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3,215,880

ELECTRON GUN ELECTRODE ASSEMBLY

Filed April 14, 1961

2 Sheets-Sheet 1

FIG. 1.

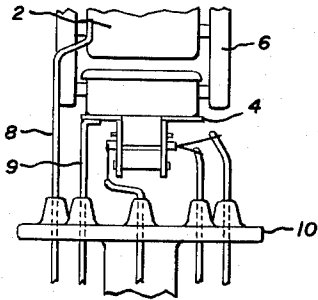


FIG. 2.

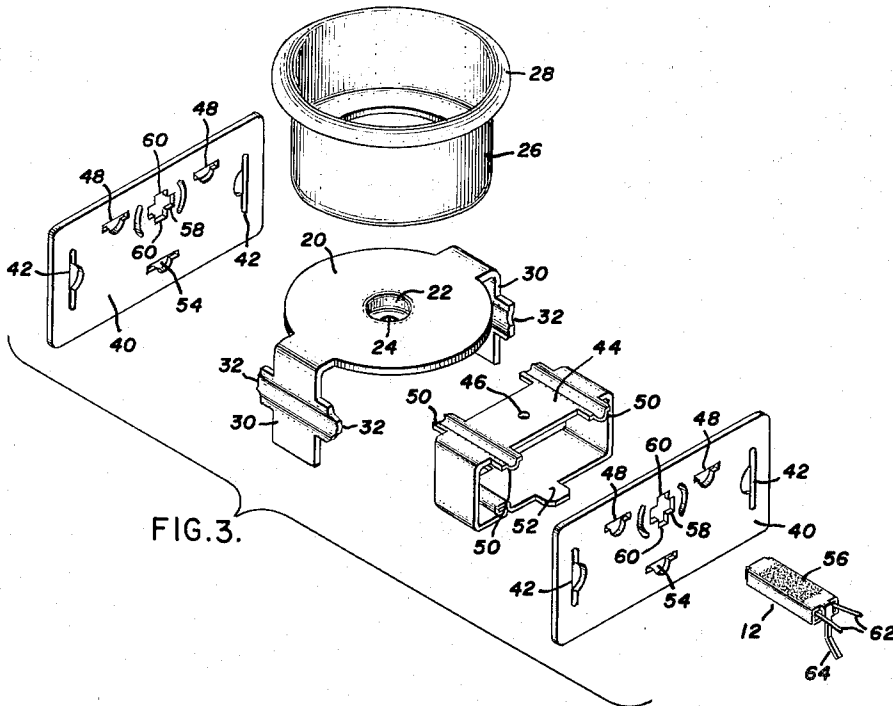
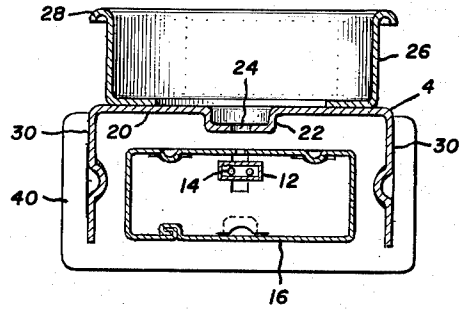
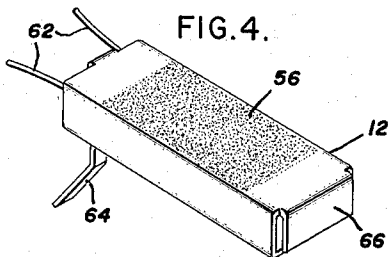


FIG. 3.

FIG. 4.



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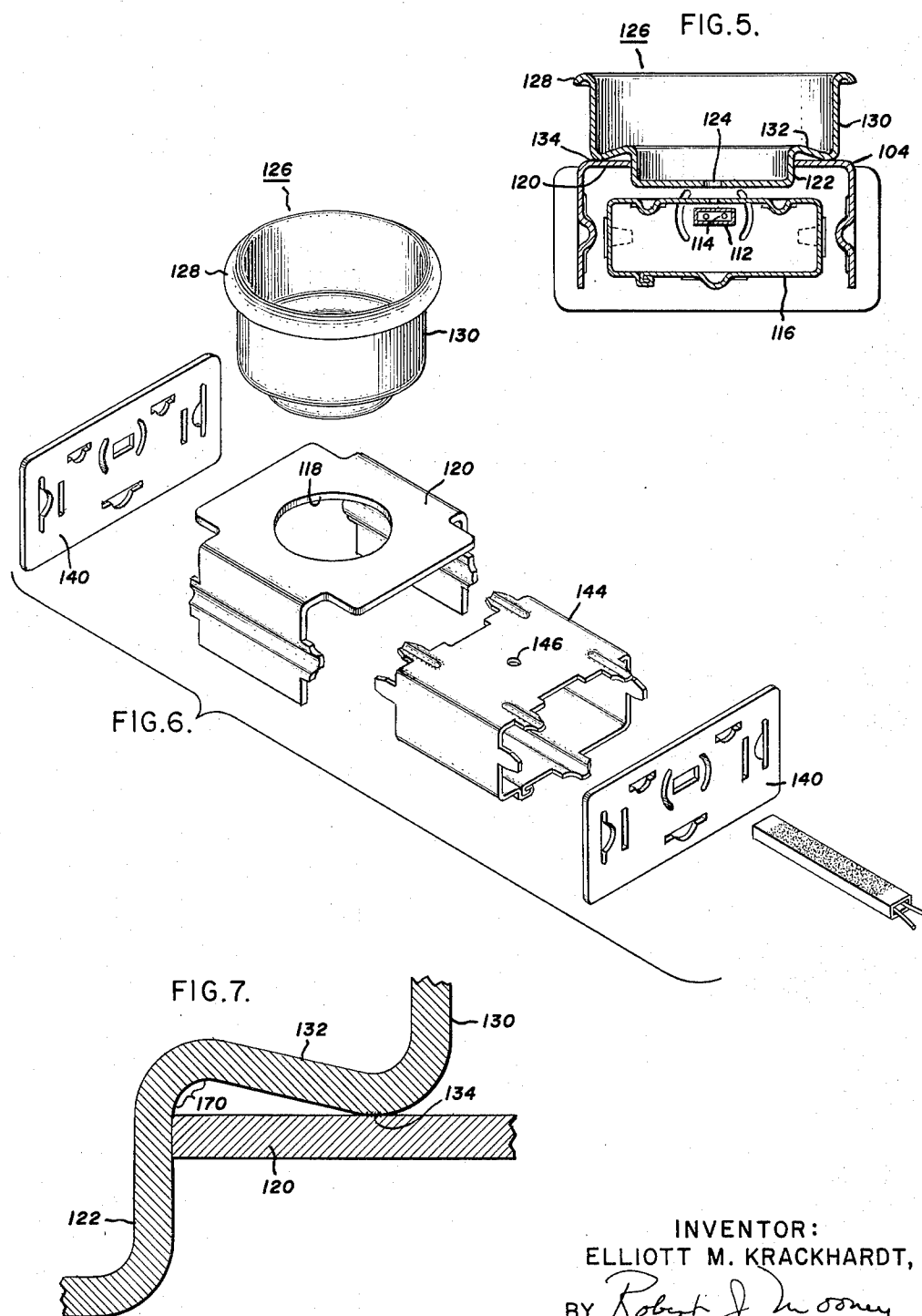
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ELECTRON GUN ELECTRODE ASSEMBLY

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2 Sheets-Sheet 2



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ELECTRON GUN ELECTRODE ASSEMBLY
Elliott M. Krackhardt, Syracuse, N.Y., assignor to General Electric Company, a corporation of New York
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1 Claim. (Cl. 313-82)

This invention relates to cathode ray tubes and more particularly to an improved electron gun electrode assembly for such devices.

The present invention relates more particularly to an improved electrode assembly for the cathode, control grid, and screen grid of a cathode ray tube, of the type wherein the cathode and control grid are supported by a pair of insulating plates which are in turn carried by the screen grid.

One object of the invention is to provide an electrode assembly of the foregoing character which is relatively inexpensive, involves a minimum number of parts, is inherently self-aligning about an electron-optical axis, insures inherent self-maintenance of the desired critical axial spacings of the parts, and can be easily assembled without any special jigs, fixtures, locating pins or the like.

Another object is to provide an electrode assembly of the foregoing character including an indirectly heated cathode which requires a minimum of heater power input.

In the drawing

FIGURE 1 is a fragmentary elevational view, to a diminished scale, of a portion of one form of an electron gun of a cathode ray tube to which the present invention is particularly adaptable;

FIGURE 2 is an enlarged sectional view of the electrode assembly portion of the structure of FIGURE 1, constructed according to my invention;

FIGURE 3 is an exploded perspective view of the structure shown in FIGURE 2;

FIGURE 4 is an enlarged perspective view of a portion of the structure of FIGURE 3;

FIGURE 5 is a view similar to FIGURE 2 of another form of electrode assembly constructed according to my invention;

FIGURE 6 is an exploded perspective view of the structure of FIGURE 5; and

FIGURE 7 is an enlarged fragmentary view of a portion of the structure of FIGURE 5.

Turning to the drawing FIGURE 1 shows a portion of one form of an electron gun to which the present invention is particularly adaptable. The electrode structure shown includes an accelerating electrode 2 and a second or screen grid 4 mechanically connected by glass rods 6 and having electrical leads 8, 9 sealed through the stem 10 which is conventionally mountable in the end of the neck of a cathode ray tube (not shown). The screen grid 4 carries the cathode 12, heater 14 and control grid 16 (not evident in FIGURE 1) as will be more fully described hereinafter.

The electrode assembly to which the present invention relates includes the screen grid 4, control grid 16, and indirectly heated cathode 12. As better shown in FIGURE 2, the screen grid includes a laterally extending sheet metal plate forming a top wall 20 having a central depressed cup portion 22 provided with a central aperture 24 for passing the electron beam. Concentrically surrounding the depressed portion of the plate 20 is an upstanding cylindrical flange 26 secured to the plate as by welds and having an outwardly rolled upper edge 28. Integrally depending from diametrically opposite side edges of the plate are flanges or side walls 30 each provided with a pair of laterally extending embossed ears 32. The side walls 30 shown are narrower than the top wall 20 so that portions of the top wall extend outwardly in a

lateral direction beyond the marginal edges of the side walls.

Extending between and carried exclusively by the side walls are a pair of plates 40 of insulating material such as mica having aligned slots 42 for receiving the ears 32. The spacing of the slots 42 in relation to the upper edge of each insulating plate 40 is so related to the spacing of the ears 32 to the underside of the top wall 20, that when the insulating plates 40 are assembled on the ears 32 the upper marginal edge of each insulating plate is urged into permanently firmly abutting contact with the underside of the top wall 20. Thus by the simple act of assembling the insulating plates 40 onto the ears 32 the spatial relationship of the plates 40 to the screen grid is permanently determined with maximum precision.

The insulating plates 40 also serve as the exclusive support for the control grid 16. The control grid is of four-sided sleeve or box-like sheet metal construction having an upper surface 44 which is intended to be parallel to and closely and precisely spaced from the confronting underside of the top wall 20 of the screen grid. The control grid upper surface also has a central aperture 46 which is intended to be precisely coaxially aligned with the aperture 24 in the screen grid. Spacing and alignment of the control grid 16 relative to the screen grid 4 is determined exclusively by the insulative support plates 40 which are provided with aligned slots 48 for receiving complementarily shaped embossed ears 50 extending from the side edges of the top surface of the control grid. Thus the mere assembly of the control grid to the insulating support plate by inserting the ears 50 in the slots 48, and subsequent assembly of the support plates 40 onto the screen grid, insures, without requiring any subsequent use of jigs or alignment tools and without any additional welding or fastening operations, precise spacing and alignment of the control grid 16 and screen grid 4. Additional tabs 52 on the lower surface of the grid 16 mate with slots 54 in plates 40 for the purpose of locking the control grid 16 and plates 40 permanently together.

Also carried by the insulating support plates 40 is the indirectly heated cathode 12 which has the form of a sheet metal sleeve of rectangular cross-section and is arranged to be mounted with its electron emitting surface 56 axially aligned opposite the aperture 46 in the control grid. The cathode is supported in slots 58 in support plates 40. Each slot is shaped to have relieved portions, such as shown at 60, for the purpose of minimizing the contact area between the cathode and each support plate 40, so as to thereby minimize heat loss from the cathode to the support plates. The leads 62 of the heater 14, which may be of the folded coil type arranged within the cathode, emerge from one end of the sleeve of cathode 12. To further reduce heat loss from the heater, a tab 64 formed integral with the sleeve 12, as best shown in FIGURE 3, is folded down across the open end of the sleeve between the heater leads 62 so as to partially mask or close off that end of the cathode sleeve. Tab 64 also forms a convenient cathode electrical lead. To further minimize heat loss the opposite end of the cathode sleeve is closed by an integral flap 66 folded across the opening as best shown in FIGURE 4. Thus heat transfer from the heater to the cathode is optimized and heat loss by the heater-cathode subassembly is minimized so that minimum heater power input is required for a given cathode operating temperature.

The electrode assembly described has a number of advantages in comparison with screen grid-control grid-cathode assemblies of the prior art. First the cathode 12 and control grid 16 are supported exclusively by the slots 42, 48 in the insulating support plates 40, which slots can be punched cheaply yet with extreme precision

of location relative to the top edge of the support plates. When the cathode, control grid, and support plates are then assembled to the screen grid 4, exact spacing and alignment of the cathode and control grid relative to the screen grid is automatically insured by the firm permanent abutment of the upward edges of the support plates against the underside of the top wall 20 of the screen grid itself. Moreover this precise spacing and alignment of parts is achieved entirely by the simple steps of assembling the parts themselves, and does not require use of any supplementary jigs, fixtures, alignment rods or the like or any supplementary fastening operations other than the insertion of the various ears 32, 50 through the corresponding slots in the insulating support plates 40.

Additionally it should be noted that the structure disclosed has a minimum number of parts, and the control grid 16 is mechanically connected to the cathode and the screen grid by only a single member, namely each support plate 40, which is the very member which performs all of the inter-electrode alignment and spacing functions. Also, the structure can be made to accommodate extremely low heater-power consumption, of the order of 0.5 watt, merely by reducing the width of side walls 30 so that plates 40 lie closer together, and correspondingly shortening the cathode 12 and control grid 16.

It is an additional advantage that the described assembly permits the cathode 12, control grid 16, and support plate 40 to be easily removed or replaced, or the remainder of the electron gun to be readily salvaged, for example in the event of tube rejection during manufacture. In such an event, the insulating support plates 40 and cathode 12 and control grid 16 supported thereby may simply be removed from the screen grid 4 and replaced by another cathode, control grid and support plate sub-assembly, thus enabling a substantial saving in material and time. Finally, variation of the control grid to screen grid spacing to achieve different operating characteristics may be accomplished without changing any of the dimensions of the parts other than spacing of the slots 48 from the upward edges of the support plates 40.

FIGURES 5, 6 and 7 show an alternative embodiment of the electrode assembly wherein the top wall 120 of the screen grid 104 has a relatively large central opening 118 and the electron beam-passing aperture 124 of the screen grid is formed in the center of the bottom of a cup-like member 126 surmounting the top wall 120. The bottom of cup 126 includes a cylindrical diminished diameter portion 122 projecting downwardly through the opening 118 in the top wall. This arrangement avoids the need for forming a depressed portion in the top wall 120 in order to achieve close screen grid-to-control grid 116 spacing. The diminished diameter portion 122 is joined to the upstanding flange portion 130 of cup 126 by a radially extending annular shoulder 132, and cup 126 is secured to the top wall 120 by welds located as shown at 134 adjacent the outer edge of shoulder 132.

It is a particularly advantageous feature of the structure of FIGURE 5 that the cup 126 may be inexpensively formed by a sheet metal drawing operation, yet when the diminished diameter portion 122 is assembled in properly spaced relation to the control grid and cup 126 is secured as at 134, the inner edge of shoulder 132 and the top of the outer cylindrical surface of the diminished diameter portion 122 are relieved or upwardly spaced from the rim of the opening 118. This raising of the inner edge of the shoulder 132 in effect insures that a cylindrical portion of the outer surface of the diminished diameter portion 122 will be situated opposite the periphery of the opening 118 when the parts are assembled. Thus the non-cylindrical surface at the top of the outside

of portion 122, such as shown at 170, which is inherently formed by the operation of drawing cup 122 in the bottom of cup 126, is precluded from engaging the rim of the opening 118 and will not thereby have any deleterious influence on the electron-optically important spacing of the bottom wall of cup 122 from the control grid 116. Also precise axial alignment of cup 126 by the opening 118, without interference by surface 170, is thereby assured. The above described relief or upward spacing of the inner edge of shoulder 132 from the rim of the opening 118 can be readily and inexpensively achieved, immediately after the diminished diameter portion 122 is drawn from the bottom of cup 126, by the simple step of slightly telescoping the diminished diameter portion upwardly into the enlarged diameter portion of cup 126.

It will be appreciated by those skilled in the art that the invention may be carried out in various ways and may take various forms and embodiments other than those illustrative embodiments heretofore described. Accordingly it is to be understood that the scope of the invention is not limited by the details of the foregoing description, but will be defined in the following claim.

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

An electrode assembly for a cathode ray tube electron gun, said assembly comprising:

- (A) a one-piece screen grid unit including a top portion having an electron beam passing aperture therein and first and second integral side portions depending therefrom, said side portions being provided with oppositely extending ear portions,
- (B) first and second insulative plates, each insulative plate having insulative plate mounting apertures therein and including a top edge surface,
- (C) said extending ear portions of said screen grid unit being received by the insulative plate mounting apertures to mount said insulative plates to said screen grid unit in spaced parallel relationship, the width of said depending side portions defining the spacing between said insulative plates,
- (D) said top surface of each of said insulative plates firmly abutting the under surface of said top portion of said screen grid unit along a substantial length of the insulative plate to define the position of said insulative plates relative to said top portion.
- (E) each of said insulative plates further having control grid unit mounting apertures and cathode unit mounting apertures therein,
- (F) a cathode unit extending between and carried by said spaced insulative plates, said cathode unit including oppositely extending ear portions received by the cathode unit mounting apertures in said insulative plates, and
- (G) a sleeve-shaped control grid unit extending between and carried by said spaced insulative plates, said control grid unit including oppositely extending ear portions received by the control grid unit mounting apertures in said insulative plates.

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