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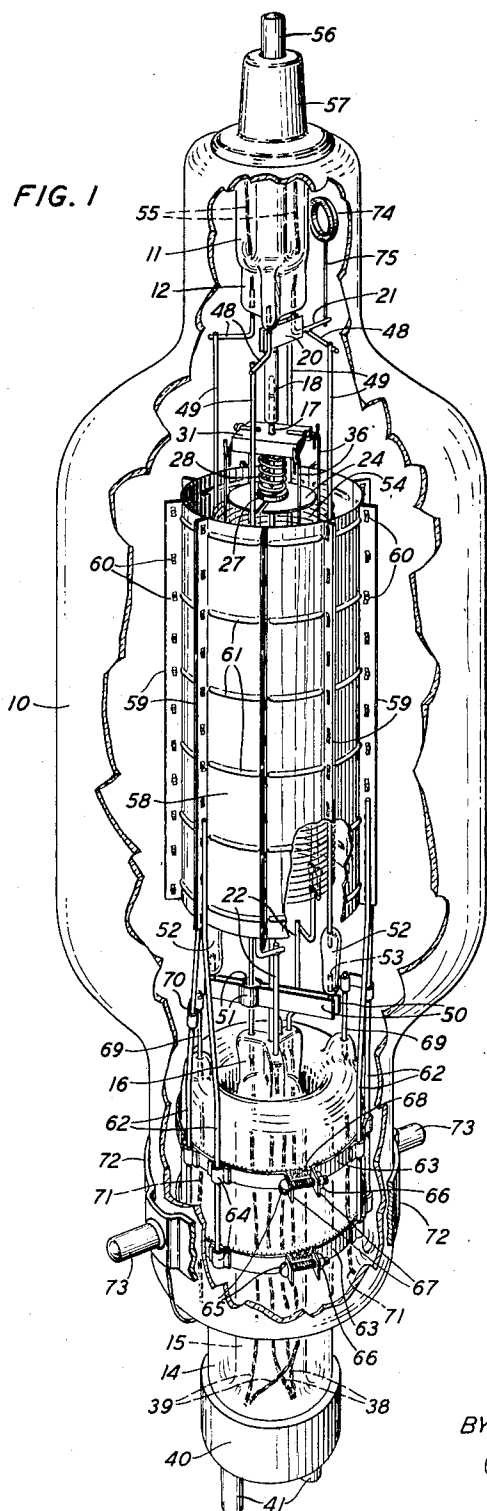
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1,927,084

SUPPORT FOR FILAMENT ASSEMBLIES

Filed Dec. 18, 1931

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

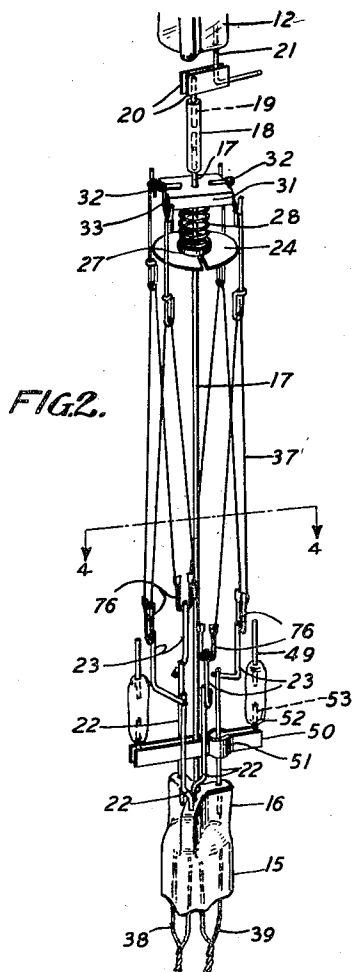


FIG. 5

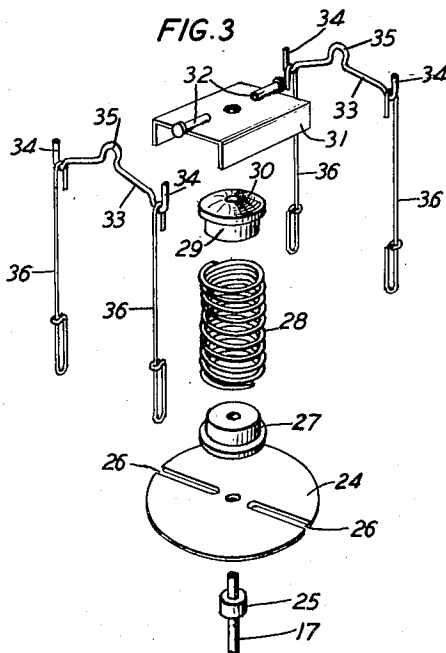
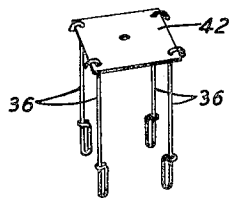


FIG. 4

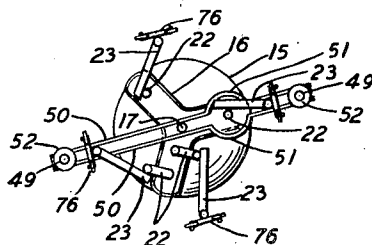
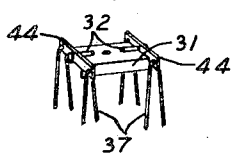


FIG. 6



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1,927,084

SUPPORT FOR FILAMENT ASSEMBLIES

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Application December 18, 1931
Serial No. 581,877

16 Claims. (Cl. 250-27.5)

This invention relates to a support for filament assemblies and more particularly to a support for filaments in discharge devices.

In high power electron discharge devices, the cathode or filament is usually formed of tungsten since this material is capable of withstanding the high temperatures necessary in the operation of the device. However, when several sections of filament are required in order to obtain the maximum degree of emission, it becomes extremely difficult to support these sections and to protect them from strain. The high temperatures incident to the operation of the sections of the filament necessarily cause abnormal expansion of the sections and any confining support results in the distortion or breakage of the filament upon contraction. Any strain produced in the refractory filament necessarily shortens its life and the usefulness of the device in which the filament is used. It is desirable, therefore, that the supporting structure should permit unrestrained expansion of the several sections of the filament while maintaining the sections in uniform relation to other electrodes, such as the control electrode and anode, in a three-electrode discharge device.

An object of this invention is to permit universal movement of several sections of filament and also to compensate for inequalities in expansion of the several sections while maintaining the sections substantially in parallel relation to adjacent electrodes in discharge devices.

In accordance with one embodiment of this invention, the support for the filament comprises a central standard around which several sections of filament are positioned and supporting the sections of the filament in a circular boundary by a resilient superstructure including a pair of spaced insulating members fitting loosely on the central standard and holding between them a compression spring which also surrounds the standard. A universally movable platform is superimposed on one of the insulating members and carries rocker arms for engagement with the filament sections.

This arrangement permits longitudinal expansion of the sections of the filament and also yields in a rotary direction to alleviate strain in the filament sections when heated. The rocker arms and the platform also compensate for unequal expansion in the several sections of the filament. The compression spring maintains a uniform tension in the sections.

In another embodiment of the invention, the rocker arms are supplanted by pivoted hooks

which act as balances for parallel filament hooks attached to the ends thereof.

Another feature of the invention relates to providing one of the insulating members with a dome-shaped bearing surface so that the platform can assume different angles with respect to the axis of the supporting standard.

In all of these modifications the superstructure is slidably mounted on the central standard and is maintained in position by the initial tension of the filament.

In another embodiment of the invention, a shield is interposed between the filament sections and the superstructure to deflect the intense heat from the filament away from the resilient supporting superstructure.

The invention will be understood more clearly from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of an electron discharge device illustrating one embodiment of this invention in which the enclosing vessel and the electrodes are broken away to show details of construction more clearly;

Fig. 2 is a detail view in perspective of the filamentary cathode and its supporting assembly as shown in the device of Fig. 1;

Fig. 3 is an enlarged exploded view of the superstructure of the filament assembly shown in Fig. 2;

Fig. 4 is a plan view of the stem and supports on the line 4-4 of Fig. 2;

Fig. 5 is a perspective view of a modification of a portion of the filament assembly shown in Fig. 3 in which the hooks are directly connected to the platform; and

Fig. 6 is a perspective view of another modification of the assembly shown in Fig. 3.

Referring now to the drawings, an electron discharge device illustrative of the various embodiments of this invention comprises a double-ended enclosing vessel 10 having a reentrant stem 11 at one end thereof terminating in a tri-armed press 12. The other end of the enclosing vessel 10 is provided with a plurality of cylindrical stems 13, 14 and 15 which are joined at contiguous edges and are concentrically disposed with respect to each other and the enclosing vessel. The innermost stem 15 terminates in a tri-armed press 16 which is disposed in axial alignment with the press 12 on the opposite stem.

A filamentary cathode assembly, shown in detail in Fig. 2, is supported from the press 16 and comprises a central standard 17, such as a rigid metallic rod, which is embedded in the press

16 at the center thereof and extends lengthwise and axially of the vessel 10. The free end of the rod 17 is slidably disposed in a bore of an insulating sleeve 18, such as a glass bead, which is supported from the stem 11 by a short stub 19 embedded in the sleeve 18 and carried by a pair of metallic bands 20 which are in turn supported by a bent wire 21 embedded in one arm of the press 12.

10 A plurality of rigid wires 22 are embedded in the arms of the press 16, as shown more clearly in Fig. 4 and extend parallel to the standard 17. Each of the wires 22 carries a bent or L-shaped wire 23 which in turn has secured thereto a U-shaped member or connector 76. A universally flexible superstructure, shown more clearly in Fig. 3, is mounted on the standard 17 adjacent the end thereof remote from the press 16 and comprises a centrally apertured sheet metal disc 24 which fits loosely about the standard 17 and rests upon a collar or shoulder portion 25 upon the standard 17. The disc 24 is preferably of a material having good heat conducting characteristics, such as molybdenum, although other materials such as mica, may be used, depending on the operating temperature of the filament, and serves as a heat shield between the elements of the superstructure and the cathode of the device. Furthermore, when the disc 24 is made of metal it may be provided with slots 26 to reduce the eddy currents path in the disc whereby excessive heating of the disc by such currents during the exacuation treatment of the device is prevented.

35 A flanged insulating member or button 27 is loosely disposed about the standard 17 and is seated upon the disc 24, and has seated thereupon a helical spring 28. Another flanged insulating member or button 29, likewise loosely disposed about the standard 17, engages the spring 28. The insulating member 29 is formed with a conical or dome-shaped bearing surface 30 upon which a flanged metallic swivel platform 31 rests. The platform 31 is provided with an oversize centrally disposed aperture through which the standard 17 extends, and mounts a pair of aligned headed spindles or supports 32. Each of the spindles or supports 32 carries a metallic rocker arm or hanger 33 provided with hook-shaped end portions 34 and a bearing portion 35 which rests upon one of the spindles or supports 32 and is disposed between the head of the spindle and the adjacent edge of the platform 31 to form a pivot for the rocker arms 33. A plurality of wire hook members 36 are suspended from the end portions of the hangers 33, the relative dimensions of the platform 31, hangers 33 and disc 24 being such that the hook members 36 are free from the disc 24.

60 A filamentary cathode 37, preferably of a highly refractory metal, such as tungsten, which has been treated to increase its emissive properties, is suspended between the connectors 76 and hooks 36 and comprises a plurality of V-shaped sections which are disposed within a substantially cylindrical boundary, the longitudinal axis of which is coincident with the axis of the standard 17.

This construction allows substantially unrestrained expansion and contraction in all directions of the sections of the cathode 37 with temperature variations, and thereby prevents the setting up of deleterious stresses within the cathode sections. The variations occasioned by longitudinal or rotative movement of the sections of the cathode are compensated for by the com-

pression spring 28 so that a substantially constant tension is maintained in the sections of the cathode 37 and the proper form of the cathode is preserved. The rocker arms or hangers 33 together with the swivel platform 31 compensate for unequal expansion of the several sections of the cathode and thereby further prevent excessive strains in the cathode and preserve the proper form of the cathode.

A plurality of leading-in conductors are sealed in the stem 15 and are connected to the wires 22. The conductors are electrically grouped into two pairs 38 and 39 and each pair is connected to one of terminal prongs 41 mounted on an insulating base 40 suitably attached to the stem 14. By this arrangement the several sections of the cathode are connected electrically in parallel, the leading-in conductors being paired preferably so that diametrically opposed connectors 76 are of the same polarity. This scheme of cathode connections enables the use of a relatively low potential source for supplying the heating current for the cathode, provides a lower cathode drop, and insures a more uniform emission over the entire cathode surface.

Various modifications may, of course, be made in the filament superstructure shown in Fig. 3 without departing from the spirit and scope of this invention. For example, in one modified form, as shown in Fig. 5, the swivel platform may consist of a flat, rectangular metallic plate 42 having apertures at its corners for receiving the hook members 36 which engage the apices of a filamentary cathode as shown in Fig. 2. The plate 42 may be mounted upon the dome-shaped surface 30 of the insulating member 29 in the same manner as the platform 32 of the embodiment shown in Fig. 3, and is universally movable to allow substantially unrestrained expansion and contraction of the filamentary cathode and to preserve the form of the cathode.

In another modification shown in Fig. 6, the hangers or rocker arms may take the form of flat, metallic balances or strips 44 which are loosely pivoted upon the headed spindles or supports 32 attached to a flanged plate 31. A filamentary cathode 37 may be threaded through oversize apertures at the ends of the strips 44, or hook members such as incorporated in the forms shown in Figs. 3 and 5 may be suspended from the strips 44.

A plurality of rigid, bent wires 48 are embedded in the arms of the press 12 and support a plurality of rectilinear uprights or rods 49 which extend parallel to one another and to the longitudinal axis of the vessel 10. One pair of opposed rods 49 are spaced at the free end by a pair of metallic bands or strips 50. The strips 50 are attached to the standard 17 and are provided with oppositely curved portions 51 disposed about and out of contact with one of the wires 22. Insulating members 52, such as quartz beads, are supported at the ends of the bands or strips 50 by stubs 53 and receive the ends of the spaced pair of opposed rods 49. These rods, however, are movable longitudinally due to the sliding fit in the quartz beads 52. A helical wire control electrode or grid 54, which may be of carbonized molybdenum, is mounted upon the uprights or rods 49 and is disposed about the cathode 27 and concentric therewith.

A plurality of leading-in conductors 55 are sealed in the press 12 and are electrically connected to certain of the bent wires 48. These conductors are joined to a terminal prong 56

mounted on an insulating member 57 which is secured to the end of the vessel 10.

A cylindrical anode 58, which may be of carbonized molybdenum, is disposed concentrically about the cathode 37 and grid 54 and comprises a plurality of arcuate sections having integral flanges 59, the flanges of adjacent sections being positioned in face-to-face relation and connected by bent integral tabs 60. A plurality of surface corrugations or embossments 61 are provided to prevent distortion of the anode by heat during the operation of the device. The anode 58 is supported from the stem 15 by a plurality of pairs of bent, rigid wires 62 which are secured to spaced split bands or collars 63 encircling the stem 13, by brackets 64. The bands or collars 63 are clamped about the stem 13 by bolts 65 and nuts 66 which pass through integral flanges 67 on the bands. A strip of wire gauze 68 is provided between each band 63 and the stem 13 to improve the frictional engagement therebetween. A pair of short, rigid wires 69 extend from the joined edges of the stems 13 and 14 and are connected to the wires 62 by metallic bands 70. Leading-in conductors 71 for the anode 58 are connected to the wires 69 and extend outwardly to terminal prongs 73 mounted upon a split metallic collar 72 clamped about the end of the enclosing vessel encircling the stem 13. The collar terminal construction is disclosed more fully and claimed in a copending application of V. L. Ronci and A. I. Crawford, Serial No. 413,165, filed December 11, 1929.

An annular troughed support 74 carries a quantity of getter material, such as magnesium, for fixing residual gases in the enclosing vessel 10, and is supported from the bent wire 21 by a short rod 75.

Although the invention has been disclosed in detail with reference to a cathode in an electron discharge device, it may, of course, be embodied in other devices, as for example, in filament structures of incandescent lamps or gaseous discharge tubes. Numerous modifications in addition to those shown and described may be made in the assembly of the superstructure without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A filament assembly comprising a plurality of filament sections, means engaging said sections at one end for rigidly fixing and spacing said sections, a rigid member having universal freedom of movement engaging said filament sections at the other end, and means engaging said member for maintaining a substantially uniform tension upon said sections.

2. A filament assembly comprising a central standard, a plurality of filament sections extending substantially parallel to said standard, a loose-fitting platform resiliently supported on said standard, and compensating means connected to said platform for relieving the strain between said filament sections.

3. A filament assembly comprising a standard, a filament having a plurality of sections disposed about said standard, a platform, means in contact with said platform and said sections for compensating for unequal expansion of said sections, and means mounting said platform from said standard for maintaining a substantially constant tension in said sections.

4. A filament assembly comprising a stem, a standard extending from said stem, a plurality of rigid conducting members embedded in said stem,

a platform mounted upon said standard and universally movable with respect thereto, and a plurality of filament sections suspended between said platform and said conducting members.

5. A filament assembly comprising a stem, a standard extending from said stem, a platform mounted upon said standard and universally movable with respect thereto, a plurality of filament sections disposed about said standard, and means pivotally mounted upon said platform and supporting said filament sections.

6. A filament structure comprising a central standard, a plurality of insulating members on said standard, a resilient member interposed between said insulating members, a platform seated on one of said insulating members and movable about said standard as an axis, a rocker arm on said platform, and a filament suspended from said rocker arm.

7. A filament structure comprising a stem, a standard extending from said stem, a plurality of conducting members embedded in said stem, a movable platform adjacent one end of said standard, a plurality of supporting members pivotally mounted on said platform, a plurality of filament sections suspended between said conducting and said supporting members, and resilient means mounting said platform from said standard.

8. A filament structure comprising a central standard, a plurality of filament sections extending substantially parallel to said standard, a loose-fitting platform resiliently supported on said standard, means between said filament sections and said standard for relieving strain in said sections, and a heat shield between said filament sections and said platform.

9. A filament assembly comprising a stem, a rod extending from said stem, a disc mounted upon said rod, a resilient member adjacent said disc, a platform supported by said resilient member and universally movable with respect to said standard, and a filament suspended from said platform.

10. A filament assembly comprising a stem, a rod extending from said stem, a heat shield mounted upon said rod, a helical spring mounted upon said shield, a platform supported upon said spring, an insulating button on each end of said spring between said shield and platform, a plurality of spindles extending from said platform, a rocker arm pivoted on each of said spindles, and a plurality of filament sections suspended from said rocker arms.

11. A filament assembly comprising a standard, an insulating member having a dome-shaped bearing surface resiliently mounted upon said standard, a platform loosely fitted about said standard and seated upon said surface, a plurality of filament sections disposed about said standard, and means carried by said platform and engaging said sections for relieving strain between said filament sections.

12. In an electron discharge device, an electrode assembly comprising a stem, a rod extending from said stem, an insulating member having a dome-shaped bearing surface slidably mounted upon said rod, a plate member seated upon said surface and loosely fitted about said rod, a plurality of spindles extending from said plate, a rocker arm pivoted on each of said spindles, a filamentary cathode suspended from said rocker arms, and means engaging said insulating member for maintaining a substantially constant tension in said cathode.

13. In an electron discharge device, an elec-

trode assembly comprising a stem, a plurality of rigid wires embedded in said stem, a standard having a shoulder thereon extending from said stem, a heat shield seated upon said shoulder, a helical spring adjacent said shield and encircling said standard, an insulating member resting upon said spring and slidable along said standard, said member having a dome-shaped bearing surface, a platform loosely fitted on said standard and seated upon said bearing surface, a plurality of rocker arms carried by said platform, and a filamentary cathode suspended between said rocker arms and said rigid wires.	80
14. An electron discharge device comprising an enclosing vessel having a reentrant stem, a rod extending from said stem, a metallic disc mounted upon said rod adjacent the end thereof remote from said stem, an insulating member seated upon said disc, a helical spring encircling said rod and seated upon said insulating member, an insulating bearing member engaging said spring and slidable along said rod, said bearing member having a dome-shaped surface, a metallic platform loosely fitted on said rod and seated on said bearing surface, a plurality of rocker arms pivoted on said platform, a filamentary cathode suspended from said stem consisting of a plurality of V-shaped sections lying in a substantially cylindrical boundary, a grid surrounding said cathode, and an anode surrounding said cathode and grid.	85
15. A filament assembly comprising a central standard, a plurality of filament sections extending substantially parallel to said standard, a universally movable platform resiliently supported on said standard, and connecting members between said platform and said filament sections, said connecting members being equally distributed about said platform.	90
16. A filament assembly comprising a central standard, a plurality of filament sections extending substantially parallel to said standard, a platform resiliently mounted on said standard, pivot members extending beyond opposite edges of said platform, and balance arms carried by said pivot members, said arms engaging said filament sections.	95
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