July 28, 1936. M. I. KAHL 2,049,164

ELECTRIC DISCHARGE DEVICE

Filed Dec. 2, 1933

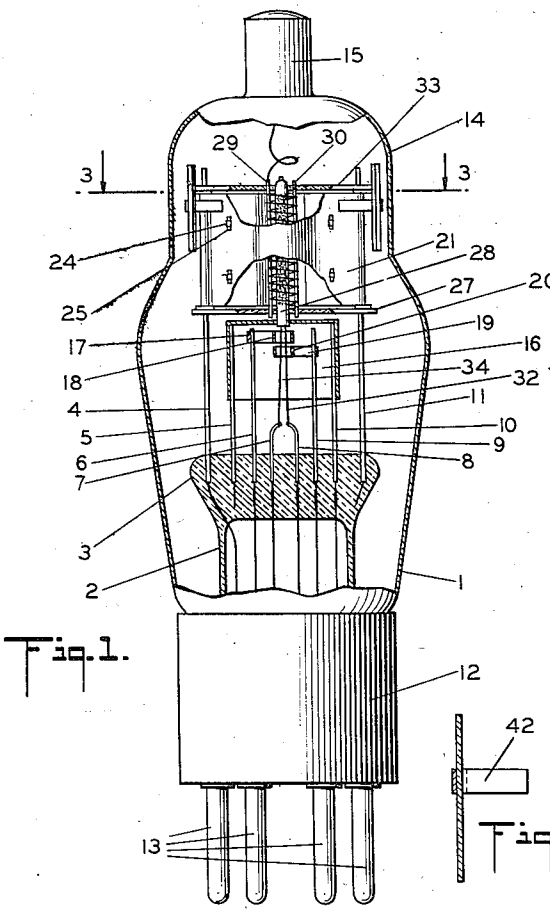


Fig. 1.

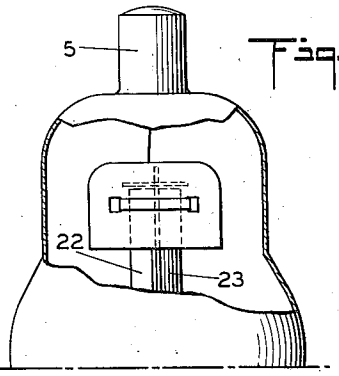


Fig. 2.

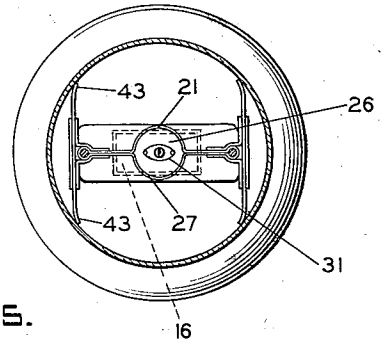


Fig. 3.

Fig. 5.

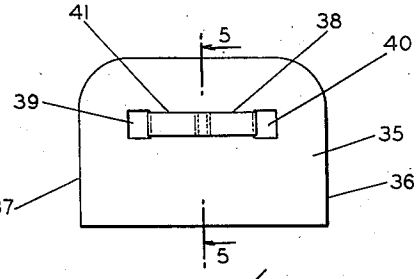


Fig. 4.

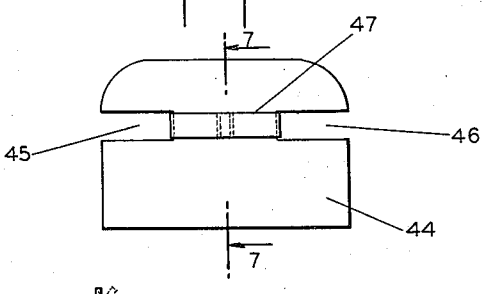


Fig. 6.

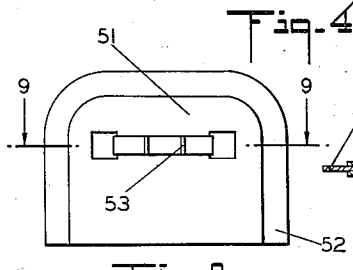


Fig. 8.

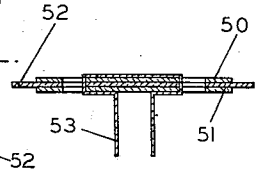


Fig. 9.

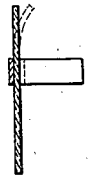


Fig. 7.

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Patented July 28, 1936

2,049,164

UNITED STATES PATENT OFFICE

2,049,164

ELECTRIC DISCHARGE DEVICE

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Application December 2, 1933, Serial No. 700,644

13 Claims. (Cl. 250—27.5)

This invention relates to electric discharge devices and with particularity to devices generally referred to as radio tubes, vacuum tubes, or the like.

An object of the invention is to provide a novel method of supporting the electrode assembly of an electron discharge tube or the like.

Another object is to provide a novel device for resiliently supporting an electrode assembly interiorly against the wall of an enclosing envelope or the like.

In radio tubes generally, and more especially in the modern types of tubes, it is imperative that the various electrodes of the electrode assembly be maintained accurately in predetermined spatial relations, both with respect to one another and also with respect to the wall of the enclosing envelope which is usually provided with an external or internal shield. So-called "unitary" mounts or electrode assemblies have hitherto been provided wherein the electrodes are interlocked by means of insulating spacers or the like, and the electrodes after being thus assembled are supported from the press of the tube envelope. While such tubes are capable of maintaining their inter-electrode spacings, nevertheless the entire weight of the electrode assembly must be borne by the press and the various wires sealed therein, the upper end of the assembly being usually free. Under certain conditions such as excessive external vibrations, the electrode assembly tends to sway or vibrate around the press support wires, so that the press adjacent these wires may crack, or one or more of the seal-ins may become defective. At the same time this vibration changes the electrostatic relation to the shield. If the vibration is not sufficient to destroy the seal, it may result in changes in the geometric configuration of the discharge space within the tube, by causing the assembly to vary its position with respect to the tube walls. This vibration usually results in so-called microphonic disturbances in the output of the tube when the latter is in use.

Accordingly, one of the principal objects of this invention is to provide a radio tube, lamp or similar device, wherein the filament or electrode assembly is supported both from the press as well as from the upper end of the envelope, whereby variations in the characteristics of the tube are substantially prevented even when the tube is subjected to heavy jars or vibrations.

Another object of the invention is to provide a so-called single-press tube with means for supporting the electrode assembly against tilting movement with respect to the press without at the same time materially increasing the assembly cost or assembly time.

A feature of the invention relates to a radio tube of the so-called "dome" envelope type in conjunction with a novel form of spacer for insulatingly supporting the electrode assembly within the dome.

A further feature relates to a novel form of "dome" spacer for radio tubes, the spacer being designed and proportioned so as to be deformable at its ends whereby it automatically conforms itself to different sizes and shapes of domes.

A further feature pertains to the novel manner of supporting a dome spacer from the electrode assembly of a radio tube.

A still further feature relates to improvements in so-called "unitary-assembly" tubes, whereby the cost of manufacture is reduced, while the reliability and accuracy of performance under varied operating conditions are materially increased.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following descriptions and the appended claims.

While the invention will be disclosed herein as embodied in specific forms, it will be understood that the invention is not limited thereto, but is capable of embodiment in tubes, lamps and similar devices of different shapes and sizes.

According to the drawing, Fig. 1 is a front elevational view, partly in section, of a radio tube embodying features of the invention;

Fig. 2 is an enlarged side view of the upper end of the tube shown in Fig. 1;

Fig. 3 is a sectional view of Fig. 1, taken along the line 3—3 thereof;

Fig. 4 is a detail view of one of the spacers according to the invention;

Fig. 5 is a sectional view of Fig. 4, taken along the line 5—5 thereof;

Fig. 6 is a view of a modified form of spacer;

Fig. 7 is a sectional view of the spacer of Fig. 6 taken along line 7—7 thereof;

Figs. 8 and 9 are detail views of a modification of the spacer of Figs. 1 to 7.

Referring more particularly to Figs. 1 and 2, the numeral 1 indicates an enclosing envelope of glass or other suitable material such as ordinarily employed in radio tubes, lamps, etc. Envelope 1 is provided with a re-entrant stem 2 which terminates in the usual press 3, where-

in are sealed the various lead-in and support wires 4 to 11 inclusive. The envelope 1 has fastened to its lower end the conventional base 12 carrying the usual contact prongs 13. Envelope 1 terminates at its upper end in a substantially cylindrical dome-shaped portion 14 which carries the metallic contact cap 15, it being understood of course, that the envelope 1 is hermetically sealed and exhausted in accordance with standard radio tube procedure, although as will be apparent from the following descriptions, the invention is not limited to so-called high vacuum tubes, but may be equally well embodied in so-called gas or vapor tubes. Attached to the wires 5 and 10 is a metallic electrode 16 rectangular in cross-section and having its upper end preferably closed, except for a small perforation for the passage of the cathode, as will be described hereinbelow. It will be understood, of course, that electrode 16 may be cylindrical or other suitable shape. Fastened to wire 6 is a metallic strip which at its unfastened end is in the form of a cylindrical ring. A similar member 19 is fastened to wire 9, and as shown, the ring portions 18 and 20 are in vertical axial alignment.

Supported on the wires 4 and 11 is a plate electrode 21 consisting of a pair of metallic members having their median portions pressed to semi-cylindrical form. One of the plate members may be provided with a plurality of small perforations 24, in its lateral flat portions, and the other plate member may be provided with a corresponding plurality of struck-up lugs 25 whereby the two plate members may be rigidly locked together as a unit to define a central cylindrical electrode space 26. The outer lateral edges of the plate members surround the wires 4 and 11 to which they may be fastened as by welding or the like. Preferably, although not necessarily, the surface of the plate members is carbonized for purposes well known in the radio tube art. Preferably, the plate members are mounted so that the cylindrical electrode space 26 is in vertical axial alignment with the ring electrodes 18 and 20. Positioned between the electrode 21 and the electrode 16 is a strip 27 of insulating material such as lava, mica or the like, provided with a central perforation through which passes the lower end of the indirectly heated cathode sleeve 28, and also with sets of lateral perforations to receive the plate support wires 4 and 11, and the support wires 29 and 30 for the helically wound grid 31. The wires 4 and 11 may be provided with suitable lugs or projections to prevent the strip 27 moving vertically. As shown in the drawing, the cathode comprises the usual hollow metallic sleeve 28 which is provided on its external surface with an an electron emissive coating. Passing interiorly through the sleeve 28 is a filament 32 which may be in the form of an inverted V, provided with a coating of a suitable refractory insulating material as disclosed in Patent No. 1,950,456. If desired, although not necessarily, the bight of the filament may be held between the pinched end of the sleeve 28. Or, if desired, the end of the sleeve may be left unpinched and the filament supported in any manner well known in the art and insulated from the sleeve 28. An insulator strip 33 similar to strip 27 is provided at the upper end of the electrode 21 and is held in place by suitable lugs (not shown), welded or otherwise fastened to the wires 4 and 11. As shown in Fig. 1, the filament heater for the upper cathode 28 extends downwardly through the ring electrodes 18 and 20 and the free ends of the filament are welded to the filament lead-in and support wires 7 and 8. Thus electrodes 18 and 20 may serve as "diode" anodes to the lower end of the cathode and electrode 16 may serve as a shielding electrode to shield electrodes 18, 19 and 20 from electrode 21. Preferably also electrode 21 is electrically connected to the sleeve 28 as shown.

As will be evident from the foregoing, the greater part of the weight of the electrode assembly is distributed towards the upper end of the main support wires 4 and 11, and thus at a relatively great distance from the edge of the press 3. In order to prevent the electrode assembly tilting about the seal-in points in the press, there are provided between the upper end of the electrode assembly and the wall of the dome-shaped portion 14, what may be termed resilient spacers. Ordinary shock take-up devices such as rubber, springs, etc., are entirely unsuitable for this purpose. Further, since there may exist differences in internal diameter of the envelope dome, ordinary rigid spacer members are impracticable for large scale production. Accordingly, there is disclosed in Figs. 1 to 5 a novel form of spacer that possesses the following advantageous features:

(1) Low heat conductivity;

(2) Minimum gas absorption;

(3) Sufficient rigidity to support the electrode assembly against heavy jars while having sufficient "edge" deformability to automatically accommodate the pad to varying internal diameters and shapes of dome.

As shown in Figs. 1 to 5 inclusive, the spacer is in the form of a sheet or strip 35 of mica or other similar insulating material, of sufficient thinness at its edges 36, 37 so that the edge portions can be slightly rounded or deformed, as shown in Figs. 3 and 6, to conform to the curvature of the dome 14. It will be also understood that the mica or other insulating strip used for this purpose has sufficient resiliency or flexibility that the rounding of the edges resulting from engagement with the dome, does not permanently deform the mica. It has been found that ordinary methods of fastening mica as by cement, rivets, etc., are unsuitable for use in spacers as described. Accordingly, the mica sheet 35 is provided with a metallic strap 38 of nickel or other suitable metal. This strap serves the double purpose of providing a weldable attachment lug and at the same time acting as a reenforcement for the central area of the mica. This latter feature is of importance since the mica may otherwise be subjected to sufficient bending forces as to cause it to break or chip. Consequently, as shown in Figs. 2 and 4, the mica sheet 35 is provided with two rectangular openings 39 and 40 through which passes the metal strap 41. As shown more clearly in Figs. 3 and 5, the said strap is bent to substantial T-shaped formation so as tightly to grip the mica on opposite faces, and with the projecting ends 42 serving as lugs for welding or otherwise fastening to the support wires 4 and 11. A pair of these mica spacers are attached to the plate support wires 4 and 11, preferably at or near their upper ends, so that the vertical edges of the mica spacers engage the wall of the dome as shown in Fig. 3. Preferably also, the mica spacers are of such a length that their vertical edges are slightly deformed or rounded by pressing against the dome wall as indicated by the numeral 43 (Fig. 3). Since the metal strap does not extend to the edges of the

mica spacer, only the median portion of the spacer is reenforced so that the non-reenforced portions are capable of considerable deformation without danger of breaking or cracking. Furthermore, the mica is preferably chosen of sufficient thinness as to provide the necessary resiliency or flexibility at its lateral edges.

The pressure against the dome thus exerted by the deformed lateral edges of the mica, provides what may be termed "cushioned resistance" to motion of the electrode assembly in a direction perpendicular to the plane of the mica, and at the same time the lateral edges offer a similar cushioned resistance to motion or vibration of the electrode assembly in a direction parallel to the mica. Thus there is provided a four-point resilient support for the upper end of the electrode assembly. It will be understood, of course, that the micas may be chosen of sufficient thickness to practically prevent motion of the assembly in response to vibrations of small amplitude, but are capable of resilient cushioning in response to heavy jars or vibrations. Furthermore, the mica is capable of self-conformation to the curvature of the dome and thus entirely prevents rattle between the mica and the wall of the dome.

While the drawing shows the mica spacers engaging the dome walls only at the vertical edges, it will be understood that if desired, the said spacers may be mounted so that their upper horizontal edges engage the dome also. It will be apparent from Fig. 4, for example, that because of the openings 39 and 49, the upper edge portion of the mica is capable of limited deformation, if it is desired to have the upper edge bear against the dome.

Referring to Figs. 6 and 7, there is shown a modified form of spacer in which the mica sheet 44, instead of being perforated to receive the reenforcing strap, is provided with aligned slots, around which the metal 47 is strapped. In this embodiment, therefore, a greater amount of flexible deformation along the vertical edges, as well as along the upper edge is attainable.

Figs. 8 and 9 show a still further modification of the spacer whereby greater flexibility is provided at the edges with increased strength in the central areas. This form of spacer is very useful where relatively great distances are to be spanned. As will be seen, this modification consists of a pair of mica discs 50, 51 of the same general shape as the disc 35 (Fig. 4), and interposed between discs 50, 51 is a third similar but larger disc 52, the three discs being held together by a metal strap 53 similar to strap 41 (Figs. 1 to 7). It will also be understood that the embodiment of Figs. 6 and 7 may be modified in accordance with the teaching of Figs. 8 and 9 so as correspondingly to reenforce and render more flexible the embodiment of said Figs. 6 and 7.

It will be understood that the invention is not limited to a so-called press, but is capable of embodiment in any well-known type of tube. Accordingly, the term "base" as employed in the claims, is intended to cover a press or any other portion of an enclosing envelope which carries one or more electrodes.

If desired, the cathode sleeve 28 may terminate just above the electrode 18 so that only the filament 34 extends through the electrodes 18 and 20. In this latter case the portion of the filament extending through the electrodes 18 and 20 may be provided with an electron emissive coating.

While the drawing shows a tube provided with a pair of oppositely disposed mica spacers, it will be understood that a greater or less number of these spacers may be provided, and that they may be attached, in the manner shown, at any other point, so long as they are positioned between the electrode assembly and the wall of the envelope. Various changes and modifications may therefore be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In combination, an enclosing envelope having a base, an electrode within said envelope supported at one end from said base, a strip of insulation having deformable end portions engaging the wall of said envelope to support said electrode at its upper end in spaced relation to said wall, and metallic means passing through said strip to reenforce it at its central portion, said metallic means being attached to said electrode.

2. In combination, an enclosing envelope having a base, a metallic upright sealed into said base, a strip of insulation having deformable end portions engaging the wall of said envelope, a metal strap passing around a portion of said strip to reenforce said strip at its center and to provide means for mounting said strip on said upright.

3. In combination, an enclosing envelope having a base at one end and a dome at the other, a pair of metallic uprights sealed at one end into said base, and a pair of insulation members each having a reenforced central portion and flexible end portions, said members being supported at the upper ends of said uprights and in engagement with the inner wall of said dome.

4. The combination according to claim 3, in which each insulator member is of mica around which passes a metal strap for reenforcement and attachment to said uprights.

5. In combination, an enclosing envelope having a base containing an electron emitting cathode and an anode therefor, another electron emitting cathode and an anode therefor, a pair of uprights sealed into said base for supporting the second anode, another pair of uprights sealed into said base for supporting the first anode above the second anode, a pair of insulator strips supported at the upper ends of the second-mentioned uprights, said strips having reenforced central portions and deformable end portions adapted to engage the inner wall of the envelope.

6. The combination according to claim 5, in which the anodes are hollow and are supported in end-to-end relation and the insulator members are of mica.

7. In combination an enclosing envelope having, a press, a metallic upright sealed into said press, a sheet of mica, an attachment lug for said sheet comprising a metal strap attached to the mica having its ends projecting through the mica, said lug being supported by said upright and with the edges of said sheet flexibly engaging said envelope.

8. In combination, an evacuated envelope containing a tubular cathode, a heating filament for said cathode, a hollow anode surrounding one end of said filament, another hollow anode surrounding another portion of said filament, said other portion of said filament being coated with an electron emissive coating, and sheet insulator means for resiliently spacing the first-mentioned anode from the inner wall of said envelope.

9. The combination according to claim 8, in which the insulator means is in the form of a

strapped mica strip attached to the first-mentioned anode.

10. In combination, an evacuated envelope, an electrode assembly within the envelope including an upper cathode, a lower cathode, common filament means for rendering both said cathodes emissive, a plurality of electrodes surrounding the upper cathode, a plurality of electrodes surrounding the lower cathode, and resilient insulating means carried by said assembly and engaging the inner wall of said envelope.

11. An anti-vibration spacer for radio tubes comprising a sheet of insulating material having flexible end portions, a metal strap for reenforcing the median portion of said sheet and having a portion extending at right angles to said sheet to serve as an attachment lug.

12. A spacer member for spacing an electrode of a radio tube from the wall thereof comprising a sheet of mica having resilient edge portions and provided with a pair of aligned openings, a metallic strap surrounding said sheet between said openings to reenforce said sheet between said openings, the ends of said strap passing through said openings to serve as an attachment lug.

13. A spacer member for spacing an electrode of a radio tube from the wall thereof comprising a pair of mica discs, one of said discs being larger than the other, and a metal strap clamping said discs together, said strap terminating in a projection for attaching said spacer to a support.

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