Dec. 12, 1967 D. W. LEWIS 3,358,172

CATHODE RAY TUBE WITH MEANS FOR SPLITTING THE ELECTRON BEAM INTO INDIVIDUALLY DEFLECTED AND FOCUSED BEAMS

Filed July 26, 1966 2 Sheets-Sheet 1

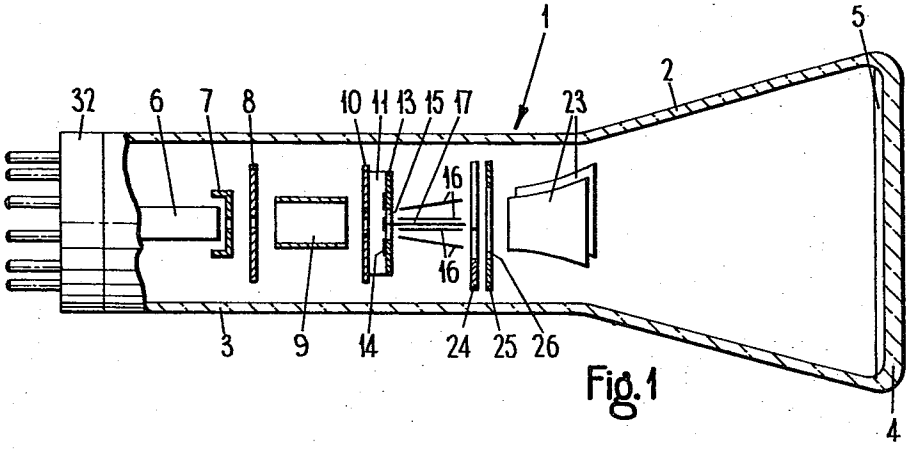

Fig.1

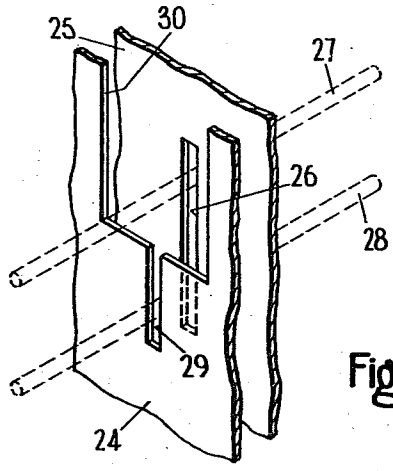

Fig.4

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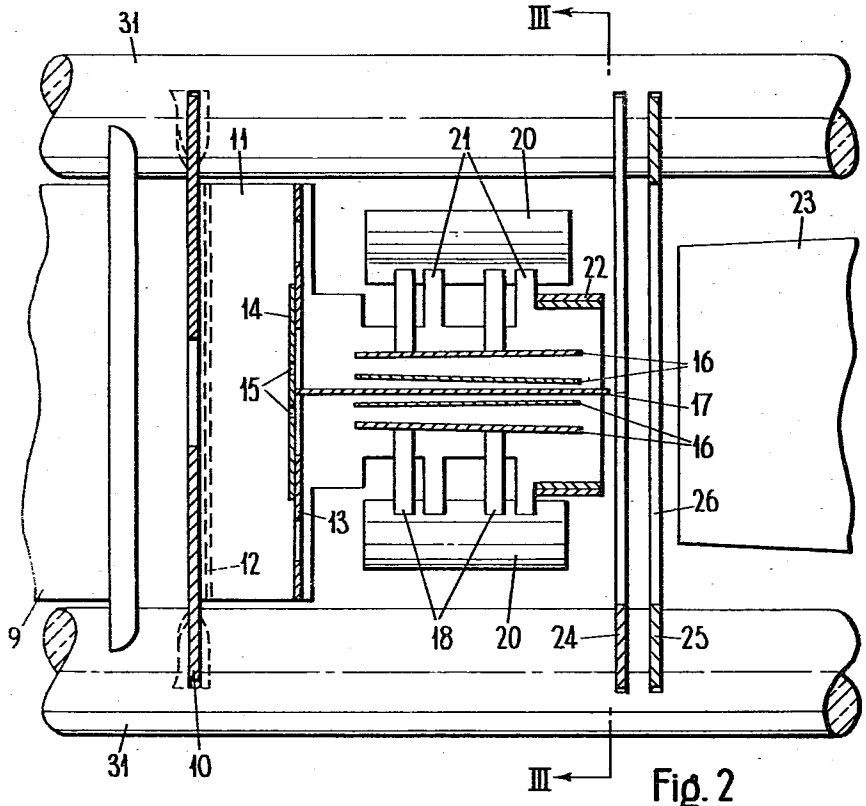

Fig. 2

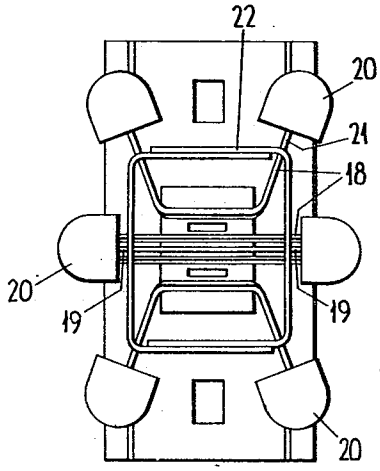

Fig. 3

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United States Patent Office 3,358,172
Patented Dec. 12, 1967

3,358,172

CATHODE RAY TUBE WITH MEANS FOR SPLITTING THE ELECTRON BEAM INTO INDIVIDUALLY DEFLECTED AND FOCUSED BEAMS

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Filed July 26, 1966, Ser. No. 567,932
Claims priority, application Great Britain, July 28, 1965, 32,261/65
6 Claims. (Cl. 313—80)

This invention relates to cathode ray tubes.

The invention relates particularly to cathode ray tubes of the kind incorporating an electron gun for producing a primary electron beam, and beam splitting means for splitting said primary electron beam into a plurality of subsidiary electron beams, each of which is arranged to pass in turn through an individual pair of deflector plates to enable the subsidiary beams to be directed to different regions of the same target, which is usually in the form of a luminescent screen.

In a cathode ray tube of the kind specified the focus of the subsidiary beams at the target is normally controlled by variation of the relative potentials of electrodes of the electron gun. Such variations effect the focus of all the subsidiary electron beams at the same time so that entirely satisfactory focussing will not be achieved unless the paths followed by the secondary beams are electrically identical. In practice this is not so due to manufacturing tolerances, contamination of electrode surfaces and possible differences in the mean potentials of the deflector plates.

It is an object of the present invention to provide a cathode ray tube of the kind specified wherein this difficulty is reduced.

According to the present invention, in a cathode ray tube of the kind specified there is provided a further electrode between each said individual pair of deflector plates and the target, each said further electrode being adapted, on application to it of a suitable variable potential, to vary the configuration of the electric field between that further electrode and said beam-splitting means along the path of a respective one of said plurality of subsidary electron beams, thereby to control individually the focus of that subsidiary electron beam at the target.

In a cathode ray tube in accordance with the invention, the relative potentials of electrodes of the electron gun may be adjusted for optimum focus in the usual manner, and then a final adjustment in respect of each subsidiary electron beam may be made by individual adjustment of the potential of the associated said further electrode.

Normally in a tube in accordance with the invention each subsidiary electron beam is arranged to pass through an individual first pair of deflector plates, and then through a second pair of deflector plates which is common to all the subsidiary electron beams, the second pair of plates normally deflecting the beam at right angles to the direction of deflection of the first pair of plates. Each further electrode is suitably in the form of a planar conductive member disposed in a plane perpendicular to the general direction of the electron beams, and provided with an aperture through which the associated subsidiary electron beam passes, the length of the slot being sufficient to accommodate any deflection of the beam which may be produced by the first pairs of deflector plates. The further electrodes may be in the same or different planes. One or more of the further electrodes may suitably be arranged to act as an electrostatic screen between the two sets of deflector plates associated with each subsidiary electron beam.

One cathode ray tube in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic side view of the tube;

FIGURE 2 is a sectional side view of a part of the electrode structure of the tube;

FIGURE 3 is a view along the line III—III in FIGURE 2; and

FIGURE 4 is a perspective view of a part of the electrode structure of the tube.

Referring to FIGURE 1, the cathode ray tube has a glass envelope **1** having a frusto-conical bulb portion **2** continued coaxially at the narrower end by a tubular neck portion **3**, and closed at its wider end by a substantially flat end wall **4** which is provided with a target layer **5** of luminescent material on its inner surface.

The electrode structure of the cathode ray tube is housed within the neck portion **3** of the envelope **1** and includes an electron gun comprising a cathode **6**, a modulating electrode **7** and three anodes **8**, **9** and **10**, the anodes **8** and **10** nearest and furthest from the cathode **6** each comprising a centrally apertured metal plate disposed in a plane perpendicular to the axis of the envelope **1** and the intermediate anode **9** comprising a metal tube disposed coaxially with the apertures in the anodes **8** and **10**.

Referring now to FIGURES 1 and 2, to the face of the anode **10** remote from the cathode **6** there is secured an electrode **11** which serves to split the beam produced by the electron gun into two subsidiary beams. The electrode **11** is of flat-bottomed U-shape cross-section having outwardly extending flanges **12** at the free ends of its side walls which are welded to the anode **10** so that the base **13** of the electrode **11** is disposed in parallel spaced-apart relation with the anode **10**. In the base **13** there is formed centrally a rectangular aperture over which is secured a thin metal plate **14** in which there are formed two small rectangular spaced-apart apertures **15**, the midpoint between the apertures **15** lying on the common axis of the apertures in the anodes **8**, **9** and **10**.

Referring now to FIGURES 1, 2 and 3, there is disposed beyond the electrode **11** a deflector plate assembly comprising two similar pairs of deflector plates **16**, each pair of plates **16** being arranged to deflect a different one of the subsidiary electron beams in the direction in which the apertures **15** are spaced apart. The plates **16** of each pair flare outwards, away from one another, in a direction away from the electron gun, and the two pairs of plates **16** are screened from one another by a metal plate **17** which is electrically connected to the electrode **11**, and extends perpendicularly from the part of the base **13** of the electrode **11** between the apertures **15**.

The deflector plates **16** and the screening plate **17** are supported by means of outwardly projecting metal tags **18** and **19** from six ceramic insulators **20** which surround the deflector plate assembly, and the insulators **20** are, in turn, supported on metal tags **21** projecting outwardly from a box-like structure **22**, formed from thin metal sheet, which partially surrounds the deflector plate assembly and is secured to the electrode **11**.

A further pair of deflector plates **23** common to both subsidiary electron beams, and arranged to deflect both subsidiary beams in directions at right angles to the direction in which the apertures **15** are spaced apart, is located between the deflector plates **16** and the luminescent screen **5**, these plates **23** also flaring away from one another in a direction away from the electron gun.

Referring now to FIGURES 1 and 4, the electrode structure also includes two further electrodes **24** and **25** in the form of two roughly square parallel spaced-apart metal plates disposed in planes perpendicular to the axis of the envelope **1** between the further pair of deflector plates **23** and the first-mentioned pairs of deflector plates

16. The electrode 25 nearer the deflector plates 23 is of a size sufficient to screen the electric fields produced between the deflector plates 16 from the electric field produced between the deflector plates 23, and has formed centrally through it an elongated rectangular slot 26 extending in the direction in which the subsidiary beams 27 and 28 (see FIGURE 4) are deflected by the plates 16, the size of the slot 26 being such as just to allow free passage of both the subsidiary electron beams 27 and 28 for all degrees of deflection by the plates 16. The electrode 24 nearer the deflector plates 16 is provided with an aperture 29 corresponding to one half of the aperture 26, but at the centre of the electrode 24, this aperture 29 opens into a relatively wide slot 30 which extends to the edge of the electrode 24. The electrode 24 is positioned with the aperture 29 in register with one half of the aperture 26 so that only one subsidiary electron beam 28 passes through the aperture 29 in operation.

The electrode structure is supported between four equally spaced-apart glass rods 31 which extend longitudinally along the neck portion 3 of the envelope 1.

Leads (not shown) from the various electrodes are connected to the pins of a conventional valve base 32 sealed into the end of the envelope 1 remote from the luminescent screen 5.

In operation of the cathode ray tube, the potential applied to the anode 9 is adjusted to obtain the best compromise focus of lines generated by the two subsidiary electron beams 27 and 28 due to deflection by the plates 23, and the potential applied to the anode 10 and the electrode 11 is then adjusted to obtain the best compromise focus of lines generated by the subsidiary electron beams 27 and 28 due to deflection by the plates 16.

Individual adjustment of the focus of the two electron beams 27 and 28 is then carried out by variation of the potentials applied respectively to the electrodes 24 and 25. It will be appreciated that, as the potential of the electrode 24 is varied, the configuration of the electric field between the electrode 24 and the electrode 11 is varied along the path of the beam 28 which passes through the aperture 29 in the electrode 24, but is not appreciably varied along the path of the other beam 27 due to the width of the slot 30. Similarly, when the potential of the electrode 25 is varied, the configuration of the electric field between the electrode 25 and the electrode 11 is varied along the path of the beam 27, but the field along the path of the other beam 28 is not appreciably varied due to the screening effect of the corresponding half of the electrode 24. The potential of each of the electrodes 24 and 25 is suitably nominally the same as that of the anode 10, and a variation of plus or minus 50 volts from this value is normally sufficient to permit the desired adjustment of focus to be achieved.

In alternative arrangements to that described above, by way of example, the further electrodes between the pairs of deflector plates may be in the form of suitably apertured planar metal members disposed in a common plane perpendicular to the general direction of the secondary electron beams. The tube described above by way of example may be modified accordingly by removing the electrode 24 and splitting the electrode 25 into two along a line bisecting the electrode 25 in a direction at right angles to the length of the aperture 26.

I claim:

1. A cathode ray tube tube comprising: an electron gun for producing a primary beam of electrons; beam-splitting means for splitting said primary electron beam into a plurality of subsidiary electron beams; a target at which said subsidiary beams are directed; a plurality of pairs of deflector plates respectively associated with said subsidiary electron beams whereby each electron beam may be individually scanned across said target; a plurality of further electrodes, each said further electrode being disposed between the target and the pair of deflector plates associated with a different one of said subsidiary beams, and electrically separated from the other electrodes so that individually variable potentials can be applied to said further electrodes to enable the configuration of the electric field between each further electrode and said beam-splitting means along the path of each said subsidiary electron beam to be individually varied, thereby to allow the focus of said subsidiary beams to be individually controlled.

2. A cathode ray tube according to claim 1 wherein each said further electrode comprises a planar electrically conductive member disposed in a plane substantially perpendicular to the general direction of the associated beam, said member having formed in it an aperture through which said associated subsidiary beam passes in operation.

3. A cathode ray tube according to claim 2 wherein said further electrodes are disposed in different parallel planes.

4. A cathode ray tube according to claim 1 including a further pair of deflector plates disposed between said further electrodes and the target which further pair of deflector plates is common to all the subsidiary electron beams.

5. A cathode ray tube according to claim 4 wherein at least one of said further electrodes comprises a planar conductive member disposed in a plane substantially perpendicular to the general direction of said subsidiary beams and whose area is sufficiently great for it to serve as an electrostatic screen between said individual pairs of deflector plates and said further pair of deflector plates.

6. A cathode ray tube according to claim 1 including focussing means for the primary electron beam disposed between the electron gun and the beam-splitting means whereby the focus of said subsidiary beams at the target may be controlled in unison.

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