Dec. 19, 1950 V. L. RONCI 2,534,373

ELECTRODE MOUNTING FOR HIGH-POWER ELECTRON DISCHARGE DEVICES

Filed March 5, 1949 2 Sheets-Sheet 1

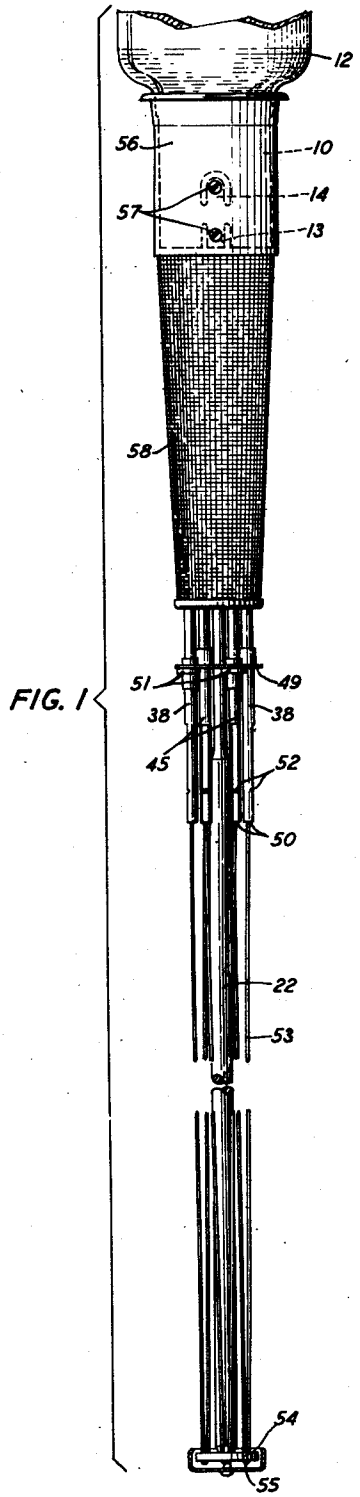

FIG. 1

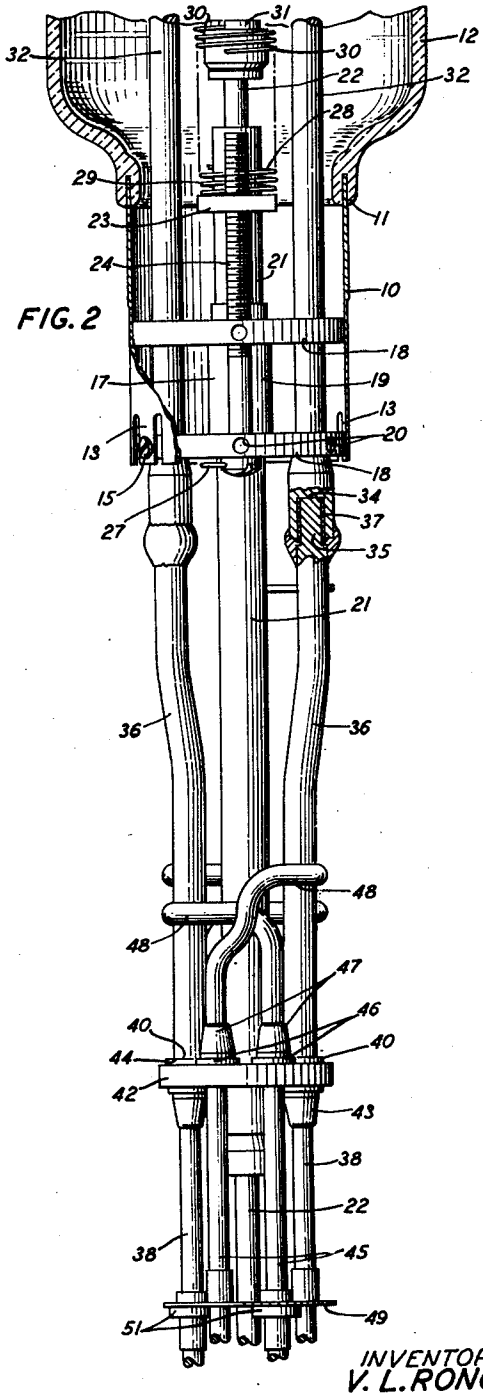

FIG. 2

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FIG. 4

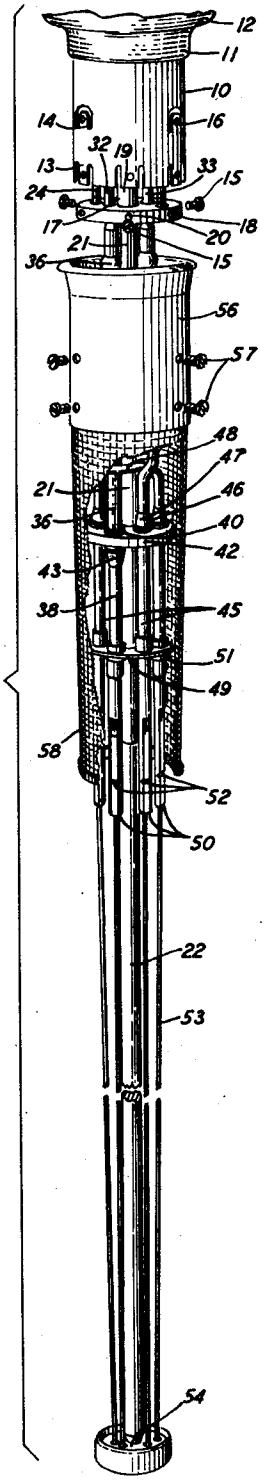
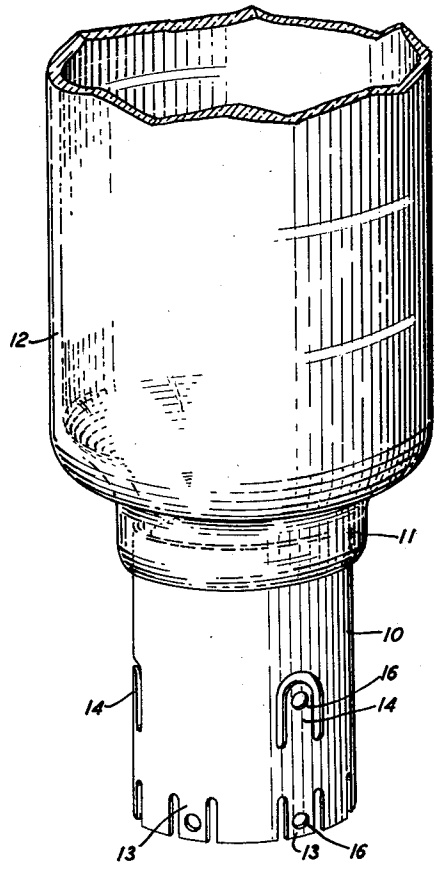


FIG. 3



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ELECTRODE MOUNTING FOR HIGH-POWER ELECTRON DISCHARGE DEVICES

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8 Claims. (Cl. 250—27.5)

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This invention relates to electron discharge devices and more particularly to electrode assemblies for such devices of high power capacity.

An object of this invention is to prevent the setting up of deleterious stresses in a glass to metal seal which supports an electrode assembly.

In one embodiment of this invention, a filamentary cathode structure of the type disclosed in Patent 1,976,521 to V. L. Ronci and J. E. Clark, issued October 9, 1934, is modified in its method of connection to one of the vitreous end portions of the device, thereby eliminating the adverse strains set up between said end portion and the metallic base of said electrode structure.

This cathode assembly includes a metallic collar which is sealed to a reentrant stem in one end of the envelope and is formed with a plurality of tabs cut in its surface and extending parallel to its axis. Each tab is connected to one or more elements of the cathode support. These tabs are secured to the flanges of a spool which is thereby maintained within the collar to serve as a support for a guide through which extends a central cathode support rod. Exterior of the collar and secured thereto through connection to the tabs is a band or sleeve which supports the upper periphery of a frusto-conical wire mesh shield. The lower periphery of this shield is connected to a filament platform which maintains its spacing from the enclosed conductor rods, insures the position of those rods relative to each other, and also connects the shield elements to the major filament support structure.

In assembling structures of this type, it has been found that the collar after fusion to the vitreous end, often assumes a form other than that of a true right circular cylinder. When the spool supporting the cathode structure is mounted in a collar of the form disclosed in the aforementioned patent, the alteration of its cross section, when the cross section has assumed a form other than a right circular cylinder, to a true circle, occasioned by the securing of the circular spool flanges by direct connection to the collar body, causes strains in the glass-to-metal seal between the stem and the collar which result in fractures and thus the destruction of the semi-processed tube element. Further, while tubes of this type are normally operated with their axes vertical, it is not possible to insure that they will be maintained so during shipping, hence gravitational forces and the jars incident to shipment tend to cause movement of the elements transverse to the tube axis. These forces, due to the length of the electrodes of this type of tube, exert

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a large moment about the base of the electrode structure, and therefore strains, often of destructive force on the glass-to-metal seal at the collar.

It will be noted that the structure as briefly disclosed above, is secured to the collar solely by flexible couplings, comprising the aforementioned axial tabs. The flexibility of these tabs permits a tight connection to the spool without pulling the entire surface of the collar into the form of a true right circular cylinder, thereby eliminating the strain developed in the seal by such a change in form. The strains which occur in shipping are also minimized to a large extent by the flexibility of the connection between the collar base and the other portions of the filament structure through the tabs to the supporting band of the wire mesh shield and the spool in the collar. Thus failures at the seal between the base collar and the glass stem of the envelope in structures of this type have been materially reduced by the expedient of employing these tabs to provide flexible couplings between the electrode structure and the seal.

The invention and the features thereof will be understood more clearly and fully from the following detailed description, reference being had to the accompanying drawings in which:

Fig. 1 is an elevational view of the cathode assembly of a device illustrative of one embodiment of the invention;

Fig. 2 is an enlarged elevational view, partially cut away, of the portion of the cathode support assembly including the seal between the glass stem and the metal collar and the associated elements within the collar, the shield and its supporting element being omitted for purposes of clarity;

Fig. 3 is an enlarged view in perspective of the glass stem and the metallic collar, showing in detail the flexible support tabs of the collar;

Fig. 4 is an exploded view of the filamentary cathode assembly of Fig. 1, partially broken away to show the conductor rod assembly more clearly.

Referring now to the drawings, an electrode structure illustrative of one embodiment of this invention, comprises a metallic sleeve or collar 10 which is sealed at its upper periphery 11 to a hollow reentrance stem 12 of one end of the tube envelope (not shown) to serve as the base for a filamentary cathode structure. This collar 10 is provided with a plurality of tabs 13 and 14, as best illustrated in Fig. 3, which are apertured to provide passages for screws which secure the remainder of the cathode structure. Within the collar and secured thereto by screws 15 pass-

ing through the tab apertures 16 is a spool 17 having end flanges 18 which are interconnected by a spindle or tubular portion 19 and which have tapped holes 20 in their periphery registering with the holes 16 in the collar tabs 13 and 14. This spool 17 rigidly supports a central tubular guide member 21 in which is slidably mounted a cathode support rod or standard 22 extending from the lower end of the guide 21 axially of the envelope within the length of the anode (not shown) and projecting from the upper end of the guide tube 21. A plate 23 is positioned adjacent the upper spool flange 18 but out of contact therewith and is supported solely by machine screws 24 which are threaded into tapped holes in it, and which slidably extend through apertures in the spool flanges 18. The screws 24 may be locked relative to each other by a cotter wire 27. A helical tension spring 28 encircles the standard or rod 22, one of its ends 29, being secured to the plate 23, while the other end 30 is secured to a cap 31 on the end of the rod 22 thereby exerting a downward force on said rod.

Lead-in conductor rods 32 extend through glass seals (not shown), through the reentrant stem 12, and apertures 33 in the spool flanges 18 so that no contact is made with the elements within the collar. The lower ends of these rods 32 are enlarged and have a bore 34 into which a reduced end 35 of a more refractory section 36 of conductor rod extends. These sections are preferably welded together, in one embodiment comprising copper lead-in sections and molybdenum end sections a nickel welding sleeve 37 is interposed between the section ends. Each of the lower rod sections 36 is formed with a threaded portion (not apparent from the drawings) and an elongated linear portion 38 extending axial of the envelope and within the anode of the device (not shown). Portions of these elongated sections extend through opposed flanged insulators 40, positioned in apertures in a metallic platform 42, and each portion has mounted thereon a nut 43, which clamps the insulators 40 against shoulders 44 on rods 36, and thereby secures the platform in position. A plurality of rods 45 extending through flanged insulators 46 in platform 42 and have secured thereto, as by welding or some other convenient method, metallic buttons 47 which lock the insulators in position. The rods 45, which may be of molybdenum, are provided with end portions 48 which are secured to the rod sections 36 as shown so that three conductors of positive polarity and three conductors of negative polarity are provided below the filament platform, each group of three comprising one conductor rod 38 and two conductor rods 45. The rods 45 and 38, the rods 36 and 32, and the platform 42 in the specific construction shown, are therefore rigidly interconnected and form a unitary assembly supported from the stem 12 through the screws 15 which connect the supports for these elements to the tabs 13. Thus a connection is formed which under operating conditions, i. e. when the tube is mounted so that the filament support structure is vertical, provides a coupling of sufficient rigidity and strength to maintain the proper position of the filamentary cathode relative to the other electrodes, however, when the device is so positioned that the gravitational forces on the filament structure are transverse to the axis or it is so handled that transverse forces are applied to the structure, the tabs, by virtue of their flexibility, will permit a limited transverse movement of the structure, thereby taking up the strain which would be applied to the glass-to-metal seal if the elements of the structure were supported directly upon the body of the collar.

The platform 42 is slidably mounted on the guide member 21 so that while it supports and acts as a spacer for the rods 38 and 45 by being rigidly connected thereto, it does not cause those elements to buckle when they expand and contract during the thermal changes in the tube. A spacer disc 49 is located below the platform 42 further insuring uniform spacing of the ends 50 of the rods 38 and 45. The rods of negative polarity are secured directly to the disc 49 thereby fixing its potential, while the rods of positive polarity pass through insulating bushings 51.

The ends 50 of the rods 38 and 45 have central bores adapted to receive the ends of filament lengths 53 which are welded therein through slots 52 extending into the bores. A disc 54, which may be of molybdenum, is mounted upon a reduced headed extension 55 of the standard 22, and is universally rockable with respect to the standard 22.

A filamentary cathode consisting of a plurality of lengths 53 forming V-shaped sections, which may be of tungsten, is suspended between the ends 50 of the rods 38 and 45 and the platform 54, and is arranged with a substantially cylindrical boundary concentrically within the other electrodes of the device (not shown). The V-shaped sections of the cathode are threaded through bores in the platform 54 and the ends of the sections are disposed in the bores of conductor rods 36 and 45 as described above. This connection arrangement, as most clearly shown in Fig. 4, places the sections of the cathode electrically in parallel.

The normal position of the cathode structure is as shown in Fig. 1. The standard 22 which is freely slidable in the guide member 21 constitutes a gravity actuated mass member the mass of which acts along the length of the cathode and thereby produces a tension in the filamentary lengths 53 of the cathode. The degree of the tension may be adjusted by varying the separation of the plate 23 and the disc 18 through the medium of the machine screws 24, thereby varying the tension on the helical spring 28. During the operation of the device, the expansion and contraction of the leading-in conductor rods 32 and 36 is accompanied by movement of the platform 42 along the guide 21, so that no buckling or deleterious stresses are produced in the rods. The expansion and contraction of the filamentary sections 53 of the cathode are compensated by the helical spring 28 acting upon the standard 22. An unequal expansion of the sections 53 is compensated by the rocking movement of the platform 54. This construction therefore maintains substantially uniform and constant tension in the section 53 and preserves the form of the cathode as a whole so that the spacing of the cathode with respect to the anode is substantially uniform and the electrical characteristics of the device are maintained substantially constant.

In order to prevent arcing discharges between the anode and relatively sharp edges of portions of the cathode supporting structure and to eliminate the electronic bombardment on the glass of the reentrant stem, a shield is provided above the assembly adjacent the stem 12. This shield comprises a cylindrical supporting band 56 which is secured to the sleeve or collar 10 by screws 57 which pass through tapped holes in the tabs 14 on

the collar and into registering holes in the periphery of the spool flanges 18 and frusto-conical perforated or wire mesh portion 58 extends from the lower periphery of the band 56 to the periphery of platform 42 and makes sliding contact with the platform. By this arrangement the shield and its associated elements are also connected to the sleeve or collar 10, solely through the medium of the flexible tabs 13 and 14 and hence any strain placed upon the shield by these members will be taken up by the tabs, thereby relieving the glass-to-metal seal at the collar periphery 11.

What is claimed is:

1. An electrode assembly mounting comprising a glass portion, a metallic collar sealed thereto, a plurality of flexible portions cut in the surface of said collar, and a rigid electrode portion extending beyond said glass portion and supported from said flexible collar portions.

2. An electrode assembly mounting comprising a glass portion, a metallic collar sealed thereto, a plurality of flexible portions in the surface of said collar and parallel to the axis thereof, and a rigid electrode portion extending beyond said glass portion and supported from said flexible collar portions.

3. An electrode assembly mounting comprising a glass portion, a metallic collar sealed thereto, a plurality of flexible portions cut in the wall of said collar and parallel to the axis thereof, a support mounted on said flexible collar portions, a standard extending through said support and slidable therein, a filamentary electrode having portions connected to said support and other portions supporting said standard, and an adjustable resilient connection joining said standard and said support.

4. An electrode assembly mounting comprising a glass portion, a metallic collar sealed thereto, a plurality of flexible portions in the surface of said collar and parallel to the axis thereof, a spool fitting within said collar and mounted on said flexible collar portions, a tubular guide member secured within the spindle of said spool, a standard slidably mounted within said guide member, an adjustable resilient connection joining said standard and said spool, and a filamentary electrode having portions connected to said spool and other portions supporting said standard.

5. An electrode assembly mounting comprising a glass stem, a metallic collar sealed thereto, a plurality of flexible portions in the surface of the collar and parallel to the axis thereof, a support mounted on said flexible collar portion, a standard extending from the support, leading-in conductors extending through said stem, a platform supported by said conductors loosely surrounding the standard, a second platform mounted on said standard and universally rockable with respect thereto, and a filamentary cathode coupled to and extending between the ends of said leading-in conductors and said second platform.

6. An electrode assembly mounting comprising a glass stem, a metallic collar sealed thereto, a plurality of flexible portions in the surface of said collar and parallel to the axis thereof, an electrode extending beyond said glass stem and supported from said flexible collar portions, and a hollow shield encircling said collar, said shield being secured to said flexible portions of said collar.

7. An electrode assembly mounting comprising a glass stem, a metallic collar sealed thereto, a plurality of flexible portions in the surface of said collar and parallel to the axis thereof, a support mounted on said flexible portions of said collar, a standard extending from said support, leading-in conductors adjacent said standard and extending through said stem, a platform slidably encircling said standard and carried by said conductors, a second platform mounted on said standard, a filamentary electrode supported between said second platform and the ends of said leading-in conductors, and a hollow shield encircling said collar, a portion of said standard, and a portion of said leading-in conductors, said shield being secured to said flexible portions of said collar at one end and slidably connecting with said first platform at its other end.

8. An electrode assembly mounting comprising a glass portion, a metallic collar sealed thereto, an electrode extending beyond said glass portion, a tubular shield attached to said electrode and surrounding said collar, said collar having flexible portions parallel to said shield, and connections fastening said shield to said flexible portions.

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