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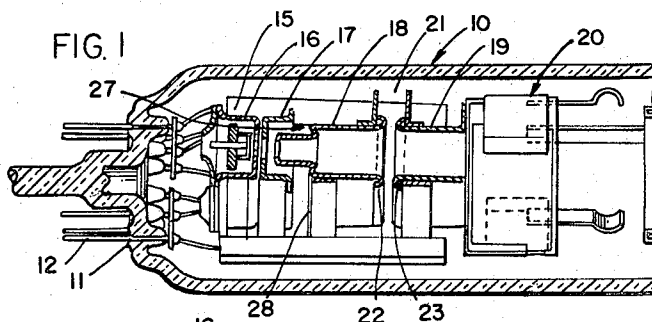
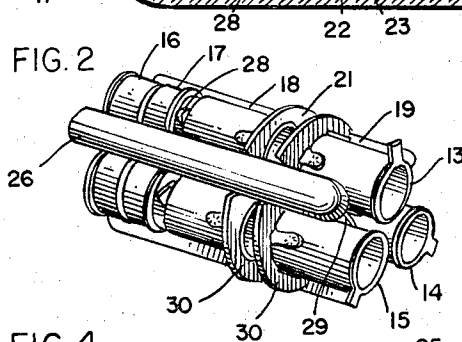
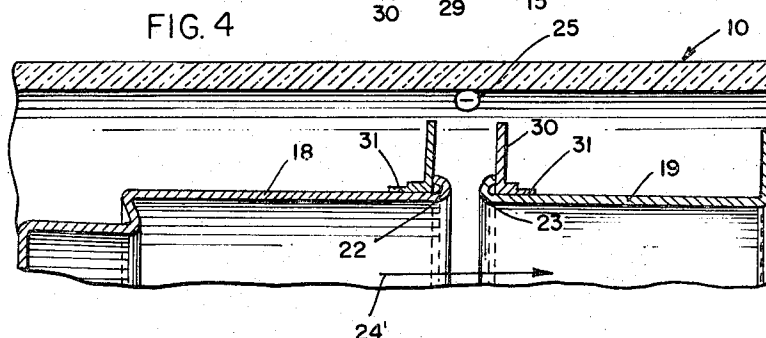
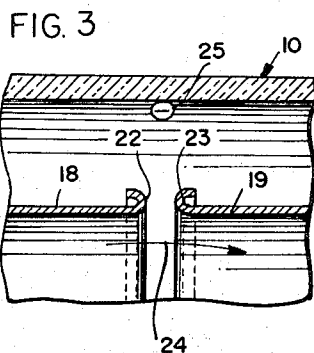
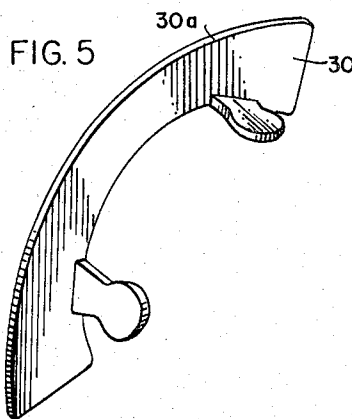
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3,376,448

MEANS FOR SHIELDING ELECTRON GUNS OF CATHODE
RAY TUBES AGAINST SPURIOUS CHARGES

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MEANS FOR SHIELDING ELECTRON GUNS OF CATHODE RAY TUBES AGAINST SPURIOUS CHARGES

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ABSTRACT OF THE DISCLOSURE

A flat, circular shield element is mounted adjacent the opposing rolled edge of the focusing grid and the accelerating grid in a multiple-gun cathode ray tube. Each of the shield elements extends radially outward beyond its associated rolled edge toward the envelope in the constricted neck portion of the tube. The shield elements associated with each gun cooperate to minimize the effect of spurious charges on the inside of the tube envelope or on the gun mounting structure.

This invention relates to an electron gun for cathode ray tubes, and, more particularly, to an electron gun developing a plurality of beams such as is useful in color television.

The problem solved by the instant invention is that of improper beam landing or divergence from desired patterns due to the adverse effect of spurious electrostatic charges about the electron gun, particularly on the glass envelope and other gun-supporting structure. This is particularly important in the areas of the exposed or unshielded electron beam such as the gap between the focusing lens cylinders G-3 and G-4. In black and white television picture tubes and other types of kinescopes, the beam is shielded by the construction of the overlapping focusing lens. Such lenses in color television are not feasible because of size and operational problems.

In color television tubes, for example, the spurious charges manifest their presence in the form of improper lines about the images presented on the face of the cathode ray tube. An image may be outlined in one of the colors because of improper convergence. In most instances, the spurious charges are transient so that any compensating adjustment of the convergence fails to permanently remedy the defect of convergence drift. Arcing between gun elements also changes spurious distribution and adversely affects convergence. The convergence drift is particularly vexing in the case of color television sets where the convergence adjustment procedure is quite complicated and not easily performed in the home.

The expedients employed for remedying this problem have not been successful. Although it is appreciated that the spurious charges may be substantially eliminated by specialized manufacturing technique, i.e., use of special glass, careful cleaning, special surface treatment, etc., such are not compatible with the high volume, low cost production of tubes. Further, the use of shields coaxial with the gun and neck of the tube have been unreliable because of the tendency of arcing to occur.

It is the general object of this invention to avoid the difficulty outlined above and more specifically to provide a novel means and method whereby the adverse effects on the electron beam by virtue of spurious charges about the electron gun are substantially minimized. Another object is to provide a solution to this problem which is compatible with low cost-high volume production of cathode ray tubes. Other objects and advantages of the invention may be seen in the details of construction and operation set down in this specification.

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The invention is explained in conjunction with an illustrative embodiment in the accompanying drawing, in which:

FIG. 1 is a fragmentary elevational view, partially in section, of the gun-end of a cathode ray tube such as is employed in color television;

FIG. 2 is a perspective view of the grid portion of the electron gun of FIG. 1;

FIGS. 3 and 4 are enlarged sectional views through the axis of one of the series of coaxial cylinder gun portions of FIG. 1 with the FIG. 3 showing lacking the inventive shielding of FIGS. 1 and 4; and

FIG. 5 is an enlarged perspective view of a shield element employed in the apparatus of FIGS. 1, 2 and 4.

In the illustration given and with particular reference to FIG. 1, the numeral 10 designates generally the neck of the glass envelope or tube used in color television and the like. A stem assembly generally designated 11 is provided at one end of the tube and sealed to the glass of the tube in conventional fashion. The stem assembly is connected by leads 12 to the three electron guns 13, 14 and 15 (see FIG. 2). The assembly 15 is shown in cross-section in FIG. 1 and, like the other assemblies 13 and 14, includes four grids 16-19 in proceeding forwardly (in the direction of the electron beam) from the stem 11. In conventional parlance, the first grid is usually designated G-1 and is referred to herein by the numeral 16. The second or acceleration grid G-2 is designated 17. The focusing grid G-3 is designated by the numeral 18, and the second acceleration grid or anode G-4 is designated by the numeral 19. The gun assembly includes a convergence assembly generally designated 20 coupled to the three guns 13-15.

Reference to FIGS. 3 and 4 reveals that the G-3 grid 18 defines with the G-4 grid 19 a gap (see reference numeral 21 in FIG. 1). At the edges of the grids 18 and 19 defining the gap 21, the grids 18 and 19 are equipped with rolled edges as at 22 and 23, respectively. This substantially eliminates the tendency of arcing to take place across the gap 21 which might occur if the edges were sharp. Also seen in FIGS. 3 and 4 is a schematic representation of the electron beam designated 24 and 24', respectively, which is originated at the cathode 15 and developed by the lines of force created by the difference in potential between the grids 16, 17, 18 and 19. For example, the grid 19 may be at 15,000 volts, while the grid 18 may be at 5500 volts. The equipotential field lines resulting from this potential differential and grid geometry assume the usual lens-like configuration, resulting in the formation of the electron beam 24.

Still referring to FIGS. 3 and 4, it will be seen that a spurious charge schematically represented by an electron and designated 25 is located adjacent the glass envelope 10 and radially outwardly of the gap 21. Such a charge 25 develops an electrostatic force pattern which extends through the gap 21 and adversely affects the electron beam 24. In many instances, the electron beam 24 will be displaced from its intended path or trajectory (compare FIGS. 3 and 4), the proper path (as at 24' in FIG. 4) being that established under conditions wherein spurious charges are substantially absent. In still other cases, the beam may be distorted from the desirably round cross-section into a cross-sectional pattern.

In still other instances, the spurious charge may be present on the insulating rods 26 which constitute part of the gun-supporting assembly generally designated 27. The gun assembly includes a centerbrace bracket 28 interconnecting the three guns 13-15 and a plurality of supporting straps 29 interconnecting the three guns with the insulating rods 26 (as shown) and the various grids 16-19. The insulating rods 26 are conventionally constructed of glass material such as porous Pyrex 10.

I find that the adverse effect on the electron beam 24 of spurious charges (such as that represented at 25 in FIGS. 3 and 4) can be substantially minimized through the use of shield means such as that designated 30 in FIGS. 4 and 5. The shield means includes a shield element of segmental circular construction which is welded as at 31 to its associated grid. Optimally, the shield elements 30 extend radially outwardly of the associated grid toward but short of the envelope 10, abutting the rolled or curled edges 22 and 23 of the grids 18 and 19. Through the use of shield elements extending laterally outwardly toward the most deleterious location of the spurious charge, the lines of force ordinarily emanating from the spurious charge directed through the gap 21 are substantially eliminated or markedly reduced.

In one specific example of the invention, the G-3 and G-4 grids 18 and 19, respectively, were of the equal diameter cylinder type having inside diameters of 0.353" with the adjacent circular edges rolled to form the curls 22 and 23 on radii that develop outside diameters of 0.440". With the guns so constructed and without the shield elements 30 installed, arcing was induced, using a high frequency Tesla coil circumscribing the gaps 21, the Tesla coil being operated at 40 kv. Checking out the beam landings before and after the arcing induced by the Tesla coil revealed a shaft of the green, red and blue dots of the order of 0.020-0.050". Results of a larger magnitude in beam shift were observed when the envelope 10 was wrapped with foil circumscribing the gaps 21 and charged to 25 kv., thus simulating the effects of spurious charges. When the shield elements were installed, the same tests produced no significant change in landing position. In the specific illustration given, each shield element (a total of six being employed) extended over a 120° sector between the various multi-forms and were constructed of 0.031" hydrogen-fired non-magnetic stainless steel. Each shield element 30 had a rounded outer edge and rounded corners at the areas adjacent the multi-form.

It is to be appreciated that in the practice of the invention, the size, shape and location of the shield elements 30 are interrelated. Optimally, the shield elements 30 should be no closer than the adjacent parts of the curled edge portions 22 and 23; otherwise, the tendency to arc may be increased. The closer the shields 30 are positioned relative to each other, the less they need to extend radially outwardly of the gap 21 to achieve the same minimization of adverse effect on the electron beam 24. Thus, in some instances, it may be advantageous to provide the shields 30 as integral portions of the grids as by extending laterally outwardly the curled portions 22 and 23. In the ordinary manufacturing operation, I find that most advantageously the shield elements 30 are installed as illustrated. Further, in some instances it may be advantageous to depart from the planar configuration of shield element illustrated, introducing a divergence as the one proceeds radially outwardly from the electron beam 24. I prefer for the area of the shield element adjacent the associated grid to be essentially planar, but this can be satisfactorily approximated in certain instances by 60

using elements of slight curvature, as in having a parabolic curvature in longitudinal section.

Generally speaking, the further the shield elements are spaced longitudinally from the gap 21, the greater their size must be, i.e., radial extent, of the shield elements 30, so as to minimize the possibility of penetration of lines of force from any spurious charge in the supporting or enveloping structure associated with the electron gun.

In the illustrated example, by positioning the shield elements 30 immediately adjacent the curled portions 22 and 23, I achieve a spacing shield elements 30 of the order of the width of the gap plus 0.070". Tests performed with the spacing of the shield elements enlarged to the gap plus 0.150" produced significantly poorer results in controlling the convergence of the electron beams 24. Further, I prefer to terminate the peripheral edges 30a of the shield elements a spaced distance from the envelope 10, so as to minimize any possibility that the tube 10 might crack during the heat treatment due to inadvertent contact between the shield element and the tube because of the different coefficients of thermal expansion of the materials employed in these two structures.

While, in the foregoing specification, a detailed description of an embodiments of the invention has been set down for the purpose of illustration, many variations in the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In a cathode ray tube having a plurality of guns for generating separate and parallel electron beams mounted in a constricted neck portion of the tube envelope, each gun including a plurality of cylindrical grids spaced along a common axis and electrically isolated from one another, two adjacent of said grids in each gun being a focusing grid and an accelerating grid operated at a potential difference of about 20,000 volts and defining opposing rolled edges for preventing arcing, the improvement comprising: a shield element for each gun adjacent the rolled edge of said focusing grid and extending radially outward beyond said rolled edge toward said constricted neck portion of said envelope, and a corresponding shield element for each gun adjacent the rolled edge of said accelerating grid and extending radially outward beyond said rolled edge toward said constricted neck portion of said envelope, said shield elements associated with each gun cooperating to minimize the effect of spurious charges in said tube.

2. The structure of claim 1 wherein there are three such guns defining a transverse triangle and each of said shield elements is a flat, circular segment attached to its associated grid.

References Cited

UNITED STATES PATENTS

2,971,118 2/1961 Burdick ----- 313-82 X

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