Aug. 11, 1942. J. E. BEGGS 2,292,863

LEAD-IN ARRANGEMENT

Filed Aug. 26, 1941

Fig. 1.

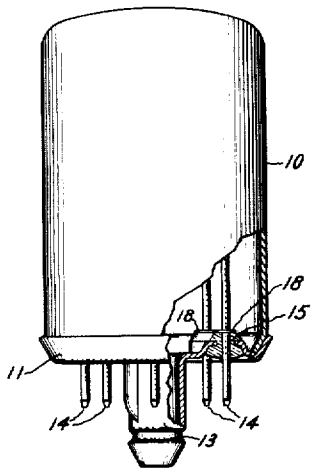


Fig. 2.

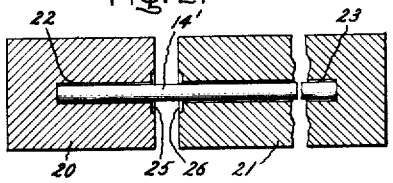


Fig. 3.

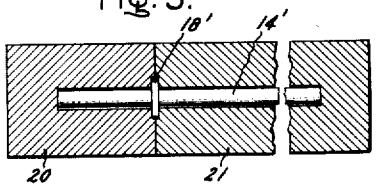


Fig. 4.

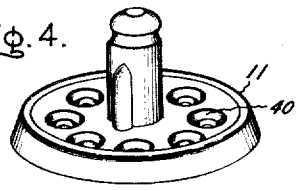


Fig. 5.

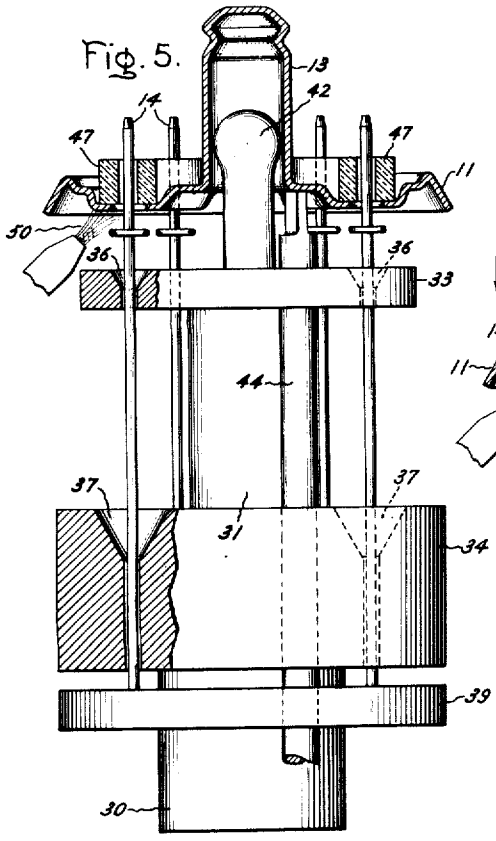


Fig. 6.

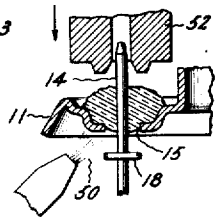


Fig. 7.

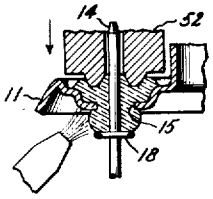


Fig. 8.

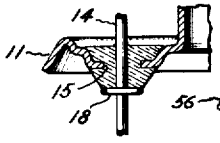
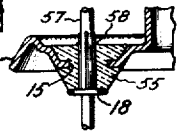


Fig. 9.



Inventor:
James E. Beggs,
by Harry E. Dunham
His Attorney.

Patented Aug. 11, 1942 2,292,863

UNITED STATES PATENT OFFICE

2,292,863

LEAD-IN ARRANGEMENT

James E. Beggs, Scotia, N. Y., assignor to General Electric Company, a corporation of New York

Application August 26, 1941, Serial No. 408,315

5 Claims. (Cl. 250—27.5)

The present invention relates to an improved arrangement for sealing a lead-in conductor through a metallic wall member. While not limited thereto, the invention is especially applicable in connection with metal-enclosed electrical discharge devices, such as metal vacuum tubes.

It is a primary object of the invention to provide an easily fabricated lead-in construction which is especially characterized by its ability to withstand mechanical and thermal shock.

In a typical embodiment the invention makes use of the combination of a bead of glass and a metal conductor sealed through the glass, the conductor being provided with an integral enlargement (e. g. a flange) which is in intimate contact with the glass at the region of its conjunction with the conductor. This is found not only to impart good mechanical strength to the resulting seal but also to equalize temperature gradients in the glass due to heat flow along the conductor, thus minimizing the likelihood of fracture of the seal due to thermally generated strains.

The features which I desire to protect herein are pointed out in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the drawing in which Fig. 1 represents a metal vacuum tube suitably embodying the invention; Figs. 2 and 3 illustrate steps in the process of preparing an individual lead-in conductor for incorporation in such a tube; Fig. 4 is a perspective view of one part of the tube envelope; Figs. 5, 6 and 7 show various steps in the process of combining a lead-in conductor with a metal wall part such as that shown in Fig. 4; Fig. 8 shows a complete lead-in arrangement according to the invention; and Fig. 9 shows an alternative embodiment of the invention.

Referring particularly to Fig. 1, there is shown a metal-enclosed vacuum tube comprising a cylindrical shell 10 which is closed at its lower end by means of a circular header 11 peripherally joined to the shell, as by soldering thereto. The shell 10 and the header 11 may be suitably constituted of iron (cold-rolled steel), and the header is provided with a protuberance 13 which serves as a guide for locating the tube in an appropriate socket. For energizing the enclosed electrode structure (not shown) there are provided relatively rigid lead-in conductors 14 which project through various openings 15 punched or otherwise formed in the header. These conductors are shaped at their outer extremities to serve as contact pins for insertion in a cooperating socket and are inwardly connected to the electrode structure. Each lead-in conductor is supported in insulatingly spaced relation with respect to the header by means of a mass of fusible vitreous material (typically glass) which also constitutes a seal for the associated header opening.

For reasons to be shortly explained each of the lead-in conductors is provided with an integral flange 18 which abuts the surface of the glass component of the associated seal at the region of conjunction of the glass and the lead-in conductor. A flange of the desired character may be provided in one way by a procedure such as that shown in Figs. 2 and 3 of the drawing. As is indicated in the first of these figures, a smooth metal (iron) wire or rod 14' is positioned in a pair of suitably recessed blocks 20 and 21 which are relatively movable and which contain openings 22 and 23 of such depth as to receive all but a small portion of the wire 14'. By the application of suitable pressure the blocks 20 and 21 are forced together as indicated in Fig. 3 and the surplus metal of the wire 14' is caused to flow outwardly, being received in circular indentations 25 and 26 provided in the opposed faces of the blocks. This procedure is generally known as "upsetting" and the resultant flange 18' formed on the wire 14' is conveniently designated as an "upset flange."

In applying conductors formed in the manner described above as lead-in wires for an enclosed electric discharge tube, a number of such wires may be positioned in a suitable jig in the manner indicated in Fig. 5. In this figure the parts 30 and 31 may be considered to represent a rigidly supported post forming a component of a seal-fabricating machine. This post supports in mutually spaced relation circular guide blocks 33 and 34 having aligned recesses 36 and 37 which are adapted to receive lead-in wires introduced from above. A further circular member 39 forms a solid rest for the lower extremities of conductors held in the guide blocks.

After the desired number of lead-in conductors are placed in the assembly apparatus, a metal header 11 (shown in perspective in Fig. 4) is brought down over the upper extremities of the conductors so that the conductors lie in appropriately positioned apertures 15 formed in the header surface. In order to impart good mechanical strength to the seal arrangement eventually to be formed in connection with the header, each of the holes 15 is associated with

a circular depression formed by deformation of the header metal, these depressions being indicated at 40 in Fig. 4. Accurate location of the header in the assembly apparatus is facilitated by the provision of a locating lug 42 adapted to interfit with the protuberance 13 appended to the surface of the header. The header is held at the correct elevation with respect to the lead-in conductors by means of appropriately positioned support rods adapted to abut the lower surface of the header, one of these rods being shown at 44 in Fig. 5.

With the header and lead-in conductors in the assembly shown, cylindrical glass beads 47 are dropped over the upwardly projecting ends of the various conductors so that the beads come to rest in the depressions respectively associated with the various header openings. Assuming the header and the lead-in conductors to be constituted of iron, the glass beads 47 may advantageously be made of a lead glass having a theoretical oxide composition consisting approximately of 45% SiO_2, 12% K_2O, 6% Na_2O, 32% PbO and 5% CaF_2. (Other suitable glasses are described in Patent No. 2,272,747, granted February 10, 1942, in the name of A. W. Hull and Louis Navias.) The particular glass specified has been found to match very closely the expansion characteristics of iron and to be well adapted for sealing to this metal. In order to improve the adherence of the glass and metal it may be desirable in some cases to provide both the header 11 and the lead-in conductors 14 with a plating of copper as a preliminary to the assembly operation illustrated in Fig. 5.

After assembly in the manner indicated, glass beads 47 may be reduced to a fused condition, for example by the application of a frame as indicated at 50. When the glass has softened, a portion of each bead may be extruded through the associated opening 15 by means of a plunger 52 forced downwardly in the manner indicated in Figs. 6 and 7. If the motion of the plunger 52 is appropriately guided and limited, the portion of the glass extruded through the opening may be caused to flow into sealing contact with the surface of the associated conductor flange 18 (see Fig. 7) so that the flange forms a seal with the glass at the region of its conjunction with the conductor. Finally, by withdrawing the plunger 52 and applying further heat the glass may be caused to flow sufficiently to assume the smooth contour shown in Fig. 8. In this figure, which represents the finished condition of the seal after cooling, it will be seen that a portion of the glass evenly fills the shallow depression surrounding the opening 15 while the remaining portion constitutes a tapering mound adhering to the lower side of the floor of the depression and extending into contact with the surface of the flange 18.

Seals having the form described in the foregoing are found to be characterized by a degree of mechanical strength sufficient to avoid cracking by strains imposed on them as a result of the use of the externally projecting parts of the lead-in conductors as contact pins. In addition, the seals are found to be unusually free from cracking resulting from strains attributable to thermal causes. This is due to the fact that the presence of the flanges 18 tends to prevent the occurrence of sharp temperature gradients at the boundary between the glass and lead-in conductors and to assure a more uniform distribution of heat flow through the various parts of the seal structure. This effect is particularly advantageous in a construction such as that shown in Fig. 1 wherein heat flow tends to occur from the electrode structures downwardly into the seals through the various lead-in conductors.

In Fig. 9 there is shown a modification of the invention which still further enhances the useful effects noted in the foregoing. In this case, as in that previously described, the seal comprises a body of glass 55 sealed in an opening provided in a metal header 56 and insulatingly supporting a wire-like conductor 57.

The seal construction of Fig. 9 is specifically claimed in my copending application Serial No. 438,559, filed April 11, 1942 and assigned to the General Electric Company. However, in this instance the embedded portion of the lead-in conductor is of fluted or ribbed character as indicated at 58, this being a feature which not only adds to the mechanical strength of the seal but also still further improves its resistance to thermal shock. Still other forms of enlargement, generally related to fluting, may be employed alternatively for increasing the surface of the lead-in conductor in relation to its mass in the region of the seal, thereby to provide better heat transfer between the glass and the conductor.

It will be understood that all the procedural steps which have been outlined in the foregoing may be carried out on a step-by-step machine of known type wherein the various operations are accomplished sequentially at successive stations. After the header and lead-in conductors are assembled in permanent relation in the manner specified, the electrode structure may be mounted on the lead-in conductors and connected thereto, and the header may be joined to the remainder of the discharge envelope by an appropriate means. In accordance with one method this is done by tinning the header and thereafter soldering it to the envelope shell.

While I have described the invention by reference to a particular application of it, it will be understood that it is capable of use in connection with various enclosed electrical devices other than electric discharge devices such as metal-enclosed capacitors and the like. I aim in the appended claims to cover all variations of structure or use which come within the true spirit and scope of the foregoing disclosure.

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

1. In an electrical device which comprises an enclosing metal wall part having a small opening therein, the combination which includes a bead of glass fused in the said opening, a lead-in conductor extending through the bead and sealed to its constituent glass, and a flange formed on the conductor and fused to the surface of the glass bead at the point of conjunction of the bead and the conductor, said flange serving to equalize temperature gradients produced in the glass by heat flow through the conductor.

2. In an electrical discharge device, an envelope enclosing electrode structure and having a metal wall part with a restricted opening therein, a bead of glass fused in place in the said opening and having a portion thereof projecting into the envelope enclosure, a lead-in conductor sealed through the said glass bead and connected to the said electrode structure, and an integral flange formed on the conductor and sealed to the surface of the said internally projecting portion of the bead at the region of conjunction of the bead and the conductor.

3. In an electrical discharge device, an envelope enclosing electrode structure, a metal header

closing one end of the envelope and having a plurality of small openings therein, glass beads respectively fused in the said openings and extending partially within the envelope enclosure, conductors sealed through the various glass beads and connected within the envelope enclosure to the said electrode structure, and upset flanges formed on the various conductors and respectively sealed to the inwardly projecting portions of the glass beads at the regions of conjunction of the beads with the conductors, said flanges serving to equalize the temperature gradients within the glass beads produced by heat flow from the electrode structure through the lead-in conductors.

4. In an electrical device, an envelope enclosing energy-converting means and having a metal wall part with a restricted opening therein, a bead of glass sealed in the said opening and having a portion thereof projecting within the envelope enclosure, a lead-in conductor sealed through the glass bead and connected to the said energy-converting means, and a flange formed on the said conductor and sealed to the said inwardly projecting portion of the glass bead at the region of its conjunction with the conductor, said flange serving to equalize the temperature gradients produced within the glass bead by heat flow from the energy-converting means through the conductor.

5. In an electrical device, an envelope enclosing energy-converting means, a body of glass forming a portion of the wall structure of the said envelope, a lead-in conductor sealed through the glass and connected to the said energy-converting means, and a flange on said conductor and sealed to the inwardly directed surface of the glass body at the region of its conjunction with the conductor, said flange serving to equalize the temperature gradients produced within the glass body by heat flowing from the energy-converting means through the conductor.

JAMES E. BEGGS.

CERTIFICATE OF CORRECTION.

Patent No. 2,292,863. August 11, 1942.

JAMES E. BEGGS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 55, claim 1, after "sealed" insert --directly--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of September, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.