Oct. 10, 1939. T. G. CRAWFORD 2,175,880

ELECTRODE MOUNTING ARRANGEMENT

Filed May 31, 1939 2 Sheets-Sheet 1

Fig. 1.

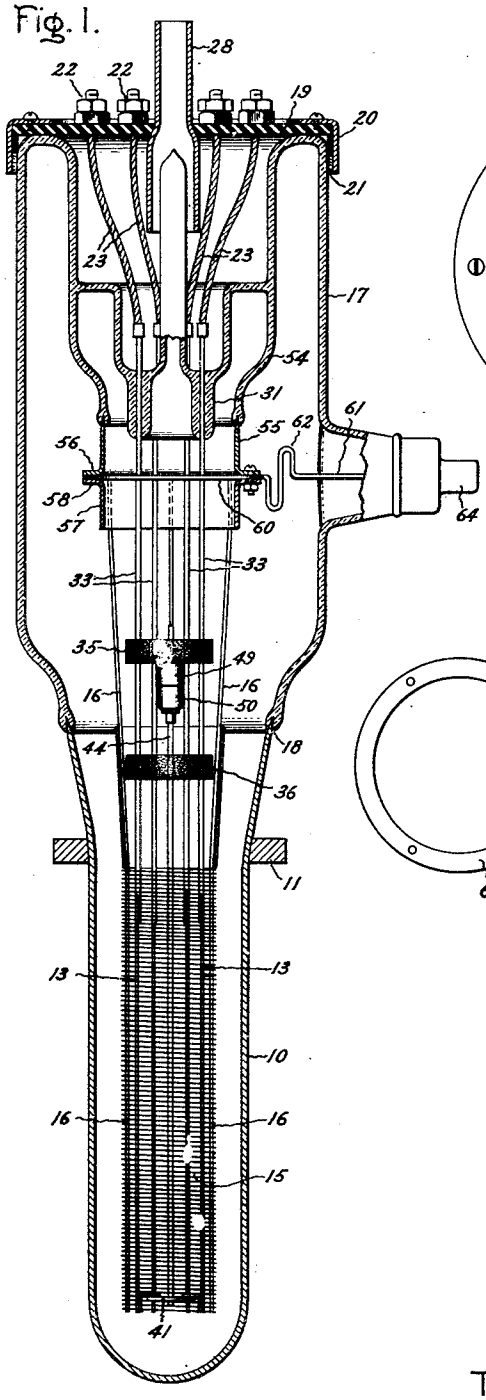



Fig. 2.

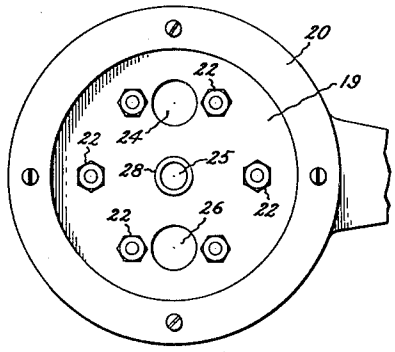
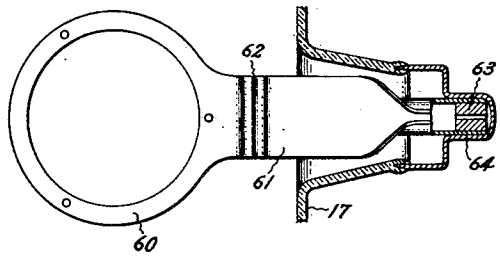



Fig. 6.




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Filed May 31, 1939 2 Sheets-Sheet 2

Fig. 3.

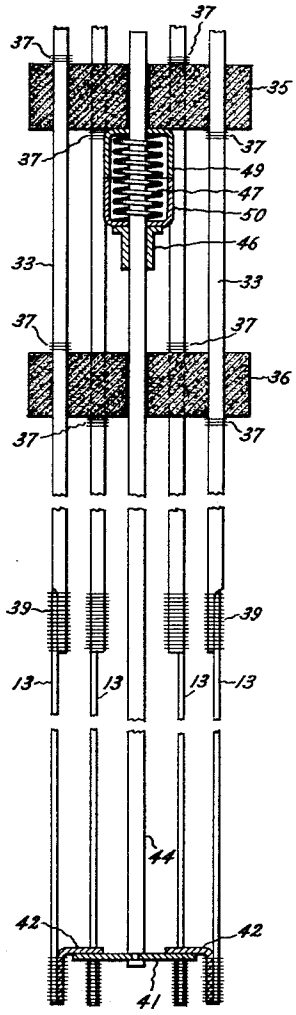



Fig. 4.

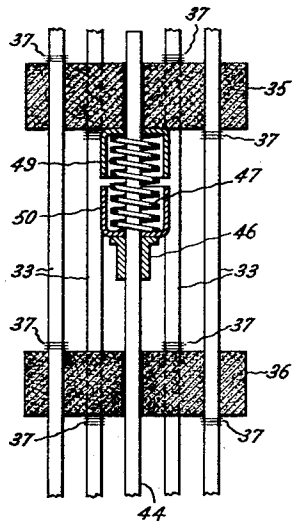
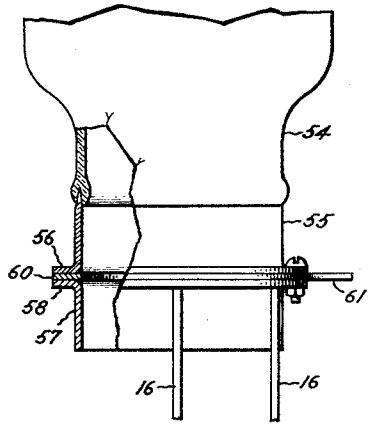



Fig. 5.




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# UNITED STATES PATENT OFFICE

2,175,880

## ELECTRODE MOUNTING ARRANGEMENT

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Application May 31, 1939, Serial No. 276,587

5 Claims. (Cl. 176—27.5)

The present invention relates to improved electrode mounting arrangements for electric discharge devices. While not limited thereto, the invention is especially applicable in connection with high frequency power tubes.

High frequency operation requires that the spacing of the cathode and grid elements be made as small as possible. However, compliance with this condition occasions considerable difficulty in maintaining the parts satisfactorily aligned and in preventing short circuiting of adjacent elements as a result of heat expansion.

It is an object of my present invention to provide an electrode mounting arrangement by which the above-mentioned difficulty may substantially be overcome.

In this connection, one important feature of the invention consists in the provision of improved means for adjusting and maintaining the tension of the cathode filaments to avoid the possibility of sagging.

Another feature comprises the use of a new form of grid mounting adapted to increase the ease and certainty of aligning the grid with the cathode.

The features which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the drawings in which Fig. 1 is a longitudinal sectional view of a discharge device suitably embodying the invention; Fig. 2 is an end view of the device of Fig. 1; Figs. 3 and 4 are fragmentary detail views illustrating the cathode spring mounting in two conditions of use; Fig. 5 is a view in partial section showing a detail of the mounting of the grid structure, and Fig. 6 is a detail view of the lead-in conductor for the grid.

Referring particularly to Fig. 1 there is shown a discharge device comprising an elongated cylindrical anode 10 consisting, for example, of copper which constitutes a portion of the enclosing envelope for the device. The anode is provided with an outwardly extending flange 11 to facilitate its assembly with a water jacket or other arrangement for bringing cooling fluid into contact with the exterior anode surface.

Within the anode and arranged coaxially therewith, there is provided a heatable cathode comprising a plurality of filaments 13 which are arranged in hollow configuration. These filaments are in turn surrounded by a grid structure which is shown as comprising grid wires 15 wound helically on a plurality of stay rods 16 which parallel the filaments 13. For high frequency operation the grid is preferably arranged very close to the cathode structure so that the spacing between the grid wires and the cathode filaments is on the order of .180 inch.

The open end of the anode is joined to a glass envelope 17 which is hermetically sealed to the anode as indicated at 18. At the end more remote from the electrode structure the envelope is provided with a base cap comprising a disk of insulating material 19. This is held in place by means of a flanged metal member 20 which is secured to the end of the envelope by appropriate cementing means as indicated at 21. The disk 19 serves to support a series of terminal connections 22 which are respectively associated with various lead-in conductors 23 for the cathode filaments. It further possesses a series of openings 24 to 26 inclusive which may serve for the ingress and egress of a current of air provided to cool the cathode lead-in seals. The central opening 25 is provided with a tubulation 28 adapted for connection to a source of air under pressure.

Within the enclosure formed by the envelope 17, there is provided a reentrant circular press 31. This serves as a mount for a plurality of filament support rods 33 which are connected outside the envelope with the current supply conductors 23. The rods 33 are maintained in alignment with one another by means of a pair of insulating disks 35 and 36 through which they respectively pass. As appears more clearly in Fig. 4 these disks are locked against longitudinal movement on the rods 33 by means of wire wrappings 37 or other keying means provided at appropriate points. The individual filament support rods respectively provide fixed anchorages and current supply means for the various cathode filaments 13, to which they are joined by means of wire wrappings as shown at 39 in Fig. 3.

The ends of the filaments 13 more remote from the filament support rods 33 are joined to a common mounting structure which comprises a circular disk 41 having a plurality of angle connectors 42 for connecting it with the various filaments. The disk 41 is fixedly secured to a rod 44 which, as will be hereinafter explained, serves as a means for applying tension to the filaments. Near the end opposite to the mounting disk 40 the rod 44 is provided with a fixed stop 46 (see Fig. 3) which serves as an abutment against which a compression spring 47 may act. The rod 44 is so dimensioned as to be freely movable through the insulators 35, 36 so that it tends to

move longitudinally under the action of the spring 47. It will be apparent also that the direction of its motion is such as to apply tension to the filaments 13.

At the respective ends of the spring 47, there are provided a pair of separable cup-shaped enclosure-forming members, numbered 49 and 50 respectively. In the arrangement shown in Fig. 3 these members provide a completely closed housing for the spring 47 and thus tend to shield it from the high frequency field and to protect it from heat developed in the discharge space. The members also increase the available radiating surface in the vicinity of the spring and cause it to run cooler than would otherwise be the case. These are found to be important factors in assuring that the spring shall not be heated sufficiently to diminish its elasticity and thus permit sagging of the filaments.

In addition to the characteristics just described the enclosure-forming members 49 and 50 have a still more useful function. Specifically, the members are so dimensioned with respect to the longitudinal dimensions of the spring 47 that they are adapted to engage in abutting relation when the degree of compression of the spring 19 is such as to apply to the filaments 13 the tension which they are desired to have in their cold state. This feature thus provides a means of adjusting the filament tension during the assembly process. In this connection, the spring 47 is compressed by exerting pressure on the member 41 until the housing parts 49 and 50 are brought into engagement. With this condition attained, the filaments 13 are drawn taut and welded or otherwise secured in place.

When the spring is released it serves to maintain the filaments in tension. The operation of the spring in this connection is illustrated in Fig. 4, which is assumed to represent the condition obtaining when the filaments 13 have expanded due to the application of heating current. It will be noted that the housing members 49 and 50 have parted slightly in accordance with the movement of the spring 47 as the latter expands to take up the looseness in the filaments.

The maintenance of alignment of the cathode filaments is adequately taken care of by the arrangement described in the foregoing. It is necessary, however, to assure that the grid alignment shall also be regulated within equally small limits. To this end, another important feature of my invention consists in an improved grid mounting.

In this connection there is provided in the region surrounding the circular stem press 31 a glass sleeve 54 which extends toward the interior of the discharge envelope. At its inner edge this sleeve is joined, preferably by a glass-to-metal seal, to a cylindrical metal member 55. This latter member may consist for example of a nickel-iron-cobalt alloy such as is described in Burger and Hull Patent 2,071,196. It is provided at one edge with an outwardly extending peripheral flange 56.

In cooperating relation with the cylindrical member 55 there is provided a similarly formed member 57 having a flange 58 which is adapted to abut with the flange 56. This latter member, consisting, for example, of molybdenum, acts as a direct support for the grid stay rods 16.

Interposed between the flanges 56 and 58 there is provided a flattened circular ring 60 which constitutes one terminal of a grid lead-in conductor. This ring may consist of silver-plated copper and is clamped between the flanges 56 and 58 so as to assure a complete circumferential contact therewith. The other features of the grid lead-in conductor are best illustrated in Fig. 6 wherein the ring 60 is shown as being integrally connected with a ribbon-like extension 61 having a reversely bent flexible portion 62 at an intermediate region thereof. The extremity of the part 61 is crimped about a cylindrical metal block 63 and is silver soldered into a cooperating contact member 64 which is hermetically sealed into a wall of the envelope 17. In use, the contact member 64 is connected to an appropriate source of grid potential. An important advantage of the grid mounting thus described—in addition to its utility in assuring fixed alignment of the grid—consists in its effectiveness in protecting the glass part on which it is mounted from burning as a result of high frequency effects. Such burning presents a difficult problem in connection with conventional arrangements in which the grid supporting means is clamped about a glass stem provided for that purpose.

While I have described my invention in connection with a particular embodiment thereof, it will be understood that numerous modifications may be made by those skilled in the art without departing from the invention. I therefore aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

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

1. In an electrical discharge device comprising an anode and a cathode of a type which includes elongated filaments, the combination of a compression spring for tensioning the filaments and a pair of separable enclosure-forming members respectively mounted on the opposite ends of said spring and providing a housing therefor, the dimensions of said members being so correlated to the dimensions of the spring as to assure the engagement of the members in abutting relation when the spring is compressed to a degree corresponding to a desired tension of the filaments in cold state.

2. In an electrical discharge device having an elongated anode and a plurality of cathode filaments arranged in parallelism with said anode, the combination which includes a stationary terminal anchorage for said filaments, a movable element connecting with the ends of said filaments remote from said anchorage, means including a longitudinally extensible compression spring acting on said element in such direction as to tension the filaments, and a pair of separable enclosure forming members respectively secured to the ends of said spring and providing a housing therefor, the dimensions of the members being so correlated to the dimensions of the spring as to assure their engagement in abutting relation when the spring is compressed to a degree corresponding to the desired tension of the filaments in cold state.

3. An electrical discharge device for use at high frequencies including an elongated cylindrical anode, a cathode comprising a plurality of filaments arranged within the anode, a grid enclosing the cathode in closely spaced relation thereto and means for maintaining the filaments in tension to prevent sagging and the consequent possibility of contact with the grid, said means including a compression spring, a movable rod arranged coaxially with the grid and cathode

and actuable by said spring to exert tension on the cathode filaments, and a pair of cup-like members providing a housing for the spring, said members being separable in accordance with the degree of extension of the spring and being so correlated to the dimensions of the spring as to assure their engagement in abutting relation when the spring is compressed to a degree corresponding to the desired tension of the filaments in cold state.

4. In a discharge device having an elongated cylindrical anode, a cathode arranged within the anode and a grid surrounding the cathode, the combination which includes an envelope for the device having a re-entrant stem press at one end of the device, conductors extending from said press to the cathode, a re-entrant glass sleeve surrounding the said stem press, a first cylindrical metal member secured to said sleeve at one edge thereof, a second cylindrical metal member abutting the first in end-to-end relation and serving as a mount for support rods for said grid, and a grid lead-in connection terminating in a circular ring which is clamped between the abutting surfaces of the said cylindrical members.

5. In a discharge device having an elongated cylindrical anode, a filamentary cathode within the anode and a grid surrounding the cathode, the combination which includes an envelope for the device having a re-entrant stem press at one end of the device, conductors extending from the press to said cathode, a glass sleeve surrounding said press and projecting toward the interior of the envelope, a first cylindrical metal member fusion sealed at one end to said sleeve and having a peripheral flange at the other end, a second cylindrical metal member serving as a mount for support rods for said grid and having a flange conforming to said first named flange, and a grid lead-in conductor terminating in a circular ring which is clamped between the said flanges of the two cylindrical members.

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