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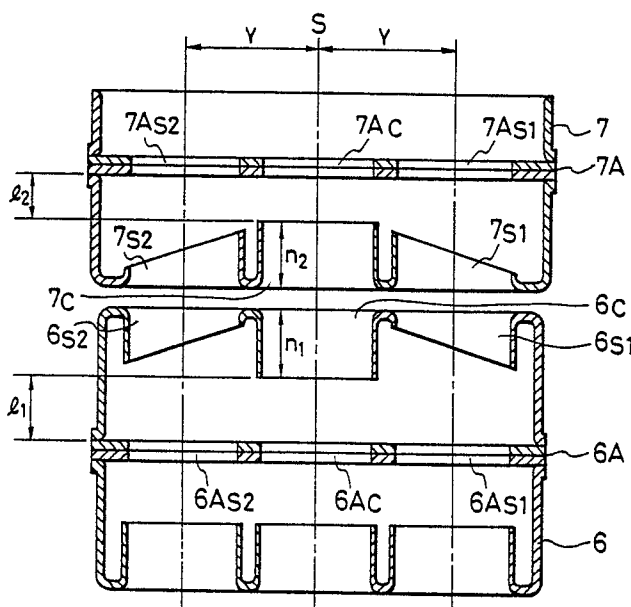
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⑤ Electron gun for color picture tube.

⑤ In order that an electron gun for a color picture tube furnished with grid electrodes each having a cylinder portion including an inclined end face may be installed in a color picture tube of different size without altering the inclination of the end face of the cylinder, an electrode for correcting an electric field is provided in at least one of the grid electrodes each of which has the cylinder portion including the inclined end face.

FIG. 1



Electron Gun for Color Picture Tube

Background of the Invention:

The present invention relates to an in-line type electron gun for a color picture tube, and more particularly to the electrode structure of an electrode for forming an electron lens, well suited to enhance focusing characteristics.

Since, in an in-line type electron gun, electron beams are arrayed on one plane, the diameter of a main lens becomes smaller than in a delta arrayal type electron gun. While the diameter of the neck of a glass bulb is better as it is smaller in view of the restrictions of deflecting current power, convergence, etc., the diameter of the main lens becomes still smaller to degrade focusing characteristics. In addition, the gap between the outside diameter of the electron gun and the inside diameter of the neck needs to be set at or above 1 mm by way of example in order to lessen the influences of undesirable electron emission etc. There are such numerous restrictions due to which the diameter of the main lens cannot be enlarged. Accordingly, a multistage focusing type electron gun has been proposed as an expedient for attaining a good focusing performance among the numerous restrictions. The multistage focusing type electron gun can focus electron beams gently, and can improve the spherical aberrations of electron lenses.

Fig. 4 is a partly sectional side view of a typical electron gun of the multistage focusing type. Referring to the figure, the electron gun is constructed of a cathode 1, a first grid 2, a second grid 3, a third grid 4, a fourth grid 5, a fifth grid 6 and a sixth grid 7. A lens system which contributes to direct electron beams in parallel to each other toward a phosphor screen is formed by the third grid 4, fourth grid 5 and fifth grid 6, while another lens system which contributes to focus the parallel beams on the phosphor screen (although actual focusing points lie on a shadow mask, they shall hereinafter be expressed as lying on the phosphor screen for the sake of brevity) is formed by the fifth grid 6 and sixth grid 7. A main lens includes these lens systems. Further, the third grid 4 and fifth grid 6 are electrically connected and have a focusing voltage of, for example, about 7 kV applied thereto, while the fourth grid 5 and sixth grid 7 are electrically connected and have an anode voltage of, for example, about 25 kV applied thereto. Thus, the whole electron gun has the focusing characteristics improved sharply as the multistage focusing type electron gun which has both a bipotential type and a unipotential type. In Fig. 4, numeral 8 indicates multiform glass.

Such a structure of the electron gun for a color picture tube is described in, for example, the official gazette of Japanese Patent Application Laid-open No. 63750/1982. The corresponding U. S. patent application is pending as Ser. No. 307,572.

When applied to a color picture tube of, for example, the 22-inch type, the multistage focusing type electron gun of the above-stated construction attains satisfactory focusing characteristics in practical use. Especially in recent years, however, it has become necessary to mass-produce also color picture tubes of the 29-inch type and of still larger sizes. As regards such a large-sized color picture tube, the distance between an electron gun and a phosphor screen differs from that of the conventional tube, and hence, the fifth grid 6 and the sixth grid 7 in which the end faces 6' and 7' of respective cylinder portions formed on both the sides thereof have unequal inclinations need to be prepared every size. Accordingly, in a case where specifications are studied on a new size, a long term is required for the fabrication of electrode components, so that the timely start of the mass production is impossible. That is, the inclination magnitudes of the both-side cylinder portions in the fifth grid and sixth grid need to be determined every kind of product, and this has posed the problem that a very long term is required for the fabrication, the determination of the specifications, etc.

Summary of the Invention:

An object of the present invention is to eliminate the difficulty of the prior art mentioned above, and to provide an electron gun for a color picture tube according to which a desired converging angle is attained using also existing cylinder portions with their end faces inclined, and focusing characteristics can be enhanced for various kinds of products.

To the accomplishment of the object, the electron gun for a color picture tube according to the present invention consists in that an electric field correcting electrode is disposed in at least one existing grid electrode having a cylinder portion one end face of which is inclined.

With the electron gun for a color picture tube in the present invention, the electric field correcting electrode is provided as stated above, whereby electron beams move substantially in parallel, and a converging angle is properly controlled.

As specified above, the electron gun to which the present invention is applicable has the grid

electrode in which the end face of the cylinder portion is inclined. Accordingly, the electron gun to which the present invention is applicable comprises first electrode means to direct at least two electron beams toward a phosphor screen and along initial paths parallel to each other, and second electrode means to establish substantially separate main lenses for the paths of the respective electron beams, thereby to focus the electron beams on a predetermined position on a predetermined surface, for example, the phosphor screen. To this end, grid electrodes which have apertures coaxial with the electron beam paths are opposingly arranged.

In at least one of the grid electrodes each of which has the apertures coaxial with the electron beam paths and also has the cylinder portion with one end face thereof inclined with respect to the center axis of the electron beam path, the electric field correcting electrode disposed anew in the electron gun of the present invention is opposingly arranged at a predetermined interval from the cylinder portion. In particular, it is often arranged on the inclined end face side of the cylinder portion. It is usually convenient that the electric field correcting electrode is flattened and is caused to intersect orthogonally to the center axis, but this setup is not restrictive. The distance t_1 or t_2 between the electric field correcting electrode and the cylinder portion of the grid electrode may be experimentally or calculatively determined so that the distance X between the focusing point of the rectilinearly-propagating electron beam (ordinarily, the central electron beam) on the predetermined surface and the focusing point of the deflected electron beam (ordinarily, the outer electron beam) on the same surface may become a desired value, for example, within 1 mm. An appropriate plus voltage is applied to the electric field correcting electrode, and it is usually convenient to electrically connect the correcting electrode with the corresponding grid electrode. Needless to say, the electric field correcting electrode is also formed with apertures for the respective electron beams.

Brief Description of the Drawings:

Fig. 1 is a sectional view of the essential portions of an electron gun for a color picture tube in an embodiment of the present invention;

Figs. 2 and 3 are graphs each showing the relationship of an electron gun in an example of the present invention, between the distance of an electric field correcting electrode from the cylinder portion of a grid electrode and the distance of the focusing point of a rectilinearly-propagating electron beam and that of a deflected electron beam;

Fig. 4 is a partly sectional side view showing a prior-art electron gun for a color picture tube; and

Fig. 5 is a side view showing the whole configuration of an electron gun for a color picture tube in an embodiment of the present invention.

Description of the Preferred Embodiments:

Now, embodiments of the present invention will be described in detail with reference to the drawings.

Fig. 1 is a sectional view of essential portions which shows an embodiment of an electron gun for a color picture tube according to the present invention, and in which identical symbols are assigned to the same portions as in the figure referred to before. Referring to Fig. 1, inside the fifth grid electrode 6, an electric field correcting electrode 6A which includes respective electron beam apertures $6A_{s1}$, $6A_{s2}$ and $6A_c$ coaxial with cylinder portions 6_{s1} , 6_{s2} on both outer sides having inclined end faces and with a central cylinder portion 6_c is arranged in opposition to the cylinder portions. Likewise, inside the sixth grid electrode 7, an electric field correcting electrode 7A which includes respective electron beam apertures $7A_{s1}$, $7A_{s2}$ and $7A_c$ coaxial with cylinder portions 7_{s1} , 7_{s2} on both outer sides having inclined end faces and with a central cylinder portion 7_c is arranged in opposition to the cylinder portions.

In an example of the embodiment, the center axes of the respective electron beam apertures were held in agreement with those of the corresponding cylinder portions. The diameter of each aperture was 5.5 mm equal to the inside diameter of the corresponding cylinder portion. In addition, the distances Y between the center axis S of the central cylinder portion 6_c (or 7_c) and the center axes of the sideward cylinder portions 6_{s1} , 6_{s2} (or 7_{s1} , 7_{s2}) were set at 6.6 mm. Besides, lengths n_1 and n_2 in Fig. 1 were respectively set at 3.1 mm and 2.8 mm.

In the present embodiment, the electric field correcting electrode 6A (or 7A) which is flat is provided near the axial central part of the grid electrode 6 (or 7), but this setup is not restrictive. Further, a conventional electrode material for picture tubes may be employed as the material of the electric field correcting electrode, and the use of the same material as that of the grid electrode is convenient.

According to such a construction, electron lenses based on electric fields are respectively formed between "the cylinder portions 6_{s1} , 6_{s2} of the fifth grid electrode 6 located on both the sides and having the inclined end faces and the central cylinder portion 6_c thereof" and "the corresponding

electron beam apertures $6A_{s1}$, $6A_{s2}$ and $6A_c$ of the electric field correcting electrode 6A". Therefore, the apparent inclination of an electron lens formed by the fifth grid electrode 6 only is corrected by the above electron lenses, so that the converging angles of the electron beams are corrected and controlled. By providing the electric field correcting electrode 7A also for the sixth grid electrode 7, the apparent inclination of an electron lens is corrected similarly to the above.

Thus, letting l_1 denote the axial distances between the cylinder portions 6_{s1} , 6_{s2} , 6_c in the fifth grid electrode 6 and the corresponding electron beam apertures $6A_{s1}$, $6A_{s2}$, $6A_c$ of the electric field correcting electrode 6A, and l_2 denote the axial distances between the cylinder portions 7_{s1} , 7_{s2} , 7_c in the sixth grid electrode 7 and the corresponding electron beam apertures $7A_{s1}$, $7A_{s2}$, $7A_c$ of the electric field correcting electrode 7A, the distance X which the electron beams are converged in the direction of the center axis S (the distance between the focusing point of the electron beam deviating toward the center axis S and the center line of the aperture of the central electron beam) is substantially in a rectilinear relation with the value of the distance l_1 or l_2 as shown in Fig. 2 in an example of a 29-inch type 110° tube, and it decreases with increase in the value of the distance l_1 or l_2 . By properly selecting the axial distances l_1 and l_2 , accordingly, an electron beam converging angle as desired (at which the distance X is made 1 mm or less by way of example) is attained. In an example of the electron gun of the present embodiment, when l_2 was fixed to 3.2 mm, the relationship between l_1 (mm) and X (mm) became as shown in Fig. 3. In the present example, l_1 was set at 4.5 mm and l_2 was set at 3.2 mm.

In a case where l_2 is fixed to an appropriate value, for example, 3.2 mm and where the converging angle of the electron beam is corrected with l_1 , favorable results are usually obtained by setting the value of l_1 at 3 - 6 mm.

Fig. 5 shows the whole configuration of an example of the electron gun for the color picture tube in the present embodiment. As shown in the figure, an electron gun 10 is so constructed that a cathode K, a first grid G_1 , a second grid G_2 , a third grid G_3 , a fourth grid G_4 , a fifth grid G_5 , a sixth grid G_6 and a shielding cup 12 with predetermined dimensions are successively stacked on stem glass 11b planted with stem pins 11a and are supported and fixed by multiform glass 10a.

In the present example, the fourth grid G_4 (5) and the six grid G_6 (7) are electrically connected, and an anode voltage of 25 kV is applied thereto. The third grid G_3 (4) and the fifth grid G_5 (6) are electrically connected, and a focusing voltage having a magnitude of 33 % of the anode voltage is

applied thereto.

By the way, the flat outer contour of the electric field correcting electrode 6A or 7A in the present embodiment is substantially the same as the contour of a grid section cut by the plane of the correcting electrode in the insertion part thereof.

Although the foregoing embodiment has referred to the case where the electric field correcting electrodes are disposed in both the fifth grid electrode 6 and the sixth grid electrode 7, the present invention is not restricted to this case, but the electric field correcting electrode may be provided in at least the fifth grid electrode 6. More specifically, in a case where the correcting electrode is provided in the sixth grid electrode 7, a wide control of converging angle is impossible because the shielding cup is disposed at the front end part of this sixth grid electrode, namely, on the phosphor screen side. By providing the correcting electrode in the fifth grid electrode 6, the converging angle can be widely controlled, and the greater part of the converging angle can be determined. When the correcting electrode is also provided in the sixth grid electrode 7, it becomes possible to finely adjust the converging angle and to set an electron beam converging angle as desired. However, even in the case where the electric field correcting electrode is disposed in only the sixth grid electrode 7, an effect to that extent is produced.

Although the foregoing embodiment has referred to the case where the electric field correcting electrode is shaped into the flat electrode, the present invention is not restricted thereto. It is needless to say that effects similar to the foregoing are attained even when the correcting electrode is constructed of a cup-shaped electrode having a cylinder portion.

The electron gun of the present invention may employ the structure of the prior-art electron gun having the cylinder portion in which the end face at one end is inclined, except that the electric field correcting electrode or electrodes is/are disposed in the fifth grid or in both the fifth and sixth grids.

As described above, according to the present invention, an electric field correcting electrode is disposed in an existing grid electrode having a cylinder portion whose end face is inclined, whereby the converging angle of an electron beam can be controlled. Therefore, when combined with various existing grid electrodes having typical dimensions of the greatest converging forces, the invention brings forth such very excellent effects that focusing characteristics can be enhanced and that electrodes can be made common for color picture tubes of various sizes.

Claims

1. In an electron gun for a color picture tube having first electrode means to direct at least two electron beams toward a phosphor screen and along initial paths parallel to each other, and second electrode means to form substantially separate main lenses for paths of the respective electron beams so as to focus the respective electron beams on a predetermined surface, the first and second electrode means being respectively constructed of grid electrodes which are oppositely arranged with an interval therebetween and each of which has apertures with center axes agreeing with those of the electron beam paths, one end of a cylinder portion of at least one of the grid electrodes being inclined with respect to the center axes; an electron gun for a color picture tube characterized in that an electric field correcting electrode is provided in at least one of said grid electrodes each of which has the cylinder portion with an inclined end face.

2. An electron gun for a color picture tube as defined in Claim 1, wherein said electric field correcting electrode is provided on the inclined end face side of said grid electrode.

3. An electron gun for a color picture tube as defined in Claim 1, wherein a shielding cup is disposed on a phosphor screen side of the grid electrode which is closest to said phosphor screen, of said grid electrodes, and said electric field correcting electrode is provided in the grid electrode which is arranged on a side opposite to said phosphor screen side.

4. An electron gun for a color picture tube as defined in Claim 1, wherein a distance between said electric field correcting electrode and said cylinder portion of said grid electrode is set so that a distance between a focusing point of the rectilinearly-propagating electron beam on said predetermined surface and a focusing point of the deflected electron beam on said predetermined surface may become a desired value.

5. An electron gun for a color picture tube as defined in Claim 1, wherein said predetermined surface is said phosphor screen.

6. An electron gun for a color picture tube as defined in Claim 1, wherein said electric field correcting electrode is in the shape of a flat plate having the electron beam apertures.

7. An electron gun for a color picture tube as defined in Claim 6, wherein an outer contour of the flat plate shape of said electric field correcting electrode is substantially the same as a contour of a section of said grid electrode at an insertion part of said correcting electrode.

8. An electron gun for a color picture tube as defined in Claim 1, wherein said electric field correcting electrode is electrically connected to the corresponding grid electrode.

FIG. 1

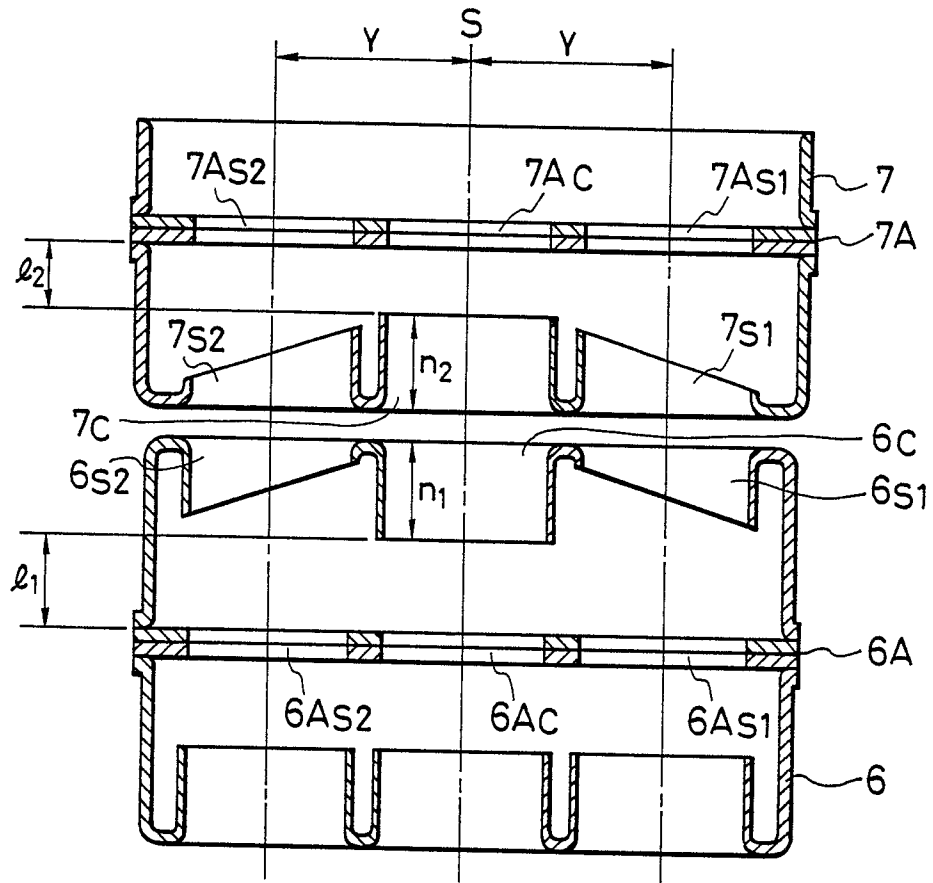


FIG. 2

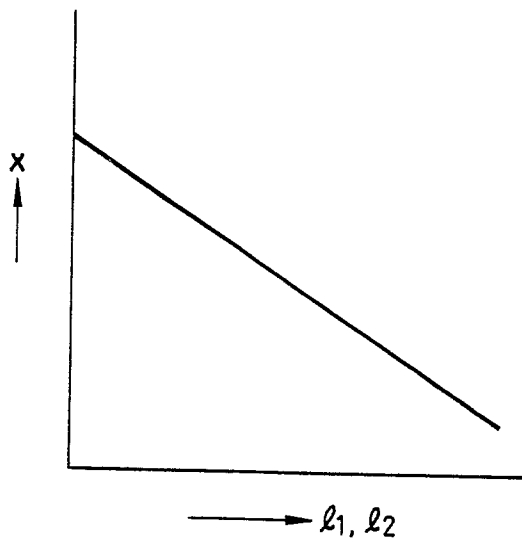


FIG. 3

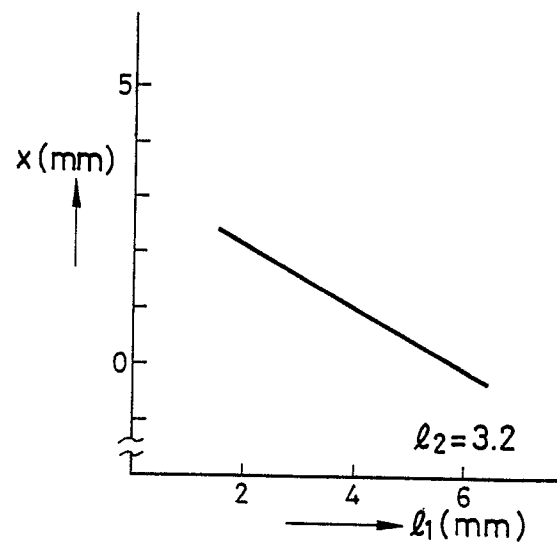


FIG. 4
PRIOR ART

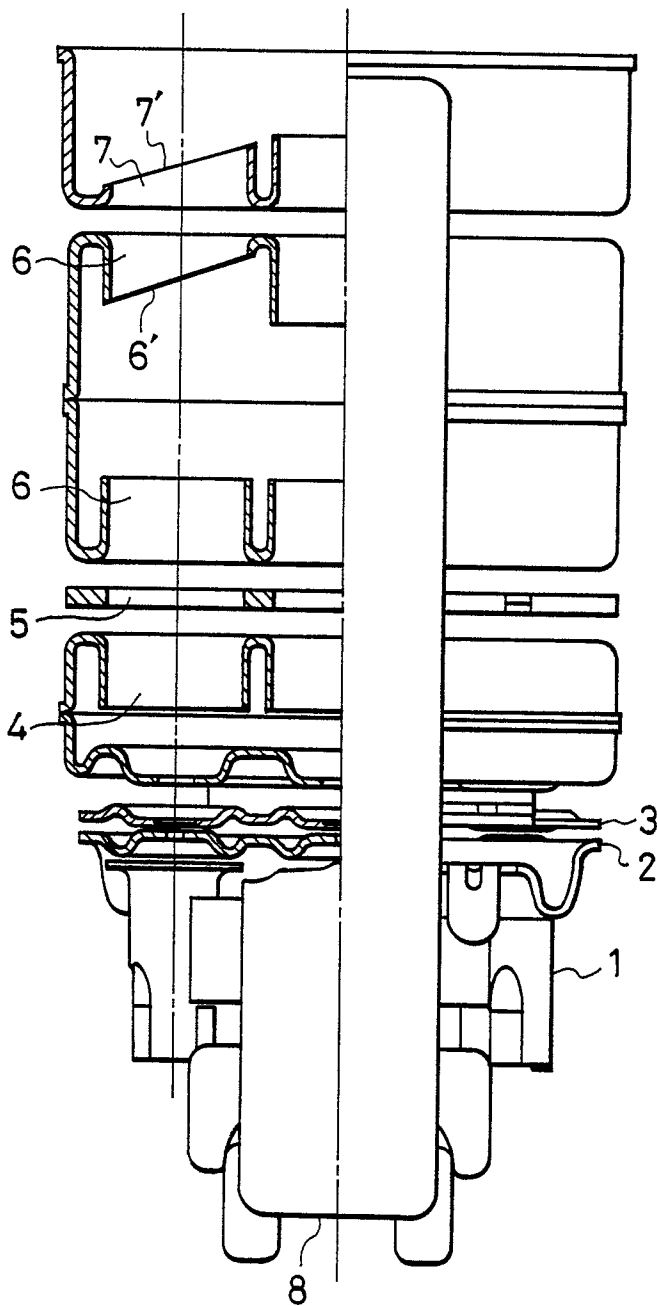


FIG. 5

