

Oct. 20, 1953

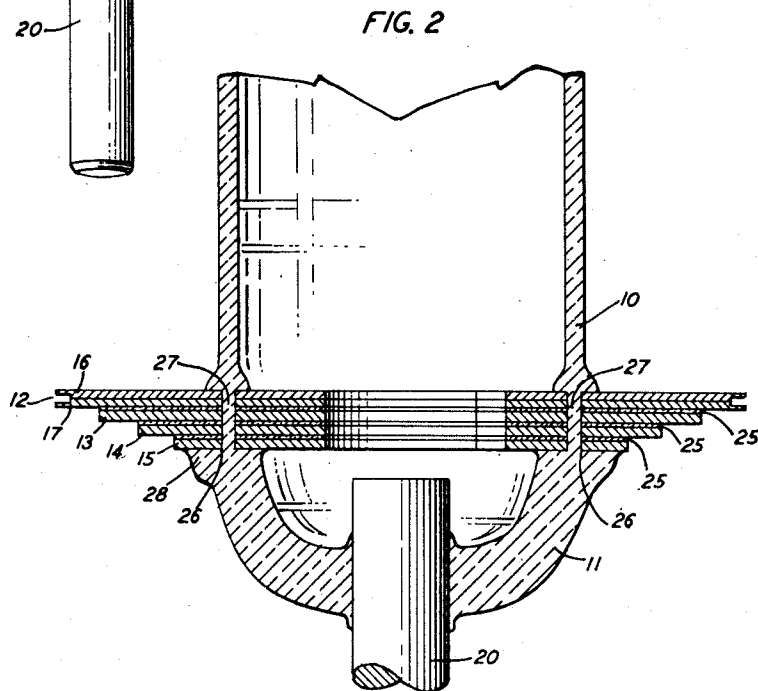
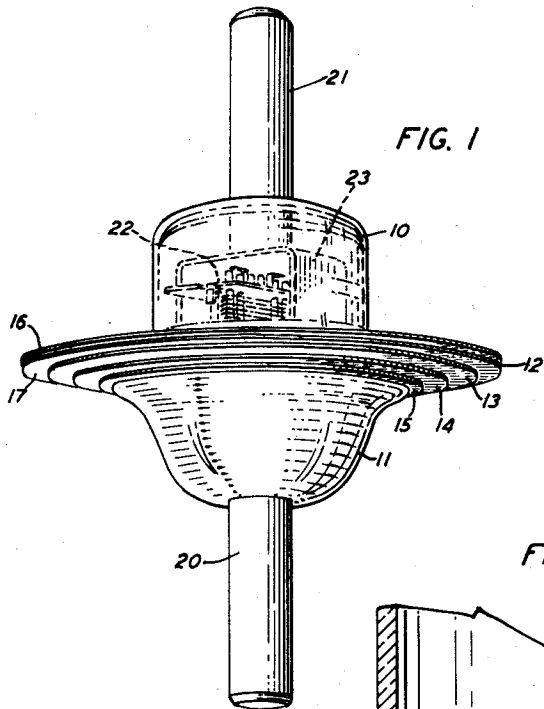
E. J. WALSH

2,656,404

LAMINATED RING LEAD-IN FOR ELECTRON DISCHARGE DEVICES

Filed Dec. 1, 1950

2 Sheets-Sheet 1



INVENTOR
E. J. WALSH
BY *[Signature]*
ATTORNEY

Oct. 20, 1953

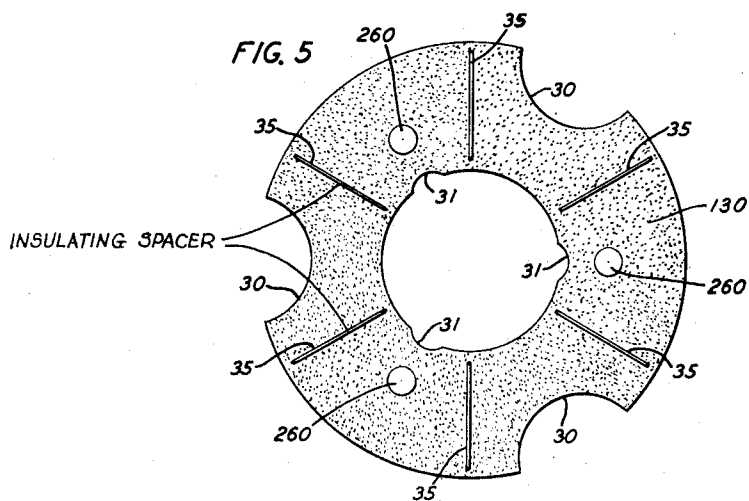
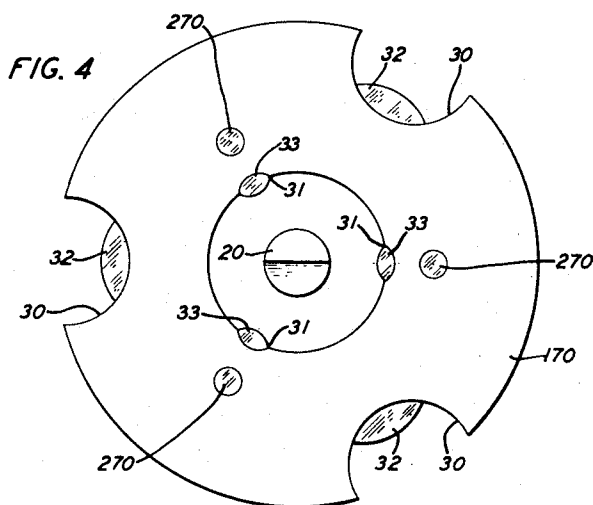
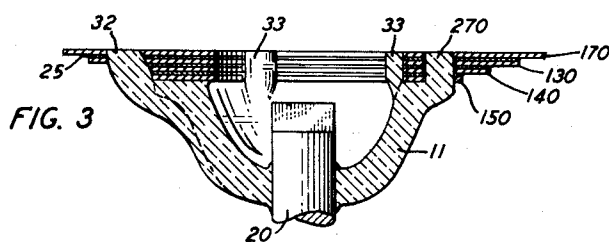
E. J. WALSH

2,656,404

LAMINATED RING LEAD-IN FOR ELECTRON DISCHARGE DEVICES

Filed Dec. 1, 1950

2 Sheets-Sheet 2



INVENTOR
E. J. WALSH
BY
[Signature]
ATTORNEY

UNITED STATES PATENT OFFICE

2,656,404

LAMINATED RING LEAD-IN FOR ELECTRON
DISCHARGE DEVICESEdward J. Walsh, Morristown, N. J., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

Application December 1, 1950, Serial No. 198,597

10 Claims. (Cl. 174—50.63)

1

This invention relates to electron discharge devices and more particularly to envelopes therefor and methods of fabricating such envelopes.

An envelope for an electron discharge device comprising a plurality of closely spaced discs extending through the envelope and forming a portion thereof is disclosed in the copending application of G. T. Ford and E. J. Walsh, Serial No. 198,598, filed December 1, 1950, now Patent 2,634,384. As there more fully described, in such an envelope the discs provide low inductance lead-in terminals for the internal elements of the device, to which they may be electrically connected, and the discs also define by-pass capacitances between these elements. The discs are advantageously separated from each other by a thin layer of a vitreous material, such as glass, which both is the dielectric of a capacitance and seals the discs together. Because of the thinness of this vitreous layer, which may be of the order of mils or even of a fraction of a mil, warping or shrinkage during the sealing process may tend to weaken the bond formed thereby, at a later time allowing even a small shock to fracture the bond.

It is one object of this invention to strengthen the seals between closely spaced discs forming a portion of the envelope of an electron discharge and separated by a thin layer of a vitreous material.

Additionally in such cases where the by-pass capacitances defined by the closely spaced lead-in disc terminals extending through the envelope and forming a portion thereof are to be accurately determined, difficulty arises because of variations in the thickness of the thin vitreous layer during the sealing of the discs together by means of this thin layer. To control the capacitance thus defined the spacing between the discs must be closely controlled.

Prior methods of controlling the spacing between discs which are distant from each other and extend through the envelope of an electron discharge device, such as using external jiggling or spacers removable after the seals are made, have certain inherent disadvantages that deter their use in devices of this type.

Another object of this invention, therefore, is to determine the spacing between adjacent discs which are sealed together by a thin vitreous layer interposed between the discs.

A further object of this invention is to determine the by-pass capacitance between two disc-shaped lead-in terminals of an electron discharge device.

2

Still another object of this invention is to facilitate the manufacture of envelopes of the type noted above for electron discharge devices.

In specific illustrative embodiments of this invention, the bonds formed between adjacent discs by the interposed thin layers of a dielectric sealing material are strengthened by reinforcing rods or ribs extending through each of the discs and between the upper and lower stem portions adjacent the top and bottom discs respectively. More specifically, the reinforcing rods may be rods of a vitreous material, such as a glass of the same character as the glass forming the stem, and they may extend through the discs. Or the rods may be positioned in cut-out portions in either the inner or outer peripheries of the discs.

In one specific embodiment of this invention, spacers are also placed between the discs in the thin layer of vitreous material interposed between the discs to determine the spacing between the discs. These spacers may be in the form of small lengths positioned radially in the glaze or other vitreous material sprayed or coated on one of the discs during the sealing operation, the spacers being of a material having thermal expansion characteristics compatible with those of the glaze or other vitreous material. The spacers are also of an insulating material and have a higher melting point than the vitreous material so that they will be undisturbed by the sealing operations and subsequently remain in the thin layer interposed between the discs.

It is therefore one feature of this invention that seals between closely spaced discs in an electron discharge device envelope be strengthened by having extending therethrough a reinforcing member or rod of a vitreous material. More specifically, in accordance with this feature of this invention, the reinforcing rod may be of the same material as the vitreous stem portions to which the discs are sealed. These reinforcing rods may extend through the discs centrally or be in cut-out portions in the inner or outer peripheries of the discs.

It is a further feature of this invention that spacers are interposed between the discs to accurately determine the spacing between the discs, the spacers being of an insulating material having a higher melting temperature than the vitreous material sealed between the discs and having thermal expansion characteristics compatible with that material.

A complete understanding of this invention and of these and other features thereof may be

gained from consideration of the following detailed description and the accompanying drawings, in which:

Fig. 1 is a perspective view of an electron discharge device embodying this invention;

Fig. 2 is a sectional view of an envelope employable with the electron discharge device of Fig. 1;

Fig. 3 is a sectional view of a portion of another envelope employable with the electron discharge device of Fig. 1;

Fig. 4 is a plan view of the envelope portion of Fig. 3; and

Fig. 5 is a plan view of one of the discs of the envelope portion of Fig. 3 prior to the sealing of the next adjacent disc thereto.

Referring now to the drawing, Fig. 1 shows an electron discharge device of the type described in the above-mentioned application which comprises an upper stem or bulb portion 10, a lower stem or bulb portion 11, and a plurality of discs 12, 13, 14 and 15 situated between the two stem portions 10 and 11. The uppermost disc 12 advantageously comprises two sections 16 and 17. The discs are also advantageously of different diameters, the diameter increasing progressively from the bottom disc 15 adjacent the lower bulb portion 11 to the uppermost disc 12 adjacent the upper bulb portion 10, for facility in mounting in a cooperating socket which makes electrical connection to each of the discs, though the discs may also be all of the same diameter.

An electrode terminal pin or post 20 extends centrally through the lower glass portion 11 of the envelope and an anode terminal pin or post 21 extends through the upper glass portion 10. Within the envelope thus defined by the bulb portions and the discs is mounted an electrode assembly 22, as described in the above-mentioned application, and a U-shaped anode 23 attached to the anode terminal pin 21 and encompassing the electrode assembly 22.

Referring now to Fig. 2, there is shown in section one envelope incorporable in the device of Fig. 1, in accordance with this invention, during the fabrication thereof. As seen in Fig. 2, a thin layer of a vitreous material 25, such as a glass powder or glaze is sealed between each adjacent pair of the concentrically aligned discs 12, 13, 14 and 15. This thin layer 25 may advantageously be of the order of a few mils or even of a fraction of a mil. Each of the discs 12 through 15 has a plurality of apertures 26, such as four, therein, which apertures on one disc are in axial alignment with those on the other discs. A glass cane or rod 27 extends through these apertures. This cane 27 is sealed at its ends to each of the bulb portions 10 and 11 and is also sealed intermediately to the various interposed vitreous layers 25. The canes 27 thus serve to additionally bond all the discs together and to further strengthen the seals between them and between them and the bulb portions.

The envelope of Fig. 2 may be advantageously assembled in the following manner. The lower bulb portion 11 is formed with terminal pin 20 sealed therethrough and a flat circular upper end 28. The discs 12, 13, 14 and 15 are positioned on top of each other with the apertures 26 aligned and a powdered glass sprayed or coated on each surface of the discs. The canes or rods 27 are then placed in the aligned apertures 26; the canes or rods 27 are advantageously solid though a glass powder placed in the aligned apertures may be employed. The discs are fired, as in an oven,

to fuse the glass powder to the discs, as the thin layer 25, and to fuse the glass powder and the discs to the rods 27. The assembly including the sealed discs and the rods 27, which slightly extend beyond the surfaces of the end discs, is then positioned between the surface 28 of the lower bulb portion 11 and the upper bulb portion 10, placed in an oven, and heated to fuse the surface 28 to the lower disc 15 and the rods 27 and the bulb portion 10 to the upper disc 12 and the rods 27. A slight pressure may advantageously be exerted on the bulb portions towards each other during this sealing operation. Additionally the discs 12 and 15 may also have a glaze thereon adjacent their respective bulb portions to facilitate the sealing thereto.

As seen in Fig. 2, the upper bulb portion 10 may advantageously not be closed at its top and subsequently sealed to the anode terminal 21. However, because of the upper disc 12 being in two sections, 16 and 17, another advantageous method of forming the envelope of the device may be employed. Specifically, the upper bulb portion 10 may be formed with the anode terminal pin 21 extending centrally therethrough and the upper section 16 of the disc 12 be sealed in a separate operation to the disc portion 17. The lower section 17 and discs 13, 14 and 15 may be sealed to the lower bulb portion 11 and the rods 27 as stated above, or the discs may be pre-glazed prior to being sealed together. The internal electrode assembly 22 may then be mounted within the lower bulb portion, as described in the above-mentioned application, and the envelope sealed by securing the two sections 16 and 17 of the disc 12 together, as by brazing. However, whichever advantageous method of assembly is employed the canes or ribs 27 extending, in the completed envelope, between the bulb portions and through the discs and interposed glass layers 25 considerably strengthen the seals between the closely spaced discs.

In one specific illustrative embodiment of this invention in accordance with Fig. 2, the canes 27, glaze layer 25, and bulb portions 10 and 11 were each of Corning 7052 glass, which is a glass having the following approximate composition, by parts: silica 68.0, alumina 8.1, sodium oxide 1.9, barium oxide 2.4, lithium oxide 8.5, and boron oxide 15.2, and the discs were of molybdenum, though Kovar, an iron-nickel-cobalt alloy, also matches the characteristics of this particular glass, and the discs were spaced from each other about .006 inch.

Referring now to Figs. 3, 4 and 5, there is shown a lower bulb portion 11 and discs 130, 140, and 150 and section 170, illustrative of another specific embodiment of this invention that can be incorporated in the device of Fig. 1. Each of the discs 130, 140, 150 and disc section 170 has therein, in addition to the apertures 260, semicircular cut-out portions 30 and 31 in the outer and inner peripheries of the discs, respectively. The central rods 270 extend through the apertures 260 while external ribs 32 are sealed to the discs and interposed glass layers 25 in the outer cut-out portions 30 and internal ribs 33 in the inner cut-out portions 31. The ribs need not be of even cross section but are advantageously of the same material as the bulb portions and serve to bond the discs and the bulb portions together.

While central rods or canes 270 and internal and external ribs 32 and 30 are all disclosed as being employed in the embodiment of Figs. 3 and 4, it is to be understood that any of them may

5

be employed singly in accordance with this invention to strengthen the bonds between the discs.

Referring now to Fig. 5 there is shown the upper surface of the disc 130 of the embodiment of Fig. 3 prior to the sealing to it of the section 170 of the disc 12. As there seen, a plurality of spacers 35 are positioned radially on the disc in the glaze 25 which has been sprayed or otherwise positioned on the surface of the disc. These spacers 35 are of a material, such as ceramic fibres including, in certain instances, quartz fibres, having a coefficient of expansion compatible with that of the glaze 25, a higher melting temperature, and are insulating so that adjacent discs are not short-circuited. The underside of the disc 170 is also sprayed or otherwise coated with the glaze 25. When the discs are then heated and the glaze melted, the spacers 35 remain undistorted and produce the definite and accurate separation or spacing desired between the discs.

While the spacers 35 have been shown as thin rods extending radially along the discs, they are not limited to such a shape but may be of other configurations, such as rings, etc. Similarly, the spacers between different discs need not be of the same width as the by-pass capacitance desired between different discs, and thus between different internal elements of the device, can be of any desired value.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Various other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An envelope for an electron discharge device comprising a pair of vitreous wall portions, a plurality of conducting members seriatly positioned between said wall portions and sealed thereto, insulating means between said members and sealing said members together, said members being spaced closely adjacent each other, and a vitreous member extending through said members and said insulating means, sealed thereto, and joined to said vitreous wall portions to strengthen the seals between said members.

2. An envelope for an electron discharge device comprising a pair of vitreous wall portions, a plurality of planar lead-in terminals seriatly positioned between said wall portions, the uppermost and lowermost of said terminals being sealed to said wall portions, a thin vitreous layer between said lead-interminals and sealing said terminals to each other, and a vitreous reinforcing member extending through said terminals and sealed to said terminals, vitreous layers, and wall portions to strengthen the seals between said terminals by said thin vitreous layers.

3. An envelope for an electron discharge device comprising a pair of glass bulb portions, a plurality of closely spaced disc-shaped lead-in terminals seriatly positioned between said bulb portions, each of said terminals having a plurality of apertures therein and the apertures in one of said terminals being aligned with the apertures in the remainder of said terminals, a thin layer of glass between said terminals and sealing said terminals to each other, and glass canes extending through said apertures and sealed to said terminals, said glass layers, and said bulb portions to strengthen the seals between said terminals by said thin glass layers.

6

4. An envelope for an electron discharge device in accordance with claim 3 wherein said apertures include cut-out portions in the periphery of said disc-shaped terminals and central apertures in said disc-shaped terminals and said glass canes are glass ribs extending in said cut-out portions and central apertures between said bulb portions.

5. An envelope for an electron discharge device comprising a plurality of closely spaced planar conductor members, a thin vitreous layer sealed between said members and separating said members, and rigid insulating spacer means positioned in said vitreous layer between said planar conducting members and determining the separation between said planar conducting members.

6. An envelope for an electron discharge device comprising a plurality of closely spaced planar conducting members, a thin glass layer sealed between said members and separating said members, and insulating spacer members positioned in said glass layer between said planar conducting members and determining the separation between said planar conducting members, said spacer members being of an insulating material having a higher melting temperature than said glass and thermal expansion characteristics compatible with those of said glass.

7. An envelope for an electron discharge device in accordance with claim 6 wherein said spacer members are of quartz fibres.

8. An envelope for an electron discharge device comprising a pair of glass bulb portions, a plurality of closely spaced planar lead-in terminals seriatly positioned between said bulb portions, the uppermost and lowermost of said terminals being sealed to said bulb portions, a thin glass layer sealed between said terminals and separating said terminals, and insulating spacers positioned in said glass layer between said terminals and determining the separation between said terminals, said spacer members being of an insulating material having a higher melting temperature than said glass layer and thermal expansion characteristics compatible with those of said glass, the spacing between said terminals being of the order of a few mills.

9. An envelope for an electron discharge device comprising a pair of glass bulb portions, a plurality of disc-shaped lead-in terminals seriatly positioned between said bulb portions, each of said terminals having a plurality of apertures therein and the apertures in one of said terminals being aligned with the apertures in the remainder of said terminals, the uppermost and lowermost of said terminals being sealed to said bulb portions, a thin layer of glass between said terminals and sealing said terminals together, the spacing between said terminals being of the order of a few mills, insulator spacing means positioned in said glass layer and determining said spacing, and glass rods extending through said apertures and sealed to said terminals, said glass layers, and said bulb portions to strengthen the seals between said terminals by said glass layers.

10. An envelope for an electron discharge device comprising a pair of glass bulb portions, a plurality of closely spaced disc-shaped lead-in terminals seriatly disposed between said bulb portions, each of said terminals having a plurality of apertures therein and the apertures in one of said terminals being aligned with the apertures in the remainder of said terminals, the uppermost and lowermost of said terminals being sealed to said bulb portions, a thin layer of glass

7

between said terminals and sealing said terminals together, the spacing between said terminals being of the order of a few mils, insulator spacer members positioned in said glass layer and determining said spacing, said spacer members being of an insulating material having a melting temperature higher than that of said glass layers and thermal expansion characteristics compatible with those of said glass layers, and glass rods extending through said apertures and sealed to said terminals, said glass layers, and said glass

8

bulb portions to strengthen the seals between said terminals by said thin glass layers.

EDWARD J. WALSH.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,562,533	Weintraub -----	Nov. 24, 1925
2,043,733	Brasch et al. -----	June 9, 1936
2,486,065	Saucet -----	Oct. 25, 1949