metal has its edge rolled back upon itself in what may roughly be described as a trough-like or cuff formation. The figures of the drawing show the actual form much more clearly than it can be described in words. The formation of the trough may be brought

about by means of die-presses, or the end of the anode may be spun over. Other methods of forming the trough structure will be readily apparent to those skilled in the art. The very edge of the cuff thus formed may be bent slightly outward, as indicated at 3. The glass wall portion 4 of the tube is then sealed, by the ordinary method of glass blowing, to the external surface of the trough or cuff 2. In the modification shown in Fig. 1, the glass is pressed up about the curved bottom of the trough on each side thereof, but it does not extend high enough on the outside to reach the edge 3 of the metal portion 1.

In the example illustrated, the electrode structure which is positioned inside the anode 1 and glass wall 4 is of the form shown in U. S. Patent 1,562,396 issued to F. E. Ward on November 17, 1925. It comprises a reentrant glass stem 5 from which is suspended an insulating member 6 by means of rods 7. The member 6 serves as a support for the grid and cathode.

As an alternative construction to that just described, the edge of the anode may be rolled inward to form an annular trough inside the anode cylinder, as illustrated in Fig. 2.

In accordance with the modification shown in Fig. 3, the glass is sealed only to that portion of the face of the cuff or trough which lies inside the metallic electrode cylinder 1.

In accordance with the alternative structure shown in Fig. 4, the glass is fused only to the portion of the trough or cuff which lies outside the cylindrical electrode 1.

In each modification shown above, the glass is kept well away from the sharp edge of the metallic portion.

The formation of the trough or cuff will be seen to be such that lines of force running from the metal electrode 1 to any electrode on the interior of the enclosure 4 would have to intersect some other portion of the metal trough 2. In accordance with well known principles of electrostatics, the portions of the trough 3 thus intersected cut off the lines of force and prevent their concentration about the sharp edge 3. All lines of electric force, therefore, emanating from the metallic portion 1, end on the rounded exterior of the trough 2 and, in accordance with well recognized principles of electrostatics, are evenly distributed thereover and prevented from concentrating at any one spot. In consequence, the glass seal is nowhere subject to an intense concentration of electric stress, and the difficulties above described, as consequent upon such concentrations, are thus avoided.

It will be noted that the trough 2 forms a very flexible structure which can readily flex and prevent the severe strains in the glass inherent in a rigid metal structure. The shape of the trough or cuff tends to evenly distribute the strain due to the thermal expansion of the copper over the seal joint. In particular there is no sharp edge of the copper anode in the seal itself to act as a wedge to split the glass when the copper expands, due to the heat of operating temperature. As a result, tubes made in accordance with my invention not only avoid the necessity for providing separate electrostatic shields within the tube but have a greater durability and strength than the seals of the prior art.

It will be evident to those skilled in the art that the principles of my invention are not limited to the particular form thereof which I have here disclosed, but are capable of application in other ways. I, therefore, desire that the broadest construction be given to the terms of the following claim which are permissible in view of their express terms and of the limitations imposed by the prior art.

I claim as my invention:

An external anode discharge device comprising a metal envelope portion and a vitreous portion enclosing a cathode, said metal portion constituting an anode and comprising a thin walled metal portion having a reentrant smooth convex surfaced free end, said vitreous portion sealed to said convex surface and contacting said surface away from the edge of said free end only of said metal portion.

In testimony whereof, I have hereunto subscribed my name this 7th day of October 1927.

GREGORY V. RYLSKY.