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ELECTRIC DISCHARGE DEVICE ELECTRODE CONNECTION

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The present invention relates to electric discharge devices and pertains more particularly to an improved electric discharge device including improved means for making electrical connections to the cathode filament leads thereof and better adapting the device for withstanding substantial shock and vibration.

Heretofore, failures of electric discharge devices have resulted from the inability of the cathode filament connections to withstand substantial shock and vibration. Such failures have occurred where, for example, the filament leads have become disconnected by fatigue from the members by which the filament circuit is made through the envelope wall. Often, also, the failures have occurred due to the relative freedom of the filament to vibrate or, in other words, the absence of adequate means for rigidly supporting the filament in the cathode assembly. Also, heretofore, it has been difficult during assembly to make satisfactory internal electrical connections between filament leads and connector elements.

Accordingly, the primary object of the present invention is to provide an improved electric discharge device including an improved filament lead connecting arrangement.

Another object of the present invention is to provide in an electric discharge device an improved filament lead connecting structure whereby the device is better adapted for withstanding substantial shock and vibration.

Another object of the present invention is to provide in an electric discharge device an improved arrangement for making an electrical connection to the leads of a cathode filament whereby the filament is mounted more rigidly in the device.

Another object of the present invention is to provide in an electric discharge device an improved arrangement adapted for minimizing failures due to shock and vibration and for facilitating manufacture of the device.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In carrying out the objects of my invention I provide an electric discharge device including an envelope comprising a plurality of coaxially stacked ceramic insulators. Sealed in the wall of the envelope and mutually insulated are a pair of annular conductive members. The conductive members each include an inner rim into which is positioned and bonded a cup-like connector. The connectors each include a chordal cross bar or strap having an intermediate portion extending parallel to the longitudinal axis of the device. The straps are relatively offset and to each is bonded a lead or leg of the cathode filament. One or more of the conductive members sealed in the wall can include a cylindrical outer surface for serving as a coaxial electrical contact. For a better understanding of my invention reference may be had to the accompanying drawing in which:

Figure 1 is a partially sectionalized side elevational

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view of an electric discharge device incorporating an embodiment of my invention; and

Figure 2 is a perspective illustration of an element incorporated in my improved structure.

Referring to the drawing, there is shown in Figure 1 an electric discharge device embodying a form of my invention. The device illustrated, including my improved structure, is shown and described in copending U.S. application Serial No. 832,994 of Robert E. Manfredi, entitled, "Electric Discharge Device," filed August 11, 1959 and assigned to the same assignee as the present invention.

As disclosed in detail in the mentioned copending application, the device includes an envelope structure 1 adapted for being evacuated and containing a plurality of cooperating electrode elements. The envelope structure 1 comprises a plurality of coaxially stacked ceramic insulators having bonded therebetween and thereto, by suitable ceramic-to-metal brazes, a plurality of annular contact members and sealing rings.

The mentioned plurality of cooperating electrodes includes an anode 2 shown in outline and a cathode assembly generally designated 3. The cathode assembly 3 is suitably supported in the device by means not shown and includes a filament or heater 4 having a pair of legs or leads 5 which are dependent and extend generally parallel to the longitudinal axis of the device.

In order to complete an electrical circuit through the heater 4 and the leads 5 attached thereto, it is necessary to provide an electrical connection through the wall of the envelope 2. To accomplish this, I have provided in the lower end of the device an annular cup-like contact member 6 which is butt-sealed by any suitable ceramic-to-metal bond at the bottom surface thereof between a pair of coaxial ceramic cylinders 7 and 8. The contact member 6 includes a dependent outer rim 9 which is spaced outwardly from the cylinder 8 and comprises a cylindrical contact surface for being received in a suitable tube socket contact.

The contact 6 also includes a dependent inner rim 10 into which is positioned and brazed a cup-like conductive member or annular connector 11, which is perhaps better seen in Figure 2. The connector 11 is adapted for having a dependent rim 12 thereof welded to the inner rim 10 of the contact 6 and is formed preferably by stamping to include a chord-like or chordal cross bar or strip 13, which extends transverse the envelope when the connector 11 is secured in place.

An intermediate portion of the cross bar 13 is twisted 90° out of the plane of the bottom of the connector 11 or so as to be generally parallel the longitudinal axis of the device. Bonded to the twisted portion of the cross bar 13, as by welding, is one of the filament leads 5.

The other of the filament leads 5 is similarly bonded to a twisted intermediate portion of a cross bar 14 on another connector 15 which can be substantially identical to the connector 11. The connectors 11 and 15 differ only in that the cross bars 13 and 14 are in relative offset positions to enable the welding thereto of the two filament leads with the latter in suitable parallel spaced relation.

The connector 15 includes a rim portion 16 which is positioned in and suitably welded to a dependent cylindrical flange 17 of an annular metal sealing member 18 having a horizontal flange 19 butt-sealed by a suitable ceramic-to-metal braze between the lower end of the insulator 8 and a cylindrical backup insulator 20. The member 18, in addition to serving as a portion of the envelope wall, serves to receive and make electrical connection to a header construction closing the lower end of the envelope and including a cup-like member 21 which serves as a coaxial contact for the corresponding end of the filament.

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In the described arrangement there is afforded circumferential contacts for making electrical connections to both sides of the heater. Additionally, the welded connections between the filament leads 5 and the twisted portions of the cross bars 13 and 14 can be substantial because of the substantial engagement obtained between the sides of the leads and the vertically extending flat surfaces of the cross bars. Thus, the leads can be secured to the cross bars with substantially large welds for increased strength of connection. Further, the disclosed structure provides for substantial rigid support of the filament leads due to the fact that both ends of each of the cross bars 13 and 14 are secured to opposed side regions of the device. This structure affords substantial resistance to any tendency of the leads to move either vertically or laterally in the device under shock or vibration conditions, with the desired result that any tendency toward failure as by disconnection of the leads due to fatigue of the leads or welds or failure by loosening of the heater in the cathode assembly are greatly minimized. Additionally, by minimizing any tendency toward longitudinal movement of the cathode assembly 3 my improved arrangement assists in maintaining constant the interelectrode spacing between, for example, the cathode and anode. Also, the disclosed structure facilitates manufacture of the device in that it enables the envelope structure including the members 6 and 18 to be fabricated separately and the connectors 11 and 15 to be subsequently welded in position. Following this, the leads 5 can be relatively easily welded to the twisted cross portions of the connectors and then the mentioned header construction and the contact member 21 can be placed and brazed in the positions illustrated.

While I have shown and described a specific embodiment of my invention I do not desire my invention to be limited to the particular form shown and described, and I intend by the appended claims to cover all modifications within the spirit and scope of my invention.

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

1. In an electric discharge device an envelope, at least one electrode contained in said envelope, an annular conductive member sealed in the wall of said envelope, a conductive cross bar electrically connected between circumferentially spaced portions of said conductive member and extending transversely in said envelope, and a lead connected between said electrode and said cross bar.

2. In an electric discharge device, an envelope, at least one electrode contained in said envelope, a plurality of annular conductive members sealed in the wall of said envelope in mutually insulated relation, a conductive cross bar electrically connected between circumferentially spaced portions of each of said conductive members and extending transversely in said envelope, and a lead connected between an electrode and each of said cross bars.

3. In an electric discharge device an envelope structure including an annular conductive member sealed in the wall of said envelope and including a cylindrical inner surface disposed in said envelope, at least one electrode in said envelope, an annular connector bonded to said cylindrical surface of said conductive member, said con-

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ductor including a chordal cross bar, and a lead connected between said electrode and said cross bar.

4. In an electric discharge device an envelope structure comprising a plurality of coaxially stacked ceramic cylinders, an annular conductive member bonded between a pair of said cylinders and including an inner rim in said envelope, at least one electrode contained in said envelope, an annular connector disposed in and bonded to said inner rim of said conductive member, said connector including a chordal cross bar, and a lead connected between said electrode and said cross bar.

5. In an electric discharge device an envelope structure comprising a plurality of coaxially stacked ceramic cylinders, a pair of annular conductive members each bonded between a pair of said cylinders and including an inner surface disposed in said envelope, at least one electrode element in said envelope, a discrete annular connector disposed in and bonded to the inner rim of each of said conductive members, said connectors each including a chordal cross bar, and a lead connected between an electrode and each of said cross bars.

6. An electric discharge device comprising an envelope including a plurality of coaxially stacked ceramic insulators, a pair of annular conductive members each bonded between a pair of said insulators and including a cylindrical inner surface disposed in said envelope, a cathode including a heater filament mounted in said envelope and having a pair of leads extending longitudinally in said envelope, a discrete annular cup-like electrical connector disposed and bonded to the inner surface of each of said conductive members, said connectors each being independent of the wall-defining structure of said envelope and having a chordal cross bar extending across the bottom thereof and transverse said envelope, the cross bars of said connectors being in offset position relative to each other, and said cross bars including intermediate portions extending parallel to the axis of said envelope and each having one of said filament leads bonded thereto.

7. An electric discharge device according to claim 6 wherein at least one of said conductive members includes a cylindrical contact surface disposed exteriorly of said envelope.

8. In an electric discharge device, an envelope, at least one electrode contained in said envelope, an annular conductive member sealed in the wall of said envelope and including a cylindrical section disposed internally of said envelope adjacent the inner surface of said wall, a discrete annular connector independent of the wall-defining structure of said envelope and including a cylindrical outer section fitted in said cylindrical section of said annular conductive member and conductively bonded thereto, said connector including a chordal cross bar extending transversely across the interior of said envelope, and a lead connected between said electrode and said cross bar.

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