Oct. 1, 1957 R. T. McKENZIE 2,808,527

CATHODE SUPPORT STRAP

Filed Nov. 22, 1955

FIG. 1.

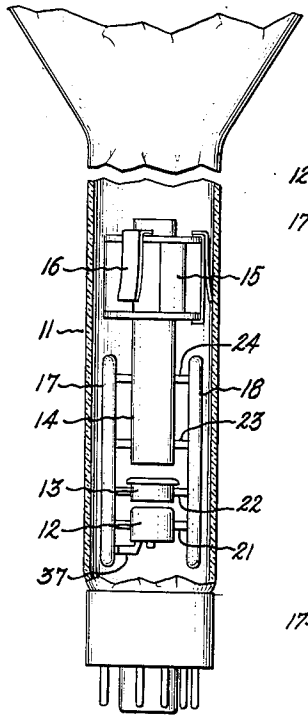


FIG. 2.

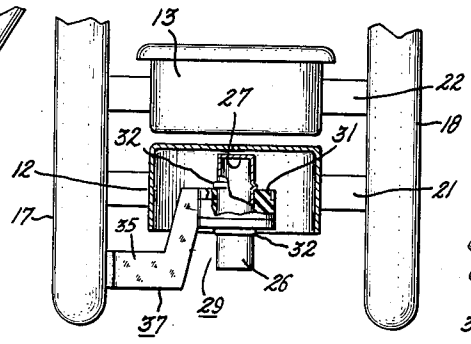


FIG. 3.

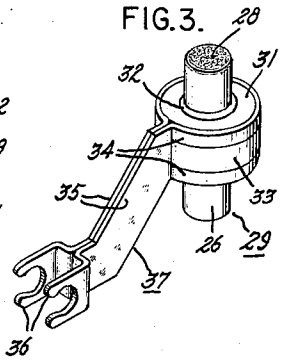


FIG. 4.

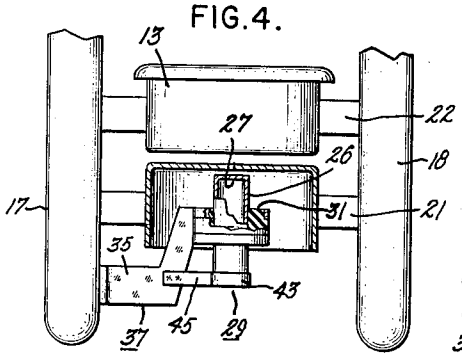


FIG. 5.

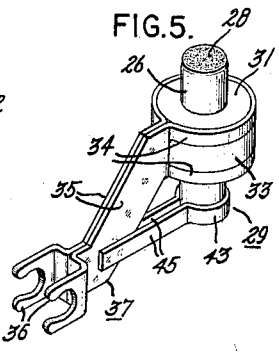


FIG. 7.

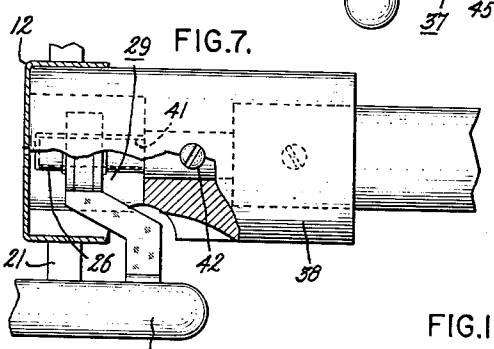


FIG. 8.

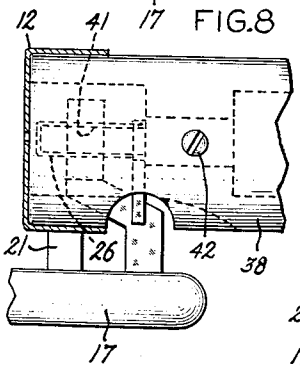


FIG. 10.

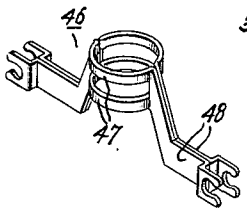


FIG. 6.

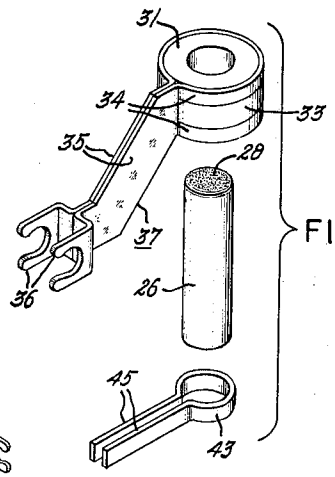
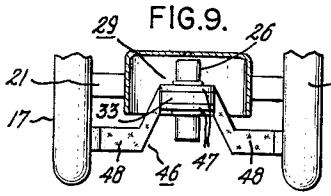


FIG. 9.



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CATHODE SUPPORT STRAP

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Application November 22, 1955, Serial No. 548,367

17 Claims. (Cl. 313—82)

My invention relates to cathode ray tubes and more particularly to support straps for cathodes employed in the electron gun assemblies of cathode ray tubes.

Heretofore, in electron gun assemblies, the cathode has been supported within a thimble-shaped control grid which is in turn attached by straps to the insulative rods which are disposed in spaced relation to support the array of electrode elements in predetermined alignment. The capped end of the thimble-shaped grid has a centrally disposed aperture which permits passage of the electron beam. The cathode is generally of the indirectly heated type and consists of a cylindrical sleeve having a disk, usually made from a nickel alloy and coated with an electron emissive material, capping one end of the sleeve. The cathode is inserted such that the coated disk is disposed adjacent to and maintained a predetermined distance from the aperture by an accurately stamped and sized spacer which fits between the capped end of the grid assembly and the insulative disk affixed to the cathode. An insulative circular collar is affixed to the cathode and positions the cathode within the grid such that the cathode is axially aligned with said aperture. The spacer and the cathode including the collar are retained in position by spot welding an expanding split ring within the control grid which bears against the underside of the cathode disk and maintains the cathode snuggly against the spacer. In assembly, the aforementioned spacer is initially fitted within the control grid assembly, the cathode and the affixed insulative disk are then inserted such that the disk bears against the spacer, and finally the expanding split ring is inserted and snugged against the opposite side of the collar and spot welded. A stamped and sized spacer, a ceramic disk, and an expanding split ring must be inserted, and a spot welding operation must be performed, resulting in a series of steps which are time consuming and costly. Another disadvantage of the prior art cathode structure is that of the cathode fails for any reason, the entire electron gun assembly and even the entire tube may have to be replaced.

Accordingly, it is a principal object of my invention to provide a new and improved cathode support for an electron gun assembly that expeditiously and efficiently affixes the cathode in predetermined relation to the other electrode elements.

Another object of my invention is to provide a new and improved cathode support strap for a cathode ray tube that permits individual replacement of the cathode element.

Another object of my invention is to provide a new and improved cathode support that permits correctly positioning the cathode during the one operation that includes anchoring the other electrode elements to the support rods.

Further objects and advantages of my invention will become apparent from the following description, and the features of novelty which characterize my invention will

be pointed out with particularity in the claims annexed to and forming part of this specification.

In carrying out the objects of my invention I provide novel cathode supports for use in electron gun structures, said cathode supports comprising strap means anchoring directly to the insulative rod members which maintain the other electrode elements in spaced relation.

For a detailed explanation of my invention, reference is made to the accompanying drawings in which:

Figure 1 is an elevation section view of a cathode ray tube gun structure embodying features of the present invention;

Figure 2 is a fragmentary enlarged elevation view, partly in cross section, of the cathode-control grid portion of Figure 1;

Figure 3 is an isometric view of the cathode structure of Figure 2;

Figure 4 is a fragmentary enlarged elevation view, partly in cross section, of the cathode-control grid portion of Figure 1 showing a modified embodiment of the invention;

Figure 5 is an isometric view of the cathode structure of Figure 4;

Figure 6 is an exploded isometric view of Figure 5;

Figure 7 is an elevation view, partly in cross section, of the cathode structure of Figures 1, 2 and 3 and including the jig used in assembly;

Figure 8 is an elevation view, partly in cross section, of the modified embodiment of the invention of Figures 4, 5 and 6 and including the jig used in assembly; and

Figure 9 is an enlarged elevation view, partly in cross section, of still another embodiment of the invention;

Figure 10 is an isometric view of the strap of Figure 9.

In Figure 1, an electron gun is shown located in the neck portion **11** of a cathode ray tube envelope; said gun including a control grid electrode **12**, a number two or screen grid **13**, an anode **14**, and a magnetic focusing means generally indicated at **15**. Each of the preceding elements or assemblies may be of any suitable conventional design, and for purposes well known to those skilled in the art. Lead wires connecting the elements **12**, **13**, and **14** to the closed end of the neck portion **11** are not shown since the arrangements therefore and the manner of connection are well known to those skilled in the art, and, per se, form no part of my invention. Spacer clips **16** of any suitable conventional type can be used to maintain the gun assembly in proper spaced relation to the wall of the neck portion **11**, as is also well known in the art.

While the present invention will be described in association with a magnetic focus type of gun structure, it will be understood that it is not limited to this particular type of gun, it being clear that electrode elements similar to those illustrated at **12**, **13**, and **14**, or the equivalent, are commonly employed in electrostatic focused guns of the so-called bent-gun, tilted-straight-gun, and other types.

For maintaining the electrode elements **12**, **13**, and **14**, in spaced alignment, one or more insulative glass rods or beads **17**, **18** are provided in parallel spaced relation to said elements and the control grid **12**, the screen grid **13**, and the anode **14** are connected to the glass beads **17**, **18** by means of support or beading straps **21**, **22**, **23** and **24** respectively. In accordance with a feature of the invention and as illustrated more clearly in Figure 2, the cathode structure **29** is positioned within the control grid **12** and is affixed to the support bead **17** by support strap **37**.

Figure 2 shows the cathode structure **29** assembled, while Figure 3 shows a pictorial view of the cathode structure **29** separately. The cathode consists of an indirectly heated cylindrical sleeve **26** having a disk **27**

which may be integral with said sleeve, capping one end of the sleeve, and a thin electron emissive material coating 28 on the disk 27. An insulative collar 31, preferably a ceramic, is friction fitted around the periphery of the sleeve 26. Protrusions 32 are formed on the sleeve 26 adjacent the upper and lower surfaces of the collar 31 after the collar is placed in position and serve to maintain the collar 31 in predetermined position on sleeve 26. A shoulder 33 is formed on the periphery of the collar 31 to permit the separated strips of body portions 34 of the strap 37 to engage the shoulder 33 therebetween and thus to securely grip the collar 31. Arms 35 of the strap 37 fold back onto themselves and may be affixed to each other as by spot welding. Spaced terminal portions 36 of the strap 37 are adapted to be embedded in the beads 17 or 18 and are, therefore, formed with recesses to permit molted bead material to be received therewithin; this type of configuration provides increased stability of support. The terminal portions 36 are further formed in parallel bifurcated relation in order to achieve a double grip effect when the terminal portion 36 is inserted into the glass bead 17. It has been found that the double grip herein disclosed provides a secure hold, rigidly affixing the strap 37 to the bead 17.

During assembly in the electron gun, the cathode structure 29 is maintained in a predetermined position within the grid 12 by means of an aligning tool or jig 38 shown in Figure 7. Jig 38 has a center projecting pin 41 which is adjusted in length by locking screw 42. Sleeve 26 is initially fitted over projecting pin 41 and then the jig 38 and the cathode structure 29 are inserted into the control grid 12, thus locating the cathode 29 centrally and also a predetermined distance from the capped end of control grid 12. The electron beam controlling elements are all placed in a machine jig which maintains the elements in correct position. Cradles (not shown) are adapted to hold the glass beads 17 and 18 are disposed in spaced relation beneath the straps. After a bead of glass is melted in the cradle the machine jig is actuated such that an end of each of the straps 21, 22, 23 and 24 which are affixed to each of the respective electrode elements is inserted into the molten bead 17. The terminal portions 36 of the cathode strap 37 are inserted into one of the beads, say bead 17, conjointly with one end of the straps 21, 22, 23 and 24. After the straps 21, 22, 23, 24 and 37 are inserted, the bead 17 is allowed to cool. The molten material which has distributed itself around the respective terminal portions 31 of the straps 21, 22, 23, 24 and 37 securely anchors the straps to the bead rod. The gun structure unit is next withdrawn leaving the cathode structure 29 securely positioned in predetermined relation with the control grid 12 and ready for further assembling of the electron gun in the cathode ray tube.

The capped cylinder comprising the control grid 12 is preferably designated somewhat less deep than previous grid cylinders to permit the use of a short strap; a short strap will provide a more stable support.

Figure 4 shows a modified embodiment of my invention. Previously if a cathode became defective the entire electron gun structure had to be removed and replaced or else the entire tube was scrapped. For many applications it is desirable to be able to replace only the cathode without disturbing the rest of the electron gun assembly. In accordance with the invention, an easily replaceable cathode is provided that will have all the characteristics of a permanent cathode. In this embodiment of my invention, the sleeve 26 is smooth; having no embossments the sleeve can be slidably fitted through the collar, as can be seen clearly from Figure 6. The strap 37 is fitted to the collar 31 in the same manner as in the first embodiment. A tie strap 43 is designed to have arm portions 45 positioned astride arms 35 of support strap 37, as shown in Figure 5. For practical manufacturing considerations the strap 43 is also of single piece construction having the body portion wrapped around and affixed to sleeve 26.

During assembly, the entire cathode structure 29 is positioned by jig 38 in the same manner as in the first embodiment. Tie strap 43 is initially spot welded to support strap 37 and then the entire cathode structure 29 is positioned within grid 12 by jig 38, Figure 8. Terminal portions 36 are next imbedded into bead 17 to secure the cathode structure 29 in position; the jig 38 is then withdrawn and the unit is ready to be assembled in the tube.

Should the electron emissive surface 28, or any part of the cathode sleeve 26 become defective the entire sleeve 26 can be removed by simply cutting arms 45 of tie strap 43 and pulling sleeve 26 out. Replacement of sleeve 26 can be effected by placing a similar sleeve, to which a replacement tie strap 43 had preliminarily been suitably affixed, onto the projecting pin 41 of the jig 38 and inserting the jig 38 in the grid 12. Pin 41 in jig 38 will position the sleeve and associated strap at a predetermined distance from grid 12, and the already centrally positioned ceramic collar 31 will maintain the sleeve in axial alignment. Next, the free ends of the arms 45 are spot welded or otherwise secured to the arms 35 of the support strap 37 and jig 38 is withdrawn and the sleeve 26 is ready for further assembly.

Yet another embodiment of my invention is shown in Figure 9 in which the cathode structure 29 is anchored to two support rod members 17 and 18. In this embodiment, support strap 46 is formed of two similar pieces each having centrally disposed semi-cylindrical center portions 47, and radially extending arm portions 48, the latter being disposed in substantial registry and placed back to back, Figure 10. The two semi-cylindrical center portions 47 are affixed to form a pair of vertically spaced encircling bands, securely gripping the collar 31 atop and below the shoulder 33, Figure 9.

A jig similar to jig 38 but having an additional cutway portion to provide for the diametrically opposed strap extensions is employed to assemble the cathode structure. The embedding process is also similar except that the extensions 48 of the strap 46 are inserted into both rods 17 and 18. This embodiment is useful where an even more rugged support for the cathode is desired. A replaceable cathode sleeve of the type shown in Figures 5 and 6 can also be employed in this embodiment; tie straps 43 would then lead from the cathode sleeve 26 to either or both extensions 48.

It will be understood that while the straps described hereinabove were wrapped around or encircle the units other means of affixing the straps to the collar such as by crimping, by prongs, or by welding may be employed. Further, it will be understood that said straps may also be formed integrally with the cathode sleeve as for example by striking out portions of the sleeve wall to form the extending portions.

It will further be understood that while glass beads or rods were described hereinabove, rods of other insulative material can be similarly employed such as quartz, mica, ceramic or the like as a base for anchoring the electrode elements of the gun assembly. Also, it will be understood that while a plurality of glass rods were described, a single rod may be employed as the supporting member.

Although the present invention has been illustrated by specific examples, it will be obvious to those skilled in the art that modifications may be made without departing from the spirit thereof.

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

1. In an electron gun assembly, an insulative rod member, a plurality of electrode elements supported in spaced alignment by said insulative rod member, a single arm anchored at one end in said rod member, and a sleeve

shaped cathode element supported exclusively by said arm independently of others of said electrode elements.

2. In an electron gun structure having at least one insulative rod member and a plurality of electrode elements adapted to be supported in spaced alignment by said insulative rod member, a cathode element comprising a sleeve, and means for supporting said cathode element exclusively from said rod independently of the other electrode elements comprising strap means affixed to said cathode and having a termination secured to said rod member.

3. In an electron gun assembly, a plurality of electrode elements supported in spaced axial alignment by at least one insulative support member, a sheet metal strap having a width substantially greater than its thickness and having one end embedded in said support member with the plane of said strap parallel to the axis of said electrade elements, and a cathode element comprising a thimble-shaped sleeve mounted on said strap with the axis of said sleeve coincident with said axis of said electrode elements.

4. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode, and a single strap connected between said rod member and said cathode exclusively supporting said cathode from said rod member independently of and in spaced relation to said other electrode elements.

5. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar mounted on said sleeve, strap means including a body portion fitted on said collar, arm portions folded back onto themselves and affixed to each other, and terminal portions integral with said arm portions, said terminal portions being disposed in furcated parallel relation and adapted to be imbedded in one of said rod members.

6. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar mounted on said sleeve, protrusions on the periphery of said collar, strap means comprising a body portion adapted to be wrapped around said collar, said body portion having separated strips to engage said protrusions therebetween, arm portions folded back onto themselves and affixed to each other, and terminal portions adapted to be affixed to one of said rod members, said terminal portions disposed in bifurcated parallel relation to provide a double grip on said rod member.

7. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar mounted on said sleeve, protrusions on the surface of said sleeve for maintaining said collar in position, protrusions on the periphery of said collar, strap means having a body portion adapted to be wrapped around said collar, said body portion having separated strips to engage said protrusions therebetween, said strap means having arm portions folded back onto themselves and affixed to each other, and said strap means having terminal portions adapted to be affixed to one of said rod members, said terminal portions disposed in bifurcated parallel relation to provide a double grip on said rod member.

8. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by a plurality of insulative rod members, a cathode comprising a tubular sleeve, a collar mounted on said sleeve, strap means affixed to said collar, said strap means comprising similar pieces, each piece having a semi-cylindrical center portion and extending portions, said semi-cylindrical center portions being disposed to form a peripheral band around said collar, said extending portions being affixed in back to back relation, and said extending portion including terminal portions adapted to be secured to said rod members, said respective terminal portions being disposed in furcated relation.

9. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by a plurality of insulative rod members, a cathode comprising a tubular sleeve, a collar mounted on said sleeve, strap means affixed to said collar, said strap means comprising two similar pieces, each piece having a center portion adapted to be affixed to said collar, extension portions being affixed in back to back relation, and terminal portions being disposed in furcated relation and adapted to be secured to said rod members.

10. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by a plurality of insulative rod members, a cathode of the indirectly heated type comprising a tubular sleeve, a collar mounted on said sleeve, strap means including center portions and extending portions, said center portions affixed to form peripheral bands around said collar, said extending portions including terminal portions adapted to be secured to said rod members, said extending portions being affixed in back to back relation, and said terminal portions being disposed in furcated relation with respect to each other.

11. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar slidably fitted on said sleeve, a first strap means attached to said collar, said first strap means having terminal portions adapted to be anchored to said rod members, and a second strap means affixed to said sleeve and to said first strap means.

12. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar slidably mounted on said sleeve, having a body portion affixed to said collar and having arm portions affixed to each other, said strap means adapted to be anchored to one of said rod members, and a second strap means having one end attached to said sleeve and having the other end attached to said first strap means.

13. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a cathode element comprising a tubular sleeve, an insulative collar slidably mounted on said sleeve, strap means having a body portion wrapped around said collar and having arm portions affixed to each other, a second strap means having a body portion being formed into a band around said sleeve and secured thereto, said second strap means having extensions positions astride said first strap means and affixed thereto.

14. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by a plurality of insulative rod members; a cathode element comprising a tubular sleeve; an insulative collar slidably mounted on said sleeve; a first strap means affixed to said collar; said strap means having a body portion wrapped around said collar and arm portions folded back onto themselves and affixed to each other; said arm portions including terminal portions disposed in furcated relation and adapted to be imbedded in one of said rod members; said terminal portions being formed to receive flowable material of said insulative member therewith; and a second strap means having a body portion affixed to said sleeve and arm portions affixed to said first strap means.

15. In an electron gun assembly having a plurality of electrode elements adapted to be supported in spaced alignment by at least one insulative rod member, a thimble-shaped control grid, a cathode element disposed within said grid, said cathode element comprising a tubular sleeve,

a collar slidably mounted on said sleeve, a first strap means affixed to said collar, said collar and said first strap means maintaining said sleeve in predetermined central alignment within said grid, said first strap means adapted to be secured to said rod members, and a second strap means affixed to said sleeve and to said first strap means to secure said sleeve a predetermined distance from the capped end of said thimble-shaped grid.

16. In an electron gun assembly having a plurality of electrode elements adapted to be supported in axial alignment by at least one insulative rod member, a thimble-shaped control grid, a cathode element disposed within said grid, said cathode element comprising a tubular sleeve, a collar slidably mounted on said sleeve, a first strap means for anchoring said sleeve to said support members, a collar fitted on said sleeve, said strap means affixed to said collar to maintain said sleeve in axial alignment, a second strap means affixed to said sleeve and to said first strap means to maintain said sleeve at a predetermined position along the axis of said grid.

17. A cathode support strap for an electron gun of the type having a polarity of electrodes adapted to be supported in spaced alignment by at least one insulative rod, said strap having a cathode receiving portion, and an arm affixed to said cathode receiving portion adapted to be supported exclusively from the insulative rod to support the cathode independently of other electrodes supported from the rod, said arm having a terminal portion adapted to be secured to the rod.

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