United States Patent

Say et al.

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[54] **METHOD OF FABRICATING A MULTIBEAM ELECTRON GUN STRUCTURE**

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[73] Assignee: **Sylvania Electric Products, Inc.**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 860,626, Sept. 24, 1969.

[52] **U.S. Cl.** **29/25.16,** 29/25.19, 316/24, 313/69

[51] **Int. Cl.**.....**H01j 9/18,** H01j 9/36

[58] **Field of Search**.....29/25.11, 25.19, 25.16; 316/24, 17; 313/69; 315/40

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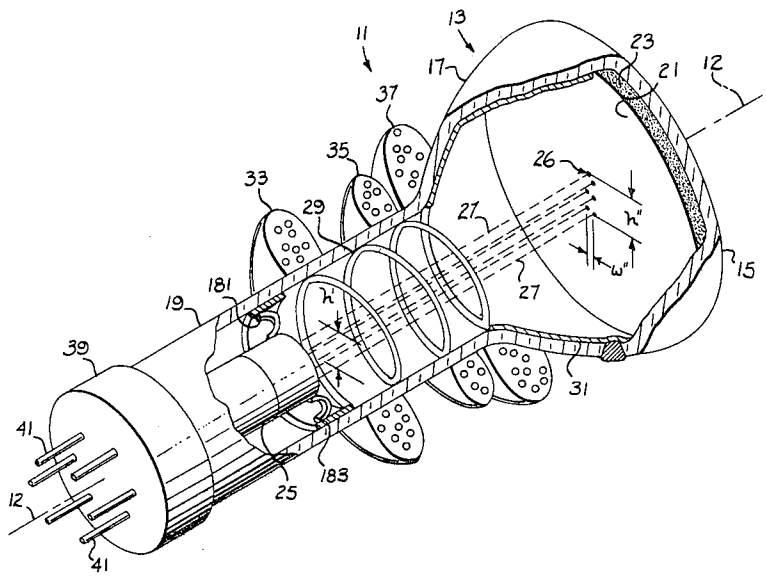
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[57] **ABSTRACT**

A method of fabricating a multibeam single electron gun structure for an electron discharge device, such as a high resolution cathode ray tube, wherein a plurality of beams emanating from a common emission plane are separately modulated by a planar arrangement of separate control electrode members each having a beam aperture therein forming an aperture array. At least one accelerating-collimating electrode plane having a similar array of apertures is oriented in spaced and substantially parallel relationship with the control grid plane to provide a collimated array of beams directed to impinge the cathodoluminescent screen in a defined pattern array.

9 Claims, 15 Drawing Figures



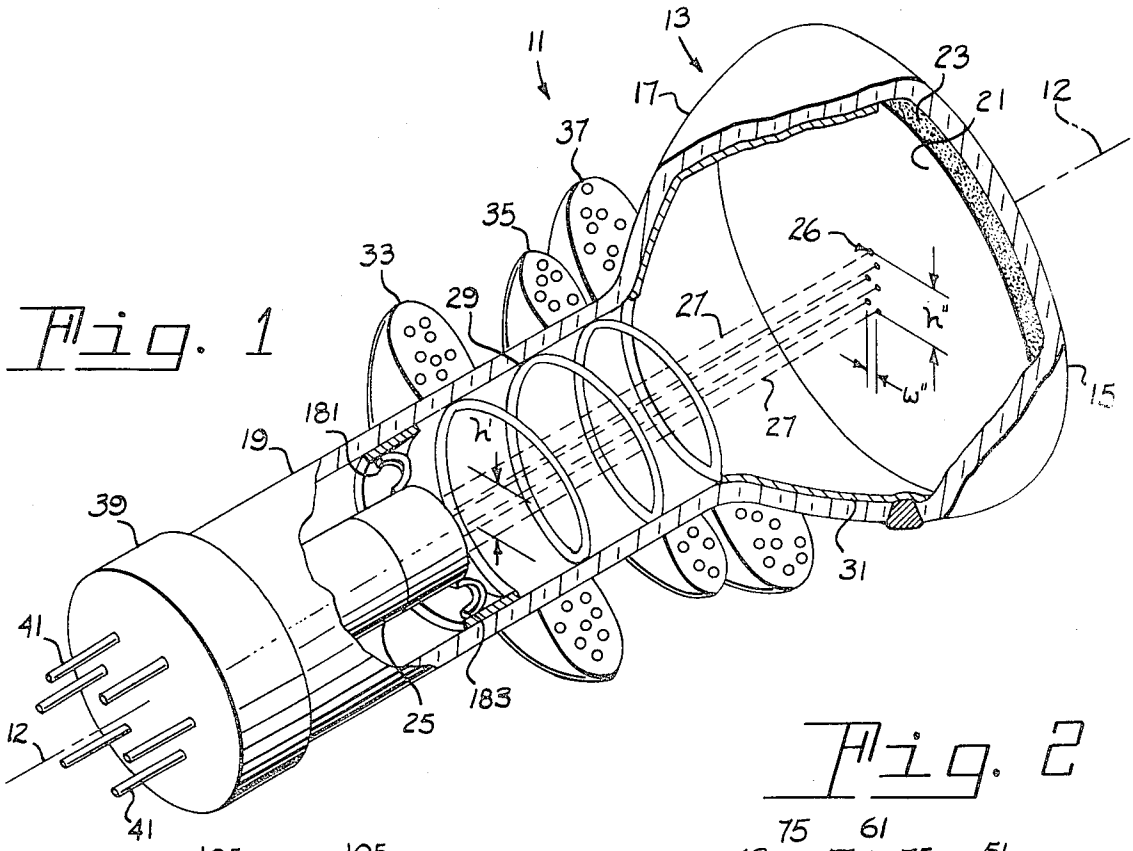


Fig. 1

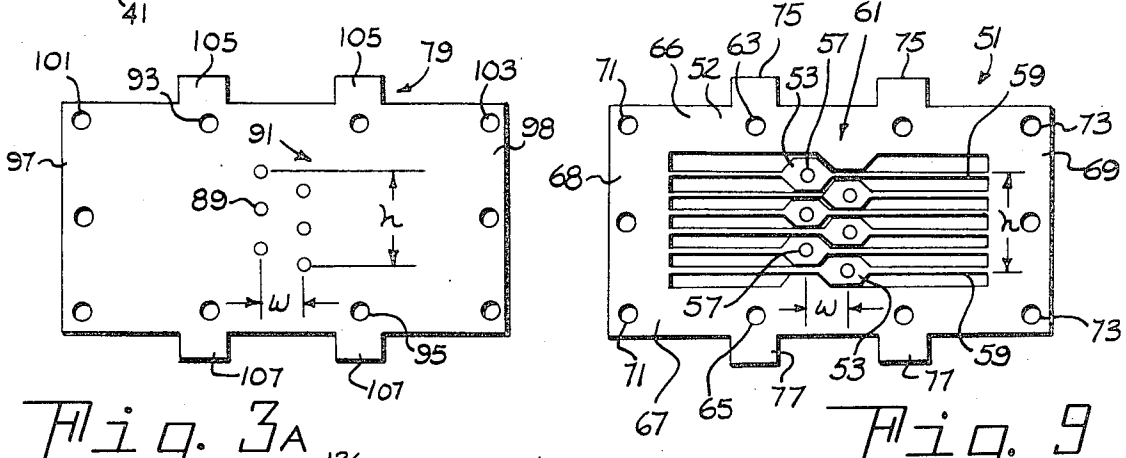


Fig. 2

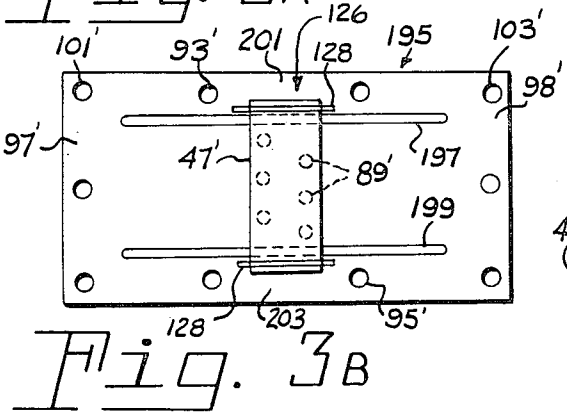


Fig. 3B

Fig. 3A

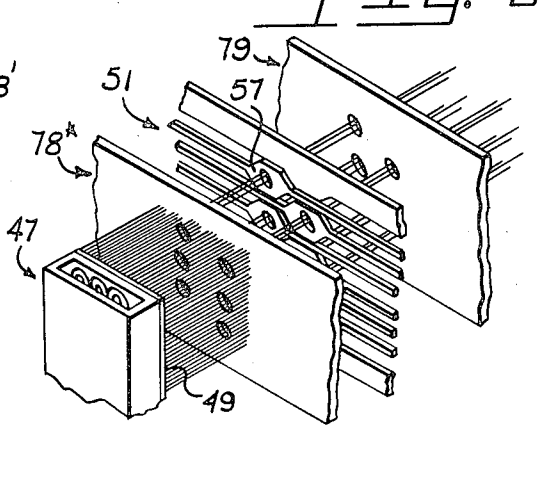


Fig. 9

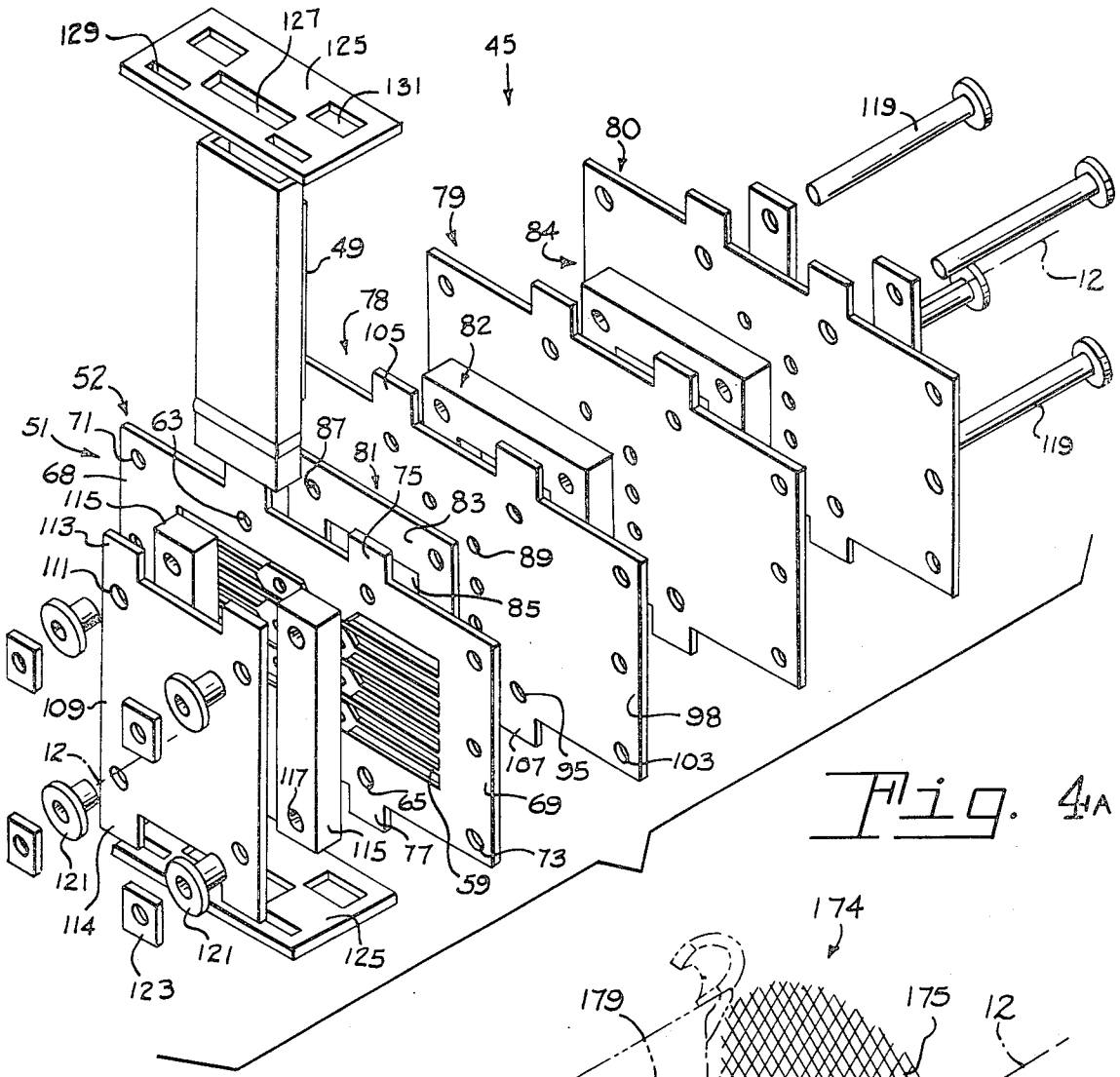


Fig. 4A

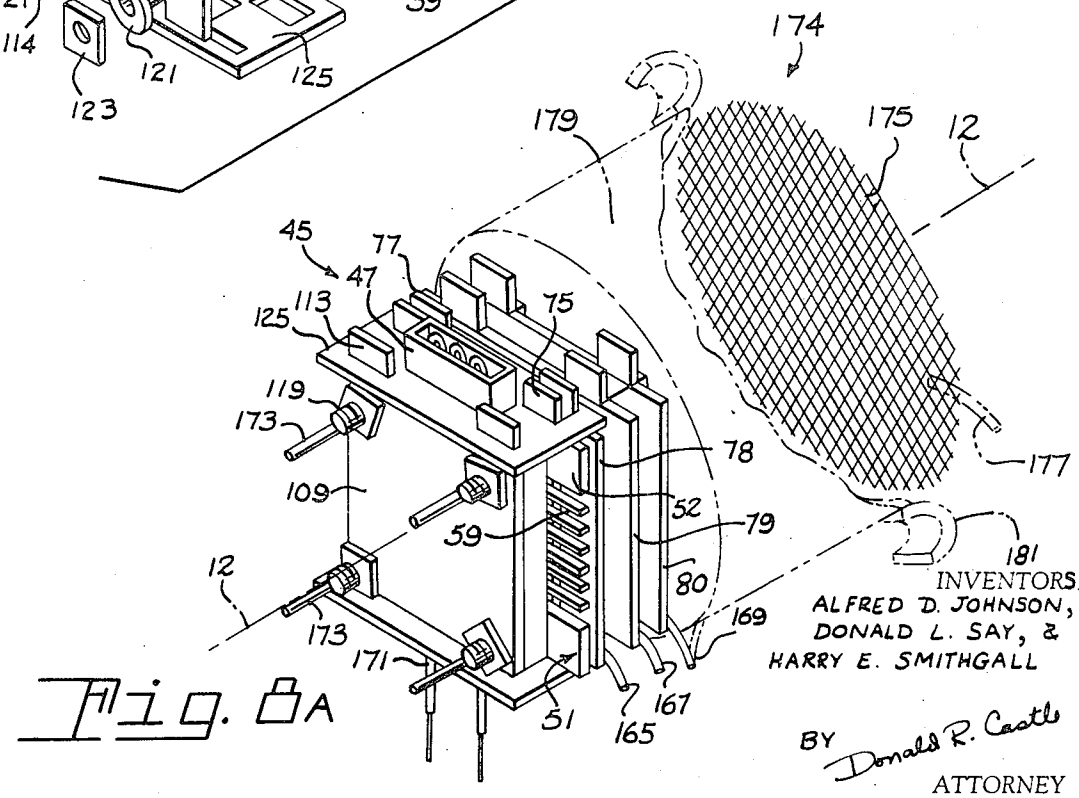


Fig. 8A

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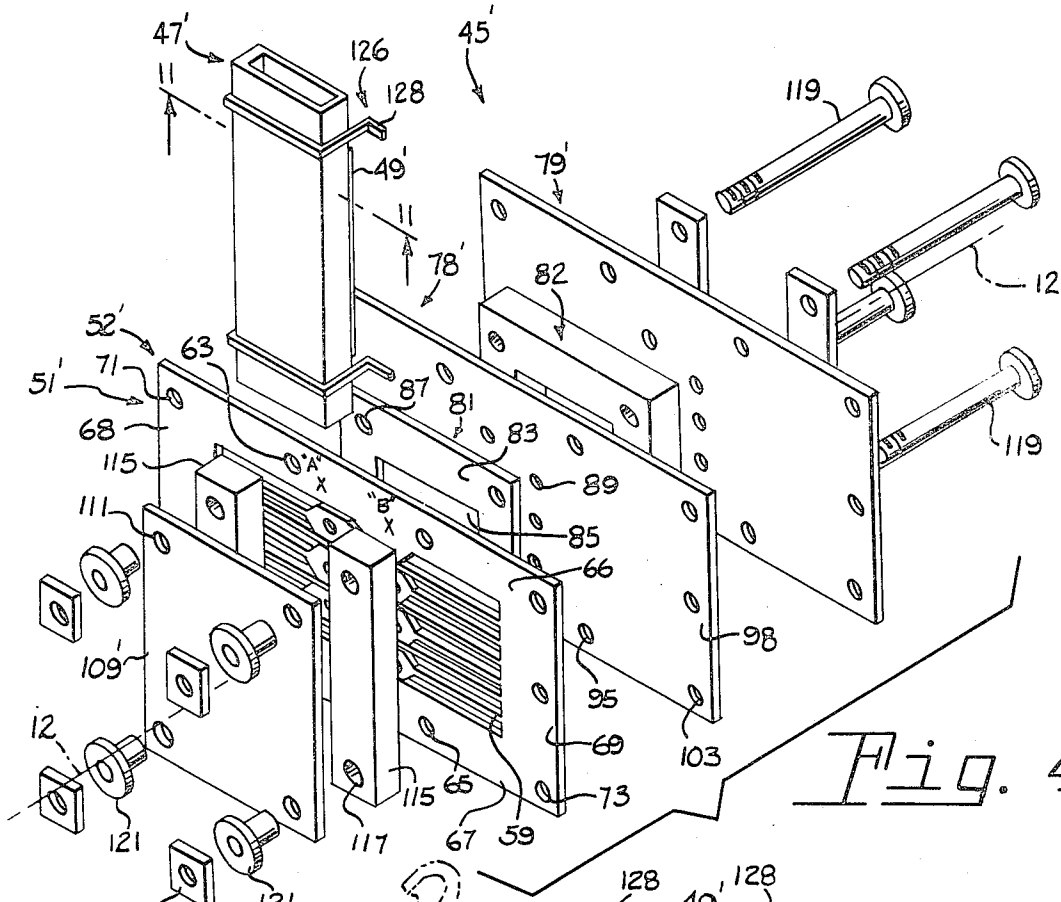


Fig. 4B

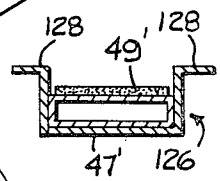


Fig. 11

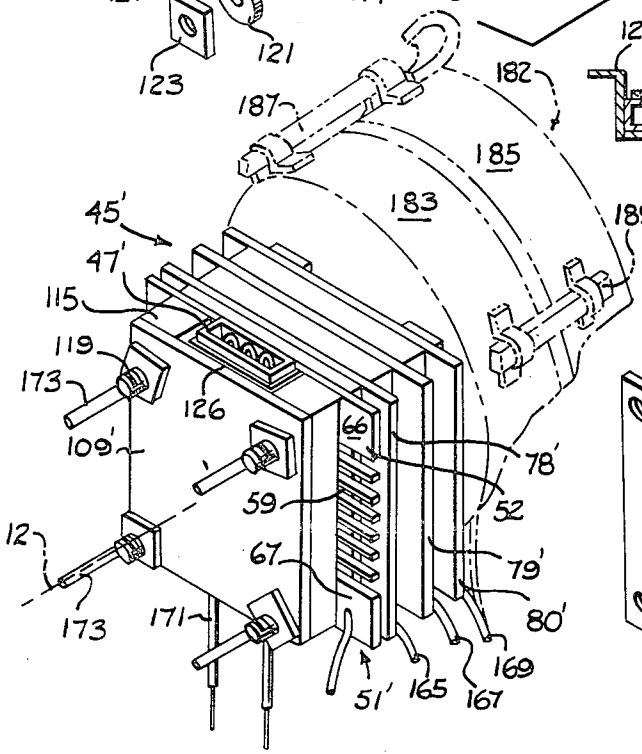


Fig. 8B

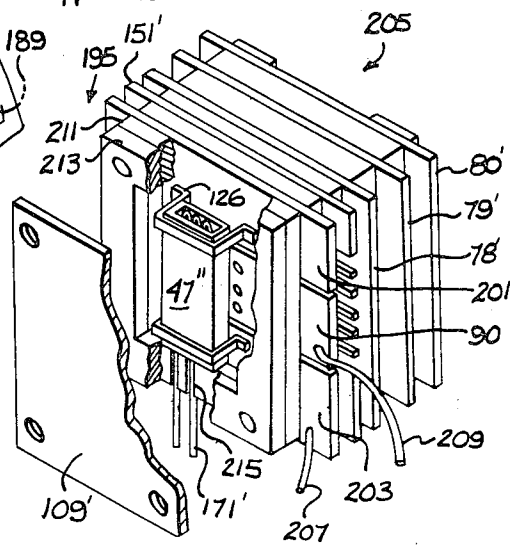


Fig. 10

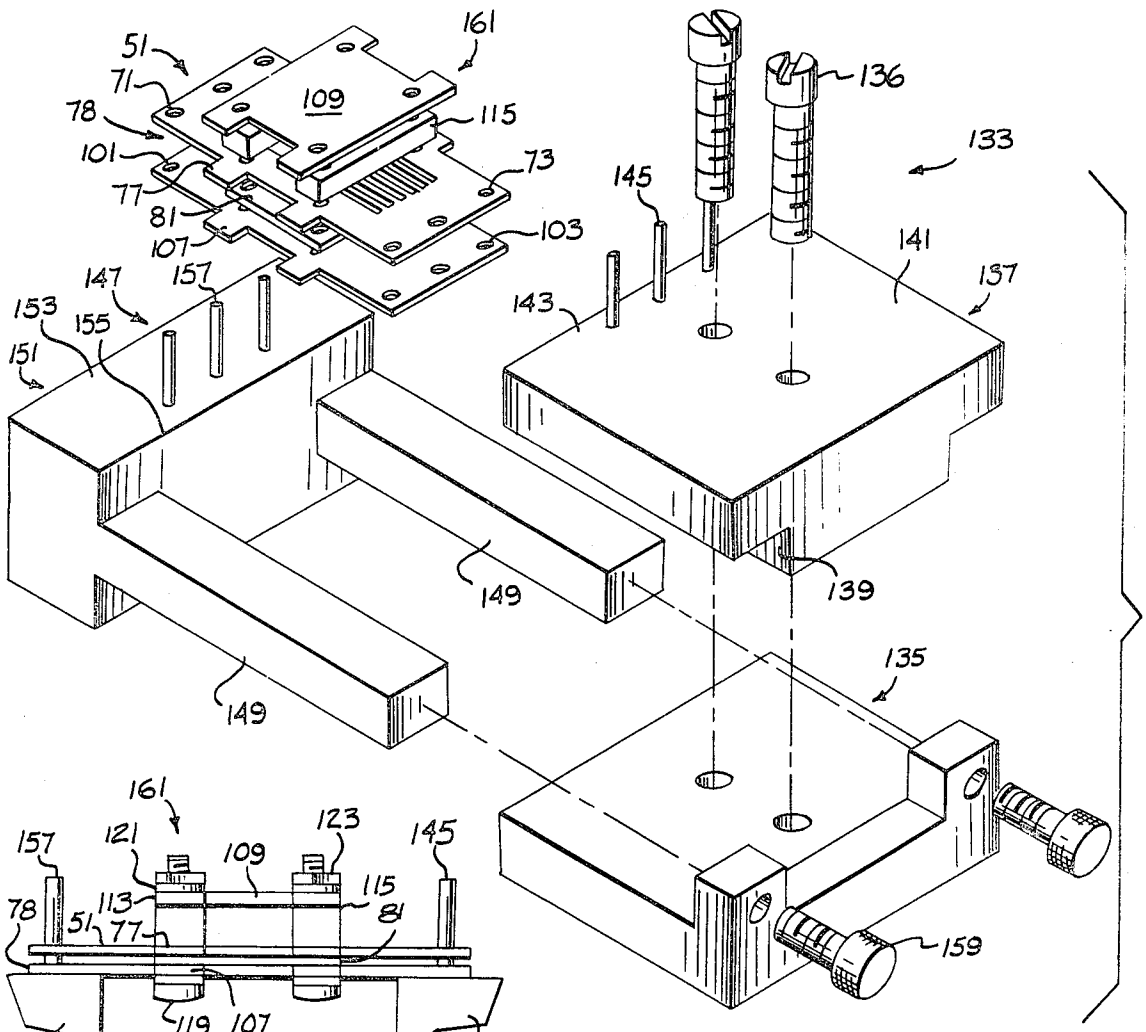


Fig. 5A

Fig. 6

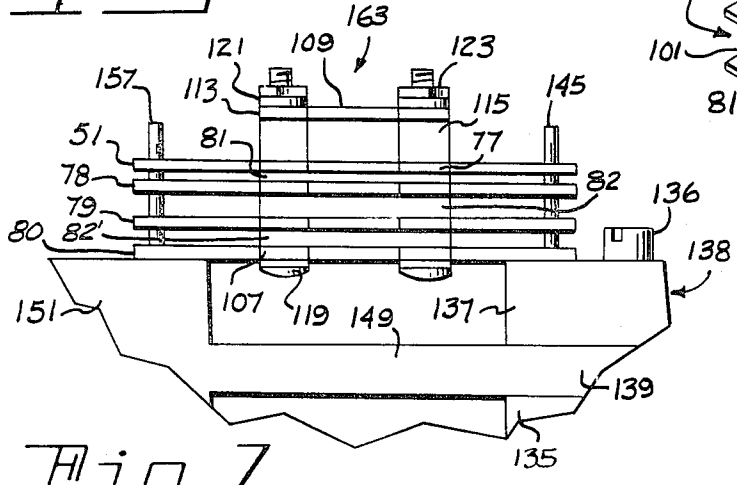


Fig. 7

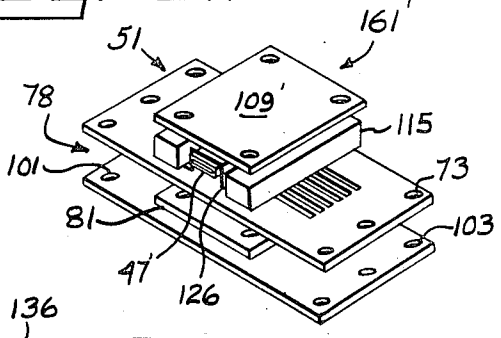


Fig. 5B

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METHOD OF FABRICATING A MULTIBEAM ELECTRON GUN STRUCTURE

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 860,626 filed Sept. 24, 1969 and contains matter disclosed but not claimed in a related continuation-in-part of application Ser. No. 860,621 filed concurrently herewith and assigned to the assignees of the present invention. This related continuation-in-part application is Ser. No. 126,609, "Multibeam Single Gun Electron Discharge Device." A previously filed application, Ser. No. 860,625 "Electrode Alignment and Assembling Device," contains matter disclosed but not claimed in the above-identified applications, Ser. No. 860,621 and Ser. No. **860,626**.

BACKGROUND OF THE INVENTION

This invention relates to a multibeam cathode ray tube and more particularly to a method of fabricating a single multibeam electron gun structure for a cathode ray tube.

In certain types of high resolution cathode ray tube displays such as may be used in alpha-numeric graphing, or mapping presentations, it has been found advantageous from the standpoint of achieving improved brightness, enhanced resolution and increased writing speed, to utilize a multibeam tube having a plurality of substantially parallel and separately modulated electron beams therein. The disadvantages of a single beam system is that display brightness is low due to sweep speeds and time sharing of the beam. It has been found that the use of a plurality of individual electron guns within a common envelope is limited by the size of the respective guns and the internal dimension of the tube neck portion wherein the guns are positioned.

Some known single gun multibeam tubes comprises intricate electron gun assemblies including electrodes having ceramic substrates and wire formed structures.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to reduce the aforementioned disadvantages and to provide an improved high resolution single gun multibeam cathode ray tube. Another object is to provide a method of fabricating an improved multibeam electron gun structure wherein the electro beams are substantially parallel and individually modulated. A further object is to provide a method of fabricating an improved multibeam gun structure that can be expeditiously accomplished.

The foregoing objects are achieved in one aspect of the invention by providing a method of fabricating an improved multibeam single gun electron discharge device such as a high resolution cathode ray tube. The multibeam gun structure is assembled by positioning, on an alignment device, at least one plural-apertured metallic planar electrode member having an array of beam apertures therein. Positioned thereon is spaced and parallel relationship therewith is a planar arrangement of separate control electrode members each having a beam aperture therein to form a similar aperture

array. The beam apertures in the several electrode members are aligned whereupon the electrode members are affixed to spacing means therebetween. A common emission plane is oriented to provide electron beams to the control electrode plane. The gun structure so fabricated provides collimated beams which are directed to impinge the cathodoluminescent screen of the tube in an array pattern as determined by the array of beam apertures in the multibeam electron gun structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partially cut-away perspective illustrating a cathode ray tube incorporating the invention;

FIG. **2** is an enlarged plan view of the control electrode plane showing the plurality of control electrode members;

FIGS. **3***a* and **3***b* enlarged plan views of two embodiments of a plural-apertured planar electrode member;

FIGS. **4***a* and **4***b* are exploded views illustrating two embodiments of the multibeam electron gun structure;

FIGS. **5***a* and **5***b* are perspective views showing pertinent aspects of multibeam gun structure assemblies;

FIGS. **6** and **7** are side views showing two embodiments of multibeam gun structures during assembly;

FIGS. **8***a* and **8***b* are perspective views illustrating additional details of two multibeam gun assemblies;

FIG. **9** is an enlarged partial cut-away illustration detailing electron beam formation in one embodiment of the invention;

FIG. **10** is a partial cut-away view showing another embodiment of the invention; and

FIG. **11** is a plan view of a cathode stand-off positioner.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following specification and appended claims in connection with the aforedescribed drawings.

With reference to FIG. **1**, there is shown one embodiment of a cathode ray tube **11** having an axis **12** therethrough and an envelope **13** including a face panel or viewing portion **15**, a funnel portion **17**, and a neck portion **19**. Suitably disposed on the inner surface of the face panel **15** is a cathodoluminescent screen **21** comprising at least one electron excitable phosphor material **23**. Oriented within the tube neck portion **19** is multibeam single electron gun structure **25**, the componental parts of which are not detailed in FIG. **1**. This single gun structure **25** is fabricated to produce a beam pattern array **26** of a defined plurality of similar substantially collimated electron beams **27** which are directed to impinge the screen **21**. By way of example, a discrete pattern array **26** comprised of six beams **27** is shown, but such number of beams is not intended to be limiting as the single multibeam gun **25** can be constructed to produce few or many substantially collimated beams **27**. In the beam pattern array **26** thus formed, each beam **27** can be separately modulated without need for convergence correction as the pattern

array is scanned over the screen 21. Thus, the pattern of plural beams, as shown, potentially increases by six times, the brightness potential of the particular display tube 11. Also, since the beam array 26 is handled as a bundle, there is a reduction of writing rate for each beam 27 by a factor equal to the number of beams.

Electrical conductive means are applied to the interior surface of the neck 19 and funnel 17 portions of the tube envelope 13 to effect an electrical connection between the electron gun structure 25 and the screen 21.

In this first embodiment, the electrical conductive means is in the form of a spiral accelerator or resistive helix 29 applied to the inner surface of the neck portion 19 in a manner to extend from the low potential of the final electrode of the gun 25 to the internal conductive coating 31 disposed on the interior surface of the funnel portion 17, thus making connection with the high potential of the screen 21. In this way the resistive helix 29 serves to build a long gradual accelerating field which in conjunction with magnetic lensing effects faithfully images the beam pattern array 26 on the screen 21.

The plural beam pattern array 26 has an object height (h') and width (w'), not shown, as it leaves the electron gun 25 and an image height (h'') and width (w'') when it impinges the screen 21. In certain display applications it is desired to effect magnification, demagnification or substantially maintain the image height (h'') and width (w'') relative to the object height (h')and width (w'). Such is effected by gun structure and magnetic lensing as will be described later in this specification.

To ensure that the beam pattern array 26 impinges the screen 21 in desired rotational alignment, a pattern rotation coil 33 is usually exteriorly positioned on the neck portion 19 of the tube 11 near the low voltage end of the helix 29. Thus, by adjustment of the pattern rotation coil 33 rotational shifting of the beam pattern array 26 is provided as, for example, in writing italics in a character generating application. In utilizing magnetic focusing and deflection, a focusing coil 35 is mounted on the exterior of the tube neck portion 19 at the high voltage end of the helix 29, and a deflection coil 37 is formed to encompass the envelope transition region 18 where the funnel portion 17 joins the neck portion 19.

The single electron gun structure 25 has a number of electrical connections, not shown, which are brought out through the tube base 39 to external connective means 41, several of which are shown.

In detailing one embodiment of a multibeam single gun structure 45, particular reference is made to FIGS. 1, 2, 3a, and 4a wherein the defined gun structure comprises a common electron emission plane and an assembly of related parallel conductive electrode planes each having an array of beam apertures therein corresponding to the number and patterned configuration 26 of the desired array of beams 27 impinged upon screen 21.

To provide greater detail and clarity, an exploded view of the gun structure 45, during construction, is shown in FIG. 4a. A source of electrons such as thermionic electron emission means 47 as, for example, a tubular cathode having electron emissive material disposed on at least part of one surface thereof forms a common emission plane 49. Spaced from and parallel with the emission plane 49, and substantially normal to the axis 12, is a metallic substantially planar control electrode mat 51 which is further detailed in FIG. 2. This control electrode mat 51 is discretely formed as for example, by chemical milling, to provide a framing member 52 encompassing a plurality of substantially strip-like self-supporting control electrode members 53 each having a beam aperture 57 therein and a separate electrical connection 59. The framing member 52 therearound comprises two opposed horizontal extremital portions 66, 67 and two related vertical extremital portions 68 and 69. The several electrode members 53 are positioned in laterally spaced relationship with one another to form a substantially centrally oriented planar control electrode aperture array 61. As shown, the aperture array 61 comprises two substantially parallel rows of beam apertures 57. To achieve array compactness, the electrode members 53 present a staggered aperture array 61 having a height (h) and a width (w). These dimensions are substantially the same as object height (h') and width (w') of the aforementioned beam pattern array 26 as it leaves the electron gun. Spaced from either side of the aperture array 61 is set of similarly oriented control electrode affixal perforations 63 and 65 oriented in each of the horizontal extremital portions 66, 67; and further spaced therefrom, in each of the two opposed vertical extremital portions 68 and 69 of the control electrode mat 51, is a set of similarly located control electrode alignment perforations 71 and 73. Protruding laterally from the control electrode framing member 52 are two sets of control electrode tabs 75 and 77 which in this embodiment are utilized in gun structure assembly 45.

Spaced form and substantially parallel with said plurality of control electrode members 53 is at least one plural-apertured metallic planar electrode mat 78, forming an accelerating-collimating electrode plane, which is further detailed in FIG. 3a. The spacing between the plurality of control electrode members 53 and the accelerating-collimating electrode plane 78 is an insulative electrode spacer means 81 in the form of a substantially rectangular-shaped member having a peripheral spacing framing member 83 defining a central cut-out portion 85. Affixal perforations 87 are suitably oriented in the peripheral framing member 83 to provide definite placement in the gun structure assembly 45. In addition to serving as an electrode spacing means, the peripheral framing member 83 serves as a support means across which the plurality of laterally spaced control electrode members 53 are bridged.

With reference to FIG. 3a, the plural-apertured metallic planar electrode mat 78 has a plurality of beam apertures 89 formed therein, as for example, by discrete chemical milling to provide a planar electrode aperture array 91 which corresponds in array configuration and number with the respective beam apertures 57 in the control electrode array 61, having substantially similar height (h) and width (w) dimensions. Spaced on either side of the planar electrode aperture array 91 is a set of similarly oriented planar electrode affixal perforations 93 and 95. In each of the two opposed vertical extremital portions 97 and 98 of the planar electrode mat 78 is a set of similarly located

When employing ceramic bonding for affixation, the cemented electrode assembly **161** is removed from the alignment device **133** and placed in a sealed enclosure, not shown, for outgassing which is accomplished by a conventional heating and exhaust procedure.

The fabrication of another embodiment of electrode assembly **163** is shown in FIG. **7** wherein additional plural-apertured metallic planar electrode mats **79** and **80** are also included along with the necessary insulative spacer means **82** and **82'**. The aforementioned assembling and affixation procedures utilized for the first embodiment **161** also apply equally as well to this second embodiment **163**. To simplify description, further consideration is substantially confined to the second embodiment **163**.

After affixation, the extremital portions of the several electrode mats, such as **67**, **69**, and the pluralities of **97**, **99** are removed adjacent to the several electrode spacer means **77**, **82** and **82'**. Such removal provides separate lead connections **59** for the individual electrode members **53** of the control electrode plane **51** as illustrated in FIG. **8***a*. A multiple apertured wafer-like insulative member **125**, such as a mica or ceramic, is positioned on either side of the electrode assembly **163** with the planes of the spacer members **125** being substantially parallel with the axis **12**. Electron emission means, such as a thermionic cathode **47**, is positioned in cathode apertures **127** of the members **125** in a manner that the emission plane **49** is adjacent the array of control electrode apertures **57**; whereupon, the members **125** are secured to the respective tabs, for example **75**, **77** and **113** as shown in FIG. **8**. In this manner, the gun structure **45** is unitized. Separate electrical connections **165**, **167**, and **169** are provided for planar electrode planes **78**, **79** and **80**, respectively. A formed heater **171** is positioned within the cathode **47**. The gun structure **45** is positioned relative to a multilead stem means, not shown, and secured to support leads **173** extending therefrom and attached, for example, to bolt means **119**. Electrical connections from the componental parts of the gun structure **45** are made to appropriate stem connective leads in a conventional manner.

In another embodiment of the multibeam gun structure **45'**, as illustrated in FIGS. **4***b*, **8***b*, and **11**, the cathode spacer means employed is in the form of a pair of spaced-apart angular-shaped stand-off positioners **126**, of, for example, tungsten, wire or strip, shaped to substantially cradle the cathode **47'** in a manner to expedite attachment thereto. Seating portions **128** are formed for affixation, such as by welding, to portions of the adjacent electrode mat which subsequently become isolated elements in the electrode plane adjacent to the cathode. For example, the several seating portions **128** are welded to the respective horizontal extremital portions **66** and **67** of control electrode mat **51**, such as at areas A and B. When the vertical extremital portions **68** and **69** are subsequently removed, the horizontal extremital portions **66** and **67** become separate elements in the gun structure electrically isolated from the center portion of the mat.

Since the laterally protruding tabs **75**, **77**, **105**, **107** and **113**, **114** on the respective electrode planes and cathode shielding means are not required when the pair of cathode stand-off positioners **126** are employed, they are eliminated in the gun structure embodiment **45'** shown in FIGS. **4***b* and **8***b*, thereby reducing the size of the resultant gun structure. The tab-less electrode planes **51'** and **78'** and shield means **109'** have elemental structural features that are similar to those noted in FIGS. **4***a* and **8***a* and therefore are numerically designated in like manner.

When the stand-off cathode positioners **126** are utilized, the cathode **47'** is attached to the adjacent electrode plane prior to the gun structure assembling operation. This is shown in FIG. **5***b* wherein electrode assembly **161'** replaces electrode assembly **161** in FIG. **5***a*, the respective electrode mats and spacers being sequentially oriented in stacked order.

To achieve high resolution images with multibeam array, it has been found advantageous in some instances to position an image array size control electrode means **174** forward of the final electrode plane to provide an additional control feature in the neck region where the beams enter the accelerating helix, if such is used. One electrode embodiment is in the form of a field forming mesh lens so positioned to effect the advantage of being either convergent or divergent depending on whether it is operated above or below its surroundings. With reference to FIG. **8***a*, the mesh lens **175**, if desired, is positioned in a substantially parallel manner forward of and spaced from the final accelerating-collimating electrode plane **80** and has a separate electrical connection **177**. A cylindrical metallic shield **179** operating at the potential of the final electrode plane **80** encompasses the space between the final electrode plane and the mesh. In referring to FIGS. **1** and **8**, the electron gun structure, in this instance the cylindrical shield **179**, has resilient electrical connective means **181** formed to contact a conductive band **183** disposed on the inner surface of the neck portion **19** and connected to the helix **29**.

Another embodiment of an image array size control electrode **182** is partially shown in FIG. **8***b* wherein spaced apart first and second cylindrical electrode members **183**, and **185**, forming a bi-potential lens having substantially like diametrical dimensions, are positionally aligned relative to the final of the accelerating-collimating electrode planes in the electron gun structure **45'**. Suitable orientation is provided by at least three longitudinal insulative supports, two of which are shown **187**, **189**. The first electrode member **183** is of the same potential as the final electrode plane **80'**. The second or forward positioned electrode member **185**, which has a separate electrical connection **191**, is operable at a potential usually above that of the first member **183** to provide control of the array image as may be desired.

While the two embodiments of the image array size control electrode means **174** and **182** are shown in FIGS. **8***a* and **8***b* as being associated with the respective multibeam gun structures **45** and **45'**, they are equally adaptable to any of the gun structures described herein.

Another gun structure embodiment is illustrated in FIG. **9** wherein another plural-apertured metallic planar electrode mat **78***, which is dimensionally similar to planar electrode mat **78**, is positioned between the common electron emissive plane **49** and the control electrode plane **51** to provide shielding effects and a pre-formed beam pattern array which is dis-

planar electrode alignment perforations 101 and 103. Protruding laterally from the accelerating-collimating planar electrode mat 78 are two sets of planar electrode tabs 105 and 107 which are utilized in gun structure assembly 45.

It has been found that in small size plural beam arrays enhanced focusing and collimation can be achieved by incorporating additional plural-apertured electrode planes to the gun structure. For example, in referring to FIG. 4a, additional accelerating-collimating electrode planar mats G-3 and G-4, forming additional lens planes, are designated as 79 and 80 respectively, and are not specifically detailed as they are substantially the same as aforedescribed planar electrode mat 78. The insulative electrode spacer means 82 and 84 are rectangular framing means having greater thickness than insulative electrode spacer means 81, otherwise they are substantially similar to what has been described.

Cathode shielding means 109 having corner oriented affixal perforations 111 and protruding tabs 113 is positioned in spaced relationship with and substantially parallel to the control electrode mat 51, being discretely spaced therefrom by insulative spacing means 115 which has a plurality of affixal perforations 117 therein. The resultant spacing between the shielding means 109 and the control electrode mat 51 accommodates the spaced positioning of the electron emission means such as cathode 47 therebetween. The several related planar electrode mats and respective spacers are joined together in a compact gun structure assembly 45 by affixal means such as cement, rod-like clamping means or bolts. For example, a plurality of threaded bolts 119, extending through the numerous affixal perforations and insulative washers 121, are suitably secured by nuts 123. By this arrangement the related plurality of apertures in the several respective electrode mats are predeterminately aligned in a manner substantially related to the axis 12.

In this embodiment, cathode spacer means in the form of a pair of apertured wafer-like insulative members 125 are individually positioned on either side of the gun structure assembly. Each has a cathode aperture 127 therein to accomodate and orient the cathode 47 relative to the control electrode mat 51; the planes of said wafer-like members 125 being substantially parallel with the axis 12. Sets of apertures or perforations 129 and 131 are also contained in the wafer-like members 125 to accommodate the shielding means protruding tabs 113 and the several tabs 75, 77, 105, and 107 protruding from electrode mats 51 and 78, respectively.

Expeditious assembling of the aforedescribed multibeam electron gun structure 45 is accomplished by utilizing an electrode alignment device 133 as illustrated in FIGS. 5, 6 and 7. The alignment device is comprised of several parts, one of which is a movable base portion 135. A cap portion 137 is shaped for fixed attachment to the base portion 135, as for example by bolt means 136 which seat in the base 135 to form a cap-base assembly 138 wherein there is provided spaced apart longitudinal guide channel means 139. The cap portion has an upper surface 141 whereof the leading edge portion 143 has a plurality of vertical pins 145 oriented adjacent thereto. The pins 145 are spaced in a manner to match one set of the respective electrode mat alignment perforations, for example 73 and 103. A slide portion 147 has a pair of longitudinal member means 149 formed to slide in the guide channel means 139 in the cap-base assembly 138. The slide portion 147 has a bridge member 151 formed substantially normal to the longitudinal member means 149. The bridge member 151 has an upper surface 153 with a forward edge portion 155 oriented in adjustably spaced relationship to the cap portion leading edge portion 143. Adjacent to the forward edge portion 155 are a plurality of vertical pins 157 oriented in a manner to match an opposed set of electrode mat alignment perforations, for example 71 and 101. The respective sets of pins 145 and 157, which are oriented in a common lateral plane, have sufficient vertical length to accommodate a plurality of planar electrode mats in spaced apart stacked arrangement. Lateral movement means 159 is incorporated in the cap-base assembly 138 to provide lateral uniform adjustable movement to each of the longitudinal member means 149 to effect controlled movement of the two respective pluralities of pins 145 and 157 and provide lateral tautness and alignment to the electrode mats accommodated thereon.

In assembling a multibeam single gun electron gun structure of the type described, an electrode assembly is first fabricated. With reference to FIGS. 5 and 6, there is shown one embodiment of an electrode assembly 161 comprising a control electrode mat 51 and a planar electrode mat 78. Such is facilely assembled by positioning an accelerating-collimating electrode mat 78 on the alignment device 133 with the sets of alignment perforations 101 and 103 mating with the corresponding sets of vertical pins 157 and 145 on the device. An insulative electrode spacer means 81 is positioned upon the accelerating-collimating electrode mat 78 with the respective affixal perforations substantially aligned. A control electrode mat 51 is positioned atop the spacer means 81 on the device 133 with the alignment perforations 71 and 73 mating with the sets of pins 157 and 145 thereon. Alignment of the respective beam apertures in the two electrode mats 79 and 51, is accomplished by discretely activating the lateral movement means 159 in the device 133 to carefully move the sets of pins 157 and 145 and provide lateral tautness to the mats. Care is exercised to avoid deformation of the respective alignment perforations. Insulative spacing means 115 are placed atop the control electrode mat 51 with the respective affixal perforations in alignment; whereupon the cathode shielding means 109 is suitably positioned. With the componental elements thus arranged, affixation is effected to form a unified electrode assembly 161. As previously mentioned, affixation is accomplished in several ways, as for example, by applying a suitable ceramic bonding material to the region of the affixal perforations, or by inserting rod-like clamping mean, such as bolts, through the aligned affixal perforations. As shown, bolts 119 are utilized, being inserted up through the assembly with the insulative washers 121 and mating nuts 123 applied adjacent to the cathode shielding means 109 to provide affixation. If ceramic bonding material is utilized for affixation, the electrode assembly 161 is retained in the device 133 until the bonding is set.

cretely beamed to the respective control electrode apertures **57**. Spacings between the electron emission means **47**, the planar electrode plane **78*** and the control electrode plane **51** are effected by either embodiment of spacer means **125** or **126**, which for purposes of clarity are not shown.

When employing the cathode stand-off positioning means **126**, a modified plural-apertured planar electrode mat **195** is utilized, such being shown in FIG. **3b**. The modified mat **195**, which may be tab-less, comprises two vertical extremital portions **97'** and **98'** and two spaced-apart horizontal slots **197** and **199** that define the two horizontal extremital portions **201** and **203** which are removed from the array of beam apertures **89'**. The two cathode stand-off positioners **126**, with the cathode **47'** cradled in and attached thereto, have their respective seating provisions **128** welded to the respective horizontal extremital portions **201** and **203**. When the vertical extremital portions **97'** and **98'** are subsequently removed during the gun structure assembling procedure, the remaining horizontal extremital portions **201** and **203**, with the cathode positioners **126** affixed thereto, are electrically isolated from the beam aperture portion **90** of the electrode mat **195**. This is further illustrated in the partial gun assembly **205** shown in FIG. **10**. A cathode connection **207** is made to either of the isolated horizontal extremital portions **201** and **203**. If desired, an electrical connection **209** can be made to the common aperture portion **90**.

A modified cathode orientation is also illustrated in FIG. **10**, wherein a shorter cathode **47''** , mounted by positioner means **126** as aforedescribed, is located in a manner to be encompassed by a pair of insulative frame-like spacer means **211** and **213**, partially detailed. These are superjacently integrated as elements in the gun structure **205** replacing insulative spacing means **115**. The legs of cathode heater **171'** are positionally oriented sandwich-like in appropriate grooves or channels **215** in the spacer means **211** and **213**. This construction, which substantially encloses the cathode **47''** within the gun structure, has been found to be advantageous in reducing warm-up time and effecting enhanced control of spurious electron emission.

Thus there is provided a method and embodiments thereof for fabricating an improved high resolution single gun multibeam cathode ray tube which incorporates one of several related embodiments of an improved multibeam gun structure that can be expeditiously assembled.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

We claim:

1. Method of fabricating a multibeam electron gun structure formed for positioning in a cathode ray tube, said gun structure having an electron emission plane, a substantially planar control electrode mat formed of an array substantially longitudinal individual electrode members each having a beam aperture therein and separate leads therefrom, at least one substantially planar accelerating-collimating electrode mat with a plurality of beam apertures corresponding in array and number to the beam apertures in the control electrode array, each of said electrode mats having therein a plurality of affixal perforations and a plurality of alignment perforations, and insulative electrode spacer means having a center opening therein, said fabricating method utilizing an electrode alignment device having a plurality of vertical pins for holding said respective electrode mats and comprising the steps of:

positioning at least one accelerating-collimating electrode mat on said alignment device with said alignment perforations mating with said pins on said device;

positioning an insulative electrode spacer means upon said accelerating-collimating electrode mat;

positioning said control electrode mat atop said electrode spacer means in said alignment device with said alignment perforations mating with said pins thereon; said longitudinal individual electrode members being bridged across said central opening in said spacer means;

aligning said beam apertures in said planar control electrode mat and said accelerating-collimating planar electrode mat; and

affixing said electrode mats to said insulative spacer means therebetween.

2. Method of fabricating multibeam electron gun structure having an axis therethrough and formed for positioning on a multi-lead stem portion of a cathode ray tube, said gun structure having a thermionic cathode with an emission plane, cathode shielding means, a substantially planar control electrode mat formed of an array of individual electrode members each having a beam aperture therein and separate leads therefrom, at least one substantially planar accelerating-collimating electrode mat with a plurality of beam apertures corresponding in array and number to the beam apertures in the control electrode array, each of said electrode mats having spaced on either side of said aperture array a set of similarly oriented affixal perforations and a set of alignment perforations located in two opposed vertical extremital portions of said mats, insulative electrode spacer means formed of a thickness to separate said electrode mats and having two sets of affixal perforations therein, and a pair of cathode spacer means, said fabricating method utilizing an electrode alignment device for holding said respective electrode mats and comprising the steps of:

positioning at least one accelerating-collimating electrode mat on said alignment device with said sets of alignment perforations mating with corresponding sets of protruding pins on said device;

positioning an insulative electrode spacer means upon said accelerating-collimating electrode mat;

positioning said control electrode mat atop said electrode spacer means in said alignment device with said alignment perforations mating with said pins thereon;

aligning said beam apertures in said planar control electrode mat and said accelerating-collimating planar electrode mat;

affixing said planar control electrode mat and said accelerating-collimating planar electrode mat to said insulative spacer means therebetween to form an electrode assembly; and

removing said vertical extremital portions of said electrode mats adjacent to said electrode spacer means, said removal providing separate lead connections for the individual electrode members of said control electrode plane.

3. The method of fabricating a multibeam electron gun structure according to claim 2 wherein said affixation of said planar control electrode and said accelerating-collimating planar electrode mats, and the respective insulative spacer means therebetween is accomplished by inserting rod-like clamping means through said similarly oriented affixal perforations.

4. The method of fabricating a multibeam electron gun structure according to claim 2 wherein the affixation of said planar control electrode and said accelerating-collimating planar electrode mats, and the respective insulative spacer means therebetween is accomplished by cement bonding means between and through said similarly oriented affixal perforations.

5. The method of fabricating a multibeam electron gun structure according to claim 2 wherein the positioning of said cathode shielding means in spaced relationship with said cathode is accomplished simultaneously with the affixation of said respective electrode mats.

6. The method of fabricating a multibeam electron gun structure according to claim 2 wherein said cathode spacer means are in the form of a pair of multiple apertured wafer-like insulative members one of which is positioned on either side of said assembly after the vertical extremital portions of said electrode mats have been removed, the planes of said wafer-like members being substantially parallel with said axis; said wafer-like member positioning being followed by the positioning of said thermionic cathode in related apertures in said wafer-like member in a manner that said emission plane is facing said adjacent electrode mat; and said apertured wafer members being secured to said gun structure to maintain the desired positioning of said cathode in said gun structure.

7. The method of fabricating a multibeam electron gun structure according to claim 2 wherein said cathode shielding means and said adjacent electrode mat have a plurality of protruding tabs extending laterally therefrom; and wherein said apertured wafer members, having tab related apertures therein, are positionally secured on said tabs.

8. The method of fabricating a multibeam electron gun structure according to claim 2 wherein said cathode spacer means are in the form of a pair of spaced-apart angular-shaped stand-off positioners attached to said cathode and affixed to isolated elements in the electrode mat adjacent to said emission plane before said electrode mat is positioned on said electrode alignment device.

9. The method of fabricating a multibeam electron gun structure according to claim 4 wherein said cemented assembly is outgassed by heating prior to the removal of said vertical extremital portions.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,686,727 Dated August 29, 1972

Inventor(s) Donald L.Say and Harry E. Smithgall

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Sheets 2 and 4 of Drawings - Delete "A. D. Johnson"

Column 1, line 19 - after "860,626" please add

--- all now abandoned. ---

This certificate supersedes Certificate of Correction issued January 23, 1973.

Signed and sealed this 30th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,686,727 Dated August 29, 1972

Inventor(s) DONALD L. SAY and HARRY E. SMITHGALL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 19 -- after "860,626" please add --- all now abandoned. ---

Signed and sealed this 23rd day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents