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March 25, 1969 L. A. SHANAFELT ET AL 3,435,269

THIN CATHODE RAY TUBE WITH ARRAY OF PLANAR VERTICAL DEFLECTION ELEMENTS

Filed Oct. 23, 1965 Sheet 1 of 3

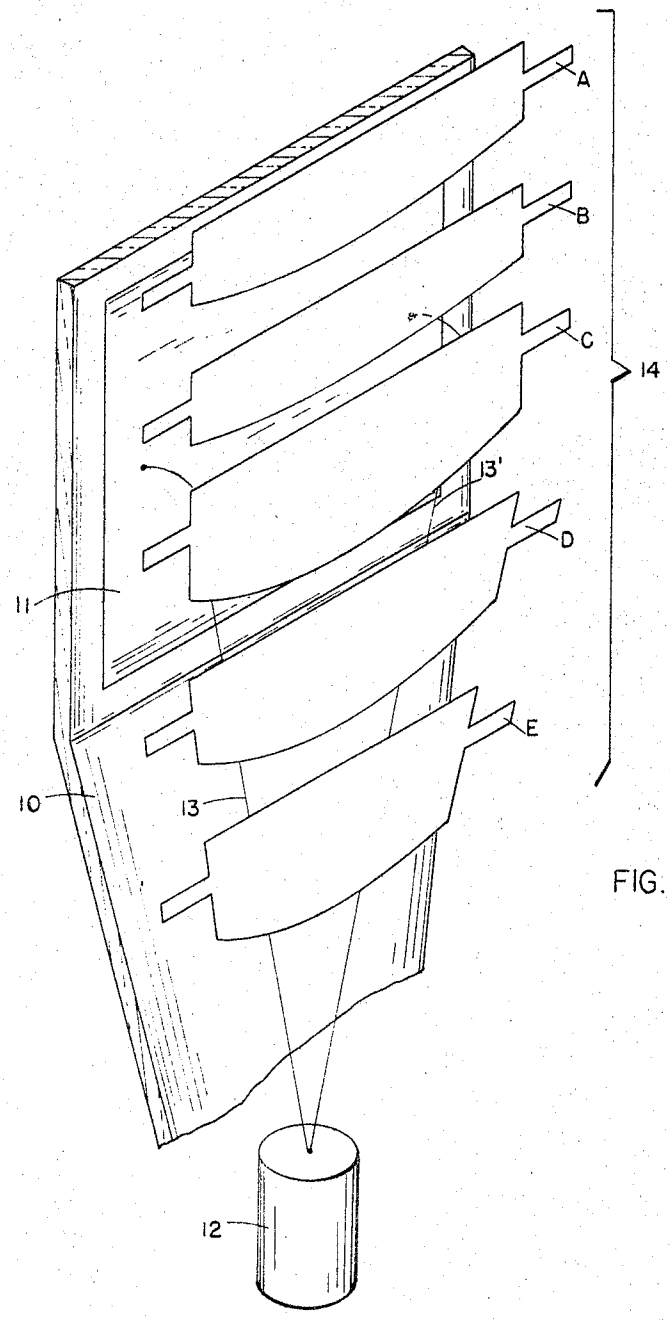


FIG. 1

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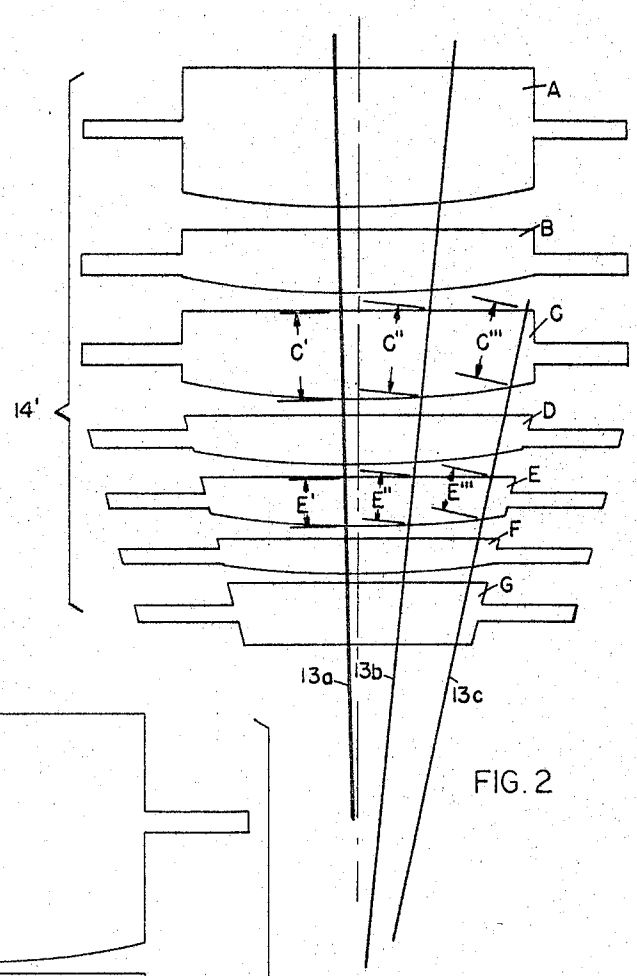


FIG. 2

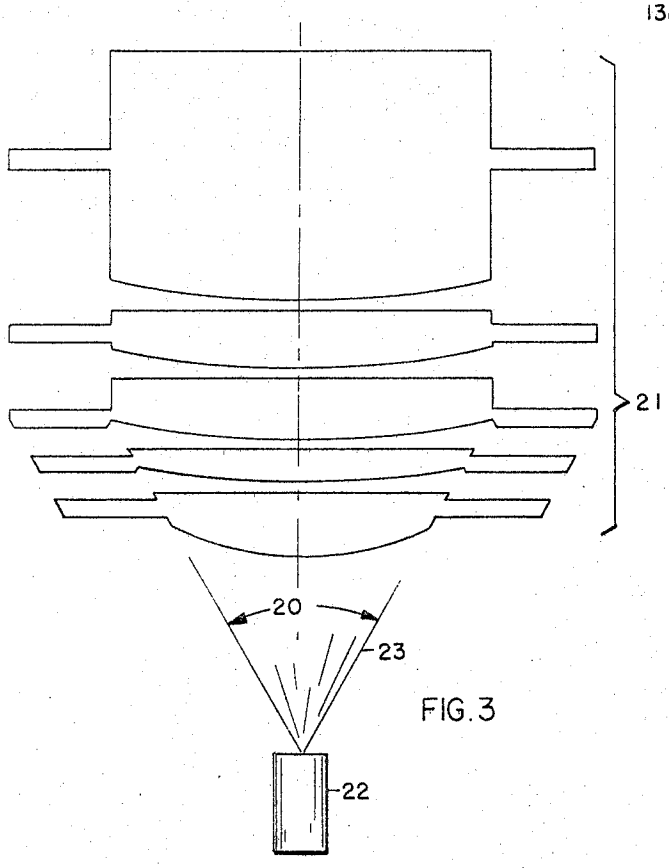


FIG. 3

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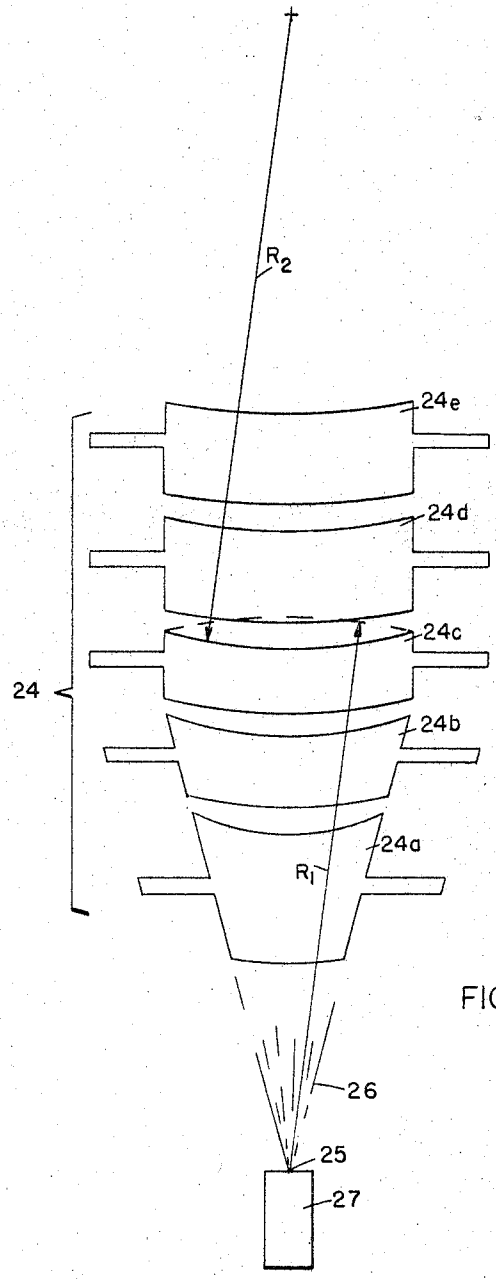


FIG. 4

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3,435,269

THIN CATHODE RAY TUBE WITH ARRAY OF PLANAR VERTICAL DEFLECTION ELEMENTS

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Int. Cl. H01j 29/74
U.S. Cl. 313—78 4 Claims

This invention relates generally to a cathode ray tube of the type described generally in Patent 2,795,731, issued June 11, 1957, to William Ross Aiken. More particularly this invention relates to a novel modification of the embodiment of FIGURES 24 and 25 of said patent.

The cathode ray tube to which this invention relates is adapted to be relatively thin so that it may be utilized in a television set which, for example, hangs on the wall and protrudes from the wall no more than 2 inches or the like or in a different version may be incorporated in a hand carried transistorized pocket television set, or may be provided as a means of displaying data for aircraft pilots in the relatively confined space of cockpits where space is at a premium.

Other advantages of this general type of tube are set forth in the aforementioned patent and in many subsequently issued patents relating to the general type.

In the particular type of tube to which this invention relates, an electron gun is provided at one side of a target screen to provide a beam of electrons with the axis of the gun lying in a plane substantially parallel to that of the target screen. The gun is provided with electrostatic or magnetic deflection means to cause the beam to sweep through an included angle of suitable size in a plane adjacent to the target screen; the plane is substantially parallel to the target screen. A plurality of deflection elements are provided lying in a plane which is parallel to the plane of the target screen and the plane which the beam sweeps, the plane which is being sweeped being between the plane of the deflection elements and the plane of the target screen. The deflection elements consist of electrically conductive material and may be plates but are preferably transparent electrically conductive material coated on a suitable supporting surface which may be a glass plate and may be part of the envelope of the tube. Suitable voltages are applied to the deflection plates in such manner that the voltage applied to each is lowered successively for each vertical sweep of the raster.

The "horizontal" lines in the raster which is produced by such a tube are not straight but are curved so that the entire raster has the shape of a segment of an annulus rather than having the shape of a rectangle. The existance of this type of difficulty is indicated in the aforementioned patent in connection with the discussion of FIGURES 24 and 25 and is also indicated in other subsequently issued patents. It has been suggested that the difficulty may be overcome by providing suitable voltage corrections by including suitable circuitry modifications in the sources for the horizontal and vertical sweep signals.

It has not been found possible to make suitably satisfactory corrections in this manner which provide straight horizontal lines in the raster and thus it has not been feasible in this manner to obtain a suitable image, especially a suitable television image.

We have provided a solution for the problem which provides perfectly straight lines in the horizontal sweep and an excellent picture. Our solution furthermore is accomplished without adding any additional cost, effort, labor or attention to the circuitry or the tube and without, in fact, adding any additional element whatever to the circuitry or the tube.

The object of the invention which has thus been accomplished is to provide for all lines in the horizontal sweep in the above described type of tube to be straight in a manner which adds substantially nothing to the cost, the complexity or the difficulty in making either the circuitry for the tube or the tube itself.

Other objects will become apparent from the drawings and from the following detailed description in which it is intended to illustrate the applicability of the invention without thereby limiting its scope to less than that of all equvalents which will be apparent to one skilled in the art. In the drawings like reference numerals refer to like parts and;

FIGURE 1 is a schematic perspective view of the principal elements of a tube according to the invention;

FIGURE 2 is a plan view of an array of vertical deflection elements in a tube according to the invention;

FIGURE 3 is a plan view of another array of vertical deflection elements in another tube according to the invention which is neither a modification nor a different embodiment from that of FIGURE 2 but merely a tube which differs in location of elements from that of FIGURE 2;

FIGURE 4 is a plan view of an array of vertical deflection elements in another embodiment.

Referring now to FIGURE 1, there is shown a front envelope member **10** which may be of glass and which may have target **11** coated thereon. Target or target screen **11** may be of any suitable fluorescent material which may suitably be used for cathode ray tubes such as for television screens or the like. Electron gun **12** is disposed at one side of screen **11** with its axis lying in a plane substantially parallel to the plane in which screen **11** lies and by means of suitable electrostatic or magnetic deflection means well known in the art and not shown for simplicity, is arranged to provide an electron beam **13** scanning or sweeping in a plane defined by beam **13** and beam **13'**. Deflection elements **14**, respectively designated A, B, C, D, and E, lie in a plane which is parallel to the plane of screen **11** and parallel to the plane defined by beams **13** and **13'** and is spaced apart from these other two planes so that the plane defined by beams **13** and **13'** lies substantially between the plane of target **11** and the plane in which elements **14** lie. Elements **14** are conductive members and may be metal plates attached to a suitable insulating backing but each preferably consists of a coating of transparent conductive material coated on to a supporting glass plate. For simplicity, the showing of such a glass plate or such insulating material has been omitted.

In any suitable manner shown in the prior art, electric generating means may be provided to provide each of elements **14** with a voltage which varies with time so that the voltage for each element is lowered sequentially to cause deflection of beams such as **13** or **13'** toward and into contact with screen **11** at a point which varies with time in a vertical direction. Because several different means are shown in the aforementioned patent for controlling the voltage supplied to such an array of vertical deflection plates, and because other means for supplying such voltages are shown in other disclosures in the prior art, the description of such means is omitted here for simplicity. A preferred means, however, is that shown in a copending application in which a plurality of neon tubes are fired sequentially to illuminate sequentially a series of photocells, the output of each of the photocells being fed respectively to elements **14**.

It will be noted that each of elements **14** is planar and that the top edge of each is straight, whereas, the bottom edge of each is curved upwardly from the center to each side. Alternatively, the top edge of each may suitably be curved downwardly from the center to each

side and the bottom edge may be curved as described or may be straight if desired, or may be curved downwardly from the center to each side.

Referring now to FIGURE 2, there is shown the manner in which one embodiment is provided. Referring, for example, to element E of elements 14', the curve of the bottom of the element is so calculated that distance E' over which beam 13A travels is equal to distance E'' over which beam 13B travels and is also equal to distance E''' over which beam 13C travels; the same is true for each of the other elements. Thus the top edge of element C is straight, and the bottom edge of element C is calculated to curve upwardly from the center towards each outside end in such fashion that portion C' of beam 13A which passes over element C is equal in length to portion C'' of beam 13B which passes over element C, and is equal to portion C''' of beam 13C which passes over element C. The amount of curvature may be slightly varied empirically if desired to correct for minor field variations and the like in order to provide straight horizontal lines in the raster.

Likewise, as shown in FIGURE 3, the position of the gun 22 with respect to the deflection elements 21 may be changed so that the average length of the beam 23 projected by the gun is changed, the number and relative spacing of the elements may be changed and the included angle 20 through which the beam sweeps is changed. Just as described in connection with FIGURE 2, the distance through which the beam passes over each element may be the same for all portions of each element throughout the sweep of the beam.

Referring now to FIGURE 4, there is shown an embodiment in which each of vertical deflection elements 24, respectively designated 24*a*, 24*b*, 24*c*, 24*d* and 24*e* is provided with both a bottom edge and a top edge which curves upwardly from the center to each side. The curvature of each of these edges may be calculated by determining the radius of the arc through which the beam 26 (emitted by gun 27) sweeps at substantially the location of the edge. The downward curvature of the edge then is made equal to the upward curvature of an arc defined by a radius extended from point 25 at which the beam is bent in or near the gun. Thus for the upper edge of element 24*b*, the radius of its downwardly extending arc R_2 is made equal to the radius of the arc R_1, through which beam 26 sweeps at substantially the same point.

In general, the deflection elements are so provided, in accordance with the invention, that the electrostatic field between the deflection array and the target screen is

altered with a correction equal and opposite to the field or force which provides arcuateness to the line provided by the beam.

It may thus be seen that the invention is broad in scope and includes such modifications as will be apparent to those skilled in the art and is to be limited only by the claims.

Having thus described our invention, we claim:

We claim:

1. In a cathode ray tube having an envelope, a target screen in said envelope and an array of planar vertical deflection elements disposed substantially adjacent to a surface spaced from and opposite to said target screen to control vertical sweep of an electron beam in the provision of a raster on said target screen, an electron gun in a symmetrical position with respect to the ends of said vertical deflection elements, below said elements, for injecting an electron beam between said elements and said target screen, means for scanning said beam in a fan-shaped pattern between said array and said target screen, said pattern being in a plane if voltages on said elements and said screen are equal, each of said vertical deflection elements having an upper and lower edge and having at least one of said edges curved for altering the electrostatic field between said vertical deflection array and said target screen to straighten the horizontal lines of said raster.

2. The tube of claim 1, wherein the top edge of each of said deflection elements is curved upwardly from the center to each side.

3. The tube of claim 2, wherein the bottom edge of each of said deflection elements is also curved upwardly from the center to each side.

4. The tube of claim 3, wherein the curves of said edges have radii substantially equal to the radial distance of said edge from the point near the gun at which the beam bends.

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U.S. Cl. X.R.

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