

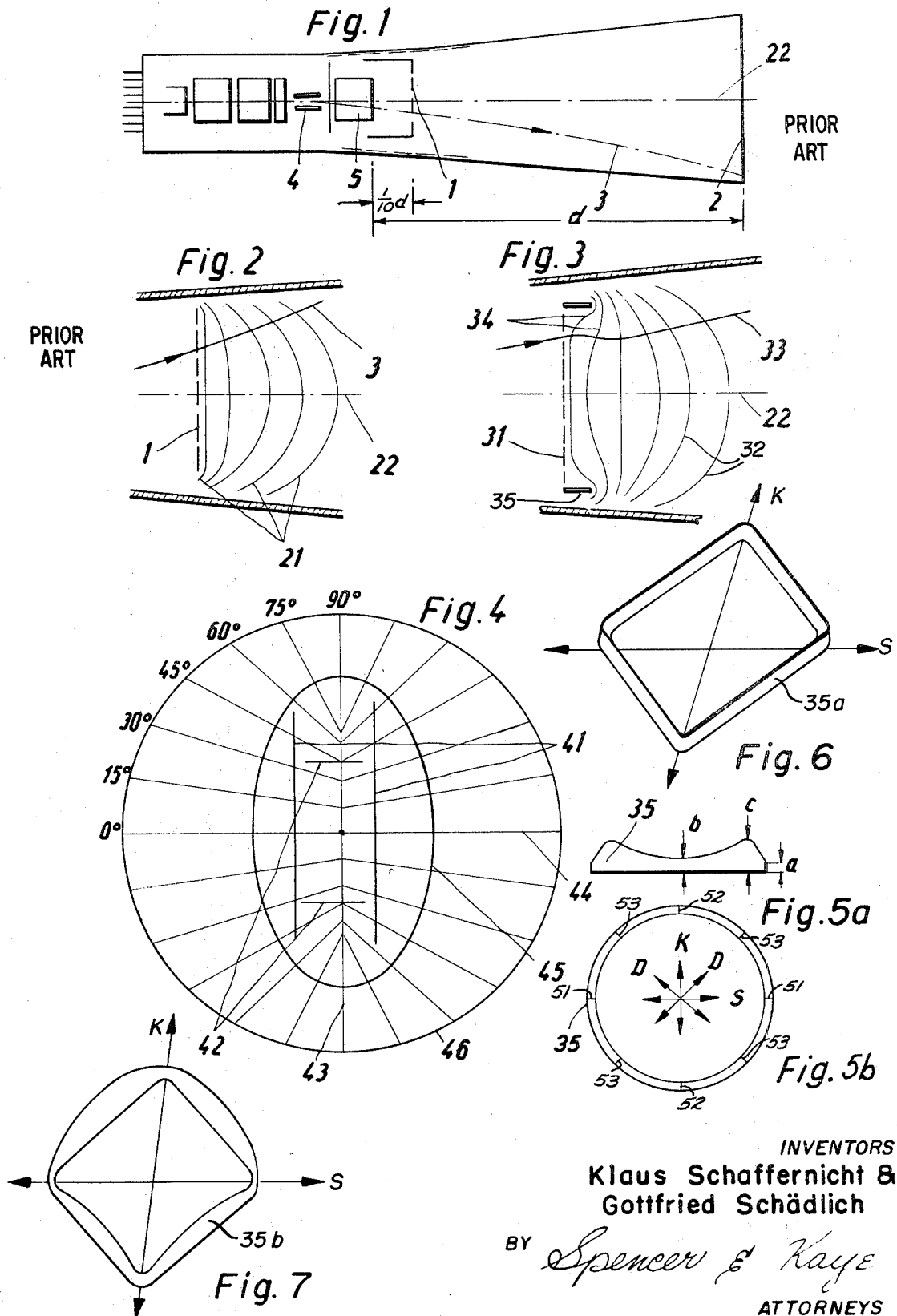
Sept. 15, 1970

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3,529,194

CATHODE RAY TUBE

Filed July 17, 1968



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3,529,194

CATHODE RAY TUBE

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Filed July 17, 1968, Ser. No. 745,580

Claims priority, application Germany, July 18, 1967,

1,614,840

Int. Cl. H01j 29/74

U.S. Cl. 313—78

10 Claims

ABSTRACT OF THE DISCLOSURE

A cathode ray tube wherein there is provided a screen and two deflecting means spaced from each other in the direction of the electron beam for deflecting the electron beam in two mutually perpendicular deflection directions. An electron-permeable, planar after-acceleration electrode is disposed transverse to the tube axis and behind the deflecting means in the direction of the electron beam for producing an after-acceleration field between the after-acceleration electrode and the screen. An electrode means is disposed at the periphery of the after-acceleration electrode for more strongly converging the after-acceleration field with increasing distance from the tube axis in the diagonal deflection directions than in the two mutually perpendicular directions while leaving unaffected the rotational symmetry of the after-acceleration field in the vicinity of the after-acceleration electrode, in consequence of which pincushion distortion is reduced or eliminated.

BACKGROUND OF THE INVENTION

The present invention relates to a cathode ray tube having two deflecting means disposed at a distance from each other in the direction of the electron beam for deflecting the electron beam in two mutually perpendicular deflection directions. An after-acceleration electrode is disposed behind the deflecting means in the direction of the electron beam. The after-acceleration electrode is permeable to electrons and is provided for the creation of an after-acceleration field between itself and a luminescent screen. The after-acceleration electrode is of a planar construction and disposed transverse to the tube axis, hence, the direction of the electron beam.

It is known in the art to increase the impact energy of the electron beam of a cathode ray tube by means of an after-acceleration field which is disposed behind the deflecting means in the direction of the electron beam. According to the known method for creating an after-acceleration field a so-called after-acceleration electrode, in the form of a net or grid, is positioned between the deflecting means and the target electrode, the latter, preferably, being a luminescent screen. This after-acceleration is planar in construction and permeable to as many electrons as possible. For example, a suitable after-acceleration electrode would be a grid or net electrode which is as transparent as possible.

It is further known, particularly where electrostatic deflection of the electron beam is produced, to provide in a cathode ray tube two deflecting means for the two deflection directions positioned in an offset relationship with respect to each other in the direction of the beam. This feature will be better understood in connection with the drawing and corresponding discussion below.

In electron beam or cathode ray tubes, of the type discussed above, it has now been found that pincushion distortion errors occur during the deflection of the electron beam. This is a significant disadvantage.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to reduce or completely eliminate the pincushion distortion errors in such cathode ray tubes.

In brief, according to the present invention, it is proposed to dispose electrodes or electrode components at the periphery of the after-acceleration electrode of a cathode ray tube, as discussed above, in such a manner that such electrodes will not affect the rotational symmetry of the after-acceleration field in the vicinity of the after-acceleration electrode, while such electrodes will cause the after-acceleration field to become more strongly convergent with increasing distance from the tube axis with respect to the diagonal deflection directions than in the two mutually perpendicular deflection directions of the field. By this arrangement, pincushion distortion errors are reduced or eliminated.

According to a preferred embodiment of the invention it is proposed that an electrically conductive rim be provided at the periphery of the after-acceleration electrode. This rim is constructed to extend toward the luminescent screen and have a height which varies above the periphery of the after-acceleration electrode, in such a manner, and/or the circumference of the rim is constructed to deviate from a circular form, in such a manner, that pincushion distortion errors are reduced or eliminated.

The annular electrode or rim provided at the periphery of the electron-permeable electrode provides a relatively simple way to substantially reduce or eliminate the pincushion distortion errors which occur as a result of the two deflecting means for the two deflection directions being arranged in offset relationship with respect to each other in the direction of the tube axis.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a prior art cathode ray tube.

FIG. 2 is an enlarged view of a portion of the cathode ray tube of FIG. 1 showing a plurality of equipotential lines of the after-acceleration field.

FIG. 3 is an enlarged view of the same portion of the cathode ray tube as in FIG. 1 and including the feature according to the present invention.

FIG. 4 is a schematically illustrated planar view of the deflection configuration assumed by an electron beam in the plane of an electron-permeable after-acceleration electrode of a cathode ray tube.

FIGS. 5a and 5b are two views of one embodiment of the electrode to be positioned at the periphery of the after-acceleration electrode, according to the invention FIG. 5b being a top view of FIG. 5a.

FIG. 6 illustrates another embodiment of an electrode according to the present invention.

FIG. 7 illustrates a still further embodiment of an electrode according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the same shows a schematic view of a known cathode ray tube arrangement. An electron beam 3 is deflected with the aid of a pair of electrostatic deflection plates 4 and 5 to a luminescent screen 2. A net electrode 1, which serves to create an after-acceleration field for generating an electron beam of increased impact energy against the luminescent screen 2, is disposed between the deflecting means 4 and 5 and the luminescent screen 2.

Referring to FIG. 2, an enlarged section of the cathode ray tube of FIG. 1 is shown together with a plurality of equipotential lines 21 as they form in the vicinity of the after-acceleration electrode, net 1. It can here be seen

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that the equipotential lines 21 of the after-acceleration field assume a convex configuration in the beam direction when, as shown, the electron beam tube is constructed, as is usually the case, as a rotationally symmetrical component having a longitudinal axis 22.

Referring to FIG. 3, this shows an enlarged cross section of a cathode ray tube, as illustrated in FIG. 2. In addition, FIG. 3 shows an electrode 35, according to the invention, in the form of a rim. The rim 35 is provided at the periphery of the electron-permeable, planar electrode 31. Thus, rim 35 is constructed to serve as an annular electrode. The resulting after-acceleration field, as is shown in FIG. 3, is modified, when compared to the after-acceleration field of FIG. 2. It is evident from the configuration of the after-acceleration field in FIG. 3 that a converging factor results in the vicinity of the electron-permeable electrode 31, i.e. in the vicinity of its periphery, as this is shown by the equipotential lines 34. At an increasing distance in the direction of the electron beam from the electron-permeable electrode 31, the after-acceleration field will assume a conventional form, in accordance with the configuration of equipotential lines 32 and similar to the form of the after-acceleration field shown in FIG. 2. In FIG. 3, the distant equipotential lines 32 produce a diverging electrostatic field. The electron beam 33 is substantially subject to the converging portion 34 of the after-acceleration field only in its deflected state and is shown in such a deflected state in FIG. 3.

The net electrode 1 is situated near the deflecting means 4 and 5 and remote from the screen 2. Thus, as shown in FIG. 1, the net electrode 1 is separated from the plates 5 by only $\frac{1}{10}$ of the deflecting means to screen distance d . This placement of the net electrode, when combined with the electrode 35 as in FIG. 3, leaves room for the physical dimensions of the electrode 35, lowers the voltage gradient between the net electrode 1 and the screen 2, and allows the corrective influence of the electrode 35 to act on the electron beam before the velocity of the electrons toward the screen has significantly risen.

Referring to FIGS. 5a and 5b, these show a preferred embodiment of the present invention. The rim 35 has an axial dimension or height which varies along its circumference. The greatest height c of annular electrode 35 is provided in the diagonal deflection direction D, as shown in FIG. 5b. However, the same dimension of the annular electrode 35 in the deflection directions of the two deflecting means, respectively, is much less. In addition, it is particularly advantageous to provide different heights for rim 35 in the two basic deflection directions, as shown in FIG. 5a. FIG. 5a shows the height a of the rim 35 in the deflection direction S of the deflecting means near the screen to be less than the height b of the deflection direction of the deflecting means near the cathode. The heights a , b , and c are represented in FIG. 5b by contour lines 51, 52 and 53 respectively. It will be understood that the screen-side deflection means are near the screen 5 in FIG. 1) and the cathode-side deflection means are near the cathode (4 in FIG. 1).

Generally speaking, the concept of the present invention, when structurally embodied in a cathode ray tube as described in the introductory paragraph, provides that the electron beam reaches, in the diagonal deflection direction with increasing deflection, an increasingly stronger, converging after-acceleration field, particularly in the vicinity of the after-acceleration net. Conversely, the electron beam reaches, upon deflection in the basic deflection directions of the two deflecting means at increasing deflection, an after-acceleration field which converges less than that in the diagonal deflection direction. It would furthermore be advisable to provide that the after-acceleration field of the deflected electron beam will be more strongly convergent in the direction of the deflecting means nearest the cathode than in the deflection direction of the deflecting means nearest the screen.

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FIG. 4 is a schematic planar view of the prevailing conditions during deflection of an electron beam in a tube of the type described in the introductory paragraph. The deflecting means plates on the cathode side of the tube are marked 42 and the deflecting means plates on the screen side of the tube are marked 41. In the illustration, the screen area 46, as well as the two planes of the deflecting plates are transposed onto the plane of the electron-permeable electrode. It can thus be seen that the so-called penetration line (i.e. the line in which the electron beam penetrates the electron-permeable electrode) forms an ellipse 45 when it is deflected toward a circle 46 on the screen surface. The elliptical form of the penetration line results from the axially displaced position of the deflection crossover points of the two deflecting means.

It can also be seen that less correction is required in the deflection direction 44 of the deflection plates 41 nearest the screen than in the deflection direction 43 of the deflection plates 42 nearest the cathode. In contrast, as seen from the illustration of FIG. 4, a maximum correction is necessary in the diagonal deflection directions (45, 135, 225, 315 angular degrees). The electron-permeable after-acceleration electrode can be provided a planar configuration or it can be curved and can consist of a thin foil, a grid, e.g. a frame grid, or a net.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations. For example, the rim may have any suitable configuration to produce the above-described after-acceleration field which converges more strongly in the diagonal deflection directions than in the two basic, mutually perpendicular directions. Thus, while the rim 35 in the embodiments of FIGS. 5a and 5b, which is shown as being configured to have different axial dimensions in the diagonal than in the basic directions, is circular, the electrode which produces the described after-acceleration field may have a constant axial dimension and be non-circular, such as rectangular. Such an arrangement is shown in FIG. 6, which depicts the rectangular electrode 35a. Moreover, the electrode may be configured to incorporate both of the above features, i.e., the electrode may, as shown in FIG. 7 at 35b, be non-circular and have different axial dimensions in the diagonal and basic directions.

What is claimed is:

1. In a cathode ray tube having a screen, two deflecting means spaced from each other in the direction of the electron beam for deflecting the electron beam in two mutually perpendicular deflection directions, an electron-permeable, planar after-acceleration electrode disposed transverse to the tube axis and located between the deflecting means and said screen in the direction of the electron beam for producing an after-acceleration field between the after-acceleration electrode and the screen, the improvement comprising electrode means disposed at the periphery of the after-acceleration electrode for more strongly converging the after-acceleration field, with increasing distance from the tube axis, in the diagonal deflection directions than in said two mutually perpendicular deflection directions while leaving unaffected the rotational symmetry of the after-acceleration field in the vicinity of the after-acceleration electrode, in consequence of which pin cushion distortion is reduced or eliminated, said electrode means being an electrically conductive rim provided at the periphery of said after-acceleration electrode, said rim extending toward the screen and having a non-circular configuration.

2. A cathode ray tube as defined in claim 1 wherein said rim has a constant axial dimension.

3. In a cathode ray tube having a screen, two deflecting means spaced from each other in the direction of the electron beam for deflecting the electron beam in two mutually perpendicular deflection directions, an electron-permeable, planar after-acceleration electrode disposed transverse to the tube axis and located between the deflect-

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ing means and said screen in the direction of the electron beam for producing an after-acceleration field between the after-acceleration electrode and the screen, the improvement comprising electrode means disposed at the periphery of the after-acceleration electrode for more strongly converging the after-acceleration field, with increasing distance from the tube axis, in the diagonal deflection direction than in said two mutually perpendicular deflection directions while leaving unaffected the rotational symmetry of the after-acceleration field in the vicinity of the after-acceleration electrode, in consequence of which pin cushion distortion is reduced or eliminated, said electrode means being an electrically conductive rim provided at the periphery of said after-acceleration electrode, said rim extending toward said screen and having an axial dimension which varies above the periphery of said after-acceleration electrode.

4. A cathode ray tube as defined in claim 3 wherein said rim is configured to have a greater axial dimension in the diagonal deflection planes than in the deflection planes of the two deflecting means.

5. A cathode ray tube as defined in claim 4 wherein each of said deflecting means includes a pair of electrostatic deflection plates.

6. A cathode ray tube as defined in claim 4 wherein said rim is configured to have different axial dimensions in the two deflection planes of the two deflecting means.

7. A cathode ray tube as defined in claim 4 wherein said rim is configured to have a greater axial dimension in the deflection plane of the cathode-side deflection means rather than in the deflection plane of the screen-side deflecting means.

8. A cathode ray tube as defined in claim 3 wherein said rim has a circular configuration.

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9. A cathode ray tube as defined in claim 7 wherein said rim has a non-circular configuration.

10. In a cathode ray tube having a screen, two deflecting means spaced from each other in the direction of the electron beam for deflecting the electron beam in two mutually perpendicular deflection directions, an electron-permeable, planar after-acceleration electrode disposed transverse to the tube axis and located between the deflecting means and said screen in the direction of the electron beam, near the deflecting means and remote from said screen, for producing an after-acceleration field between the after-acceleration electrode and the screen, the improvement comprising electrode means disposed at the periphery of the after-acceleration electrode for more strongly converging the after-acceleration field, with increasing distance from the tube axis, in the diagonal deflection directions than in said two mutually perpendicular deflection directions while leaving unaffected the rotational symmetry of the after-acceleration field in the vicinity of the after acceleration electrode, in consequence of which pincushion distortion is reduced or eliminated.

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U.S. Cl. X.R.

313—80; 315—24