

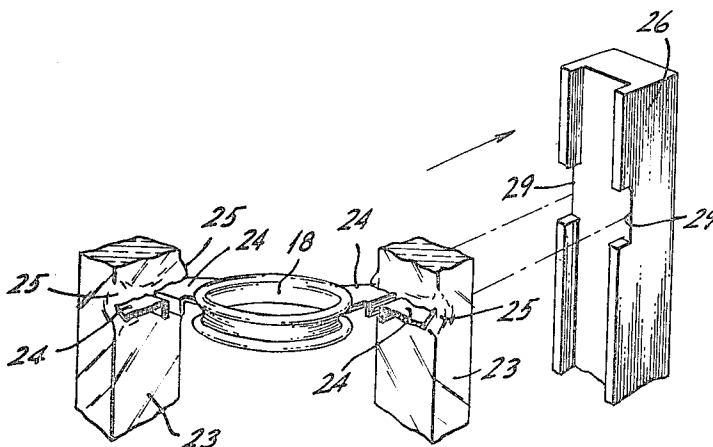
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 [22] Filed **Nov. 3, 1969**
 [45] Patented **Sept. 28, 1971**
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[56] **References Cited**
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[54] **PLURAL ELECTRON GUN ASSEMBLY**
3 Claims, 6 Drawing Figs.
 [52] U.S. Cl. 313/70 C,
 313/251
 [51] Int. Cl. H01j 25/50,
 H01j 29/02, H01j 1/92
 [50] Field of Search 313/69 C,
 69, 70, 70 C, 92 B

ABSTRACT: An electron gun for a color cathode-ray tube includes three sets of axially aligned cylindrical grids supported upon glass side rods by radially projecting studs of different widths. In fabrication of the gun, and during a beading operation in which the side rods are in molten state, each of the side rods is supported in a beading trough including notched wall sections in the regions of insertion of the relatively wider ones of the studs into the rods. The notched sections accommodate formation of strain-relieving bulges in the regions of wider stud insertion in the molten rods.



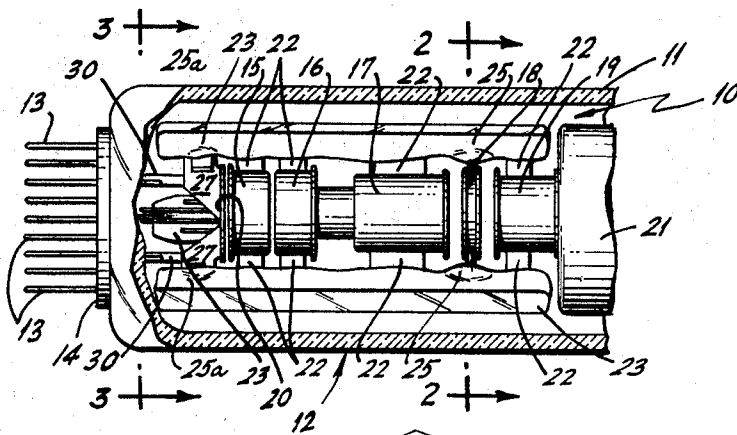


FIG. 1.

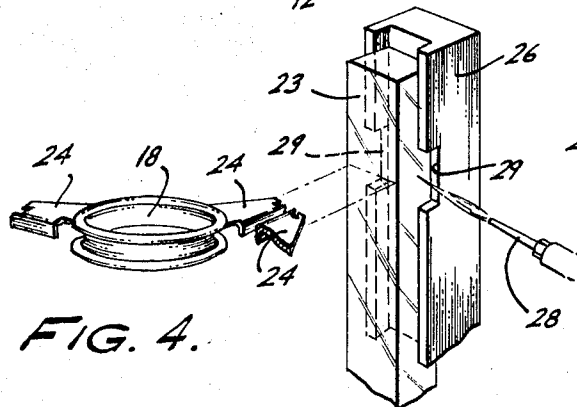


FIG. 4.

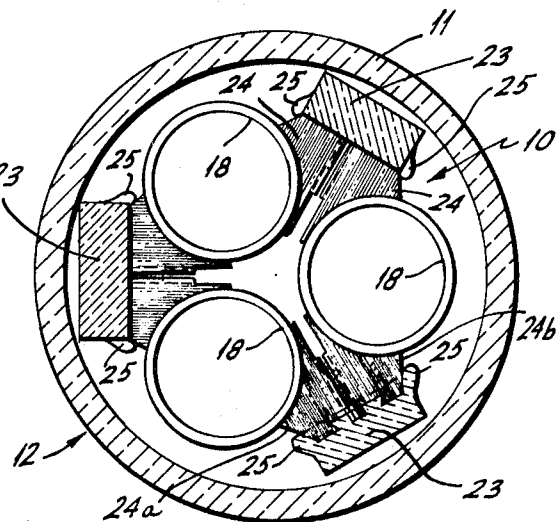


FIG. 2.

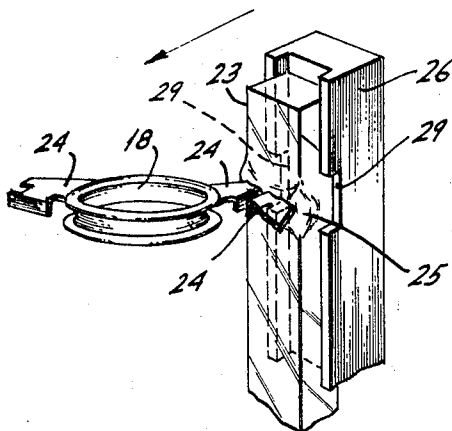


FIG. 5.

FIG. 6.

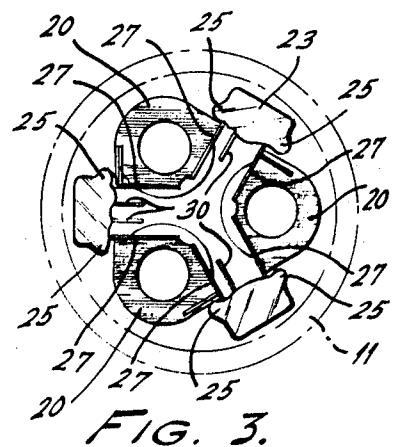
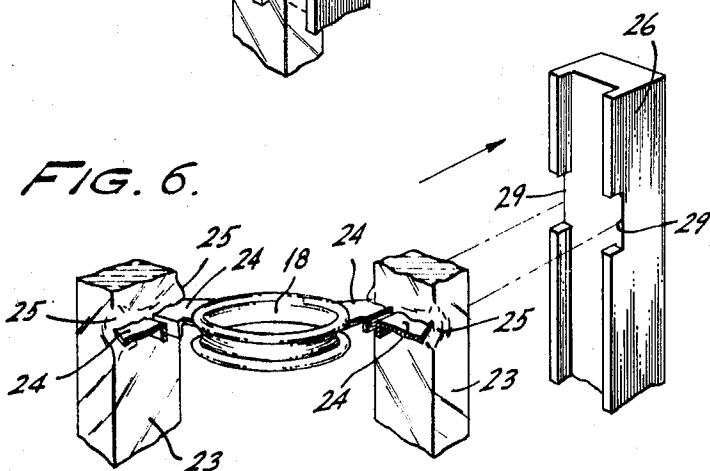


FIG. 3.

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PLURAL ELECTRON GUN ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to electron guns and, while of broader applicability, is directed especially to improvements in structure and fabrication of electron guns for color cathode ray tubes.

In guns of the aforementioned type, individual gun grids are supported in the desired axial and radial disposition relative to one another by means of mounting studs embedded in insulative material, such as elongate glass rods or beads. In conventional practice, the studs are embedded in the glass rods while in a heat-softened state, and while the grids and rods are held by suitable fixtures or the like. After assembly, the gun structure is held in place by a conventional insulative tube base provided with pins that serve as terminals for the several grids of the gun. In the manufacture of one such structure known as an einzel gun, there are five such grids, one of which is a focus grid known as grid 4, or G-4, and which particularly is susceptible to undesirable arching due to the relatively high potential to which it is subjected. It has been found advantageous to form this grid as a single stamping comprising a cylindrical body portion with rolled edges and radially presented flat spades serving as the studs. Prior to this invention these spades have presented problems since, at the G-4 location, they extend transversely of, rather than parallel to, the long axis of the glass rods, with a resulting tendency to chip or extend beyond the glass and expose a sharp corner of the spade. This renders the assembly highly susceptible to arcing between grid 4 and adjacent elements. Also, there is a tendency to chipping of the rod in the vicinity of the cathode where there may be as many as four stud elements extending side by side into the rod.

It is an objective of the present invention to provide an improved electron gun structure, and method of fabricating the same, that overcomes the aforementioned difficulties.

SUMMARY OF THE INVENTION

In achievement of the foregoing, as well as other general objective, the present invention is featured by a novel electron gun structure, and method of fabrication thereof, characterized by provision of means for relieving the glass beading strains which previously were encountered in the manufacture of such structure when the grid mounting studs were inserted into the heat-softened glass beads, or rods. Relief is achieved by removal of opposed sections of the sidewalls of the glass beading trough, so that during the beading operation softened glass in the vicinity of the studs is allowed to flow freely as the studs are urged into the glass. Upon cooling, the glass hardens to form strain-free bulges about the outer edges of the studs. Advantageously, provision of the strain-free bulges greatly improves reliability of the gun.

The manner in which the foregoing as well as other objectives of the invention may best be achieved will be understood more clearly from a consideration of the following description, taken in light of the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational showing, partly in section and with parts broken away, showing one set of axially aligned cylindrical grids of an einzel cathode ray tube gun structure embodying the invention;

FIG. 2 is an enlarged sectional view of apparatus illustrated in FIG. 1, but illustrating the three sets of grids characteristic of such a gun, the view being taken generally in the direction of arrows 2—2 applied to FIG. 1;

FIG. 3 is a sectional view of a portion of the apparatus shown in FIG. 1, as seen looking generally in the direction of arrows 3—3 applied thereto; and

FIGS. 4, 5, and 6 are perspective views including portions of the gun structure illustrated in FIGS. 1 and 2, and showing techniques utilized in assembling the same.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With more particular reference to the drawing, and first to FIG. 1, an electron gun assembly 10 made according to the invention is mounted in the neck 11 of a color cathode ray tube 12. Portions of the net 11 are shown broken away for convenience of illustration. Gun assembly 10 includes three individual guns, each comprising tubular and cup-shaped, axially aligned grids 15, 16, 17, 18 and 19 on support rods 23 mounted on certain of the terminal pins 13. The electrodes, or grids, of the interiorly disposed gun assembly are electrically connected by conventional strap connectors (not shown) to appropriate ones of terminal pins 13 extending through the base portion 14 of the tube neck 11. Gun grids 15 to 19 cooperate with one another, and with a conventional heater and cathode therefor (not shown), and several conventional external voltage sources of different values, to produce a high velocity stream of electrons. Such operation is conventional, and need not be discussed in further detail for an understanding of the invention.

Considering gun assembly 10 in more detail, and with reference also to FIGS. 2 and 3, three identical guns, one for each color, are spaced at substantially equal radial distances about the axis of tube neck 11. The above-identified grids of each gun are further characterized as control grid 15, accelerating grid 16, and focus grids 17, 18, and 19. The focus grids 19 support a conventional convergence shield 21 electrically connected, by the usual spring snubbers (not shown), to the inside conductive coating of the tube. Pins 13 support the cathode and heater elements (not shown) within the control grid 15.

Each of grids 15, 16, 17 and 19 includes a pair of mounting studs 22 extending generally tangentially therefrom, at an inclined angle of about 120°. Studs 22 of adjacent corresponding grids face one another, as is the usual practice, so that a pair extend into a corresponding support rod 23 substantially in line with the long axis of the rod and well spaced inwardly from the sides of the rod.

However, and as is best seen in FIG. 2, the construction of each of the focus grids 18, also known as the G-4 grids, is such that its studs 24, unlike the other studs, extend transversely of the axis of extension of a glass rod 23. Adjacent pairs of studs 24, see for example the pair shown at 24a and 24b in FIG. 2, span almost the full width of the rod. Preferably, each of grids 18 and their studs 24 are formed as a unitary, integral subassembly from a metal stamping. This construction affords advantages over prior art electrode constructions in which G-4 grid, or the like, is formed with its rolled edges, and its mounting studs are spot welded to the grid. In contrast, the studs 24 and grid 18 comprise a single piece stamping, which construction has a reduced fabrication cost and lends itself to reducing the axial dimension of the grid and to improve edge rolling, since provision of extra material for welding of the stud is not required.

In further, and more especial accordance with the invention, the substantial lateral extension of the G-4 grid studs 24 is accommodated by lateral bulges 25 in corresponding regions of a rod 23. These bulges prevent chipping of the glass or exposure of sharp edges of the grid. The bulges are shown in section and in full in FIG. 2. The procedure by which bulges 25 are formed, in conjunction with apparatus shown in FIGS. 4, 5, and 6, will be described in what follows.

There is shown in FIG. 4 a partial gun assembly, together with a beading trough 26 within which a corresponding glass rod 23 is nested. In achievement of the particular orientation illustrated, sets of electrode comprising the three guns are held in their desired positions by suitable fixture apparatus (not shown), of a type well known in the art. Preferably, the fixture holds the electrodes in such a position that their axes extend generally vertically, with corresponding vertical alignment of sets of mounting studs 22 and 24. The beading troughs 26, of which there are three, are held in vertical position op-

posite a like number of sets of aligned mounting studs. As is known, the troughs 26 further are mounted for reciprocable frontal movements toward and away from the set of studs, as is indicated by directional arrows applied to FIGS. 5 and 6. Each of the troughs is generally channel shaped, and is so dimensioned as to retain a glass rod 23 of generally rectangular cross section. In accordance with conventional practice, means 28 (FIG. 4) is provided to play a flame onto each rod in each region of stud mounting. Upon attainment of the desired heat-softened consistency of such rod regions, the troughs are moved toward the studs a sufficient distance to embed the latter (FIG. 5), and then retracted to allow the rods to cool (FIG. 6).

In especial accordance with the invention, the "low-profile" leg portions of the conventional channel-shaped troughs 26 are provided with notched sections 29 in the regions of stud insertion, so that insertion of studs 24 into the heat-softened rods 23 urges sides of the rods outwardly into the notched sections to form strain-relief bulges 25. These are particularly important in the region of said studs 24, since they comprise sheets lying in a plane transverse the axis of the glass rods.

While not illustrated, leg portions of channel-shaped troughs 26 also are cut away in the regions of extension of both the studs 27 of the cathode heater supports 20, and the studs of the several terminal and gun support brackets designated generally by the numeral 30 (FIGS. 1 and 3). Relieving of the glass rods in these regions permits bulging, as is illustrated in FIG. 3, to accommodate insertion of the larger number of mounting studs 27. For example, the left hand rod 23 in FIG. 3 supports four such mounting studs with ease, in accordance with teachings of the invention.

Comparative tests between identical gun assemblies made according to the invention and those not made according to the invention have evidenced remarkable reduction in arcing

at the G-4 location. In short, the invention has overcome a serious problem encountered in the fabrication and use of color cathode-ray tube electron guns.

We claim:

1. In an electron gun assembly of the type comprising three similar group of coaxial, generally tubular electrodes symmetrically spaced from each other on longitudinally converging axes for forming three distinct converging electron beams, the combinations comprising: support means including a pair of support studs for each electrode, the support studs for each group of electrodes being formed to lie adjacent corresponding support studs of the other groups; three elongate glass rods of generally rectilinear cross section engaging said support studs and rigidly supporting the same, the support studs of at least one pair of corresponding electrodes present in two adjacent electrode groups being in adjacency and having portions extending transversely of and imbedded in a corresponding one of said rods, said studs further including outer edge portions extending with angularity to said rods and intersecting corner edge portions thereof thereby spanning substantially the full width of said one rod, said rod including laterally bulged regions formed by heat softening of the rod and disposed at each of the regions of intersection of said last-recited support studs with said corner edge portion, said bulged regions preventing cracking of the glass of the rod, or protrusion of said imbedded stud portion laterally of said rod.

2. A gun assembly according to claim 1, and further characterized in that said studs are formed laterally with corresponding ones of said one pair of electrodes.

3. A gun assembly according to claim 2, and further characterized in that said studs are generally flat and include angle sections extending along confronting edge portions of the recited adjacent studs.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,609,400 Dated September 28, 1971

Inventor(s) Bruce G. Marks et al.

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 21, "arching" should read -- arcing -- .

Column 2, line 6, "net" should read -- neck -- .

Column 4, line 6, "group" should read -- groups -- ;

line 9, "combinations" should read -- combination -- ;

and

line 28, "laterally" should read -- integrally -- .

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents