Aug. 18, 1970 G. A. BURDICK 3,524,235

METHOD FOR ASSEMBLING A MULTIPLE ELECTRON GUN STRUCTURE FOR CATHODE RAY TUBE

Original Filed May 31, 1966 3 Sheets-Sheet 1

Fig. 1

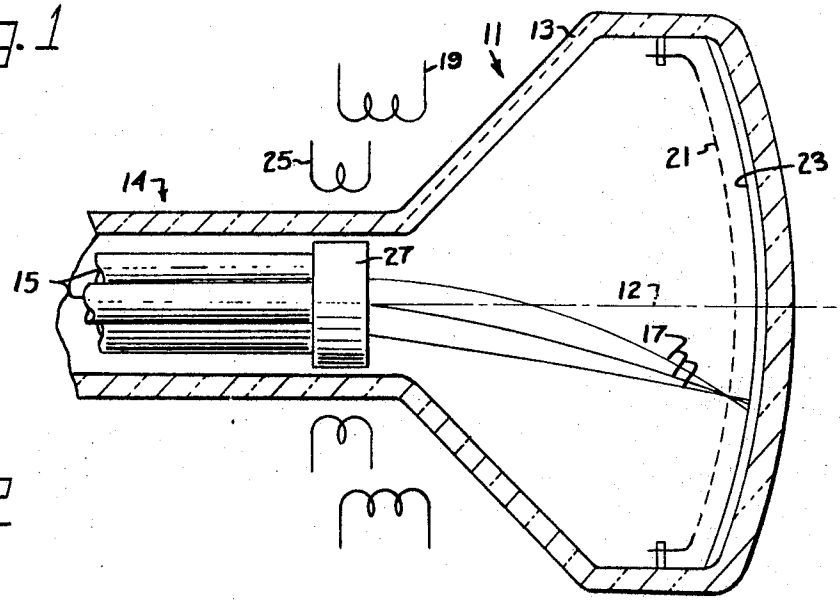
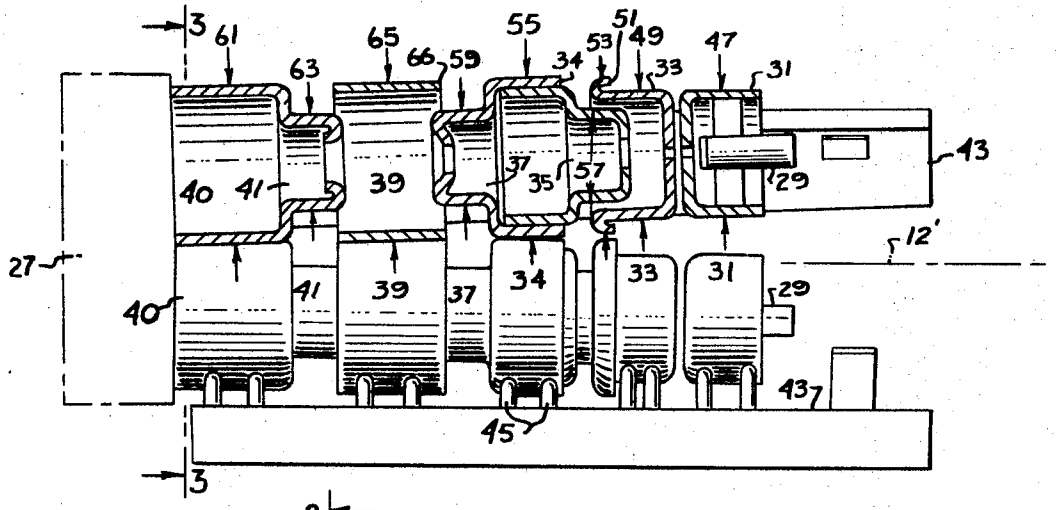


Fig. 2



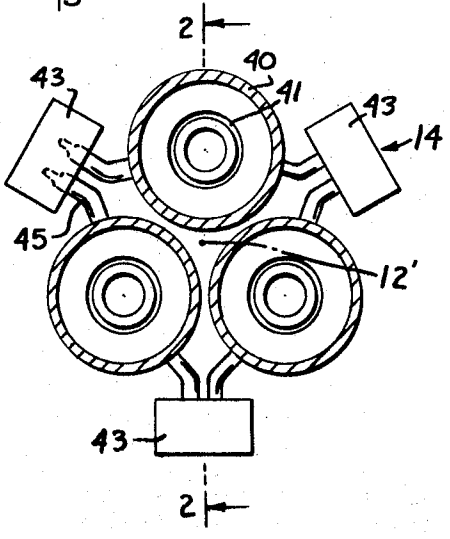


Fig. 3

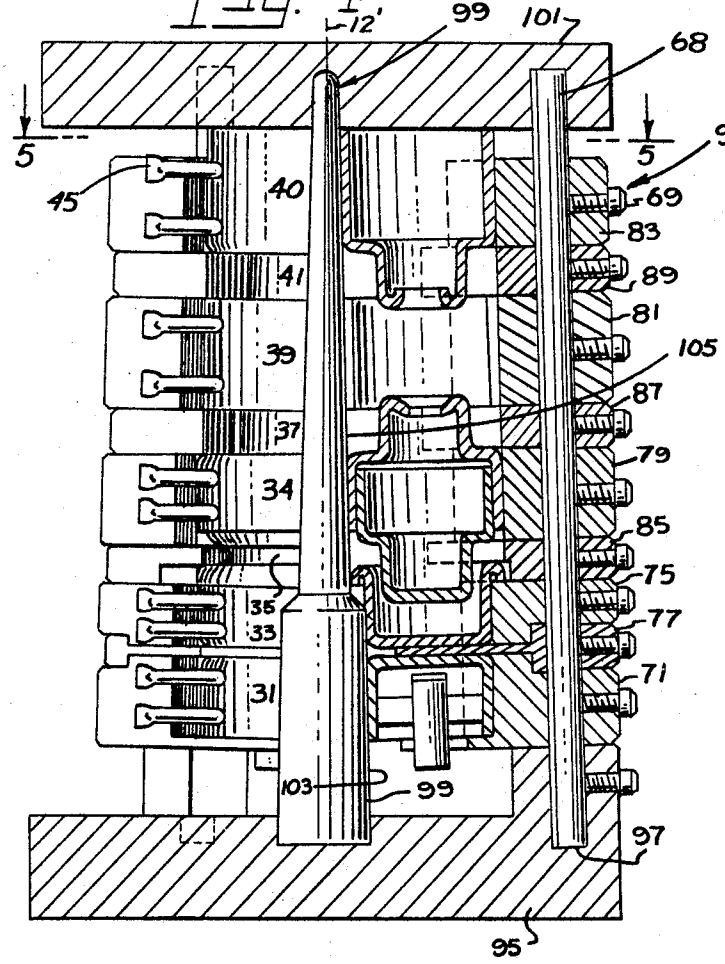
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METHOD FOR ASSEMBLING A MULTIPLE ELECTRON GUN STRUCTURE FOR CATHODE RAY TUBE

Original Filed May 31, 1966 3 Sheets-Sheet 2

Fig. 4



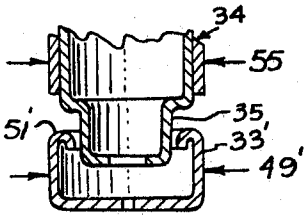


Fig. 6

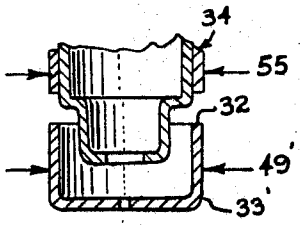


Fig. 7

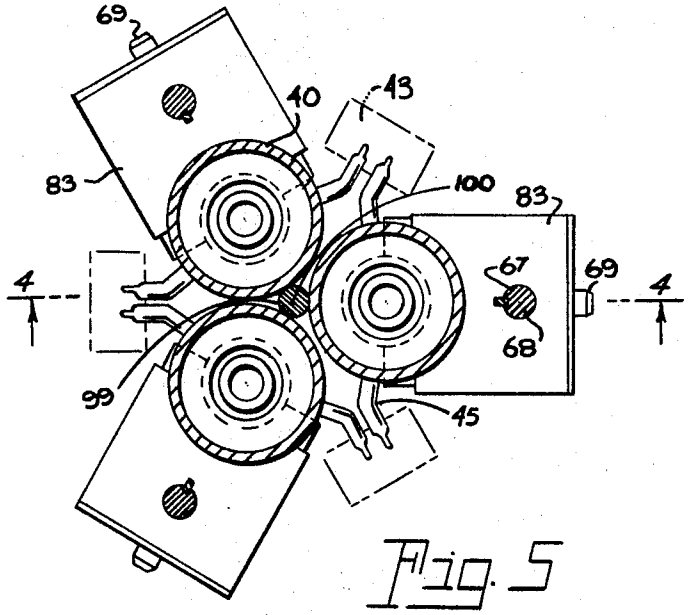


Fig. 5

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METHOD FOR ASSEMBLING A MULTIPLE ELECTRON GUN STRUCTURE FOR CATHODE RAY TUBE

Original Filed May 31, 1966 3 Sheets-Sheet 3

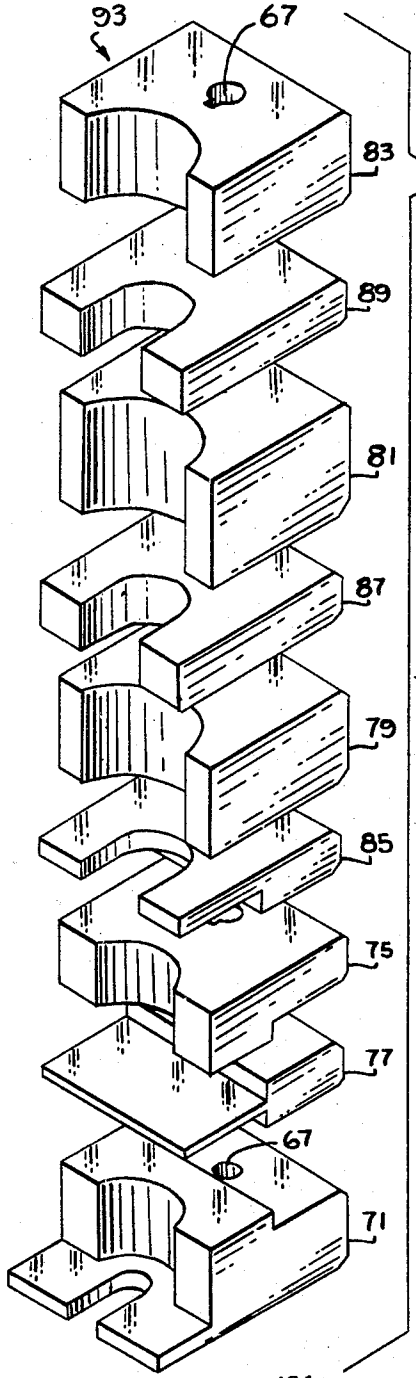


Fig. 8

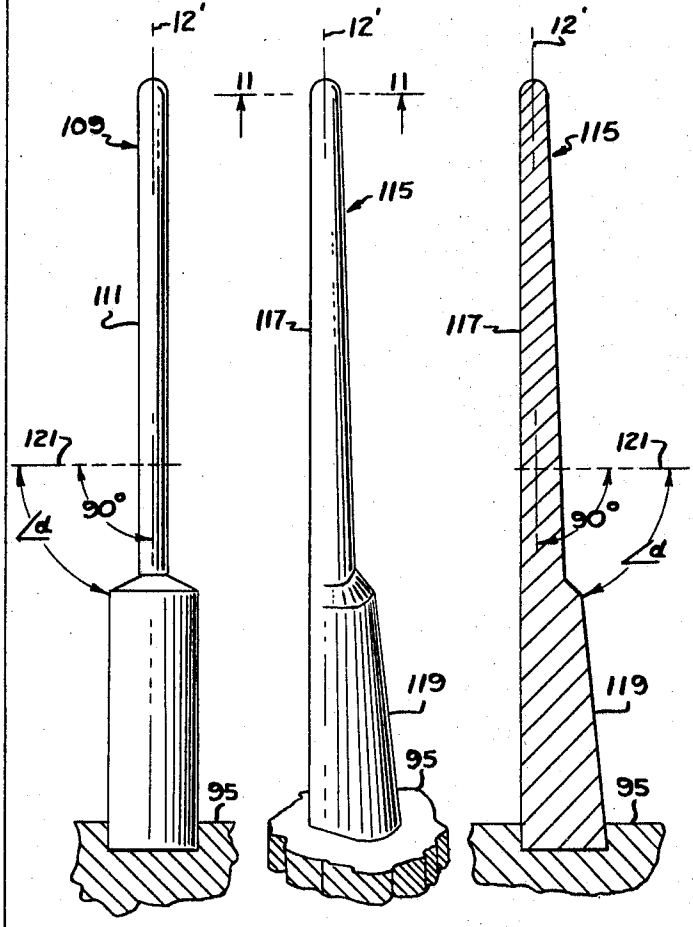


Fig. 9 Fig. 10 Fig. 11

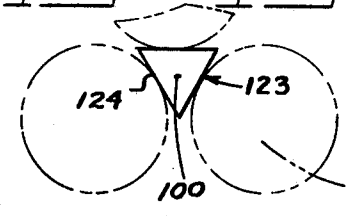


Fig. 12

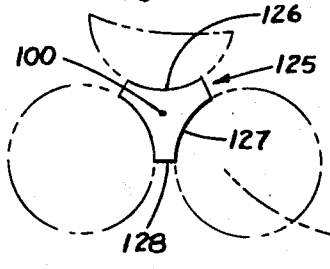


Fig. 13

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United States Patent Office 3,524,235
Patented Aug. 18, 1970

3,524,235

METHOD FOR ASSEMBLING A MULTIPLE ELECTRON GUN STRUCTURE FOR CATHODE RAY TUBE

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Original application May 31, 1966, Ser. No. 553,752, now Patent No. 3,396,297, dated Aug. 6, 1968. Divided and this application Mar. 6, 1968, Ser. No. 711,073
Int. Cl. H01j 9/18, 9/36
U.S. Cl. 29—25.16 2 Claims

ABSTRACT OF THE DISCLOSURE

A method of assembling a multiple electron gun structure comprising a plurality of related unipotential low-voltage focusing lens guns employing overlapping focusing electrodes. The successive cylindrical electrodes of each gun have related external diameters and are axially aligned in sequential order by loading the respective electrodes in electrode support means oriented about a removable common central support post in a manner whereby a cylindrical portion of all electrodes makes contact therewith to effect the respective gun alignments. Securement means are applied to retain the guns in a related manner as an integrated multiple mount structure, whereupon the common support post is withdrawn from the structure.

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a divisional application of Ser. No. 553,752, filed May 31, 1966, which is assigned to the assignee of the present invention. This divisional application contains matter disclosed but not claimed in another application Ser. No. 711,074, filed concurrently herewith, which application is also a division of Ser. No. 553,752.

BACKGROUND OF THE INVENTION

This invention relates to electron discharge devices and more particularly to color cathode ray tube multiple electron gun structures employing unipotential low-voltage focusing lenses.

Many of the cathode ray tubes presently employed in color television display applications are of the type having an envelope with a patterned multi-phosphor cathodoluminescent screen disposed on the viewing panel thereof with an apertured structure or foraminous mask positionally spaced therefrom. Electrons from a multiple electron gun mount structure, positioned within the envelope, are beamed through the apertured structure to discretely impinge and luminescently excite the electron-responsive phosphors of the screen. Focusing of the electron beams from the individual guns is usually achieved by means of two cylindrical bipotential focus lenses of the familiar equi-diameter type.

The focus voltage of each bipotential gun is commonly in the order of 15 to 20 percent of the anode voltage, thus with an anode voltage in excess of 20,000 volts, the focus voltage may be well above 3,000 volts. It is well known in the art that the proper focusing action of bipotential lenses is critically dependent on the ratio of the focus voltage to the respective anode voltage. To achieve the desired ratio, it is necessary in color television equipment employing color cathode ray tubes employing bipotential focusing to either regulate the anode voltage to keep it constant or to supply a bleeder means for maintaining a substantially constant ratio as the beam current

changes. Either one of the aforementioned procedures has the related manufacturing disadvantage of requiring special circuitry provisions in the allied equipment to accomplish the desired control. From the standpoint of display quality, electron guns employing bipotential focusing tend to "bloom" or produce large spot size under high beam current condition and are susceptible to degraded focus at the periphery of the screen.

In monochrome cathode ray tubes certain of the aforementioned disadvantages have been overcome by utilizing electron guns having unipotential focusing lenses. An example of this type of gun is the overlapping unipotential, focusing gun wherein a G_4 overlapping focusing electrode is formed to encompass a portion of the adjacent duo-diameter G_3 and G_5 electrodes on either side thereof. Since the focusing voltage in this type of gun is normally within the range of -200 to $+500$ volts it is referred to as employing a low-voltage focusing lens. From the viewpoint of the manufacturer of television equipment, a cathode ray tube with low voltage focusing is desirable as such voltage is readily and economically available in a typical television receiver.

The assembly of bipotential lens guns into a mutiple gun structure is conventionally accomplished by aligning the several electrode elements of each gun on an internally positioned mandrel oriented at the desired angle and extending through the gun elements. With the respective gun electrodes so relatedly positioned, heated insulating rods are simultaneously applied by a beading operation to studding support means projecting from the gun electrodes to integrate the several guns into the mount structure, whereupon, the supporting mandrel is slidably removed from within each aligned gun.

In the overlapping unipotential lens gun, the focusing G_4 electrode has a larger diameter than the adjacent G_3 and G_5 electrodes on either side thereof. Thus, guns of this type cannot be assembled by utilizing withdrawable internal mandrels, as a mandrel which is small enough to go through the G_3 and G_5 electrodes cannot support the larger diametered focusing G_4 electrode.

One type of unipotential lens gun known to the art employs a short focus G_4 electrode which has an inside diameter equal to that of the G_3 and G_5 elements on either side thereof and which does not overlap or encompass these adjacent electrodes. While this short focus lens unipotential gun lends itself to internal mandrel assembly means, it is functionally inferior to the overlapping lens type. In the short focus lens gun it is necessary to use a very short G_4 focus electrode, which may be less than 0.125 inch in length, to obtain a focus voltage in the desired region of within a few hundred volts of cathode voltage. The short G_4 length makes proper alignment of this element with the adjacent elements difficult to achieve and maintain. In addition, the open gaps between the focusing G_4 and the adjacent electrodes subjects the insulating rods to electron charging effect which not only results in distortion of the electron beam being focused but also increases the likelihood of inter-electrode voltage breakdown or arcing.

It is possible to bead the electron guns individually and then assemble the several guns into an integrated mount structure, but this produces an unwieldly and awkward gun structure having a bulk much larger than desired for the current state of the art. In addition, past experience has shown that the integration of pre-assembled guns into a multiple gun structure introduces troublesome alignment problems due to the inherent tolerances present in each of the gun assemblies. Thus, it is extremely difficult to consistently achieve beam landings of desired quality.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to reduce the aforementioned disadvantages and to economically fabricate a compact multiple electron gun mount structure that maintains desired focus over the whole screen under varying beam current conditions.

Another object is the provision of a rigid multiple electron gun structure wherein each low-voltage focusing gun is an assembly of sequentially aligned electrodes in interspaced relationship.

A further object is to provide improved means for fabricating a compact multiple electron gun structure employing overlapping low-voltage focusing lens guns therein.

A still further object is to provide a method for assembling an improved multiple electron gun structure having desired electron optics and alignment.

The foregoing objects are achieved in one aspect of the invention by the provision of a cathode ray tube multiple electron gun structure having therein three unipotential low-voltage focusing lens guns employing overlapping focusing electrodes. The plurality of successive cylindrical electrodes of each gun are axially aligned in sequential order from an end or first electrode having an external maximum alignment diameter. Each successive electrode therefrom has an external maximum alignment diameter which is at least equal to the maximum diameter of the preceding electrode. Fabrication of the unipotential multiple gun structure is facilitated by a plurality of assembly support means having electrode support segments for each gun formed to be compatible with a portion of the external curvature effected by the alignment diameter of each electrode. This provides for each gun a cradle-like aligned arrangment of interspaced electrodes each of which has a portion of its cylindrical surface confined within its respective support segment, while another portion of its surface and its studding means are exposed in a sequential longitudinal manner. The loaded support means are relatedly oriented to enable a portion of the exposed cylindrical surface of each electrode to contact a common central support post and be confined thereagainst to facilitate electrode alignment. The exposed studs are then embedded in heated insulated rods to retain the desired gun alignments. With the removal of the electrode support means and the slidable withdrawal of the common support post, there is provided a compact multiple electron gun structure that exhibits performance and fabrication advantages heretofore unattained.

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 accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a cathode ray tube;

FIG. 2 is an enlarged view of the multiple electron gun structure utilized in the tube shown in FIG. 1 taken along the line 2—2 of FIG. 3;

FIG. 3 is an end view of the multiple electron gun structure taken along the line 3—3 of FIG. 2;

FIG. 4 is a view illustrating the assembly means for fabricating the multiple gun structure taken along the line 4—4 of FIG. 5;

FIG. 5 is an end view showing the assembling means of FIG. 4 taken along the line 5—5 thereof;

FIGS. 6 and 7 are partial plan views of individual electron guns of the multiple gun structure showing the relationship between the G_2 and G_3 electrodes;

FIG. 8 is an exploded perspective showing the arrangement of the electrode support means;

FIG. 9 is an elevational view showing an embodiment of the common support post;

FIG. 10 is a perspective view illustrating another embodiment of the support post;

FIG. 11 is a longitudinal sectional of the embodiment shown in FIG. 10 taken along the line 11—11 thereof; and

FIGS. 12 and 13 are plan views showing cross-sectional embodiments of the common support post.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the drawings, FIG. 1 illustrates a typical plural beam shadow mask type cathode ray tube 11 having an axis 12 therein. Suitably disposed within the neck portion of the envelope 13 is a multiple gun structure 14 wherein, for example, three electron guns 15 are relatedly positioned approximately 120 degrees apart to provide three electron beams 17. Externally positioned coils 19 are generally utilized to deflect these beams over the raster area and consummate convergence at the aperture structure or shadow mask 21 to pass therethrough and impinge upon the cathodoluminescent screen 23 spaced therebeneath. To facilitate the abovementioned convergence of the separate beams 17 over the entire screen, external dynamic convergence magnets 25 are conventionally employed in conjunction with an internal convergence assembly 27 positioned on the front or screen directed end of the multiple electron gun structure 14. In this specification, the convergence assembly is not considered as part of the multiple gun structure of the invention since it is attached to the unified gun structure subsequent to the fabrication thereof. Therefore, little reference will be made to the convergence assembly herein.

In greater detail, there is illustrated in FIG. 2 an enlargement of the multiple gun structure 14 in which, to enhance clarity, only two of the three electron guns 15 are shown. These are unipotential, low-voltage focusing lens guns employing overlapping focusing electrodes. Structurally, each electron gun comprises an electron source or cathode 29 oriented within a G_1 control electrode 31, a G_2 screen electrode 33, and a G_3 first anode portion 35 arranged substantially in axial alignment to provide the source, control, pre-focusing and acceleration for electron beam 17. An electrostatic focusing assembly comprising a G_3 first lens cup 37, a G_4 focusing electrode 39, and a G_5 accelerating electrode 40 having a second lens cup 41 is shown mounted in substantially axial alignment with the aforementioned electrodes upon a plurality of common securement means such as insulating support rods 43. Each of the electrodes is suitably supported by studding means 45 embedded in the respective insulating rods to provide the integrated multiple gun mount structure 14.

The relationship of the three electron guns is shown in FIGS. 1 and 2 wherein the individual guns are positioned about the axis 12' of the unified mount structure. To promote clarity, the subsequently attached convergence assembly 27 is noted in phantom as an undetailed structure.

It will be noted in the embodiment shown, that the successive electrodes comprising each gun, beginning with an end or G_1 electrode thereof, have exterior alignment diameters that are equal to or greater than the maximum diameter of the preceding electrode. The substantially cup-shaped G_1 and G_2 electrodes, 31, and 33 respectively, have external maximum alignment diameters 47 and 49 that are substantially equal. The G_2 electrode has an outwardly rolled peripheral edge portion or corona ring 51 having a maximum external diameter 53 greater than the alignment diameter 49 thereof. The G_3 composite electrode 34 has an external alignment diameter 55 which is at least equal to the G_2 corona ring external diameter 53. The first anode portion 35 of the G_3 electrode, having an external diameter 57 smaller than the G_3 alignment diameter 55, is formed for spaced orientation relative to the interior of the G_2 electrode 33. The first lens cup 37 of the

multi-diameter G_3 electrode is likewise of reduced external diameter **59**. Spaced therefrom and in alignment therewith is the duo-diameter G_5 electrode **40** having an external alignment diameter **61**. The second lens cup portion **41** thereof has an external diameter **63** similar to that of the opposed first lens cup **37**.

Formed to coaxially encompass the aforementioned lens cups in a spaced and substantially overlapping relationship, is the cylindrical G_4 focusing electrode **39** having an external alignment diameter **65** which is substantially equal to the external alignment diameters **55** and **61** of the respective adjacent G_3 and G_5 electrodes. To reduce arcing possibilities, the peripheral edges **66** of the G_4 focusing electrode are polished to be free of burrs or projections thereon.

It has been found that an overlapping G_4 electrode having a circumferential dimension or alignment diameter substantially equal to that of the electrodes on either side thereof has several advantages in the multiple gun structure as described herein. First, even though several electron guns are in closely spaced relationship, enhanced shielding is provided to prevent beam distortion in each low-voltage focusing lens. Secondly, improved shielding is also provided in the reverse manner to prevent charging of the insulating support rods which greatly reduces the likelihood of voltage breakdown or arcing; and thirdly, it has been found that the similar alignment diameters of the aforementioned electrodes in each of the several guns provides an alignment relationship between the guns which promotes the facile integration of the compact multiple gun structure.

With reference to FIGS. 4, 5, and 8, the related assembly of the several guns is shown wherein, beginning with the end or G_1 electrode of each gun, each successive electrode therefrom has an external alignment diameter at least equal to that of the preceding electrode. To assemble each of the several guns, there is, beginning with the G_1 electrode **31** having the cathode **29** positioned therein, a plurality of integrated external support means **93** in the form of related individual electrode support segments with electrode spacing separators providing longitudinal interspacing therebetween. Each electrode support segment is dimensionally formed according to the respective electrode alignment diameter to be compatible with a portion of the external curvature of the electrode to provide a cradle-like alignment arrangement. Each of the several segments has an aligned aperture **67** therein formed to accommodate an alignment rod **68** which is inserted therethrough to provide an integrated support means for the electrodes of each gun, the second segments and spacers being suitably retained in desired orientation and alignment by affixing means **69**. For example, the G_1 control electrode **31** is loaded into the compatible support segment **71**. Successively therefrom the G_2 screen electrode is positioned in the G_2 support segment **75** being separated from the G_1 electrode by the G_1–G_2 spacer **77**. The G_3, G_4, and G_5 electrodes **34**, **39**, and **40** are seated in the formed G_3, G_4, and G_5 support segments **79**, **81**, and **83** respectively, with the spacers **85**, **87**, and **89** therebetween in sequential order with each electrode having a portion of its cylindrical surface along with its studding exposed in a sequential longitudinal manner.

The several loaded support means **93** are then positioned in similar lateral relationship in a suitable seating means such as seating holder **95**. Several equi-spaced holes **97** therein accommodate the lower protruding end of each alignment rod **68** to provide positioning of the aligned electrodes of each gun about a common central support post **99** oriented in the holder. The central support post is equi-distantly positioned relative to the aligned electrodes of each gun in a manner so that the exposed cylindrical surface of each electrode of each gun is adjacent thereto.

Securing means for clamping the several positioned support means **93** in an equi-distant manner relative to the common central support post **99** is facilitated by utilizing cap **101** having cavities therein to receive the ends of the individual alignment rods **68** and central support post **99**. Consummation of the clamping step diametrically confines the respective successive electrodes of each gun in spaced longitudinal alignment between the support segments and the central support post. In this manner, the similar electrodes of each gun are laterally oriented in spaced adjacency with one another.

With all electrodes securely clamped in their respective alignment positions heated insulating support rods **43** are simultaneously applied, by means not shown, to embed therein the plurality of exposed electrode studding means **45**. Thus, the electrodes of the several guns are locked into compact aligned confinement.

Release of the clamping means by removing the cap **101** and freeing the alignment rods **68** from the seating holder **95** allows the support segments and spacers of electrode support means to move free from the insulative rod supported electrodes. Removal of the common support post **99** is consummated in a slidable withdrawing manner from between the adjacently oriented end electrodes of the multiple electron gun mount structure.

It will be noted that in the example given, the several electron guns are tilted with reference to the mount structure axis **12'**. In the tube of this instance, the axis of the mount structure is coincidental with the tube axis **12**. The mount structure shown in FIGS. 2, 3, 4, and 5, the assembly of which has been described, has the individual guns angularly tilted toward the tube axis with the terminal or G_5 electrodes being nearest thereto. To achieve this desired tilt, the common support post **99** is in the form of a tapered pin having a center line **100** coincidental with the axis **12'** of the mount structure. The external electrode support means for each gun is positioned at a compatible angle in accordance with the taper of the pin thereby maintaining the proper dimensional relationship to facilitate the accommodation of the respective electrodes confined therebetween. Since the G_1 and G_2 electrodes have alignment diameters that are less than those of the successive G_3, G_4, and G_5 electrodes, the common support post **99** has a stepped or dimensionally graduated taper which facilitates both electrode alignment and subsequent post withdrawal; the larger diametrically tapered dimension **103** being adjacent the G_1, and G_2 electrodes of smaller diameter and the smaller diametrical tapered dimension **105** being contiguous with the larger diametered G_3 to G_5 electrodes. With the central common support post or pin having at least one dimensional step therein, transitional to a sequential change in pin cross-sectional dimensions, the larger cross-sectional dimension thereof is adjacent the end electrode to facilitate post-fabrication withdrawal of the pin.

If desired, although not shown, the several electron guns of the integrated mount structure can be tilted away from the tube axis with the G_1 electrodes being nearest thereto. In this instance, in keeping with the teaching of this invention, the terminal or G_5 electrode would be considered as the end electrode with the G_4, G_3, G_2, and G_1 being successive electrodes in reverse order therefrom. Thus, the assembly of the mount structure would be inverted to enable withdrawal of the common support post therefrom upon completion of the fabrication procedure.

It is to be understood that a multiple gun structure therein can be fabricated by utilizing a common support post or pin similar to that shown in FIG. 4 but which has no taper therein.

In FIGS. 6 and 7 other embodiments of the G_2 and G_3 electrode relationship are shown wherein the G_2 screen electrode **33'** in FIG. 6 has an inwardly rolled corona ring **51'**. This enables the G_2 alignment diameter **49'** to substantially equal the G_3 alignment diameter **55**. Similar diametrical relationships are evidenced in FIG. 7

where the G_2 electrode has a burr-free edge 32. Thus, the individual electron guns in the multiple structure can be fabricated wherein all of the gun electrodes are of substantially the same external alignment diameters.

Further delineation of the common support post is made with reference to FIG. 9 wherein the common support means or post 109 has at least one longitudinal support surface 111 that is substantially parallel with the mount structure axis 12' extending substantially axially therethrough. A support post of this type is utilized to assemble the electron guns in parallel relationship. If it is desired to orient one or more guns in parallel or different angular relationships or tilts, with reference to the axis 12' of the amount structure, another embodiment of the common support rod 115 shown in FIGS. 10 and 11 can be utilized wherein at least one portion of the longitudinal surface 117 is substantially parallel with the axis while one or more other portions of the longitudinal surface 119 are angular thereto. The angular relationship of the common support surface to the mount structure axis for all embodiments of the withdrawable post can be referenced from a common intersecting plane 121 perpendicular to the axis 12', wherein the intersection of the plane with the common support surface forms in the direction of support withdrawal at least one exterior having a value not exceeding 90°.

In FIG. 12 another cross-sectional embodiment of the common support post is shown and relates to any portion or portions of the post contacted by electrodes. The substantially triangular embodiment 123 has three longitudinal sides thereon and is oriented in a manner whereby each side thereof provides a surface 124 against which an array of gun electrodes retained by said electrode support means is positioned to consummate gun alignment.

There is shown in FIG. 13 still another cross-sectional embodiment of the common support means, similarly oriented as that illustrated in FIG. 12, wherein the pin 125 has three longitudinal flutes 126 formed therein. These flutes are equispaced from the pin center line 100 and from one another with lands 128 therebetween. As previously mentioned, the center lines 100 of the respective pins are coincidental with the mount structure axis 12'. Each flute is of an arcuate cross-sectional formation 127, so shaped to compatibly accommodate a circumferential portion of the respective electrodes in each gun. The orientation of the pin is such that each flute provides an arcuate contact surface against which a surface portion of each electrode in each gun array, retained by said electrode support means, is positioned to consummate gun alignment.

There is thus provided a compact multiple electron gun mount structure of the low-voltage, overlapping focusing lens variety that is economical to fabricate and wherein each successive electrode has a sequential alignment diameter that is at least equal to the maximum diameter of the preceding electrode. Means for facile assembly are provided wherein the aligned electrodes of the several guns are positioned with external portions adjacent a common support post which is withdrawable from the completed mount structure. The resultant multiple gun structure along with the means and method of assembly thereof are achievements heretofore unattained.

While there has been shown and described what is 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.

What is claimed is:

1. A method for assembling an improved multiple gun gun cathode ray tube mount structure having therein at least two overlapping, unipotential, low-voltage focusing lens electron guns relatedly mounted by studding means on insulating rods, each gun having a plurality of successive substantially cylindrical electrodes of which at least one has multi-diameter portions, the end electrode in each gun having an external maximum alignment diameter and each successsive electrode therefrom having an external maximum alignment diameter at least equal to the maximum diameter of the preceding electrode, said method comprising the steps of:

loading said respective electrodes of each gun in an electrode support means with each end of said successive cylindrical electrodes being seated and aligned in interspaced relationship in a compatible support portion formed to accommodate the respective electrode alignment diameter, each electrode having a portion of the opposed cylindrical surface and the studding means exposed in a sequential longitudinal manner beginning with said end electrode in each gun;

positioning said loaded support means in a similar lateral relationship in a seating holder in an equispaced manner about a common central support post oriented therein with said exposed cylindrical surface of said successive respective electrodes of each gun being adjacent thereto;

clamping said positioned support means relative to said common central support post to diametrically confine the respective successive electrodes in spaced longitudinal alignment therebetween with said similar electrodes of each gun being substantially laterally oriented in spaced adjacency with one another;

applying heated insulating rods in a simutaneous manner to said exposed electrode studs to consummate embedment therein and to connect the electrodes of each gun as well as to connect each gun to at least one other gun;

releasing said clamping means to allow said electrode support means to move free from said rod supported electrodes; and

removing said common support post in a slidable withdrawing manner from between the adjacently oriented end electrode of said multiple electron gun mount structure.

2. A method for assembling an improved multiple gun cathode ray tube mount structure having therein at least two overlapping, unipotential, low-voltage focusing lens electron guns relatedly mounted by studding means on insulating rods, each gun having a plurality of successive substantially cylindrical electrodes of which at least one has multi-diameter portions, the end electrode in each gun having an external maximum alignment diameter and each successive electrode therefrom having an external maximum alignment diameter at least equal to the maximum diameter of the preceding electrode, said method comprising the steps of:

loading said respective electrodes of each gun in electrode support means oriented about a removable tapered common central support post in a manner that all electrodes of all guns contact said post to consumate respective gun alignments;

applying securement means to permanently retain both said electrodes and said guns in an integrated multiple mount structure; and

removing said support means and said post from said mount structure.

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JOHN F. CAMPBELL, Primary Examiner

R. B. LAZARUS, Assistant Examiner

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,524,235 Dated August 18, 1970

Inventor(s) Glen A. Burdick

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

Column 6, line 66 of the specification before "therein" should read--having substantially parallel positioning of the guns--.

Column 7, line 14 "amount" should read--mount--.

Column 8, line 11 of Claim 1 -- delete "end" --.

SIGNED AND SEALED
NOV 3 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents