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EXHAUST TUBULATION FOR ELECTRONIC DISCHARGE TUBES

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Fig. 1.

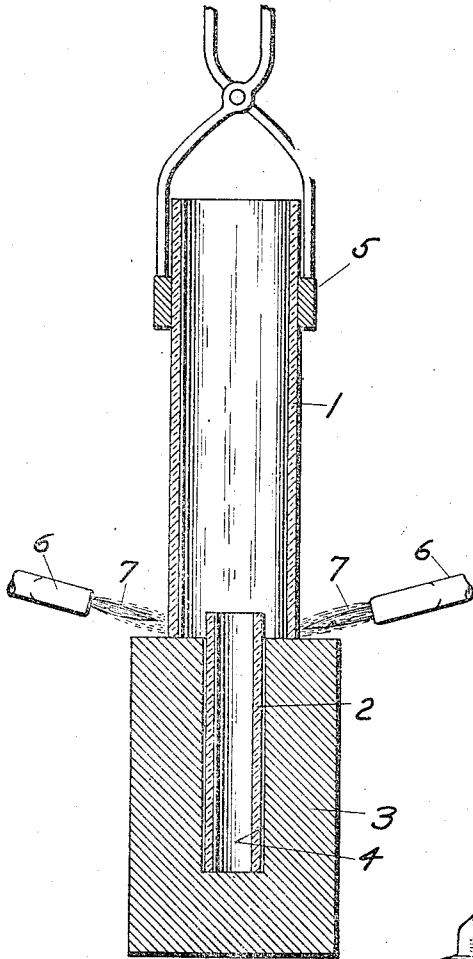


Fig. 2.

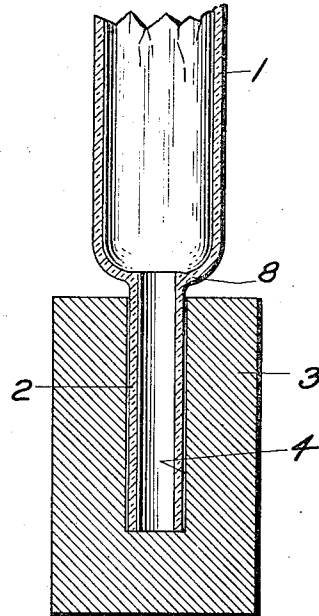
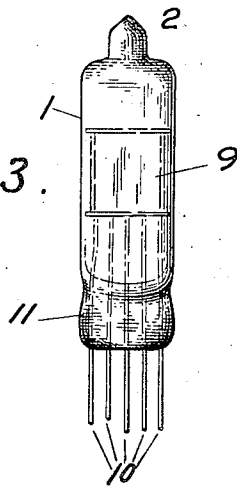


Fig. 3.



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EXHAUST TUBULATION FOR ELECTRONIC DISCHARGE TUBES

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2 Claims. (Cl. 49—82)

1

This invention relates to a sealing arrangement between an exhaust tubulation and an electronic discharge tube envelope, and to a method of producing the same. Heretofore the attaching of such tubulation, especially to the envelopes of small size, did not lend itself readily to fabrication by automatic machinery, and where manual operators were utilized a very high degree of skill was required in order to produce a satisfactory seal between the tubulation and the envelope. Even where acceptable seals were produced, a tendency existed for the seal to be the weakest part of the associated portion of the device, so that relatively large numbers of cracks occurred in devices of this kind at the seal both during manufacture and during use.

An object of this invention is to devise a sealing arrangement of the above type in which the degree of skill necessary to produce the tubulation arrangement is greatly reduced.

Another object is to enable the tubulation seal to be produced readily by simple automatic machinery.

A further object is to increase the strength of the seal so as to substantially eliminate the previous tendency for cracks to occur.

A still further object is to devise a novel method of producing the seal so as to produce a device possessing the above advantages, and also in which the size of the exhaust conduit is maintained at a maximum.

The foregoing and other objects of this invention will be best understood from the following description of an exemplification thereof, reference being had to the accompanying drawing, wherein:

Fig. 1 is a diagrammatic cross-sectional view of an apparatus for producing my novel sealing arrangement and illustrating the first step in the process of producing a seal between an exhaust tubulation and an electronic discharge tube envelope;

Fig. 2 is a view similar to that of Fig. 1, showing the completed seal between the tubulation and the envelope; and

Fig. 3 is a side view of a completed electronic discharge device incorporating my invention.

In the drawing, 1 represents a straight-sided cylindrical glass tube which is to constitute the envelope of the completed electronic discharge tube. My invention is particularly adaptable to devices of very small size, and in a practical case the outside diameter of the tube 1 has been about one-third of an inch. The exhaust tubulation which is to be attached to the envelope 1 is represented

2

by the numeral 2. In the case mentioned above, the outside diameter of this tubulation has been about .125 inch. The machine in which the seal is made includes a block 3 formed with a bore 4 which receives the exhaust tubulation 2. The lower end of the envelope 1 either rests upon the upper surface of the block 3 or is held closely adjacent thereto by a suitable clamp 5. It will be noted that the bore 4 is made of a limited depth so that the upper end of the tubulation 2 extends beyond the upper surface of the block 3, and thus projects into the lower open end of the envelope 1. A plurality of gas jets 6—6 are disposed so as to project gas flames 7—7 against the sides of the envelope 1 adjacent its lower end. The apparatus is arranged as is usual in devices of this kind to produce relative rotation between the elements 1—5 and the gas flames 7—7.

The gas flames 7—7 heat the lower end of the envelope 1 to its softening temperature, whereupon the surface tension of the softened glass and the pressure exerted on the softened glass by the flames 7—7 cause the lower end 8 of the envelope 1 to flow inwardly against the outer surface of the upper end of the tubulation 2 and fuse thereto, as shown in Fig. 2.

It will be noted from Fig. 1, however, that the lower end of the envelope 1 either rests upon the upper surface of the block 3 or is so close thereto as to substantially completely shield the projecting portion of the tubulation 2 from the direct action of the gas flames 7—7. However, the lower portion of the envelope 1 is heated to such a temperature that it radiates a substantial amount of heat which is intercepted by the outer surface of the projecting portion of the exhaust tubulation 2. This causes substantially a surface fusing of the tubulation 2 without heating the inner walls thereof to a sufficiently high temperature to cause softening of those inner walls. Thus, when the softened lower end of the envelope 1 comes into contact with the outer surface of the projecting portion of the tubulation 2, intimate fusing of these members is readily produced. At the same time, however, the inner walls of the tubulation 2 being in a solid state act as an abutment to withstand the sealing pressure exerted, due to the surface tension of the molten glass and the pressure of the flames 7 insuring a good seal, while at the same time maintaining the maximum cross-sectional exhaust conduit area leading from the envelope 1. If the flames 7 were permitted to act directly upon the projecting portion of the exhaust tubulation 2 or if the temperature of

3

this tubulation were permitted to rise to an excessive value, the tubulation would tend to collapse. This would either substantially reduce the cross-sectional area of the exhaust conduit leading from the envelope 1, or in some cases might completely close off the exhaust tubulation.

After the sealing arrangement is completed as above described, an electronic discharge tube, such as illustrated, for example, in Fig. 3, may be fabricated therefrom. This tube may consist of an electrode assembly 9 placed within the envelope 1 from which a plurality of lead-in wires 10 project. These lead-in wires may be sealed through a stem 11 formed at one end of the envelope 1 by fusing the glass at said end and pressing it around the lead-in wires 10. Thereafter the tube is evacuated through the exhaust tubulation 2 in accordance with the usual practice. When the exhaust of the tube 1 is completed, a gas flame is directed against the tubulation 2 adjacent the envelope 1 so as to seal off said tubulation and remove the excess portion from the device.

I have found that the sealing arrangement which I have devised, as described above, eliminates the various critical factors which heretofore had existed in attaching an exhaust tubulation to an electronic discharge tube envelope. Thus my novel seal lends itself readily to fabrication by simple automatic machinery. Likewise it may be produced by relatively unskilled operators. Furthermore I have found that the strength of the seal thus produced is much greater than has heretofore been possible with previous devices. As a matter of fact, in tubes made in accordance with my invention, breakage and losses due to weaknesses at the exhaust tubulation have been substantially eliminated. An additional advantage of the arrangement which I have described is that exhaust tubulations may be attached as described in a very uniform manner with very little variation in the dimensions of the seal elements. This is in contrast with previous arrangements in which substantial variations in dimensions have occurred at the exhaust tubulation seal. This is particularly important when tubes of the small size which I have described are involved, since variations of a very small fraction of an inch are

4

substantial when dealing with such small dimensions.

Of course it is to be understood that this invention is not limited to the particular details as described above as many equivalents will suggest themselves to those skilled in the art.

What is claimed is:

1. The method of sealing a glass exhaust tubulation to a glass envelope of an electrical space discharge tube which comprises inserting a substantially straight-sided glass tubulation into a bore in a refractory block so that only a relatively small portion of said glass tubulation, sufficient to have said portion sealed to an envelope, projects beyond said block, supporting a substantially straight-sided tubular glass envelope having an open end with said end substantially in contact with the surface of said block and surrounding said portion of said tubulation, heating the outer wall of said end to the softening point by means of a flame applied from the exterior of said envelope whereby said portion of said tubulation is heated to sealing temperature substantially solely by radiation of heat from said end of said envelope.

2. The method of sealing a glass exhaust tubulation to a glass envelope of an electrical space discharge tube which comprises inserting a substantially straight-sided glass tubulation into a bore in a refractory block so that only a relatively small portion of said glass tubulation, sufficient to have said portion sealed to an envelope, projects beyond said block, supporting a substantially straight-sided tubular glass envelope having an open end with said end substantially in contact with the surface of said block and surrounding said portion of said tubulation, heating the outer wall of said end to the softening point by means of a flame applied from the exterior of said envelope whereby said portion of said tubulation is heated to sealing temperature substantially solely by radiation of heat from said end of said envelope, and causing the softened end of said envelope to move solely under the action of said flame into sealing contact with the outer wall of said portion of said tubulation.

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