Aug. 11, 1936. W. H. TEARE 2,050,867

SEAL FOR ELECTRIC DISCHARGE DEVICES

Filed Sept. 27, 1935

Fig. 1.

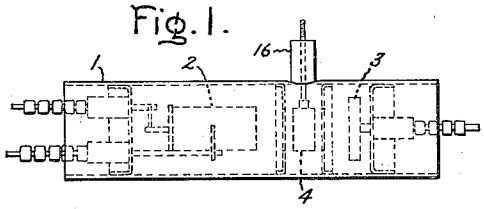


Fig. 2.

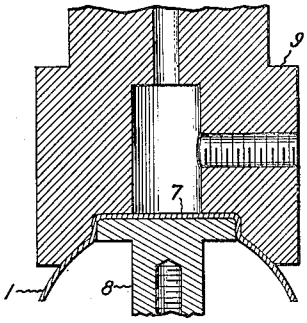


Fig. 3.

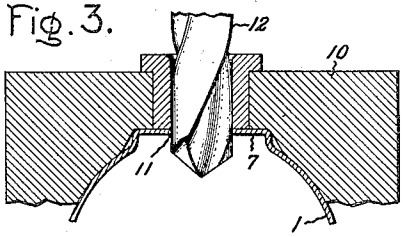


Fig. 4.

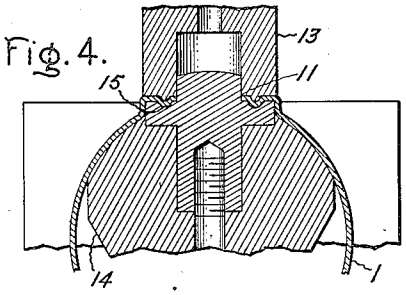


Fig. 5.

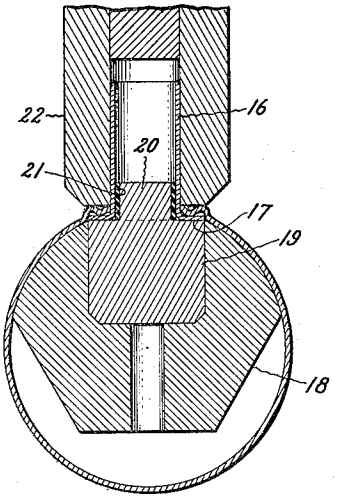


Fig. 6.

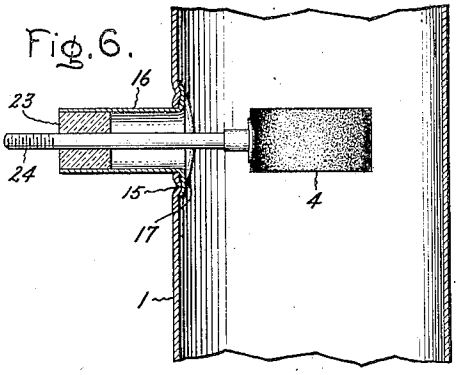
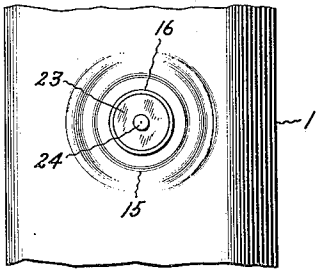


Fig. 7.



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UNITED STATES PATENT OFFICE

2,050,867

SEAL FOR ELECTRIC DISCHARGE DEVICES

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Application September 27, 1935, Serial No. 42,425

5 Claims. (Cl. 250—27.5)

My invention relates to an improved lead-in seal for metal enclosed electric discharge devices and to a method for producing such a seal.

The obvious advantages of all-metal enclosing envelopes with respect to ruggedness and compactness has now led to their wide spread adoption for many types of discharge devices. It is, however, a practical requirement of all-metal discharge tubes that they be fabricated from a number of separate, conveniently handled metal parts. For this reason their manufacture requires an improved technique in joining and sealing the various elements together.

It is desirable from the standpoint of economy and appearance to form the main body of the tube envelope as a smooth seamless cylinder. At the same time this shape has rendered it very difficult to seal lateral tubulations hermetically to the cylinder wall. Previously employed methods, such as brazing, which are entirely satisfactory for other structural applications fail to produce the perfectly tight joints which are essential to successful discharge tube operation.

It is, therefore, an object of the present invention to provide a joint for a laterally extending electrode stem which will be entirely vacuum-tight and which can be uniformly reproduced under the conditions of mass production. It is a further object of my invention to provide a seal fulfilling the above specifications which is at the same time characterized by simplicity and economy of manufacture.

In the practice of my invention there is produced on the envelope wall a partially flattened surface having a sectional contour which assures a continuous line contact with a corresponding plane metal surface associated with the electrode supporting stem. Fusion at the line of contact is then obtained by the passage of a high intensity welding current of short duration.

The novel features which I consider to be characteristic of my invention are pointed out with particularity in the appended claims. My invention itself, however, may best be understood by reference to the following specification taken in connection with the accompanying drawing in which Fig. 1 shows in outline a sealed envelope enclosing a discharge producing electrode structure; Figs. 2, 3, and 4 are sectional views illustrating the various steps employed in reducing a portion of the envelope wall to a form suitable for the practice of my invention; Fig. 5 illustrates in section the assembly used in fusion welding the metal parts comprising the sealed joint; Fig. 6 is a view partially in section illustrating an electrode mounting embodying my improved seal, and Fig. 7 is an elevation depicting another aspect of the same.

In Fig. 1 I have illustrated in elementary fashion a complete discharge device of the type with which my invention is primarily concerned. This is shown as comprising a sealed metallic envelope 1 enclosing discharge electrodes including a cathode 2 and an anode 3. A control electrode or grid 4 is shown as being supported intermediate the ends of the tube by a laterally extending tubulation 16. In the usual case, tubes of the type illustrated contain a small quantity of an ionizable medium such as mercury vapor at a pressure sufficient to support an arc-like discharge. It will be understood that for satisfactory operation of such a discharge device, the envelope 1 must be capable of being highly evacuated and of such a construction as to be substantially vaccum-tight throughout the entire duration of its use. It is, consequently, necessary for the electrode lead-in seals, such as that associated with the grid 4, to be perfectly free from the possibility of gas leakage.

Referring now to Fig. 2, I have shown a fragmentary section of the wall of the metallic envelope 1. The envelope as a whole may assume any curvilinear outline but typically comprises a seamless cylinder. While it is at present considered most feasible to use steel as the envelope material, it will be obvious that other ductile materials may under some circumstances prove equally suitable.

For forming the flattened area designated by the numeral 7, I provide a stationary tool-piece 8 immovably supported on a rigid base or foundation table (not shown). A forming die 9, driven in a downward direction by a power press, cooperates with the stationary tool-piece 8 to form the envelope surface into the shape illustrated. The plane surface thus created preferably has a circular outline based on a diameter equal to the section shown in Fig. 2.

Following the shaping operation just described the work-piece 1 is moved to a second station and locked against rotation by the restraining action of the block 10. Here a circular aperture 11 is formed in the flattened surface 7 by means of a downwardly moving drill 12. Because of the high degree of accuracy and the absence of rough edges or burrs obtainable, I prefer to use the drilling operation described rather than to punch out a corresponding section. It will be obvious, however, that the latter method may be substituted if sufficient care is taken to avoid surface irregularities.

The flattened area surrounding the aperture 11 is given a desired contour by means of the die and block assembly illustrated in Fig. 4. The embossing operation there shown is accomplished by a power driven member 13 having an annular projection on its lower surface. This is capable of exerting enough force to cause a portion of the tube wall surface to flow into corresponding depressions indicated in the stationary block 14. The result of this operation is to form a continuous ridge 15 of annular shape completely surrounding the aperture 11. A more complete picture of the embossed portion is afforded by the elevational view of Fig. 7.

In the applications in which my invention has proved particularly useful an electrode supporting stem in the form of a flanged tubulation 16 is passed outwardly through the aperture 11 in such a way that the surface of the flange 17 abuts the surface 7 in continuous line contact with the annular ridge 15. For use with discharge electrode assemblies of the type hereinafter described, this tubulation should consist of a metal capable of being fused directly both to steel and to glass. Such a metal has been disclosed and claimed, for example, in Hull and Berger application, Serial No. 705,250, filed January 4, 1934, and assigned to the same assignee as the present invention. A preferred example described in that application comprises an alloy of 54 per cent iron, 28 per cent nickel, and 18 per cent cobalt which is shown to have expansion characteristics almost identical with those of a standard hard glass. (Corning G–71).

In the assembled relationship above set forth the tube parts are next placed between welding electrodes such as are illustrated in Fig. 5. Referring more particularly to this figure, I have shown a stationary electrode part which may suitably comprise a heavy copper base 18 having a welding tip 19 of a highly conductive wear-resisting alloy. The tip 19 includes an upwardly projecting centering portion 20 which with the interposition of an insulating fiber cylinder 21 fits snugly inside the flanged tubulation 16. A corresponding electrode part 22 fits down over the outer surface of the tubulation into pressure contact with the cylinder above the embossed portion thereof. With the various parts in the positions illustrated a surge of high amperage alternating current from a suitable source (not shown) is passed between the electrode parts 19 and 22. The duration of the welding impulse is extremely short, covering no more than a few cycles of current reversal, so that burning of the metal is substantially avoided. However, due to its high current density and the extremely restricted contact which exists between the ridge 15 and the flange 17 sufficient heat is generated to insure a practically perfect fusion weld.

Fig. 6 illustrates a complete electrode assembly utilizing a sealed joint of the type which I have just described. It will be seen that the flange 17 has been pressed into good sealing contact with the raised surface of the ridge 15. After the operations set forth, a sufficient degree of fusion is found to exist between the contacting surfaces to provide a seal which is vacuum-tight under the most severe conditions. The outwardly projecting portion of the tubulation 16 is hermetically closed at its end by a body of glass 23 which is in fused contact therewith. Passing through the glass plug and also fused thereto is a conducting lead 24 which supports at its end a grid or control electrode 4 symmetrically disposed with respect to the envelope wall and comprising a material such as graphite. The nature and appearance of a seal made in accordance with my invention may be realized by an inspection of this view and a comparison thereof with the corresponding elevation of Fig. 7. The latter illustrates the manner in which the annular ridge 15 completely surrounds the central portion of the flattened wall section and the aperture 11 formed therein. The other elements shown are numbered in accordance with the designations adopted in connection with Fig. 6.

It is alternatively possible, and my invention contemplates, that the embossed ridge may be formed on the surface of the tubulation flange rather than on the flattened area surrounding the aperture 11. In this modification, as in that previously described, a vacuum-tight line contact may be formed by passing welding current between the raised ridge surface and the abutting face of the flattened wall portion.

It will also be apparent that the order of procedure outlined above may be variously modified without essential departure from the spirit of my invention. For example, it is possible to combine the steps of flattening and embossing the wall surface into a single operation. Furthermore, while I have shown a particular structural embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto since many modifications in the shape and proportions of the various parts may be made. I, therefore, contemplate by the appended claims to cover all such equivalent modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. A sealed joint for a metal envelope having a curvilinear wall, comprising a flattened surface on said wall having an aperture therein, a metal tubulation projecting through said aperture and having a flanged surface thereon abutting the said flattened surface of said wall, one of said surfaces having a continuous ridge thereon welded in continuous line contact with said other of said surfaces around said aperture.

2. A sealed joint for a cylindrical metal envelope comprising a continuous ridge projecting from the surface of said envelope and surrounding an aperture in such surface, and a metal tubulation projecting through said aperture having a flange welded in continuous contact with said ridge.

3. A sealed joint for a metal envelope having a curvilinear wall surface, comprising a flattened area on said surface having an aperture therein, a continuous ridge projecting inwardly from said surface and surrounding said aperture, and a metal tubulation projecting through said aperture having a flange welded in continuous contact with said ridge.

4. The method of sealing a flanged metal tubulation to a curvilinear metal envelope wall which comprises flattening a portion of said wall, forming an aperture in said flattened portion, raising an annular ridge on the flattened surface surrounding said aperture, threading said tubulation through said aperture to bring the tubulation flange into continuous contact with said ridge, and passing a heating current through said contact to cause welding of said flange and said ridge.

5. The method of sealing a flanged metal tubulation to a curvilinear metal envelope wall which comprises flattening a portion of said wall and forming an aperture in said flattened portion, raising an annular ridge on the flange of said tubulation, threading said tubulation through said aperture to bring said ridge into continuous contact with said flattened wall portion around said aperture, and passing a heating current through said contact to cause welding of said wall and ridge.

WILLIAM H. TEARE.