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2,233,795

ELECTRON DISCHARGE DEVICE

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Fig. 1

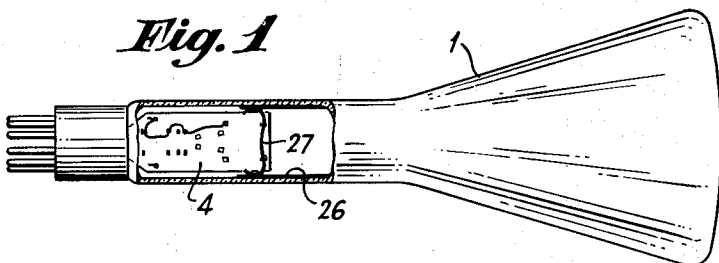


Fig. 2

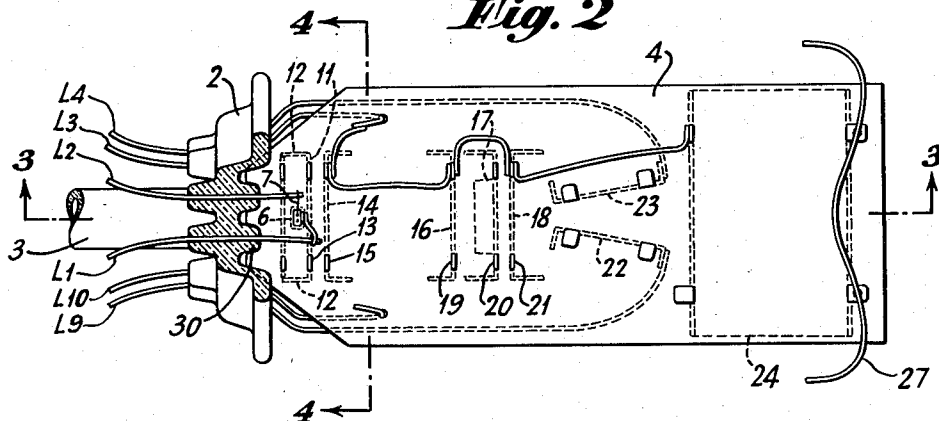


Fig. 3

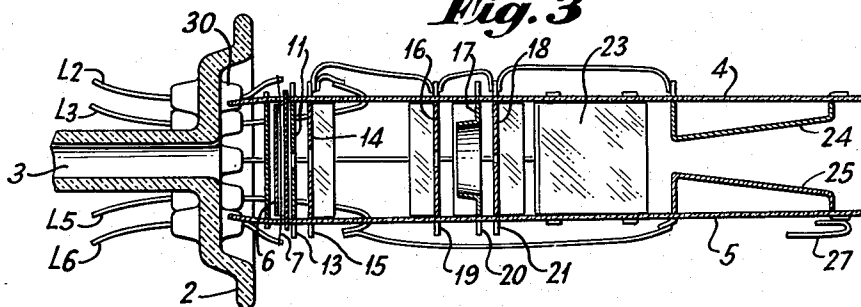
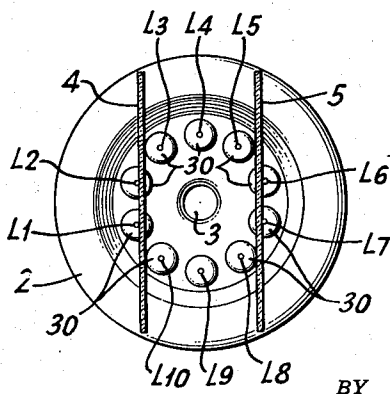


Fig. 4



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ELECTRON DISCHARGE DEVICE

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7 Claims. (Cl. 250—141)

My invention relates to electron discharge devices and particularly to mount structures and means to support the electrodes in such devices.

The electrodes of cathode ray tubes are usually mounted within an envelope and supported from rigid conductors which extend from the lead wires sealed in the stem or press of the tube. The lateral support furnished the electrodes by such conductors is usually insufficient where accurate alignment of the electrodes must be maintained, as in cathode ray tubes having a cathode supported in axial alignment with a plurality of apertured disks or cylinders. While it has been customary to support the free end of the electrode structure, such as from the sides of the envelope, this means of support is usually inadequate to meet the requirements of proper and permanent alignment.

One object of my invention is to provide an improved cathode ray gun of greater rigidity and with better alignment of the electrodes than is found in conventional devices of the kind. It is another object to provide a structure adapted to a simplified and improved method of assembling the electrodes into a rigid and accurately aligned cathode ray gun assembly.

In accordance with my invention, I provide an electrode structure which is resiliently supported from one end by a plurality of members under mechanical stress so that lateral displacement of the electrodes is greatly reduced or wholly eliminated. Further in accordance with my invention, I provide a resilient supporting means and so proportion the supporting means and the electrodes that the supporting means is under constant mechanical stress, such as tension or compression. These and other objects, features and advantages of my invention will become apparent when considered in connection with the following description and the accompanying drawing in which:

Fig. 1 is a longitudinal view of a cathode ray tube incorporating my improved electron gun and mount structure;

Fig. 2 is a plan view of the mount structure, partially in section;

Fig. 3 is an elevation view of the mount structure in full section taken along the lines 3—3 of Fig. 2, and

Fig. 4 is a view showing the stem and electrode supports without the electrode structure shown in Fig. 2 taken along the lines 4—4 in Fig. 2.

The cathode ray tube shown in Fig. 1 is, in general, of the conventional type wherein the evacuated envelope or bulb 1 has a fluorescent

screen or target at the large end and, at the other end, a tubular neck which contains an electron gun and mount structure supported from a stem 2 through which the current-carrying leads enter the bulb 1. The leads through the stem 2 are preferably arranged annularly of a central exhaust tube 3.

Accurate alignment of the electrodes supported by the stem 2 is essential for the proper operation of the tube, and this alignment should be maintained in use, notwithstanding variations in temperature to which the electrodes are subjected either in manufacture or use. A common way of holding the electrodes in alignment is to provide rigid conductors extending from the stem and to weld the projecting ends of these conductors to the electrodes while the electrodes are held in alignment on a mandrel or in a jig. This method of assembly is relatively slow, requires considerable hand work and skill, and experience has shown that the electrodes of such a structure quite often move out of alignment either just subsequent to assembly or during use of the tube.

In accordance with my invention, I maintain the electrodes of the electron gun and mount structure in rigid and permanent alignment by providing two substantially parallel planar support members which extend from and are supported by the stem in a novel manner. Each of the electrodes is provided with integral lugs or tabs which are inserted in accurately punched holes or slots in the parallel support members. Referring particularly to Figs. 2 and 3, the mount support members 4 and 5 are preferably of resilient material, such as two sheets of mica, and in accordance with my invention, extend from and are supported by the stem member 2 in substantially plane parallel relation, as will appear hereinafter more in detail. The electron gun electrodes comprise the tubular cathode 6 which extends transversely of the longitudinal axis of the mount structure and is supported close to its ends by the two support members 4 and 5. The cathode 6 is provided on its surface facing away from the stem 2 with an electron emissive coating such as barium or strontium oxides, and the cathode with its oxide coating is heated by a filamentary heater 7 positioned within the cathode and supplied with current through two of the leads sealed in the stem. Between the stem and cathode I provide a stem shielding member to prevent electrons from collecting thereon, and on the opposite side of the cathode and closely adjacent the cathode I provide an apertured grid

electrode 11 having flanges 12 provided for mechanical rigidity. The grid electrode 11 is also provided with four lugs or tabs 13, two of which extend through each of the support members 4 and 5. The grid electrode 11 is provided with an aperture centrally positioned with respect to the emitting portion of the cathode 6 so that electrons issuing from the cathode are directed toward and through an apertured accelerating electrode 14, likewise having its aperture centrally located and aligned with that of the grid electrode. The accelerating electrode is likewise provided with lugs or tabs 15, extending through the two support members. The spacing between the grid electrode 11 and the accelerating electrode 14 is relatively small and is determined by the electrical characteristics desired for any particular cathode ray tube construction, as well known in the art. Located at a substantial distance from the accelerating electrode 14 I provide an apertured electrode 16 which is electrically connected to the accelerating electrode. The next electrode in progressing from the cathode may be termed a first anode 17, since it is operated at a lower positive voltage with respect to the cathode than the accelerating electrode. The next electrode, which I will term the second anode 18, is located adjacent the first anode 17 but further removed from the cathode. Each of the above-described electrodes is provided with lugs or tabs such as the tabs 19 on the apertured electrode 16, the tabs 20 on the first anode 17, and the tabs 21 on the second anode 18 which may be bent over after being inserted through the support members 4 and 5 to retain the electrodes in position. My invention is not particularly directed to the specific shape or separation of the afore-mentioned electrodes but is rather directed to the method of supporting such electrodes, and for this reason, the particular shape and location, together with the aperture sizes of these electrodes are not set forth in detail, inasmuch as these factors may vary within wide limits depending on the particular application for which the tube is designed.

Further in accordance with my invention and in addition to supporting the electrodes referred to above, I use the support members 4 and 5 for supporting the first set of electrostatic deflection plates, such as the plates 22—23, and the second set of deflection plates 24—25. Each of these plates is provided with lugs or tabs which extend through the two support members 4 and 5 in a manner similar to that explained in connection with the electron gun electrodes. The two sets of plates 22—23 and 24—25 are mounted in a mutually perpendicular manner so that the electrons liberated from the cathode and directed toward the fluorescent screen referred to in connection with Fig. 1 may be deflected in two mutually perpendicular directions to scan the fluorescent screen. As shown by the drawing, the plates 22—23 are supported between the support members 4 and 5, while the plates 24—25 are individually and wholly supported by the support members, plate 24 by the member 4 and plate 25 by the member 5.

I have shown the base 2 as having ten lead wires, numbered consecutively L_1 — L_{10} , sealed therein, this number being sufficient for the electrodes used in the type of tube illustrated in the drawing. The lead L_1 is connected to the cathode 6; L_2 and L_3 to the heater 7; L_4 to the accelerating electrodes 14 and 16, the second anode 18 and the deflection plate 24; L_5 and

L_6 to the deflection plates 23—25 and 22 respectively; L_7 to the grid electrode 11; L_8 to the first anode, leaving L_{10} for use in flashing a getter (not shown) of the type disclosed by E. A. Lederer in U. S. Patent No. 2,130,190.

Referring more particularly to my method of supporting an electron gun and deflection structure, it will be observed by referring to Figs. 2 and 3 that the support members 4 and 5 extend to and are supported on the stem 2. Each of the lead wires L_1 to L_{10} extending through the stem 2 is provided with beads or fillets 30 which are integral with the stem 2, extend within the bulb 1 above the stem and rigidly support the leads passing therethrough.

The support members 4 and 5 which are made of resilient material such as mica have one edge cut out to conform to the fillets 30, as best shown in Fig. 2, to give an increased area of support on the stem 2. The leads L_3 and L_{10} are bent toward and passed through the support member 4 to hold it against the stem, and the leads L_5 and L_8 are similarly bent toward and passed through the support member 5 in a similar manner so that these support members are held against the stem.

I prefer to use at least four leads for the lateral support of the support members 4 and 5. Thus two pairs or groups of leads, L_1 — L_2 and L_6 — L_7 , are on opposite sides of the longitudinal axis of the tube, that is, on opposite sides of the exhaust tube 3, and each of the support members 4 and 5 abut one pair of these leads.

I have referred to maintaining the support members under mechanical stress and I therefore proportion the length of the electrodes, especially those near the stem, and the thickness of the support members 4 and 5 so that the support members are forced toward and fit snugly against the leads which pass through the stem. More specifically, the length of the electrodes, such as the grid 13 and accelerating electrode 14 in the direction perpendicular to the planes of the support members plus the thickness of the support members, is made greater than the separation between the leads L_1 — L_7 and between the leads L_2 — L_6 . Since the support members 4 and 5 abut and are wedged against the leads, it will be observed that the support members bulge inwardly toward each other adjacent the stem so that the surfaces of the support members adjacent the stem are no longer truly parallel. Thus the distance between the support members immediately adjacent the stem is less than the distance between the support members at points adjacent the electrode nearest the stem member. The support members may, however, be said to be still substantially parallel. One or more of the electrodes such as the electrodes 16 and the first or second anodes 17 and 18 may be made somewhat shorter in a direction between the support members 4 and 5 to bow the support members back toward the axis of the tube. This will insure even greater rigidity of the mount structure. While I prefer to bulge the support members inwardly, that is, toward the longitudinal axis of the tube, the support members may be located on the opposite sides of the leads L_1 — L_2 and L_6 — L_7 , whereupon the length of the electrodes, such as the grid 13 and accelerating electrode 14, is made less than the distance between the adjacent surfaces of the support members at points immediately adjacent the points of entry of the lead wires into the bulb 1. With this alternative construction the support members are bulged outwardly, that is, away from the

longitudinal axis of the tube at points adjacent the stem. In this modification, one or more of the electrodes, such as those designated 16, 17 or 18, may be made somewhat shorter than the electrodes 11 and 14 to insure increased rigidity. As a result of my new and improved construction, the support members 4 and 5 are maintained under mechanical stress within the elastic limit of the material such as mica comprising said members, are rigidly anchored to the stem member and are restrained from bowing either during the manufacturing process or during use. While I prefer to use the leads passing through the stem 3 to provide an abutting lateral support for the support members, at least four rigid members embedded in or formed integrally with the stem and extending within the envelope space would serve an identical purpose.

My improved mount assembly is very easy to assemble, since all of the electrodes are mounted either between or on two substantially parallel sheets of resilient material which I have referred to as the support members. Material such as mica may be punched very accurately by the use of conventional punching dies, and both of the support members may be identical. Following the punching operation, the electrodes are assembled, preferably starting from the cathode end of the assembly by inserting the lugs or tabs through correspondingly punched holes or slots, and since it is relatively easy to provide flat or flanged accurately dimensioned electrodes, it is not necessary to use elaborate jig structures during the assembly process. In addition, the use of the substantially parallel support members facilitates the assembly of the deflection plates, since they may be mounted directly upon the support members. Since it is customary in the art to support the deflection plates from either the bulb wall or on brackets, it will be obvious that the use of my improved supporting means considerably reduces both the cost and labor in assembly.

Following the assembly of the mount as described above, the stem may be sealed to the neck section of the bulb 1 which, if desired, may carry a conductive coating 26 to provide a continuation of the second anode 18. The conductive coating may be connected through the bulb wall to an outside potential source, or electrical contact may be obtained by connecting a resilient conductor 27 between one of the electrodes at second anode potential such as the deflection plate 24 and the conductive coating 26. Following the sealing of the stem carrying the mount structure, the tube may be evacuated through the exhaust tube in a manner well known in the art.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated its use in cathode ray tubes, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that it is equally applicable to other tubes of the electron discharge type and that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

I claim:

1. An electron discharge device including an envelope, a stem member at one end of said envelope, at least four rigid members extending from said stem into said envelope, a pair of planar rigidly separated support members of elec-

trically insulating material supported by, extending in one direction only from, and resting on said stem, each of said support members abutting two of said rigid members and being wedged between said rigid members and resiliently distorted from their planar condition adjacent said stem member to restrain said support members against lateral motion transverse to the planes of said support members and a plurality of electrodes extending between and supported by said support members.

2. An electron discharge device having an elongated envelope, a stem member closing one end of said envelope, a centrally positioned exhaust tubulation in said stem member, at least four rigid leads sealed through said stem member and extending within said envelope and arranged so that at least two of said rigid members are on opposite sides of said centrally positioned exhaust tubulation, two electrode support members, said support members resting on said stem on opposite sides of said exhaust tubulation and each abutting at least two of said rigid members to restrain said support members against lateral displacement in a direction toward said rigid members and a plurality of electrodes mounted between said support members, said electrodes being of such length as to bend said support members against said rigid members and maintain said support members under mechanical stress.

3. A cathode ray tube having an elongated envelope, a stem member extending cross-wise of said envelope and sealing one end thereof, at least four current carrying leads sealed in said stem and extending within said envelope, a pair of planar resilient sheet-like electrode support members supported on and extending in one direction only from said stem and in the direction of the longitudinal axis of the elongated envelope, each of said support members being wedged against and abutting two of said leads and resiliently distorted from their planar condition adjacent said stem member, and a plurality of plate-shaped electrodes extending transversely of said longitudinal axis and supported wholly by said support members.

4. A cathode ray tube having an elongated envelope, a stem member extending transversely across and sealed to one end of said envelope, a centrally positioned exhaust tubulation axially aligned with the longitudinal axis of said envelope, at least four electrically conducting lead wires sealed in said stem member to form at least two groups of two lead wires each, each group being on opposite sides of said tubulation, two sheets of mica supported on said stem member on opposite sides of said exhaust tubulation, each sheet abutting against one of said groups of lead wires, an electron emitting cathode extending between said sheets of mica adjacent said stem member and a plurality of planar electrodes extending from one sheet of mica to the other in a direction perpendicular to the planes of said support members, the length of said electrodes plus the thickness of each support member being greater than the separation between said two groups of lead wires.

5. A cathode ray tube as claimed in claim 4 including a pair of deflection plates, one on each side of the longitudinal axis of said envelope extending between said sheets of mica and being attached thereto by portions of said plates extending through said sheets of mica to deflect the electron beam from said gun in a plane parallel with said sheets of mica and a second pair of

deflection plates to deflect the electron beam in a direction substantially perpendicular to the planes of said sheets of mica, the plates of said second pair being on opposite sides of said longitudinal axis, each plate of said second pair being individually supported on one of said sheets of mica.

6. A cathode ray tube having an elongated envelope, a stem member at one end of said envelope, two pairs of oppositely disposed lead wires extending through said stem member, two rigidly separated sheets of mica supported on said stem member and wedged between said pairs of lead wires, a plurality of electrodes extending between said sheets of mica leaving a sufficient portion of said sheets extending beyond said electrodes in the direction of said stem member so that said sheets are bent toward each other without breaking and stressed within the elastic limit of the

mica comprising said sheets between said electrodes and said stem member.

7. A cathode ray tube including an envelope, a stem closing one end of said envelope, at least four oppositely disposed lead wires extending through said stem member into the space enclosed by said envelope, two sheets of mica supported on said stem, each wedged against at least two of said lead wires, a plurality of electrodes extending between said sheets of mica so positioned that a portion of each of said sheets extends beyond said electrodes in the direction of said stem member, the distance separating said sheets at points immediately adjacent the stem member being less than the distance between said sheets at points adjacent the electrode nearest said stem member.

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