July 23, 1929. V. L. RONCI 1,722,016

ELECTRICAL CONDUCTOR AND METHOD OF MAKING SAME

Filed May 29, 1926

Fig. 1.

Fig. 2.

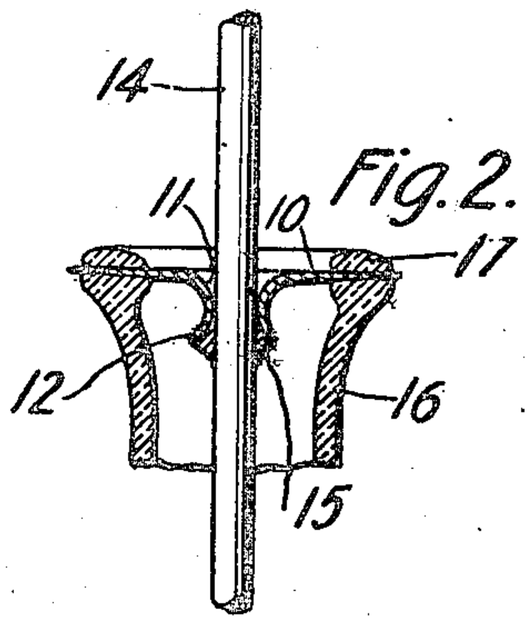
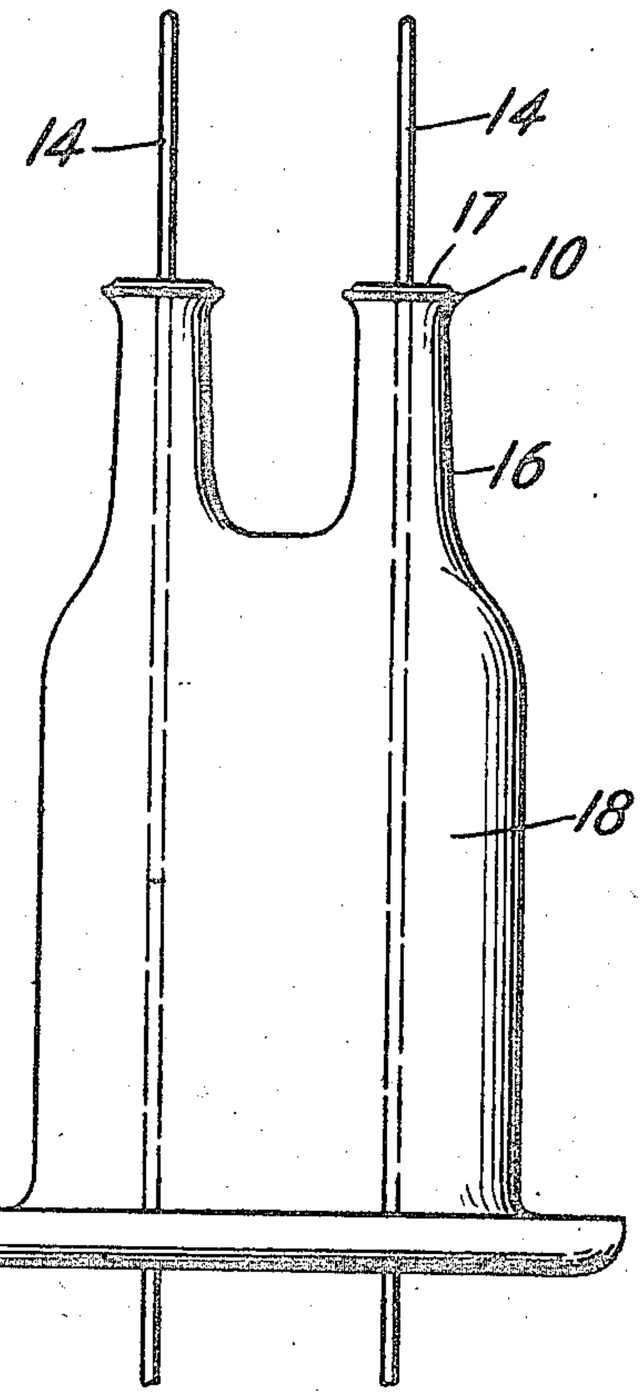


Fig. 3.



Inventor:
Victor L. Ronci.
by Joel C. Palmer Att'y.

Patented July 23, 1929. 1,722,016

UNITED STATES PATENT OFFICE.

VICTOR L. RONCI, OF BROOKLYN, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRICAL CONDUCTOR AND METHOD OF MAKING SAME.

Application filed May 29, 1926. Serial No. 112,514.

This invention relates to an electrical conductor and method of making the same and more especially to leading-in conductors for the electrodes of high voltage water cooled discharge devices.

An object of the invention is to increase the flexibility of a metal to glass sealed joint.

Another object is to provide a sealed joint capable of withstanding longitudinal stresses due to expansion and contraction.

A further object of the invention is to provide a metal seal of small area for a leading-in conductor capable of carrying large currents.

In electron discharge devices of the external anode type, the electrodes within the device, particularly the cathode or filament, are supplied with current through leading-in conductors sealed into the glass portion of the device. Due to the large diameter of these conductors, it is preferable to solder a thin metal disc to the conductor and seal the edge of the disc to the glass wall of the device in accordance with a method disclosed in W. G. Housekeeper Patent, 1,293,441, issued February 4, 1919, and entitled "Combined metal and glass structure and method of forming same". This arrangement forms an air-tight sealed joint since the edge of the disc is so thin that the slight strains set up transversely of the disc are not sufficient to overcome the adhesion between the sides of the disc and the glass.

However, the rigidity of the soldered joint between the metal disc and the leading-in conductor results in a connection in which longitudinal expansion of the conductor and disc is limited. Therefore, when a large diameter conductor is soldered to the disc for the passage of a relatively large current, the stresses set up in the structure crack the seal at the juncture of the glass and the metal and destroy the high vacuum maintained in the device.

In accordance with the present invention this difficulty is overcome by forming a central conical embossment on the disc, piercing the apex of the embossment, and securing a leading-in conductor to the disc at the point of contact between the conductor and the inner edge of the pierced disc, exterior to the conical embossment. Preferably the edge of the pierced apex of the embossment is flared outwardly to provide a funnel shaped cavity between the flared edge of the disc and the leading-in conductor which passes therethrough. A filling of solder is deposited in the cavity so that the metal disc may be brazed to the leading-in conductor to form an air-tight joint. This arrangement increases the flexibility of the sealed joint and allows sufficient longitudinal expansion of the leading-in conductor to prevent the seal from cracking at the juncture of glass to metal. Furthermore, the small portion of the metal disc in direct contact with the leading-in conductor affords greater pivotal flexibility for the leading-in conductor without endangering the brazed joint.

The invention may be better understood by referring to the following detailed description and the accompanying drawing in which Fig. 1 shows an enlarged cross sectional view of a metal disc made in accordance with this invention.

Fig. 2 illustrates in cross section the assembly of the leading-in conductor and the disc seal, and

Fig. 3 illustrates one form of glass stem of an electron discharge device through which the leading-in conductors are sealed.

Referring particularly to Fig. 1, the invention in one of its forms, comprises a thin metal disc 10 having a concentric conical opening 11, the edge of the opening being flared outwardly as at 12. This edge is machined prior to the flaring operation to provide a knife edged extremity, the advantages of which will be described hereinafter. The peripheral edge of the disc 10 is also tapered to a knife edge as at 13. This type of disc forms an intermediate member between a relatively large diameter conductor through which heavy current is to be passed and the vitreous wall of an enclosing vessel which is highly evacuated. This arrangement provides a sealed joint in which substantially the whole surface area of the disc is out of intimate contact with the conductor and a considerable degree of mechanical flexibility is obtained. Furthermore, because of the conical air space formed by the opening 11 in the disc, the air-tight joint between the thin knife edge of the flare portion 12 and the conductor does not fuse in the subsequent operations of sealing the disc to the glass member.

Preferably the following series of steps are executed to provide a secure, air-tight and non-corrosive union between the disc 10 and

the conductor 14. The conductor is cleaned at the point to which the disc is to be attached, to remove foreign substances and oxide coating. This can be done expeditiously with a flux, such as a borax solution generally used in soldering. A similar cleaning process is performed on the metal member or disc which is to be attached to the conductor. The apertured disc 10 having the same diameter as the conductor, is then slipped on the conductor and positioned at a point where it is desired to be affixed. The close fit between the curved wall of the apertured disc and the conductor forms two separate and opposed funnel-shaped channels, one channel being of larger diameter at its outer edge than the other channel. A ring of high-melting-point solder is slipped on the conductor and is positioned in the small funnel-shaped channel formed by the flared inner edge 12 of the disc 10. This solder preferably consists of a silver alloy such as is disclosed in U. S. Patent 1,640,469, issued August 30, 1927. The conductor is heated electrically by passing current through a portion of the conductor on either side of the metal disc. This heating is insufficient to fuse the alloy solder due to its high melting point and also due to the fact that the metal disc conducts the heat away from the portion of the conductor adjacent the annular channels which is cooler than the heated portion of the conductor. However, a gas torch flame is applied locally to the ring of solder which fuses and flashes into a bright and manifestly tight brazed joint 15. The flow of the solder is restricted to the small funnel-shaped channel formed by the tapered knife edge 12 on one side of the disc and is prevented from flowing into the larger conical channel on the opposite side of the disc by the close contact between the conductor and the curved wall of the apertured disc. The assembled structure may then be sealed to the vitreous material without danger to the fused joint, by heating the outer edge of the disc in a glass blower's flame and simultaneously applying a glass tube 16 to each peripheral surface, the union being heated thoroughly to weld the glass and metal together. After the weld is completed, the glass tube projecting from the side of the disc having the larger conical channel is heated, extended and internally blown to form a thin walled bulb adjacent the fused end of the tube. This bulb is broken down, leaving an annulus of glass 17 on the outer peripheral surface of the disc. The final heating of the metal to glass joint is then performed to finish the weld and remove any air bubbles which have formed.

This type of seal may be worked into any type of vitreous vessel, for instance, a glass stem portion 18 as shown in Fig. 3, and incorporated in an electron discharge device. The increased flexibility of the conductor seal obtained in accordance with this invention prevents any undue strain being placed on the brazed joint or the metal to glass welded joint, since the small area and thin edge of the metal member in contact with the conductor allows a greater portion of the seal to respond to changes in temperature and provides a wider range of longitudinal and angular movements.

What is claimed is:

1. A metal seal between a leading-in conductor and a glass wall of an electron discharge device comprising a metallic disc having an opening whose walls form two contiguous funnel-shaped portions, one of which merges into said disc and the other having a free edge, said conductor being substantially tangent to the narrowest part of said funnel-shaped portions, and sealing means filling the space between said conductor and said free edge.

2. A metal seal for an electron discharge device comprising an apertured flexible disc having a central conical embossment, said embossment having an outwardly curved tapered edge at the free end thereof, a conductor extending through said disc, said conductor being in contact with said disc only at the intermediate portion of said embossment and outwardly curved edge, and a solder filling between said tapered edge and said conductor whereby longitudinal and pivotal flexibility is secured.

3. A seal for an electron discharge device comprising an apertured copper disc having a tapered edge, an insulating tubular member sealed to said tapered edge, said disc having a central conical dished portion extending into said tubular member, the free extremity of said conical portion being reversely curved with respect to said conical dished portion, a conductor extending through said disc and having a diameter the same as the smallest diameter of the aperture in said disc, and a soldered joint between the reversely curved edge of said conical dished portion and said conductor within said tubular member.

In witness whereof, I hereunto subscribe my name this 26th day of May A. D., 1926.

VICTOR L. RONCI.