

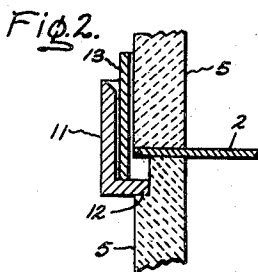
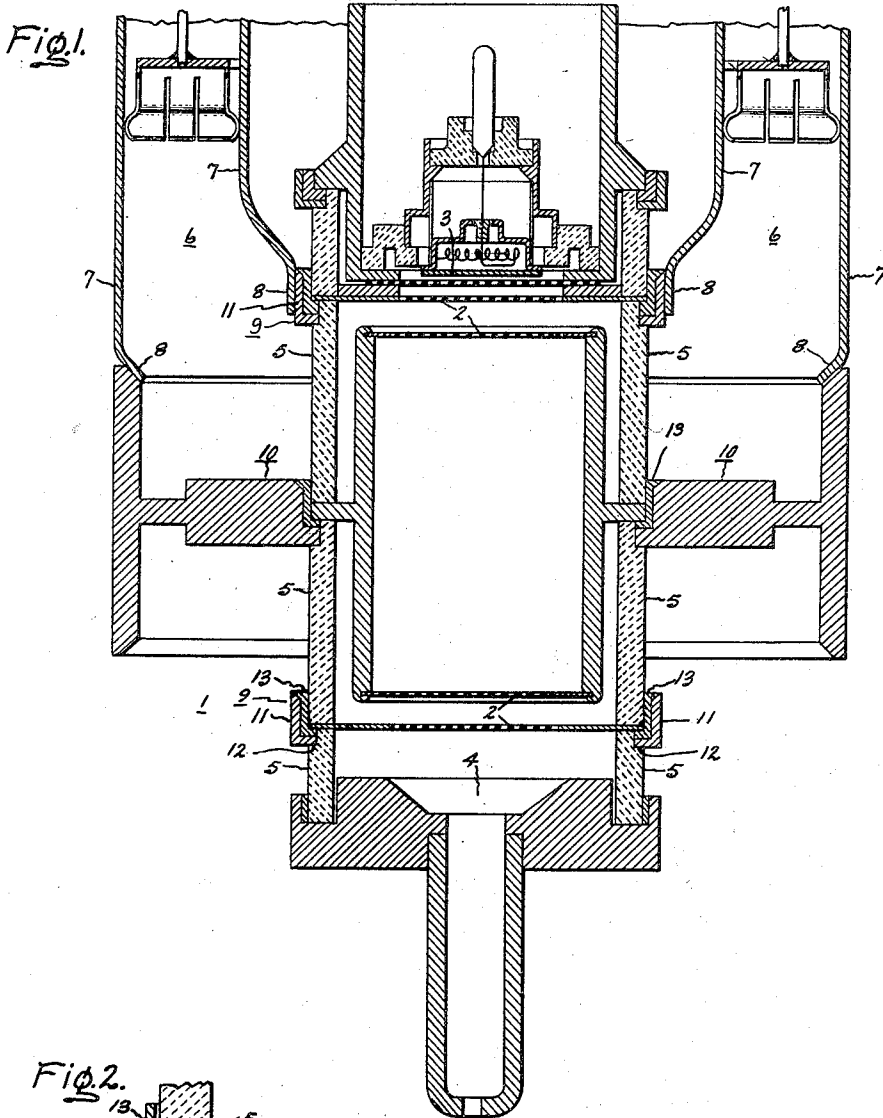
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2,773,570

COMBINED VACUUM SEAL AND ELECTRODE TERMINAL

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COMBINED VACUUM SEAL AND ELECTRODE TERMINAL

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2 Claims. (Cl. 189—36.5)

This invention relates to solder joint structures and has particular reference to vacuum seals for electron discharge devices.

A hermetic seal between two insulating tubes separated by a metal member is frequently required in high frequency electron discharge device construction where disk-shaped electrodes are spaced in parallel planes by tubular insulator envelope portions. In apparatus employing such devices, the exposed external peripheries of the electrodes are usually designed to be conductively engaged by resonator conductors and hence the seals between such disks and the tubular spacers must be mechanically strong.

It is a primary object of our invention to provide a simple and economic means for making a vacuum seal between two insulating tubes separated by a metal member.

It is another object of our invention to provide an improved solder seal for evacuated discharge devices which also serves as an external electrode terminal.

It is still another object of our invention to provide an improved vacuum seal for parallel plane discharge devices requiring a minimum of supporting fixtures during assembly.

Briefly, in accordance with an embodiment of our invention, an annular metallic trough member is positioned around the junction of two vertically stacked hollow insulating cylinders or tubes having a disk-shaped electrode spaced between them. The trough member surrounds the junction and has a bottom portion extending radially inward to rest on an external shoulder of the lower tubular insulator. The trough so formed is filled with solder which bonds and seals the tubular insulators to each other and also provides a conductive connection between the electrode and the trough member. In this way, the trough member thus serves in the soldered assembly as an external electrical terminal.

The features of the invention to be protected are pointed out in the appended claims. The invention itself, together with its further objects and advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawing, in which Fig. 1 is a cross-sectional view of an electron discharge device having electrode seals embodying the invention and Fig. 2 is an enlarged view of one of the seal assemblies prior to melting of the solder.

Fig. 1 illustrates an electron discharge device of a type profitably employing vacuum seals constructed according to our invention. This device 1 has a plurality of disk-shaped electrodes 2 spaced in a series of parallel planes across the electron discharge path between its cathode 3 and anode 4. Each of the electrodes 2 is electron permeable, suitably having a number of fine tungsten wires positioned in parallel and brazed to a tungsten washer or annular disk which constitutes the peripheral or terminal portion of the electrode. Some of the electrodes 2 are spaced by tubular envelope portions 5 having substantially the same diameter as the

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electrodes and suitably made of a ceramic or other insulating material. In order to provide high frequency circuit connections, concentric line resonators are coupled to the various electrodes at their external peripheries. One such resonator 6 is shown in Fig. 1. Each of the resonator conductors comprises a hollow tubular conductor 7 having spring fingers 8 at the end thereof for engaging the external terminal electrodes. In this way, the periphery of an electrode 2 can be brought into contact with a hollow conductor member 7 and electrode lead length minimized.

Not all of the resonator connections for the particular device illustrated in Fig. 1 are shown in the drawing for the sake of simplicity. The particular device illustrated incorporates a dual space charge modulation and velocity modulation means as described and claimed in a copending application, Serial No. 345,112, filed March 27, 1953, and assigned to the assignee of the present invention. The problems encountered so far as the electrode seals are concerned are typical of those in disk-seal tubes except in so far as the difficulties are multiplied by the multiplicity of grid electrodes 2.

Two such combined seals and electrode terminals incorporating our invention are illustrated at 9 in Fig. 1. A similar seal 10 is also shown in which the external contact surface is extended to meet the requirements of a particular apparatus. In each of these seals a pair of hollow cylindrical ceramic envelope members 5 are vertically stacked with the metal annulus or washer representing the periphery of one or more electrodes 2 positioned between them.

Referring now particularly to one of these seals as an example, a seal corresponding to that shown at 9 is illustrated in Fig. 2 before the solder is melted. A trough defining metal ring 11, which also serves as the external terminal surface, is positioned around the junction of the envelope members 5 and the electrode washer with its vertical side wall slightly spaced from the surface of the assembly. The trough member 11 has a bottom wall integral with the side or vertical wall which extends inwardly from the side wall to engage the lower envelope member 5 in a region somewhat below the junction to be sealed. In order to position the trough member without the aid of supporting jigs, the lower envelope member 5 is provided with an external shoulder 12, preferably defined by cutting down or rabbetting the upper portion of the outside surface of the envelope member. With the terminal ring 11 in place, a circular trough surrounding the envelope is thus defined, one wall of the trough being that portion of the device structure including the portions which are to be sealed.

Since it is preferable in most cases to provide the cylindrical envelope members 5 with the same thickness and diameter, the effect of cutting away part of the lower cylinder 5 to provide a shoulder also widens the bottom portion of the trough. This permits the trough to hold more molten solder and also exposes a portion of the lower side of the periphery of the electrode 2 to the solder. At the same time, since the upper part of the trough has a narrow width, the effect of surface tension of molten solder is more readily overcome, the solder tending to flow around into all parts of the trough due to capillary action rather than to remain concentrated in one portion of the trough due to the effect of surface tension.

Still referring to Fig. 2, a strip of solder 13 is formed around the junction to define a ring loosely fitting within the solder trough. Various solders may be employed but a soft solder such as lead is preferred because of its ability to yield without breaking the seal when stresses result from the different coefficients of expansion of the metal and insulating members of the seal. In order to

provide enough solder to fill or almost fill the trough, the height of the solder ring 13 is preferably greater than the trough depth. The inside upper edge of the trough defining terminal 11 is preferably beveled in order to help funnel the solder into the trough as the solder is melted. Before melting of the solder, however, the ceramic surfaces of the envelope members 5 must first be prepared. While various means may be utilized, such as first metallizing the surfaces so that they will be wet by the solder, the titanium hydride process is found especially useful and practicable. In this method, the surfaces of the ceramic or other insulating material to be soldered are sprayed or otherwise coated with a flux or wetting agent such as titanium hydride. When the assembly is placed in a vacuum and heated, the solder is melted and retained in place by the trough defining member 11. When the flux becomes active, the solder wets the insulating surface as well as the metal surfaces of the trough defining member 11 and the electrode periphery 2. Upon cooling a firm bond is thus obtained between the upper and lower insulators 5 through means of the solidified solder in the trough and at the same time the solder furnishes a conductive connection between the periphery of the electrode disk 2 and the trough defining member 11. Means for bonding with titanium hydride are disclosed and claimed in U. S. Letters Patent 2,570,248, issued October 9, 1951, to Floyd C. Kelley and assigned to the assignee of the present application and in an application, Serial No. 36,244, filed June 30, 1948, by Ralph G. Bondley, now abandoned, and also assigned to the assignee of the present invention. It is obvious that the solder itself may be applied in various forms without departing from the spirit of our invention.

The completed bonds shown at 9 and 10 in the discharge device of Fig. 1 are illustrative of the application of our invention. In the seal 9, the annular terminal ring 11 is designed to be engaged by spring contact fingers of a resonator conductor. In the seal 10, the trough defining member has a radial conductive extension to facilitate connection of two larger hollow conductors thereto but its trough defining portion is the same.

While a particular embodiment of our invention has been shown and described, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the invention in its broader aspect and we aim, therefore, in the appended

claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. In an electron discharge device a first cylindrical insulator, a disk-shaped electrode, and a second cylindrical insulator co-axially stacked in that order, said second insulator being indented adjacent said electrode to provide an annular shoulder spaced axially from said electrode, an integral trough forming member supported on said shoulder and having an annular part in contact with said shoulder and a cylindrical part surrounding and spaced from adjacent peripheral portions of said insulators and said electrode to provide a solder trough therewith and a body of solder in said trough bonding said insulators, said electrode, and said member together to provide a combined vacuum seal and electrode terminal for said device.

2. In an electron discharge device a first cylindrical insulator, a disk-shaped electrode, and a second cylindrical insulator all three having substantially the same outside diameter and being co-axially stacked in that order, said second insulator being indented adjacent said electrode to provide an annular shoulder spaced axially from said electrode, an integral trough forming member supported on said shoulder and having an annular part in contact with said shoulder and a cylindrical part surrounding and spaced from adjacent peripheral portions of said insulators and said electrode to provide a solder trough therewith, said peripheral portions being conditioned to be wet by molten solder, and a unitary body of solder in said trough bonding said insulators, said electrode, and said member together to provide a combined vacuum seal and electrode terminal for said device.

References Cited in the file of this patent

UNITED STATES PATENTS

1,866,857	Lindquist	July 12, 1932
2,129,892	Vatter	Sept. 13, 1938
2,396,320	Guadenzo et al.	Mar. 12, 1946
2,411,656	Henderson et al.	Nov. 26, 1946
2,446,017	McArthur et al.	July 27, 1948
2,623,090	Böhlke et al.	Dec. 23, 1952