

July 8, 1952

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FILAMENT MOUNTING FOR HIGH POWER
ELECTRON DISCHARGE DEVICES
Filed Jan. 14, 1949

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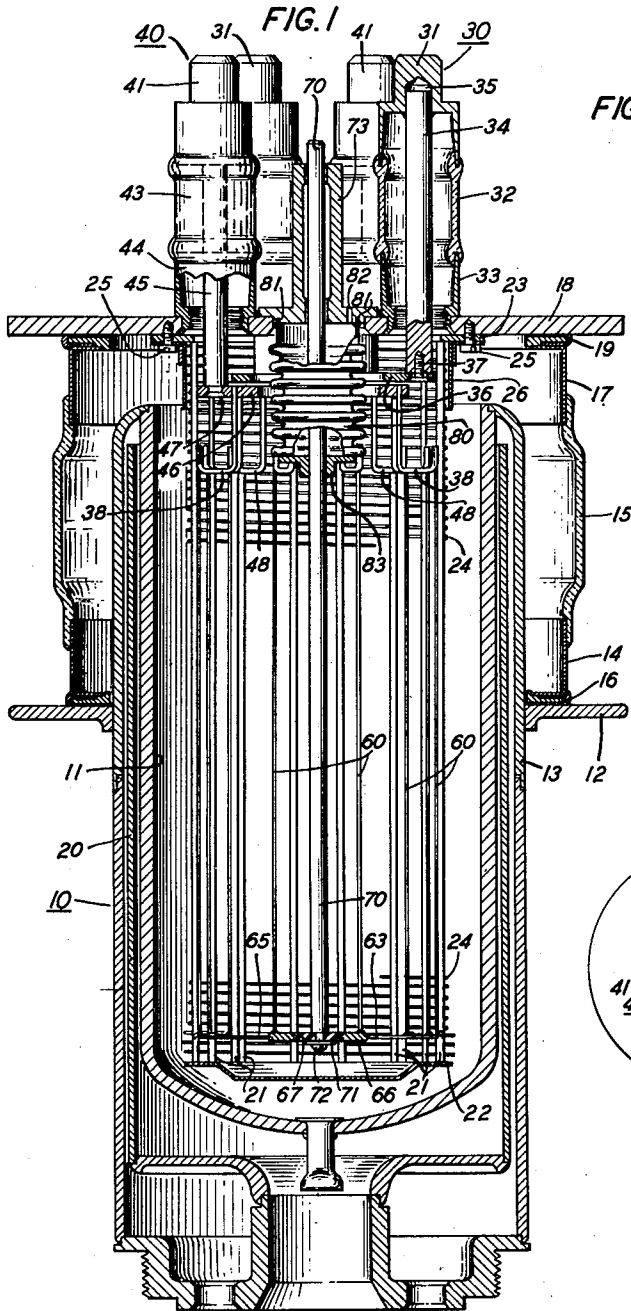


FIG. 3

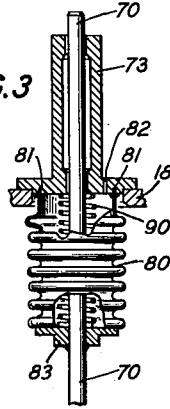
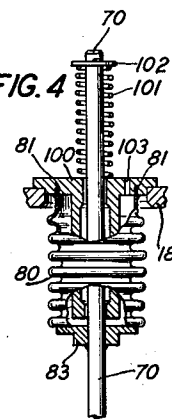


FIG. 4



UNITED STATES PATENT OFFICE

2,602,907

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ELECTRON DISCHARGE DEVICES

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Application January 14, 1949, Serial No. 70,883

17 Claims. (Cl. 313-278)

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This invention relates to filament mountings for electron discharge devices and more particularly to filament mountings for high power water or air-cooled electron discharge devices.

In some types of electron discharge devices, it is generally necessary for the multistrand filament assembly to be mounted under tension in order to prevent bowing and possible contact of the filaments with adjacent elements. In most conventional constructions this is accomplished by springs and bearings within the high temperature zone of the device. However, the spring and bearings thus located within the envelope are subjected to intense heat and bombardment effects from the filament and are frequently damaged thereby.

One general object of this invention is to improve filament mountings for electron discharge devices. More specifically, objects of this invention are to prevent heat and bombardment effects upon such mountings, to facilitate the mounting and tensioning of multistrand filaments and to expedite the realization and maintenance of a prescribed tension in such filaments.

One feature of the invention relates to a pressure sensitive element or bellows arrangement for tensioning the filament by atmospheric pressure acting on a bellows, the bellows sealing off one end of the device.

Another feature relates to the addition of a pressure means for altering the tension on the filament resulting from atmospheric pressure acting on the bellows.

A further feature involves the provision of bearing members external of the envelope for positioning the standard which supports and tensions the filament assembly, where they are accessible for lubrication and far enough removed from the filament so as not to be affected by heat and bombardment effects.

The invention and the features thereof will be more fully understood from a consideration of the embodiments illustrated in the accompanying drawings in which:

Fig. 1 is a view, partly elevational and partly sectional, of a water-cooled electron discharge device embodying features of this invention;

Fig. 2 is an enlarged perspective view of portions of the filament assembly showing details of the mounting structure for the multistrand filaments employed in the device of Fig. 1;

Fig. 3 is an elevational view, partly in section, of a modification of the bellows arrangement as applied to the device of Fig. 1, in which a spring member is provided within the bellows for alter-

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ing the tension exerted on the multistrand filament by atmospheric pressure acting on the bellows;

Fig. 4 is an elevational view, partly in section, of another modification of the bellows arrangement in which the filament standard bearings are positioned within the bellows and a spring member is arranged externally of the bellows for altering the tension exerted on the multistrand filament by atmospheric pressure; and

Fig. 5 is a plan view of the device of Fig. 1 showing the arrangement of terminals, filament standard and filament standard bearings on the mounting plate.

Referring now to the drawings, 10 is a water-cooled high vacuum discharge device in which a tubular anode 11 and flange 12, preferably of copper, are joined, as by soldering with silver, to water jacket 13. A metallic sleeve or ring member 14, preferably of Kovar, which is an alloy of nickel, iron and cobalt, is plated with pure gold to facilitate the sealing thereto of a glass cylinder 15 which forms part of the enclosing vessel of the device. A cold rolled steel ring or insert 16 is soldered between sleeve 14 and flange 12 to provide an efficient joint between the Kovar and copper members of the casing. Another Kovar sleeve 17 is hermetically sealed to the opposite end of the cylinder 15 and joined to a rigid closure disc or base plate 18, preferably of Monel alloy, by a similar ring insert 19. A cylindrical metallic sleeve or partition member 20 is mounted intermediate the anode 11 and water jacket 13 to form inlet and outlet chambers for the circulation of a cooling medium such as water, in the device to dissipate the intense heat energy generated in the anode during operation.

The heavy base plate 18 is the main supporting body for the grid and filament assemblies. The grid comprises a plurality of metal support rods 21 which are arranged in a circle within the tube, equidistant from the cylindrical anode 11, with the lower end of each rod 21 welded to end plate or disc shield 22 and with the upper end of each rod 21 welded to a flange 23. A helical grid coil 24 is wound around the support rods 21 continuously from one end to the other end thereof and is welded to these support rods 21 at each point of contact therewith. The flange 23 is attached to plate 18 by a plurality of screws 25. A guard ring or shield 26 is also attached to plate 18 by screws 25. The grid helix 24 is thus electrically connected to plate 18 which forms an external ring terminal.

The multistrand filament assembly includes a

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plurality of terminals, one of which, terminal 30, is shown in section in Fig. 1. A metallic stud 31, preferably of copper, is plated with pure gold to facilitate the sealing thereto of a glass cylinder 32 which forms part of the structure of terminal 30. Another gold plated copper sleeve 33 is hermetically sealed to the opposite end of the cylinder 32 and is joined to plate 18 by brazing it thereto. The upper end of a rod 34 is tightly fitted with a cavity 35 of stud 31. A metallic circular platform 36 is secured to the lower end of rod 34 by a screw 37.

Terminal 40 is constructed similar to terminal 30. A metallic stud 41, preferably of copper, is plated with pure gold to facilitate the sealing thereto of the glass cylinder 43. Another gold plated copper sleeve 44 is hermetically sealed to the opposite end of cylinder 43 and is jointed to plate 18 by brazing it thereto. The upper end of rod 45 is tightly fitted in a cavity in stud 41. A metallic circular platform 46 is secured to the lower end of rod 45 by a screw 47.

The device shown in Fig. 1 has a plurality of terminals, which are arranged with alternate terminals connected to platforms 36, 46 respectively. In the tube illustrated there are three terminals attached to platform 36 and three attached to platform 46, arranged in a circle about the axis of tube 10, as shown in Fig. 5.

As shown in Fig. 2, platform 36 supports a plurality of filament support hooks 38 welded thereto at their upper ends in apertures 39. Hooks 38 extend through clearance holes 43 in platform 46. Platform 46 supports hooks 49 welded to it, at their upper ends in apertures 50. Hooks 38, 49 alternate in a circle around platforms 36, 46, the center of the circle lying on the vertical axis of device 10. There are the same number of hooks 38 as there are of hooks 49. They are used in pairs, each pair supporting one of a plurality of filament loops 60. The lower end of each filament loop 60 extends under the hooked ends 61, 62 of metallic support fingers 63, 64, respectively, which protrude from disk 66. Similar support fingers 65 are spaced in pairs around the periphery of metallic disk 66. Disk 66 is rigidly supported by insulating disk 67 which is attached to filament standard 70 by a washer 71 and screw 72 which threads into the end of filament standard 70. The upper ends of filament loops 60 are welded to hooks 38, 49. The upper end of filament standard 70 is guided in a vertical position by a sleeve bearing 73, which is brazed to terminal plate 18.

As shown in Fig. 1, a bellows member 80 is attached to bearing 73 by brazing the upper edge 81 into a circular recess in the lower face of bearing 73. The bearing 73 has a vent 82 for maintaining atmospheric pressure within the bellows 80. A bushing 83 is brazed to the lower face of bellows 80. Filament standard 70 extends through and is welded to bushing 83 to form an airtight seal.

The operation of the filament mounting shown in Fig. 1, is that the atmospheric pressure within bellows 80 forces the lower surface of bellows 80 downward. The filament standard 70 which is rigidly attached to bellows 80, applies this force to disk 67 which in turn forces disk 66 downward thus forcing the support fingers 63, 64, 65 downward. As the upper ends of the filament loops 60 are rigidly attached to platforms 36, 46, by means of hooks 38, 49, the downward force on the support fingers 63, 64, 65 tensions the filament loops 60.

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Fig. 3 illustrates another embodiment of the invention in which a helical spring 90 is positioned within bellows 80 extending spirally around filament standard 70 between the lower face of bearing 73 and the upper face of the bottom of bellows 80. Spring 90 may be in compression or it may be extended. In the latter case it is rigidly attached to the lower surface of bearing 73 at its upper end and its lower end is rigidly attached to the upper face of the bottom of bellows 80.

In the embodiment of the invention shown in Fig. 3 the function of helical spring 90 within bellows 80 is to alter the tension exerted on the filament loops 60 by atmospheric pressure acting on the bellows 80. If spring 90 is placed in the bellows in compression, the tension on filament loops 60 by atmospheric pressure within bellows 80 is increased. If spring 90 is in tension between bearing 73 and the lower face of the bellows 80 the resulting tension on the filament loops 60 is less than would be caused by atmospheric pressure only.

Fig. 4 shows another embodiment in which a bearing 100 for filament standard 70 is brazed to plate 18 and extends inwardly within bellows 80 and a helical spring 101 extends around filament standard 70 between the upper face of bearing 100 and a collar 102 which is rigidly attached to the upper end of filament standard 70. Spring 101 may be in compression or it may be extended. In the latter case its upper end is rigidly attached to collar 102 and its lower end is rigidly attached to the upper surface of bearing 100. Bearing 100 has a vent 103 for maintaining atmospheric pressure within bellows 80.

In the embodiment of the invention shown in Fig. 4, the function of helical spring 101 is to alter the tension exerted on the filament loops 60 by atmospheric pressure acting on the bellows. If spring 101 is placed on filament standard 70 in compression, the tension on filament loops 60 by atmospheric pressure within bellows 80 is increased. If spring 101 is in tension between collar 102 and bearing 100 the resulting tension on filament loops 60 is less than would be caused by atmospheric pressure only.

A typical device which may embody this invention is disclosed in detail and claimed in the application of C. E. Fay and D. A. S. Hale, Serial No. 68,346, filed December 30, 1948, now Patent No. 2,534,548, issued December 19, 1950.

While this invention has been disclosed with reference to various specific embodiments, it is, of course, understood that other modifications may be devised by those skilled in the art without departing from the scope and spirit of the invention.

What is claimed is:

1. A filament mounting assembly comprising a closure having an opening on one end of the casing of an electronic discharge device, a standard extending through said closure, a filament supported by said standard, and a pressure responsive element carried by said closure for sealing said opening and attached to said standard to apply tension by atmospheric pressure to said filament.

2. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, bearing members on said closure engaging said standard, and a pressure responsive bellows supported by said closure and at-

tached to said standard to apply atmospheric pressure to tension said filament.

3. A filament mounting assembly comprising a bellows element forming a closure for one end of the casing of an electronic discharge device and responsive to atmospheric pressure, a shaft within said casing coaxial therewith and rigidly attached to said bellows element, a multistrand filament, and means on the inner end of said shaft for supporting said filament whereby said filament is tensioned by atmospheric pressure.

4. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament support on said standard, bearing members on said closure engaging said standard, a bellows responsive to atmospheric pressure supported by said closure and attached to said standard to apply tension to said filament by atmospheric pressure, and means within said bellows to alter the tension on said filament.

5. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, bearing members on said closure engaging said standard, a bellows responsive to atmospheric pressure supported by said closure and attached to said standard to apply tension by atmospheric pressure to said filament, and a helical spring coaxially about said standard and having one end abutting against one of said bearing members and the opposite end abutting against said bellows.

6. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, bearing members on said closure engaging said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply tension to said filament by atmospheric pressure, and a helical spring coaxially about said standard and extending between one of said bearing members and said bellows.

7. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, said closure having an aperture therein, a standard extending through said closure, a multistrand filament supported on said standard, bearing members on said closure engaging said standard, a bellows responsive to atmospheric pressure supported by said closure and attached to said standard to apply atmospheric pressure to tension said filament, and a helical spring coaxially about said standard in compression between the inner face of one of said bearing members and said bellows.

8. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, bearing members on said closure engaging said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply atmospheric pressure to tension said filament, and means within said bellows to increase the tension applied to said filament by said bellows.

9. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said

standard, bearing members on said closure engaging said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply atmospheric pressure to tension said filament, and means within said bellows to decrease the tension applied to said filament by said bellows.

10. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, a bearing member external of said closure engaging said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply tension by atmospheric pressure to said filament, and a helical spring around said standard within said bellows in compression between said closure and the bottom of said bellows.

11. A filament mounting assembly comprising a closure on one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, a bearing member external of said closure engaging said standard, a pressure responsive bellows supported by said standard to apply atmospheric pressure to tension said filament, and a helical spring around said standard within said bellows in tension between said closure and the bottom of said bellows.

12. A filament mounting assembly comprising a closure having an opening in one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply atmospheric pressure to tension said filament, a bearing member attached to said closure and extending internally of said bellows and engaging said standard, a collar rigidly attached to the external end of said standard, and a helical spring around said standard external of said closure in compression between said collar and said closure.

13. A filament mounting assembly comprising a closure in one end of the casing of an electronic discharge device, a standard extending through said closure, a multistrand filament supported on said standard, a pressure responsive bellows supported by said closure and attached to said standard to apply tension by atmospheric pressure to said filament, a bearing member attached to said closure, extending internally of said bellows and engaging said standard, a collar rigidly attached to the external end of said standard, and a helical spring around said standard external of said closure in tension between said collar and said closure.

14. An electron discharge device comprising a sealed and evacuated envelope, said envelope including a bellows as part thereof with one side of said bellows exposed to the evacuated interior of the envelope and the other side exposed to the atmosphere at the exterior of the envelope, a cathode in said envelope, and means connecting the bellows and cathode applying longitudinal tension in the cathode from atmospheric pressure applied to the bellows.

15. An electron discharge device comprising a sealed envelope having a filamentary cathode therein, means securing said cathode at one part thereof, means having tensioning engagement at another part of said cathode holding taut the intervening portion of said cathode between the two said means, and a flexible member connected

to the second mentioned said means, said member having a differential of pressure applied on opposite sides thereof and maintaining a flexing moment on said flexible member and said flexible member thereby continuously exerting a sliding moment to said second mentioned means and thereby a constant tension to said portion of the cathode.

16. An electron discharge device comprising a sealed and evacuated envelope having a filamentary cathode therein, means securing said cathode at one part thereof, a second means having tensioning engagement at another part of said cathode holding taut the intervening portion of said cathode between the two said means, and a flexible member having one side exposed to the evacuated interior of said envelope and an opposite side exposed to the exterior atmosphere thereby maintaining a flexing moment on said flexible member, said flexible member being responsive to said flexing moment and said flexible member being in engagement at its said side interior of the envelope with said second means whereby inward deformation of said flexible member exerts a continuous moment of force on said second means by excess of atmospheric pressure exterior of the envelope over the lesser interior pressure resulting from evacuation of the envelope and whereby the inward deformation of said flexible member moves the said second means in the

direction of tensioning of the said cathode portion.

17. An electron discharge device comprising a sealed and evacuated envelope having a filamentary cathode, providing a leg and a bight, means securing said leg in fixed position in said envelope, a second means having supporting engagement with said cathode under the said bight thereof, and means including a part exposed exterior to said envelope and to the atmosphere and movable under influence of differential of interior and exterior pressures and the last said means having tension-applying connection with the second means whereby the leg of the cathode is tensioned by atmospheric pressure.

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