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(54) **Multibeam cathode ray tube and device comprising such a tube.**

(57) A multibeam cathode ray tube having in an evacuated envelope (1) an electrode-optical system (6) centred around an axis (9) and comprising means to generate at least two electron beams which are each focussed to form a spot on a display screen (28) in the tube by means of common focussing means (27) centred around the axis (9) and which are deflected over said display screen (28) by deflection means (29), a common convergence lens (25, 26) being present between the means for generating the beams and the focussing means and being centred around the axis (9). If said convergence lens (25, 26) has such a strength that the distance between the axis of the outermost electron beam (21) to the axis (9) of the electron-optical system (6) is at least five times smaller than the maximum diameter (*d*) of the individual beams in the focussing and deflection means, one common focussing lens may be used as a result of which all beams are focussed to substantially the same extent and substantially no disortion occurs of the spot frame upon deflecting the beams.

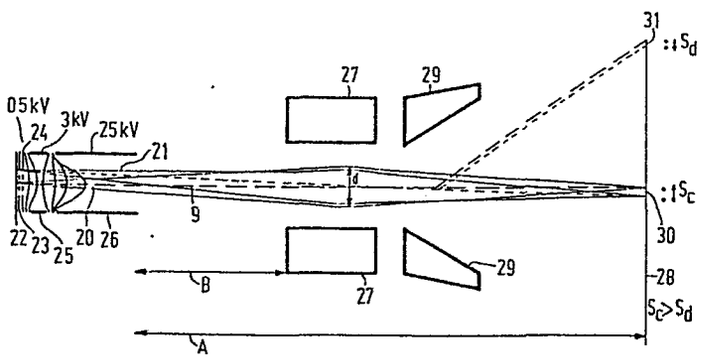

FIG.2a

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Multibeam cathode ray tube and device comprising such a tube.

The invention relates to a multibeam cathode ray tube having in an evacuated envelope an electron-optical system centred around an axis and comprising means to generate at least two electron beams which are each focussed to form a spot on a display screen by means of common focussing means centred around the electron-optical axis and which are deflected over the display screen by means of deflection means, a common convergence lens centred around the axis being present between the means for generating the beams and the focussing means.

The invention also relates to a device comprising such a tube.

Multibeam cathode ray tubes are used, for example, as projection television display tubes or as tubes for displaying data (Data Graphic Display). They are also used for displaying television pictures and for photorecording.

In such tubes the focussing means and/or the deflection means may be provided in or around the tube envelope. Focussing may be carried out, for example, by means of an accelerating lens or a unipotential lens in the envelope or by means of a magnetic focussing lens around the envelope or by means of a combination of these two lens types. The deflection may be carried out by the means of deflection coils around the envelope or by means of deflection in the envelope.

A multibeam cathode ray tube for displaying data is known from United States Patent Specification 4,338,541. This specification describes that the beam aberrations are reduced if in the focussing means and deflection means the distances from the beams to the tube axis are decreased. The beam currents in such data display tubes are comparatively low (smaller than 100 μ A overall current).

For a number of applications, for example projection television, tubes having a much higher overall current (above 1 mA) are desired. If a good resolution (resolving power) is still to be achieved, special meausures have to be taken.

It is therefore an object of the invention to provide an

multibeam cathode ray tube with a high beam current and a good resolution.

Another object of the invention is to provide a device having such a tube in which during the deflection of the beams the distances between the spots on the display screen remain substantially constant.

According to the invention, a multibeam cathode ray tube of the kind described in the opening paragraph is characterized in that the convergence lens has such a strength that the distance between the axis of the outermost electron beam and the axis of the electron-optical system is at least five times smaller than the maximum diameter of the individual beams in the focussing and deflection means. As a result of this beams cross each other after the focussing lens. The precise location of this crossing can be adjusted by means of the convergence lens.

The invention is based on the recognition of the fact that the beam diameter upon passing the deflection and focussing means must be large obtain the desired small spot dimensions. For a large number of electron beams this requires a comparatively large space unless, as is suggested, according to the invention the eccentricity of the beams is made small as compared with the beam diameter in the deflection and focussing means. The advantage of this is that one common focussing lens may be used so that all the beams are focussed to substantially the same extent and upon deflecting the beams substantially no distortion of the spot frame occurs.

A correct beam adjustment can be obtained by a suitable choice of the location of the point of convergence (crossing) of the beams. This adjustment depends on the location and type of the focussing and deflection means. This means that components such as lens deflection coil of a mono-beam tube may be used. Moreover, if this should be necessary, the shape of all the spots can be corrected simultaneously by one dynamic multipole corrector. Such a miultipole corrector is placed in the proximity of the focussing and deflection means.

It is noted that United States Patent Specification 4,338,541 mentioned hereinbefore discloses cross-over which is located between the focussing means and the deflection means while there is no requirement for the ration between the beam diameter and the

eccentricity of the outermost beam.

A first preferred embodiment of a multibeam cathode ray tube in accordance with the invention is characterized in that -viewed in the direction of propagation of the beams - the last electrode of the means for generating the beams is an apertured in an plate which extends substantially at right angles to the electron-optical axis and which is succeeded by the convergence lens which comprises at least two cylindrical lens electrodes centred around the axis, the diameter of the cylinders being at least two times as large the maximum eccentricity of the apertures in the said plate. In that case substantially no abberations are introduced into the beams.

The length of the first cylindrical lens electrode - viewed in the direction of propagation of the beams - is preferably smaller than the diameter of the said lens electrode.

During operation of a device comprising a multibeam cathode ray tube according to the invention the potentials at the lens electrodes of the convergence lens during the deflection may be varied so that he mutual distance of the targets on the display screen remains substantially constant during the deflection.

A multibeam cathode ray tube according to the invention is preferably used in a projection television device.

The invention will now be described in a greater detail, by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a diagrammatic longitudinal sectional view of a multibeam display tube, and

Figure 2 a and 2 b show diagrammatically the operation and construction of such a tube.

Figure 1 is a digrammatic longitudinal sectional view of a display tube according to the invention. It comprises a glass envelope 1 consisting of a neck 2, a funnel-like part 3 and a display window 4. A display screen 5 comprising luminescent material is provided on the inside of the display window. Provided in the neck 2 of the tube is an electron gun system 6 for generating at least two electron beams. The at least two generated electron beams are focussed on the display screen 5 by means of a focussing means (not shown in Figure 1). The electron gun system 6 is connected to a source of control signals 8 - via a connection 7 - with which each electron gun is controlled. The electron

gun system is centred around the tube axis 9. The electron beams are deflected over the display screen by means of deflection means which are not shown in Figure 1.

The sectional views of Figures 2 a and 2 b show diagrammatically the operation and construction of a tube having two electron beams 20 and 21 of which the lines of intersection of the beam envelopes with the plane of the drawing are shown. The electron beams are generated by means of a number of cathodes situated in the plane 22, a control electrode 23 and an anode 24. Anode 24 consists of a metal plate extending substantially at right angles to the tubes axis 9 and comprising apertures. Instead of this triode construction it is of course also possible to use a number of so-called P-N cathodes which are situated in one plane. The use of a number of P-N cathodes is described in Netherlands Patent Application 830444 laid open to public inspection which may be deemed to be incorporated herein by reference. The cathodes may be situated in a row or in a matrix on a flat or curved surface and at equal or varying distances from each other. The convergence lens is formed by two cylindrical lens electrodes 25 and 26 having a diameter of 10 mm and being centred around the axis 9. The diameter of the said cylindrical electrode must be at least two times as large as the maximum eccentricity of the apertures uin the said plate-shaped anode 24. Equipotential lines are shown between the electrodes 24, 25 and 26. The length of electrode 25 is smaller than the diameter and is 5 mm. The length of electrode 26 is 20 mm. The electron 20 and 21 are then focussed by the focussing means 27 and deflected over the display screen 28 by deflection means 29. The distance A between electrode 26 and the display screen 28 in this case is 280 mm. The distance B between electrode 26 and the focussing means 27 in this case is 100 mm. Both magnetic and electrostatic components or combinations thereof may be used for the focussing and deflection. For example, focussing may be done electrostatically and deflection may be done magnetically, or conversely. It is also possible to perform the focussing simultaneously electrostatically and magnetically.

By applying the potentials indicated in Figure 2 a the convergence lens has such a strength that the distance between the axis of the outermost electron beam 21 and the axis 9 is at least five times smaller than the (maximum) diameter of the individual beams 20 and 21 in

the focussing and deflection area. In this case the diameter d takes the value of 7 mm. During the deflection of the beams from the centre 30 of the display screen 28 towards the edge 31, the distance S between the spots formed on the display screen becomes smaller (S_c(centre) S_d (edge)). By applying the potentials shown in Figure 2 b the distance between the spots on the display screen during the deflection becomes substantially constant ($S_c \approx S_d$). It is possible to make the distance entirely constant by energizing the convergence lens between the electrodes 25 and 26 dynamically during the deflection. During the deflection focussing is preferably done dymatically by means of the focussing means.

By making the eccentricity of the electron beams according to the invention small with respect to the beam diameters in the deflection and focussing means, one focussing lens may be used as a result of which all beams are focussed to substantially the same extent and substantailly no distortion of the spot frame occurs during the deflection of the beams.

CLAIMS

1. A multibeam cathode ray tube having in an evacuated envelope an electron-optical system centred around an axis and comprising means to generate at least two electron beams which are each focussed to form a spot on a display screen by means of common focussing means centred around the electron-optical axis and which are deflected over the display screen by means of deflection means, a common convergence lens centred around the axis being present between the means for generating the beams and the focussing means characterized in that the convergence lens has such a strength that the distance between the axis of the outermost electron beam and the axis of the electron-optical system is at least five times smaller than the maximum diameter of the individual beams in the focussing and deflection means.

2. A multibeam cathode ray tubes as claimed in Claim 1, characterized in that the last electrode - viewed in the direct ion of propagation of the beams - of the means for generating the beams is an aperture plate extending substantially at right angles tot the electron-optical axis and being succeeded by the convergence lens which comprises at least two cylindrical lens electrodes centred around the axis, the diameter of the cylinders being at least two times larger than the maximum eccentricity of the apertures in the said plate.

3. A multibeam cathode ray tubes as claimed in Claim 1 or 2 characterized in that the length of the first cylindrical lens electrode - viewed in the direction of propagation of the beams - is smaller than the diameter of the said lens electrode.

4. A multibeam cathode ray tube as claimed in any of the preceding Claims, characterized in that the said tube is a projection television display tubes.

5. A device comprising a multibeam cathode ray tube as claimed in any of the preceding Claims and a supply for applying potentials at the electrodes, characterized in that during operation of the device the potentials at the lens electrodes of the convergence lens during the deflection are varied so that the mutual distances between the spots on the display screen during the deflection remain substantially constant.

6. A device as claimed in Claim 5, characterized in that it is a projection television device.

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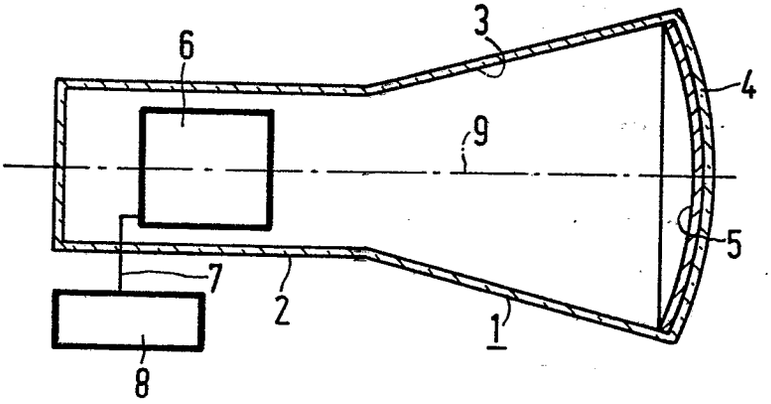

FIG.1

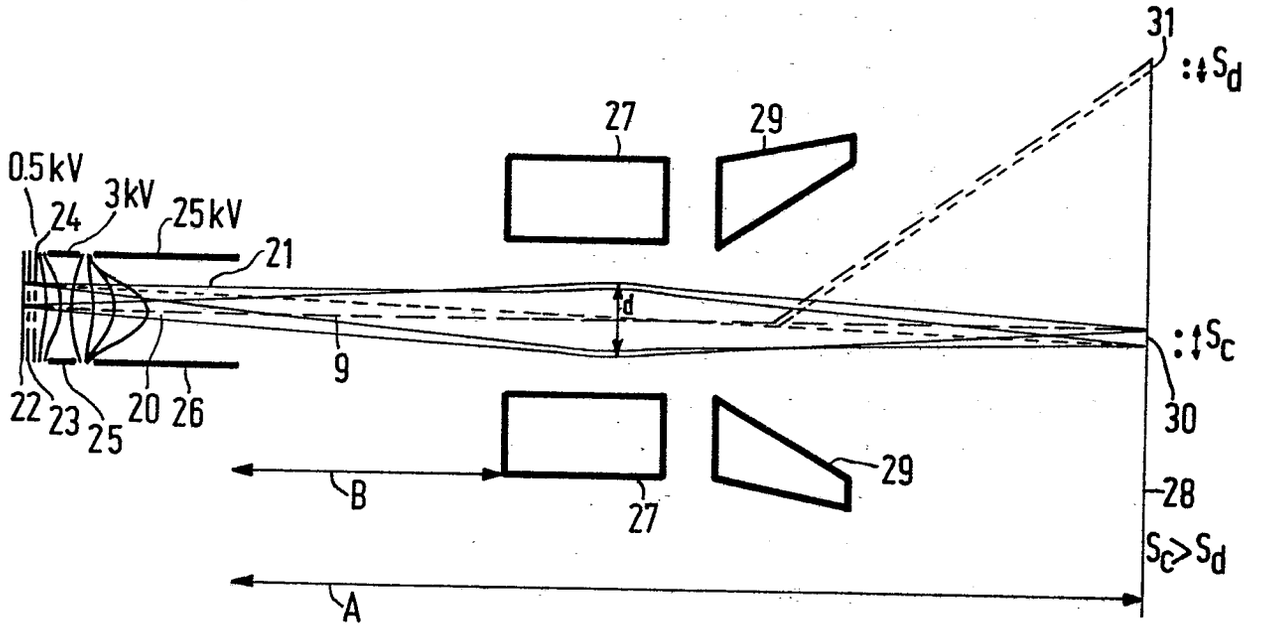

FIG.2a

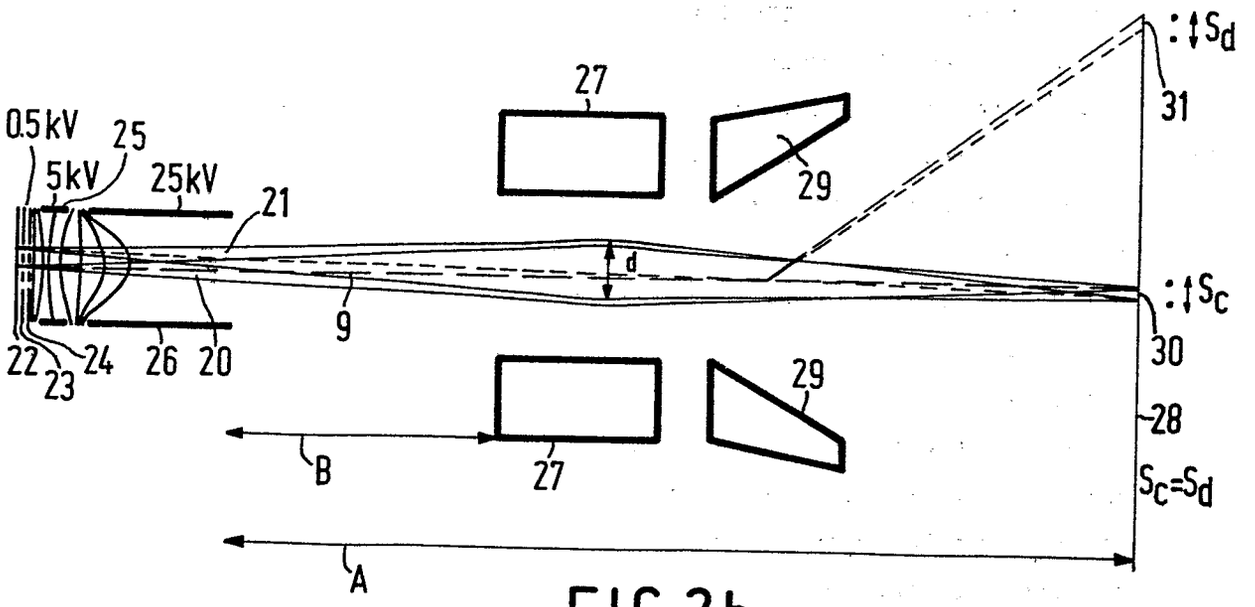

FIG.2b

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EUROPEAN SEARCH REPORT

0205218
Application number

EP 86 20 0992

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-3 798 478 (SAY) * Column 4, lines 30-48; column 5, lines 12-33; column 6, lines 33-56; figure 2 *	1,2	H 01 J 29/46
A	US-A-3 735 190 (SAY)		
A,D	EP-A-0 030 270 (IBM)		

TECHNICAL FIELDS SEARCHED (Int Cl.4)

H 01 J 29
H 01 J 31

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-09-1986	WITH F.B.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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