May 25, 1965 J. EVANS, JR 3,185,879

CATHODE RAY TUBE HAVING DEFLECTION ENHANCEMENT MEANS

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Fig. 1.

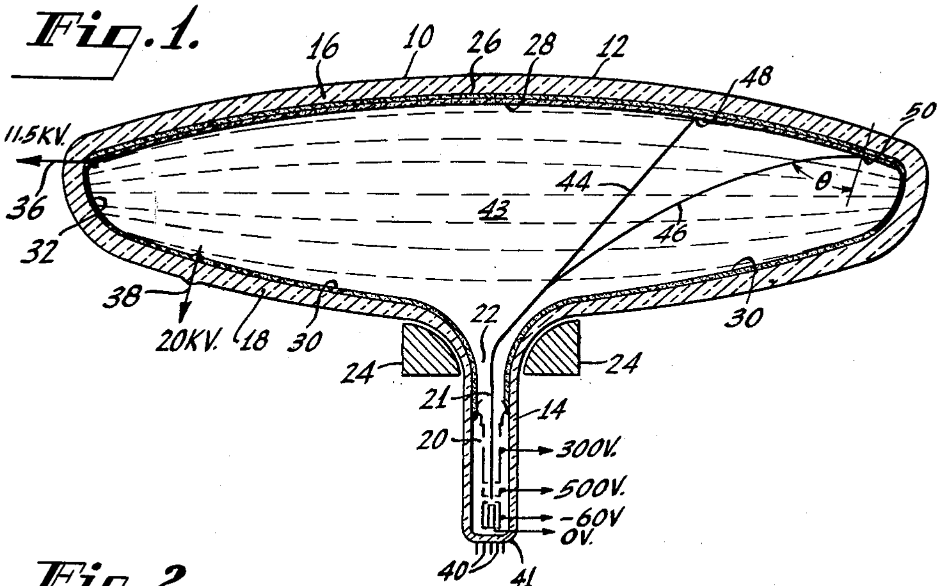


Fig. 2.

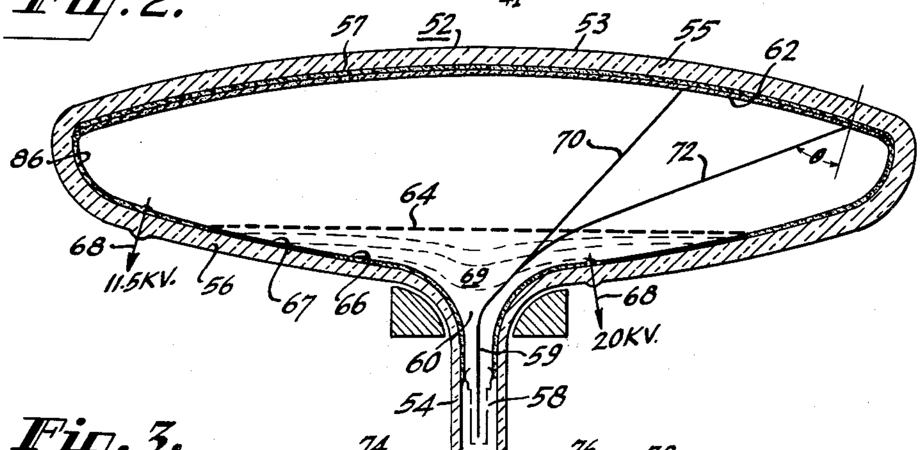
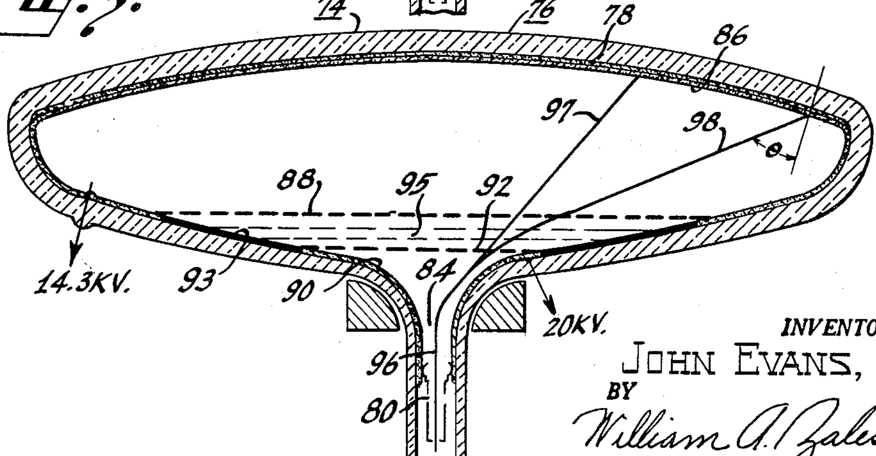


Fig. 3.



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CATHODE RAY TUBE HAVING DEFLECTION ENHANCEMENT MEANS

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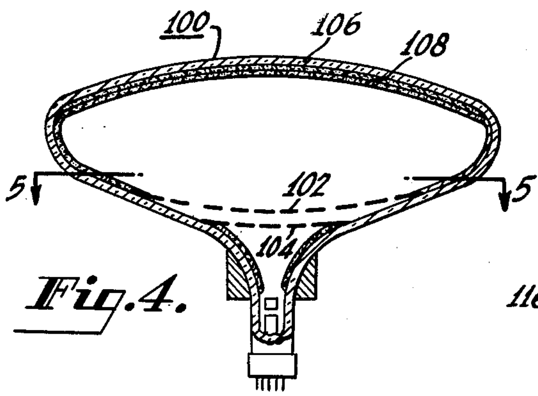

Fig.4.

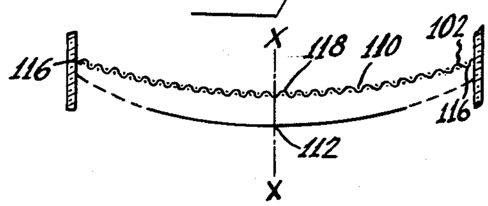

Fig.6.

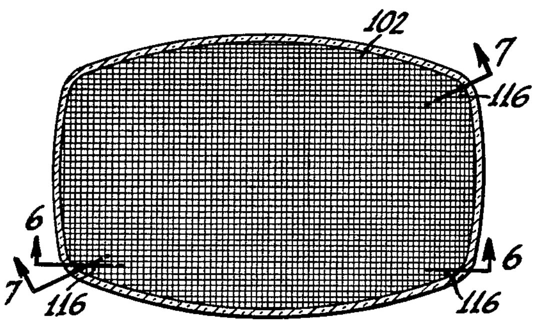

Fig.5.

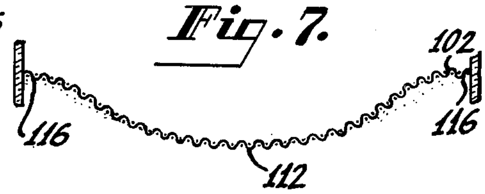

Fig.7.

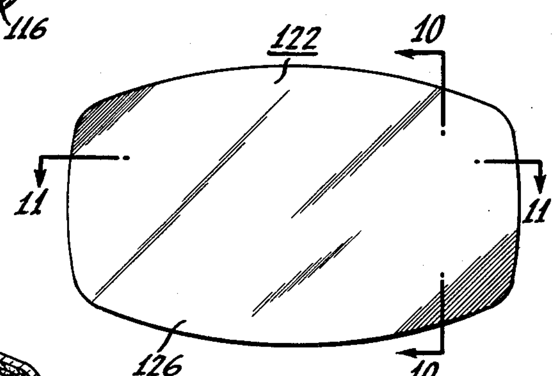

Fig.9.

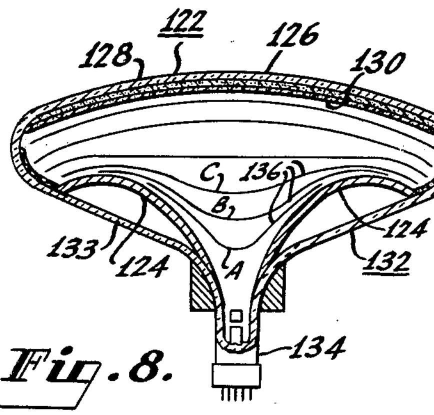

Fig.8.

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Fig. 12.

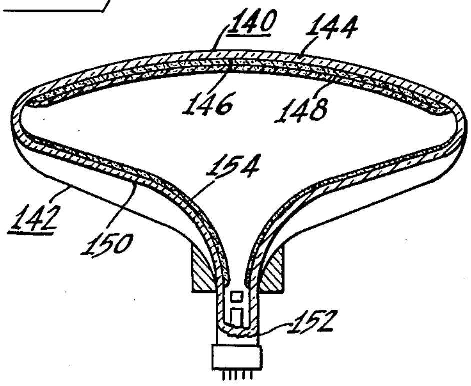
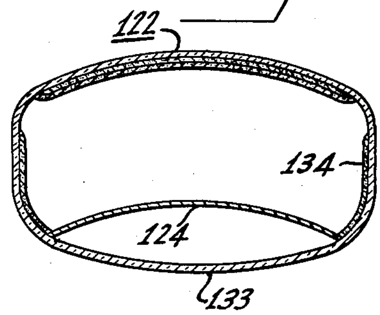


Fig. 10.



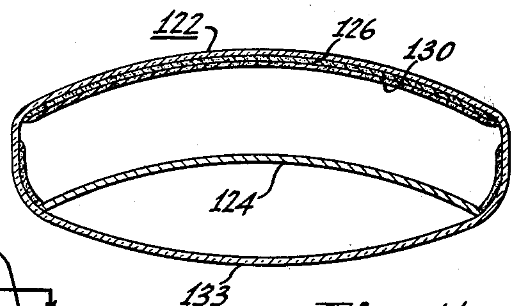
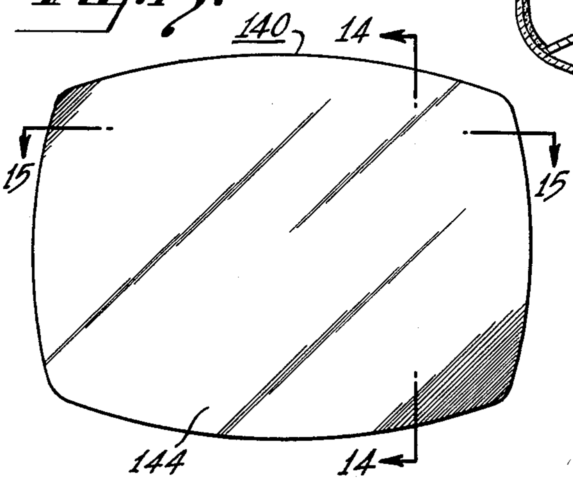


Fig. 11.

Fig. 13.



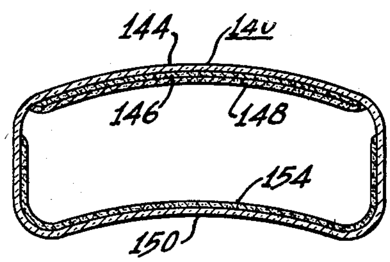


Fig. 14.

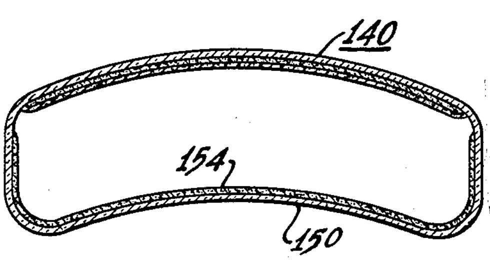


Fig. 15.

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3,185,879
CATHODE RAY TUBE HAVING DEFLECTION ENHANCEMENT MEANS

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Filed Mar. 17, 1960, Ser. No. 15,705
12 Claims. (Cl. 313—78)

This invention relates to cathode ray tubes and particularly to novel deflection means which permit shortening of the tube.

In the pror art type of cathode ray tube in which the envelope includes a neck section, a faceplate, and an interconnecting funnel section, the electron beam is deflected in a primary deflection zone where the neck joins the funnel. In order to make such cathode ray tubes having a given screen size axially shorter, the trend has been to provide larger angle deflection in this primary deflection zone. Such deflection is conventionally provided by electrostatic deflection plates within the envelope or a magnetic deflection yoke external of the envelope. However, to provide larger angle deflection in the primary deflection zone according to prior art practices very large deflection forces are required. Accordingly, one limiting consideration to this approach is the corresponding very large amounts of deflection power or energy required.

It is therefore an object of my invention to provide a cathode ray tube having improved means for deflecting an electron beam whereby an effectively wider angle of deflection is obtained with no substantial increase in amount of consumed power. It is a further object of my invention to provide a cathode ray tube having novel improved electrostatic beam deflection means to supplement associated conventional deflection means.

According to my invention an electrostatic electron-decelerating, radial deflection field is established in the funnel portion of the tube. Such a field may be established by providing a potential difference between a pair of grids disposed across the funnel perpendicular to the tube axis, between one such grid and a conductive surface on the tube envelope, or between a conductive coating on the target or phosphor screen and a conductive surface on at least a portion of the funnel. According to the last described form of a tube, which constitutes a preferred embodiment of my invention, the desired electrostatic field is contiguous and co-extensive with the phosphor screen and may, in fact, substantially completely fill the funnel volume of the tube. Thus, the electron beam in traversing the funnel volume is continuously radially deflected in the same direction as it was initially deflected in the primary deflection zone by associated conventional deflection means. Thus, a supplemental deflection of the electron beam is provided. The additive effect of the two deflections makes it possible to obtain a given size raster in a shorter tube using the same amount of deflection power as would be used in a conventional tube.

In all of the above-described modifications the electrostatic, electron-decelerating, radial deflection field according to my invention is provided by operating the phosphor screen at a substantially lower positive potential than the positive potential on the funnel adjacent the primary deflection zone of the tube. Such relative potentials result in an overall deceleration of the electron beam between the deflection zone and the phosphor screen.

In the drawings:

FIG. 1 is a longitudinal section view partly in schematic of a cathode ray tube illustrating a preferred embodiment of my invention;

FIGS. 2, 3, and 4 are longitudinal section views partly in schematic of other embodiments of my invention.

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FIG. 5 is a transverse section of the tube of FIG. 4 taken along line 5—5 showing a grid thereof;

FIGS. 6 and 7 are side elevation and section views respectively of the grid of FIG. 5 taken along line 6—6 and line 7—7 respectively;

FIG. 8 is a longitudinal section view of another embodiment of my invention;

FIG. 9 is a top plan view of the tube of FIG. 8;

FIGS. 10 and 11 are section views of the tube of FIG. 8 taken along line 10—10 and line 11—11 respectively of FIG. 9;

FIG. 12 is a longitudinal section view of another embodiment of my invention;

FIG. 13 is a top plan view of the tube of FIG. 12; and

FIGS. 14 and 15 are section views of the tube of FIG. 12 taken respectively along line 14—14 and line 15—15 of FIG. 13.

In FIG. 1 a cathode ray tube **10** is shown to comprise an envelope **12** having a neck section **14**, a faceplate **16**, and an interconnecting funnel section **18**. At least one electron gun **20** of conventional design is disposed in the neck **14** and is adapted to develop and project an electron beam **21** through a primary deflection zone **22** and onto the faceplate **16**. Deflection of the electron beam **21** in the primary deflection zone **22** is provided by a conventional magnetic yoke **24** positioned adjacent the primary deflection zone **22** externally of the envelope **12**. The magnetic yoke **24** is adapted to have suitable electric signals applied thereto to scan the electron beam **21** over a phosphor screen target **26** on the faceplate **16** according to a desired pattern.

According to the invention, the cathode ray tube **10** includes a substantially electron permeable conductive coating **28** on the phosphor screen **26**. The conductive coating **28** may be provided by any suitable known manner such as the evaporating of a metal, e.g., aluminum, onto the phosphor screen **26**. A conductive coating **30** is also provided on the wall of the funnel **18** to provide a conductive surface which extends both into the neck **14** and to adjacent to, but uniformly spaced from, the conductive coating **28** on the phosphor screen **26**. The conductive funnel coating **30** may likewise be provided by any suitable known means such as the painting of "Aquadag" material thereon. The conductive coatings **28** and **30** are effectively electrically insulated from each other by an annular area **32** which extends around the envelope **12** in the region where the faceplate **16** joins the funnel **18**. The annular area **32** is preferably coated with high resistive materials so that it not only effectively electrically insulates the two conductive coatings **28** and **30** from each other but also provides a high resistance conductive path to prevent electrical charges from building up on the annular area **32**. The use and composition of such high resistive material is well known and will not be further described herein.

High voltage terminals **36** and **38** are provided for making contact with the conductive coatings **28** and **30**, respectively. The terminals **36** and **38** may comprise conventional lead-in means sealed through the wall of the envelope **12** at locations suitable for contacting their respective conductive coatings internally of the tube. A plurality of lead-ins **40** are sealed through a stem structure **41** which in turn is sealed to the free end of the neck section **14**. The lead-ins **40** connect (not shown) to various ones of the electrodes of the electron gun **20** to provide operating potentials thereto.

In the operation of the cathode ray tube **10** according to my invention, conventional operating potentials such as indicated by the schematic arrow lead-ins are applied to the tube **10**. In accordance with the invention and as contrasted with prior art operation of a similar type tube, the high positive potentials applied to the phosphor screen and funnel coating electrodes 28 and 30 are of different magnitude with the potential on the phosphor screen electrode being substantially less than that on the funnel electrode. Such novel application of relative voltages serves to establish an electron decelerating electrostatic field 43 primarily in the region between the primary deflection zone 22 and the faceplate 16. It is this decelerating field 43 which serves to provide supplemental radial deflection as is hereinafter described.

The electron beam 21 projected by the electron gun is deflected in the primary deflection zone 22 by the magnetic yoke 24 in a predetermined scanning pattern. At one given time the electron beam 21 may be deflected an amount which, in the absence of the decelerating field 43, would cause it to travel toward the phosphor screen 26 along a path 44. Note that the path 44, which is representative of prior art operation of this general type tube, is substantially rectilinear following its deflection curvature in the primary deflection zone 22. However, in the cathode ray tube 10 wherein the decelerating field 43 according to my invention is established, the electron beam 21, instead of following the path 44 after leaving the primary deflection zone 22, is progressively deflected radially outward and follows a path 46. Accordingly, the effective radial displacement of the electron beam 21 at the phosphor screen is increased by an amount as indicated by the impinging points 48 and 50 of the respective beam paths 44 and 46.

The action of the decelerating field 43 can be explained if we consider that the velocity of the electron beam 21 after undergoing its primary deflection comprises an axial component and a radial component. The decelerating field established between the primary deflection zone 22 and the faceplate 16 is decelerating substantially only with respect to the axial velocity component of the electron beam 21. Thus, while the radial velocity component of beam velocity remains unchanged, the axial velocity component is progressively decreasing. Thus, an increase in the ratio of radial component to axial component takes place during the traversal of the electrons from the primary deflection zone 22 to the phosphor screen 26. Such an action results in the progressive deflection along the curved path 46 of the electron beam 21. Of course, for that moment of time when the electron beam 21 passes through the primary deflection zone 22 without any deflection so as to travel an axial path toward the phosphor screen 26, the electrostatic decelerating field 43 will have no effect to radially deflect the beam from its axial path. Radial deflection provided by the decelerating field 43 is effective only when the electron beam 21 has been initially deflected by the magnetic yoke 24 away from the tube axis. Then the decelerating field acts to enhance such deflection by the magnetic yoke 24 in the same radial direction as was provided by the yoke 24.

It was believed that the phosphor screen must be operated at the highest, or ultor, voltage of the tube in order to obtain adequate light output. However, I have discovered that with the improved phosphors now available and because of the unique advantages obtained by the practice of my invention, such high voltage screen operation is not necessary. Although for a given phosphor, light output is lowered by operating the screen at a lower voltage than the funnel, image contrast on the screen is so greatly improved by the practice of my invention that the reduction of light output is largely compensated thereby. Improvement in contrast obtained by the practice of my invention results from the avoidance of secondary and back scatter electrons striking the phosphor screen. These electrons are now attracted away from the region near the phosphor screen and toward the funnel coating 30 which is at a substantially higher potential than the phosphor screen.

In addition to contrast improvement, my invention also results in good resolution since the electron gun 20 is connected to the ultor voltage in the tube. This results in high beam velocity at the gun which as is well known contributes to good resolution.

Voltage relationships in the practice of my invention are not limited to any specific ratio or range of ratios. The greater the difference between the screen voltage and the funnel voltage, the greater the deflection enhancement obtained.

To obtain greatest enhancement of deflection it is desirable to make the difference of the screen and funnel voltages large by making the screen voltage low and the funnel voltage high. However, conflicting considerations arise since a low screen voltage means reduced light output and a high funnel voltage has the attendant disadvantages of expensive circuitry and high voltage insulation problems. Should the screen voltage be made too low, the electron beam 21 may actually fail to penetrate the metallic conductive coating 28 on the screen. Also, an extremely high funnel voltage necessarily requires corerspondingly high energizing currents for the magnetic yoke 24 in order to produce a given angle of deflection in the primary deflection zone 22. Hence, these conflicting considerations must be balanced so as to produce the most desirable operational condition. With this in mind, and for present day entertainment type kinescopes and circuitry therefor, one set of suitable operating voltages comprises a phosphor screen potential of 11.5 kv. and a funnel potential of 20 kv. This is adequate to provide an effective total deflection of approximately 140° using a conventional 110° deflection yoke and 110° deflection angle in the primary deflection zone.

FIGS. 2 and 3 illustrate other embodiments of my invention wherein either a single grid or a pair of grids is disposed transversely across the funnel of the tube to serve as means for establishing the decelerating field.

In FIG. 2 a cathode ray tube 52 is shown to comprise an envelope 53 having a neck 54, a faceplate 55, and an interconnecting funnel 56. A phosphor screen 57 is disposed on the faceplate 55. An electron gun 58 of conventional design is positioned in the neck 54 and is adapted to project an electron beam 59 throgh a primary deflection zone 60 and onto the phosphor screen 57.

A first conductive coating 62 is disposed over the phosphor screen 57 and part way down the funnel 56. A planar grid 64 is mounted transversely across the funnel 56 at the edge of the conductive coating 62 in contact therewith. A second conductive coating 66 is disposed over a portion of the funnel 56 adjacent the neck 54 to provide a conductive surface which extends into the neck a short distance. The two conductive coatings 62 and 66 are separated by an annular nonconductive area 67 of uniform width which may include a coating of a high resistive material such as iron oxide. Lead-in terminal mean 68 are provided for applying different voltages to the conductive coatings 62 and 66 so as to establish an electron decelerating field 69 between the second coating 66 and the planar grid 64. One set of suitable operating potentials for the two coatings 62 and 66 are 11.5 kv. and 20 kv., respectively, as is shown by the schematic lead-in arrows.

The decelerating field 69 functions similarly to the field 43 of the cathode ray tube 10 of FIG. 1. The electron beam 59 of the cathode ray tube 52 is given an initial deflection in the primary deflection zone 60 and in the absence of the decelerating field 69 would follow a substantially rectilinear path 70 to impinge on the phosphor screen 56. However, by virtue of the decelerating field 69, the electron beam 59 undergoes a supplemental radial deflection in the region between the primary deflection zone 60 and the grid 64 so that it is further deflected away from the central axis of the tube 52. This action is essentially identical to that obtained in the tube 10 except that the supplemental radial deflection forces provided in the tube 52 are confined to the region adjacent the grid 64 on the primary-deflection-zone side thereof. Accordingly, the electron beam 59 traverses a substantially rectilinear path 72 from the grid 64 to the phosphor screen 56.

FIG. 3 shows a cathode ray tube 74 comprising an envelope 76, a phosphor screen 78, an electron gun 80, and a primary deflection zone 84 identical to the corresponding elements of the tube 52. The tube 74 includes a first conductive coating 86 overlying the phosphor screen 78 and extending down along the funnel of the tube and in contact with a first planar grid 88 mounted transversely across the funnel. A second conductive coating 90 is disposed over a portion of the funnel adjacent the primary deflection zone 84 to provide a conductive surface which extends down into the neck of the envelope. A second planar grid 92 is mounted transversely across the funnel and in contact with the second conductive coating 90 and is spaced from and parallel to the first planar grid 88. The two conductive coatings 86 and 90 are separated by an annular nonconductive area 93 on the funnel which may include a coating of a suitable high resistance material. Lead-in terminal means 94 are provided for applying different voltages to the conductive coatings 86 and 90 and to their respective grids 88 and 92 so as to establish an electron decelerating field 95 in the region between the two grids. One set of suitable operating potentials for the two grids 88 and 92 are 14.3 kv. and 20 kv., respectively, as is indicated by the schematic lead-in arrows.

An electron beam 96, when given an initial deflection away from the central tube axis in the primary deflection zone 84, is further deflected as it passes through decelerating field 95 between the two grids. In the absence of the two grids and the associated decelerating field 95, the electron beam 96 would traverse a substantially rectilinear path 97 from the primary deflection zone 84 to the phosphor screen 78. However, when the beam 96 is passed through the decelerating field 95 in accordance with my invention, it is caused to follow an additionally deflected path 98. As is the case with the tube 52 of FIG. 2, the electron beam path 98 is substantially rectilinear from the grid 88 to the phosphor screen 78. Supplemental deflection occurs entirely between the two grids 88 and 92.

FIGS. 4–7 illustrate a double grid tube 100 similar to the tube 74 of FIG. 3 except that the pair of grids 102 and 104, corresponding to grids 88 and 92, are provided with curved contours. The two grids 102 and 104 have substantially the same contours and are thus substantially parallel with each other. FIGS. 5, 6, and 7 illustrate a preferred shape of the grids 102 and 104 for providing correction of pincushioning of the raster.

The tube 100 includes a generally rectangular faceplate 106 supporting a generally rectangular phosphor screen 108. Accordingly, the grids 102 and 104 are also somewhat generally rectangular in shape. FIG. 5 illustrates the rectangularity of the grid 102. The grid 102 is provided with a domed contour which is opened toward the phosphor screen 108 of the tube. In FIG. 6, the side elevation view of the grid 102 illustrates that its edge 110 is bowed or arcuate and also open toward the phosphor screen 108. The grid 102 is so shaped that its central portion 112 is closest to the electron gun of the tube 100 along a central longitudinal axis XX thereof. The four corner portions 116 of the grid 102 are disposed closest to the faceplate 108 along the longitudinal axis XX, and the mid point 118 of the edge 110 is intermediate the central portion 112 and the corner portions 116 along the axis XX.

FIG. 7 illustrates a section diametrically through the grid 102. As there shown, the corner portions 116 include a generally planar section adjacent the ends thereof which merges into the domed contour similar to that illustrated in FIG. 6. Such an overall contour as herein described might be generally thought of as that which would result by supporting the corners 116 of the grid 112 and forming a spherical depression at the center portion 112 such that the side edges 110 are also slightly depressed.

An electron decelerating field established between the two grids 102 and 104 according to the invention is contoured according to the grid contours. By virtue of the grid shape described above, the decelerating field is domed at the central portion thereof and somewhat flatter at the corner portions. Such a field exerts a greater radial deflection on an electron beam passing through the central portions of the grids than is exerted upon a beam passing through the peripheral or corner portions of the grids. Thus, the corners of a raster are effectively drawn inwardly to correct pincushion distortion caused by other operational characteristics, such as primary magnetic deflection.

FIGS. 8–15 illustrate modifications of the tube 10 of FIG. 1 wherein greater deflection enhancement is obtained by virtue of a preferred shaping of the decelerating field established in the funnel region of the tube.

FIGS. 8–11 illustrate a tube 122 similar to the tube 10 except that it includes four contoured conductive insert elements 124 disposed therein. The tube 122 is provided with a generally rectangular faceplate 126 as illustrated in FIG. 9. A correspondingly rectangular phosphor screen 128 is disposed on the internal surface of the faceplate 126. The phosphor screen 128 includes a conductive coating 130 similar to the coating 28 of tube 10. Inasmuch as the faceplate 126 is generally rectangular, the funnel 132 includes generally four sides 133 where it joins the faceplate 126. These four sides 133 merge into a generally circular opening at the neck 134 of the tube.

The inserts 124 comprise, for example sheet metal convexities as viewed from the faceplate side thereof, which substantially overlie the sides 133 of the funnel 132. FIGS. 10 and 11 illustrate the inserts 124 in cross section. The inserts 124 are shown to contact the sides 133 of the funnel at their edges and are humped such that they form convex conductive surfaces internally of the tube 122 which extend over a major portion of the sides 133. A conductive coating 134 is provided on the funnel 132 which together with the inserts 124 form a continuous conductive surface characterized by the humped contours.

As a result of the convex conductive surfaces provided by the inserts 124, the decelerating field established in the funnel region of the tube 122 includes equipotential lines A, B, and C, for example, which are formed with a relatively steep sloping portion 136. Such steep slope of the equipotential lines A, B, and C result in greater outward deflection of an electron beam passing therethrough than is provided by flatter equipotential field lines such as those of the tube 10. Thus, radial deflection is even further enhanced.

FIGS. 12–15 illustrate the substantial electrical equivalent of tube 122 wherein the humped conductive surfaces are provided as coatings on the wall of the envelope of the tube itself. Instead of the inserts 124 as employed in tube 122, the tube 140 of FIGS. 12–15 incorporates a novelly shaped funnel 142.

As shown in FIG. 13, the tube 140 comprises a generally rectangular faceplate 144. A correspondingly rectangular phosphor screen 146 is deposited thereon which includes a conductive coating 148. Accordingly, the funnel 142 of the tube 140 comprises generally four sides 150 where the funnel 142 joins the faceplate 144. The four sides 150 converge and merge into a generally cylindrical neck section 152 of the tube 140.

Each of the four sides 150 is provided with an internal hump or convexity as viewed from the faceplate side thereof. FIGS. 14 and 15 illustrate, respectively, contours of the short and long sides of the rectangular funnel 142. In contrast to prior art cathode ray tube envelopes, the funnel 142 includes a convex contour internally of the tube over a major portion of its side areas 150. This is illustrated in FIG. 12 wherein the sectioned contour of the funnel 142 is shown to be convexed over the major portion of its length from the neck 152 to the faceplate 144.

It will be appreciated that, by virtue of the unique shape of the funnel **142**, a conductive coating **154** applied thereon results in a conductive surface substantially similar in contour to the conductive surface resulting from the inserts **124** of the tube **122**. Accordingly, as described with reference to the tube **122** of FIG. 8, the decelerating field established in the funnel region of the tube is provided with a shape which results in even greater enhancement of the radial deflection than that which results from the tube **10** of FIG. 1.

The incorporating of the single grid **64** in the tube of FIG. 2, the pair of grids **88** and **92** in the tube of FIG. 3 or **102** and **104** in the tube of FIG. 4 serves to concentrate the decelerating fields established thereby. Such concentration has the effect of causing the supplemental radial deflection obtained to occur in a region spaced from the phosphor screen of the tube. Thus, for a given deflection enhancement the angle of incidence of the electron beam in the gridded tubes **52**, **74**, and **100** is less than the angle of incidence in the nongridded tube **10**. It is recognized that the smaller the angle of incidence, the smaller the resulting spot size produced by the beam on the phosphor screen. Thus, the gridded tubes **52**, **74**, and **100** have the advantage of better center to edge resolution uniformity than that obtained from the nongridded tube **10**. However, gridded tubes have the inherent disadvantage of reduced screen current due to electron interception by the grids. This, of course, reduces light output, one of the primary considerations of acceptable cathode ray tube operation.

It will be appreciated by those skilled in the art that such conflicting considerations of center to edge resolution uniformity versus light output, as well as the conflicting considerations involved in the selection of operating potentials, can be so evaluated as to best serve the requirements of the proposed application of the invention.

I claim:

1. A cathode ray tube comprising an envelope, a phosphor screen within said envelope, an electron gun including a cathode disposed in said envelope and adapted to project an electron beam through a primary deflection zone and upon said phosphor screen, and means including a conductive electrode surface supported on the inside of said envelope and producing an overall electron accelerating field of one polarity between said cathode and said zone and an overall electron decelerating field of opposite polarity between said zone and said screen, said conductive electrode surface being spaced from said phosphor screen by an insulative region of substantially uniform width on said envelope.

2. A cathode ray tube comprising an envelope, a phosphor screen within said envelope, an electron gun including a cathode disposed in said envelope and adapted to project an electron beam through a primary deflection zone and upon said phosphor screen, and means including at least one electron permeable grid means disposed generally normal to the undeflected path of said electron beam and a conductive electrode surface supported on the inside of said envelope for producing an overall electron accelerating field of one polarity between said cathode and said grid and an overall electron decelerating field of opposite polarity between said grid and said screen, said conductive electrode surface being spaced from said grid by an insulative area of substantially uniform width.

3. A cathode ray tube comprising an envelope having a neck section, a faceplate, and an interconnecting funnel section, a phosphor screen on said faceplate, an electron gun including a cathode disposed in said neck and adapted to project an electron beam toward said phosphor screen through a primary deflection zone and upon said phosphor screen, and means including a plurality of lead-in conductors and a conductive electrode surface supported on the inside of said funnel for applying electric potentials to said cathode, screen, and conductive electrode surface with the polarity of the electrode voltage relative to the screen voltage being opposite the polarity of the cathode voltage relative to the screen voltage for establishing an electron decelerating electrostatic field between said deflection zone and said phosphor screen contiguous and co-extensive with said phosphor screen, said conductive electrode surface being separated from said phosphor screen by an insulative region of substantially uniform width.

4. A cathode ray tube comprising an envelope having a neck section, a faceplate, and an interconnecting funnel section, a phosphor screen on said faceplate, an electron including a cathode disposed in said neck and adapted to project an electron beam from said cathode through a primary deflection zone and upon said phosphor screen, and means including a conductive electrode surface supported on the inside of said funnel for producing an overall electron accelerating field of one polarity between said cathode and said zone and an overall electron decelerating field of opposite polarity between said zone and said screen so as to enhance the radial deflection of said beam initiated in said primary deflection zone, said conductive electrode surface being separated from said phosphor screen by an insulative region of substantially uniform width.

5. A cathode ray tube comprising an envelope having a neck section, a faceplate, and an interconnecting funnel section, a phosphor screen on said faceplate, an electron gun including a cathode disposed in said neck and adapted to project an electron beam toward said phosphor screen through a primary deflection zone and upon said phosphor screen, and means including at least one electron transmissive grid disposed across said funnel and a conductive electrode surface supported on the inside of said envelope for producing an overall electron accelerating field of one polarity between said cathode and said grid and an overall electron decelerating field of opposite polarity between said grid and said screen to reduce the axial velocity component of said electron beam to supplement any radial deflection of said beam initiated in said primary deflection zone, said conductive electrode surface being spaced from said grid by an insulative area of substantially uniform width on said envelope.

6. A cathode ray tube comprising an envelope, a phosphor screen within said envelope, an electron gun including a cathode disposed in said envelope and adapted to project an electron beam through a primary deflection zone and upon said phosphor screen, and means including conductive coating electrodes on said screen and on the inside surface of said envelope together with said cathode which are adapted to have applied thereto different voltages with the polarity of the conductive envelope coating electrode voltage relative to the conductive screen coating electrode voltage being opposite the polarity of the cathode voltage relative to the conductive screen coating electrode voltage for establishing an overall electron decelerating field in the region between said deflection zone and said phosphor screen contiguous and coextensive with said screen, said conductive envelope coating electrode being spaced from said conductive screen coating electrode by an insulative envelope area of substantially uniform width, said region being devoid of any physical obstruction to passage of the electrons of said beam therethrough.

7. A cathode ray tube comprising an envelope including a neck section, a faceplate, and an interconnecting funnel section, a phosphor screen on said faceplate, an electron gun including a cathode disposed in said neck section and adapted to project an electron beam toward said phosphor screen through a primary deflection zone and onto said phosphor screen and means including, a first conductive coating electrode on said phosphor screen, a second conductive coating electrode on the portion of said funnel adjacent to said neck and extending into said neck, and terminal means external of said envelope connected to said coating electrodes and to said cathode for electri-

cally energizing said second conductive coating electrode relative to said first conductive coating electrode with a polarity opposite the energization of said cathode relative to said first conductive coating electrode so as to establish an electric field contiguous and coextensive with said phosphor screen for producing an overall deceleration of said beam between said primary deflection zone and said phosphor screen, said conductive coatings being insulated from each other by an insulative annular area of substantially uniform width extending around the portion of said funnel adjacent said faceplate.

8. The cathode ray tube according to claim 7 and wherein said insulative annular area includes a coating of relatively high resistance material.

9. A cathode ray tube according to claim 7 and wherein said faceplate is generally rectangular and said funnel comprises generally four sides at said faceplate which merge into a circular opening at said neck, and wherein said sides comprise convexities internally of said envelope extending over a major portion of said sides.

10. A cathode ray tube according to claim 2 and wherein said faceplate is generally rectangular, said grid means is generally domed and open toward said faceplate, and wherein its edges corresponding to the sides of said rectangular faceplate are arcuate and open toward said faceplate.

11. A cathode ray tube according to claim 5 and wherein said faceplate is generally rectangular, said at least one grid means comprises a pair of substantially parallel grids which are similarly contoured, said grids being generally domed with the central portion axially closest to said gun, the four corner portions corresponding to the corners of said rectangular faceplate being axially closest to said faceplate, and the edge portions intermediate said four corner portions being axially between said central and corner portions.

12. A cathode ray tube comprising an envelope having a neck section, a generally rectangular faceplate, and an interconnecting funnel section comprising generally four sides connected to said faceplate which merge into said neck, a phosphor screen on said faceplate, an electron gun disposed in said neck and adapted to project an electron beam toward said phosphor screen through a primary deflection zone and upon said phosphor screen, and means including a conductive electrode surface supported on the inside of said funnel and comprising portions which overlie said four sides and which are generally humped internally of said envelope for establishing an electron decelerating electrostatic field between said deflection zone and said phosphor screen contiguous and co-extensive with said phosphor screen, said conductive electrode surface being separated from said phosphor screen by an insulative region of substantially uniform width.

References Cited by the Examiner

UNITED STATES PATENTS

2,409,514	10/46	Pratt	313—82
2,728,024	12/55	Ramberg	315—17
2,813,224	11/57	Francken	315—31
2,890,379	6/59	Lee	315—41
2,981,864	4/61	Burdick et al.	315—16

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