(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 153 784**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 85200213.8

(22) Date of filing: 20.02.85

(51) Int. Cl.⁴: **H 01 J 31/12**

(30) Priority: 29.02.84 GB 8405231

(43) Date of publication of application: 04.09.85 Bulletin 85/36

(84) Designated Contracting States: DE FR GB IT

(71) Applicant: PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED
Arundel Great Court 8 Arundel Street
London WC2R 3DT(GB)

(84) Designated Contracting States: GB

(71) Applicant: N.V. Philips' Gloeilampenfabrieken
Groenewoudseweg 1
NL-5621 BA Eindhoven(NL)

(84) Designated Contracting States: DE FR IT

(72) Inventor: Blackler, Francis Geoffrey
"Willow Mead" Kingcombe Road Toller Porcorum
Dorchester Dorset DT2 0DG(GB)

(74) Representative: Moody, Colin James et al,
Philips Electronic and Associated Industries Limited
Patent Department Mullard House Torrington Place
London WC1E 7HD(GB)

(54) **Flat cathode ray tube.**

(57) A flat cathode ray tube (10) having a micro-channel plate electron multiplier (26) spaced a short distance from a fluorescent screen (24) applied to a substantially flat face-plate (20). A deflection electrode array (28) is disposed behind and spaced from the electron multiplier (26) so as to be parallel therewith. An electron gun (36) is disposed laterally of the space (40) between the electron multiplier (26) and the deflection electrode array (28) and an electron beam (38) produced by the electron gun (36) enters the space (40) along a path of movement substantially parallel to the deflection electrode array (28). Magnetic scanning means (42) are provided to deflect the electron beam (38) in a plane parallel to the deflection electrode array (28).

The magnetic scanning means (42) enables a range of different screen shapes and sizes to be made without the risk of deflection defocusing at the edges of the screen and the deflection electrode array (28) enables the depth of the tube envelope to be substantially independent of the screen size.

Fig. 1.

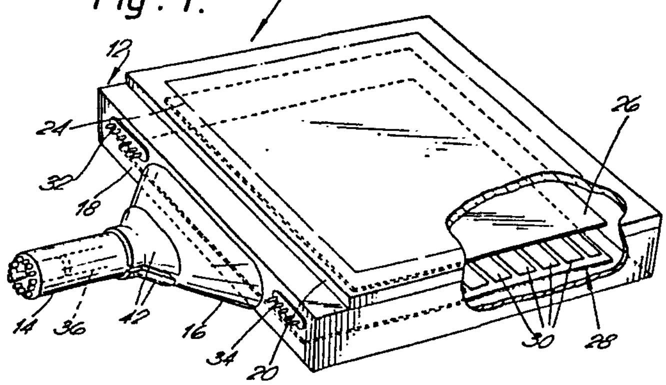
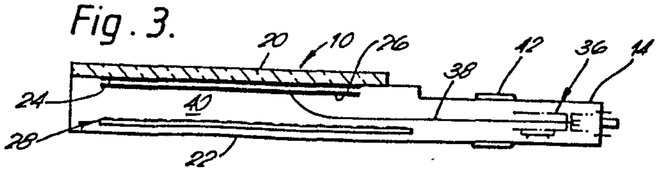


Fig. 3.



FLAT CATHODE RAY TUBE

The present invention relates to a flat cathode ray tube.

There have been many proposals for the design of flat cathode ray tubes some of which have been more practical than the others. Generally these known proposals can be put into three classes. Firstly those in which a repelling field is established between a transparent electrode carried by a fluorescent screen and a rear electrode space therefrom and the electron beam is introduced along a trajectory which makes a constant acute angle with the fluorescent screen. The electron beam under the influence of the repelling field follows a parabolic trajectory to strike the fluorescent screen at a substantially constant angle. The range of the beam is determined by the strength of the repelling field which can be varied by altering the voltage applied to the rear electrode. Such a type of cathode ray tube is disclosed in British Patent Specification 865667. One drawback to such a proposal tube is that the larger the fluorescent screen size, the greater the depth of the space between the fluorescent screen and the rear electrode. Another drawback is that the electron beam enters the repelling field with its final energy, for example 15keV and a large repelling field is required which has to be varied at frame or line frequency.

Secondly there is the type of cathode ray tube in which the electron beam enters laterally into an electrostatic field between two spaced apart electrodes one of which is carried by a fluorescent screen, which in certain cases is provided on a rear wall of an envelope, whilst the other electrode is transparent and is provided on the faceplate. The electron beam is introduced laterally into the electrostatic field by a pair of deflection plates, the voltage applied to them being varied at frame rates to alter the angle of entry into the electrostatic field and thereby the range. This operation may be regarded as lobbing the electron beam into the electrostatic field. Examples of this type of cathode ray tube are disclosed in British Patent Specifications

1592571 and 2071402 and Specification WO 83/00406. These display tubes suffer from the same drawbacks as the first type of cathode ray tubes.

Thirdly there is the type of cathode ray tube in which the electron beam is produced by an electron gun mounted behind a screen with its axis parallel to the plane of the screen. The electron beam produced undergoes line scanning after it has left the electron gun. Thereafter it is reflected through 180° before being deflected towards the fluorescent screen. This type of display tube is disclosed in British Patent Specification 739496. In a variation of this type of cathode ray tube it is known from British Patent Specification 2101396A to provide an electron multiplier adjacent to, but spaced from, the fluorescent screen. This has the advantage that the scanning and deflection of the electron beam can be separated from producing a light output from the cathode ray tube. In both these known proposals the scanning of the electron beam as it leaves the electron gun is done electrostatically using deflection plates which are inclined relative to each other. Further experimental work has shown that there can be a limitation on the length of a line which can be scanned because deflection defocussing is introduced by the scanning system causing poor edge resolution. Such poor edge resolution cannot be tolerated in datagraphic and instrument cathode ray tubes which frequently have different aspect ratios for the display area to that ratio of 4:3 used for television display. The deflection defocussing is due to the maximum scan angle not being great enough to keep the beam spot in focus over the desired display area, the scan angle having to change depending on the throw of the electron beam from the electron gun.

It is an object of the present invention to provide a flat cathode ray tube in which the envelope thickness is substantially independent of screen size and in which the maximum scan angle is such that greater line lengths, relative to frame height, are obtainable.

According to the present invention there is provided a flat cathode ray tube having an envelope with a substantially planar faceplate and a rear wall opposite to, and spaced from, said faceplate, and, within the envelope, a fluorescent screen on the inside of the faceplate, an electron multiplier disposed substantially parallel to, but spaced from, the faceplate, a deflection electrode array disposed adjacent a rear wall of the envelope, opposite the faceplate, said deflection electrode array being substantially parallel to and co-extensive with the electron multiplier, means for producing an electron beam, said means being disposed laterally of a space formed between the electron multiplier and the deflection electrode array, said means in use introducing an electron beam into said space in a direction substantially parallel to the deflection electrode array, magnetic means disposed downstream of the path of movement of the electron beam for deflecting the electron beam laterally of its path of movement from the electron gun and means for connecting the electrodes of the deflection electrode array to a source of deflection voltages whereby in response to said deflection voltages the electron beam is deflected towards the electron multiplier.

Compared with the known proposals for cathode ray tubes described above, the cathode ray tube used in the apparatus made in accordance with the present invention has the advantages of having substantially the same envelope thickness for a range screen size and also a greater maximum scan angle than is obtainable with electrostatic beam deflectors thereby enabling a wider variety of screen shapes to be made without the problem of deflection defocussing causing poor edge resolution. Further by using an electron multiplier, particularly a micro-channel plate electron multiplier, a high resolution image is obtainable on the fluorescent screen and also the addressing of the electron multiplier can be carried out using a low voltage, low current electron beam.

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view, partly broken away, of a cathode ray tube made in accordance with the present invention,

Figure 2 is a plan view of the cathode ray tube shown in Figure 1, and

Figure 3 is a diagrammatic cross sectional view along the longitudinal axis of the cathode ray tube shown in Figure 1.

The cathode ray tube 10 comprises an envelope formed essentially of three parts: a generally box-like display section 12, a cylindrical neck 14 and and a divergent section, hereinafter termed a fan 16, connecting the neck 14 to an edge wall 18 of the display section 12. The display section 12 comprises a substantially planar, optically transparent faceplate 20, a substantially planar rear wall 22 (Figure 3) which is parallel to the faceplate 20 and edge walls interconnecting the faceplate 20 and the rear wall 22.

A fluorescent screen 24 is provided on the internal surface of the faceplate 20. A micro-channel plate electron multiplier 26 is mounted within the display section 12 so that it is parallel to, and co-extensive with, the faceplate 20. A deflection electrode array 28 is provided either on the rear wall 22 if it is of an electrically insulating material or on an electrically insulating substrate which is carried by the rear wall 22. The electrode array 28 comprises a plurality of separate, generally elongate electrodes 30 which may be straight or curved. Electrical connections to the electrodes 30, the electron multiplier 26 and to a transparent electrode on the faceplate 20 are brought out of the envelope <u>via</u> connectors or lead-throughs 32, 34 in the edge wall 18.

An electron gun 36 is provided in the neck 14 and is arranged so that its longitudinal axis coincides with the plane of symmetry extending through the thickness of the envelope. The fan 16 has substantially flat upper and lower surfaces with the lower surface being arranged to be co-extensive with the rear wall 22. The cross-sectional height of the fan 16 is less than that of the display section 12. Consequently the electron beam 38 emerges from the electron gun 36 on a path of movement which is closer to the deflection electrode array 28 than the electron multiplier 26. The depth of a space 40 between the electron multiplier 26 and the deflection electrode array 28 is such that the electron beam 38 can be turned from a path of movement parallel to the deflection electrode array 28 to approach the electron multiplier 26 at a substantially constant angle under the influence of the fields produced between the electrodes 30 and the electron multiplier 26. Thus irrespective of the length of the throw of the electron beam 38 from the electron gun 36 the depth of the space 40 remains same.

Scanning coils 42 are provided on the outside of the envelope at the neck-fan transition. As indicated in Figure 2 in the case of a square display area of say 125mm by 125mm, the deflection angle for the electron beam to reach the corners furthest from the electron gun 36 is 37° whilst that to reach the nearest corners is 90°. In consequence in use of the cathode ray tube 10 the deflection angle varies from 0° to 90° and at the same time the beam spot size at the input to the electron multiplier 26 has to be substantially constant. This has been found possible by using electromagnetic scanning, rather electrostatic scanning, and providing focusing modulation for the electron spot and keystone correction for the raster.

In operation a low voltage, low current electron beam 38 is produced by the electron gun 36 which has a final anode voltage of +400V relative to the cathode voltage (for example 0V). The electron beam 38 undergoes line scanning by means of appropriate currents through the scan coils 42.

The input side of the electron multiplier 26 is at a voltage corresponding to the final anode voltage of the electron gun (+400V) and the voltage applied to the output side is 1kV greater. Finally the voltage applied to the electron on the fluorescent screen is of the order of 10kV higher than that applied to the output side of the electron multiplier 26. Suitably the electrodes 30 of the electrode array 28 are at 0V so that the electron beam 38 enters a repelling field causing it to be deflected towards the nearer edge of the fluorescent screen. Beginning with the electrode 30 nearest the electron gun 36, its voltage is increased substantially linearly to +400V so that a field free space is produced through which the trajectory of the electron beam 38 passes substantially undisturbed until it reaches the repelling field which causes it to be deflected towards the electron multiplier 26. In order to produce a substantially linear scan, it is arranged that when the voltage of one of the electrodes 30 is approximately half the final voltage that is +400V in this example, then the voltage applied to the next electrode 30 in the array 28 is increased at the same rate and so on.

Obviously if it is desired to deflect the electron beam in the opposite direction, then all but the two most distant electrodes 30 from the electron gun 36 which are respectively at 0V and +200V, are initially at +400V and then in reverse sequence the voltages on the electrodes are progressively reduced to 0V in turn.

In variant of the illustrated cathode ray tube arrangement, the externally mounted scan coils 42 are replaced by internally arranged pole pieces and/or deflection coils.

The number of electrodes 30 in the array 28 is a compromise between the acceptable thickness of the tube and the number of the frame scan voltage generators required. By way of example for a screen size of 125mm by 125mm the tube thickness could be reduced to 25mm if twenty-one electrodes were used or alternatively if the number of electrodes is of the order of seven then the thickness would be of the order of 40mm.

If it is desired to produce a coloured display for datagraphic and instrumentation purposes then this can be achieved by making the fluorescent screen 24 from a penetron phosphor. Different colours are produced by suitably varying the voltage applied to the transparent electrode on the faceplate 20, the voltage on the output side of the electron multiplier 26 being held constant.

CLAIMS:

1. A flat cathode ray tube having an envelope with a substantially planar faceplate and a rear wall opposite to, and spaced from, said faceplate, and, within the envelope, a fluorescent screen on the inside of the faceplate, an electron multiplier disposed substantially parallel to, but spaced from, the faceplate, a deflection electrode array disposed adjacent a rear wall, said deflection electrode array being substantially parallel to and co-extensive with the electron multiplier, means for producing an electron beam, said means being disposed laterally of a space formed between the electron multiplier and the deflection electrode array, said means in use introducing an electron beam into said space in a direction substantially parallel to the deflection electrode array, magnetic means disposed downstream of the path of movement of the electron beam for deflecting the electron beam laterally of its path of movement from the electron gun and means for connecting the electrodes of the deflection electrode array to a source of deflection voltages whereby in response to said deflection voltages the electron beam is deflected towards the electron multiplier.

2. A cathode ray tube as claimed in Claim 1, characterised in that the magnetic means comprise coils mounted on the outside of the envelope.

3. A cathode ray tube as claimed in Claim 1, characterised in that the magnetic means are disposed within the envelope.

0153784

Fig. 1.

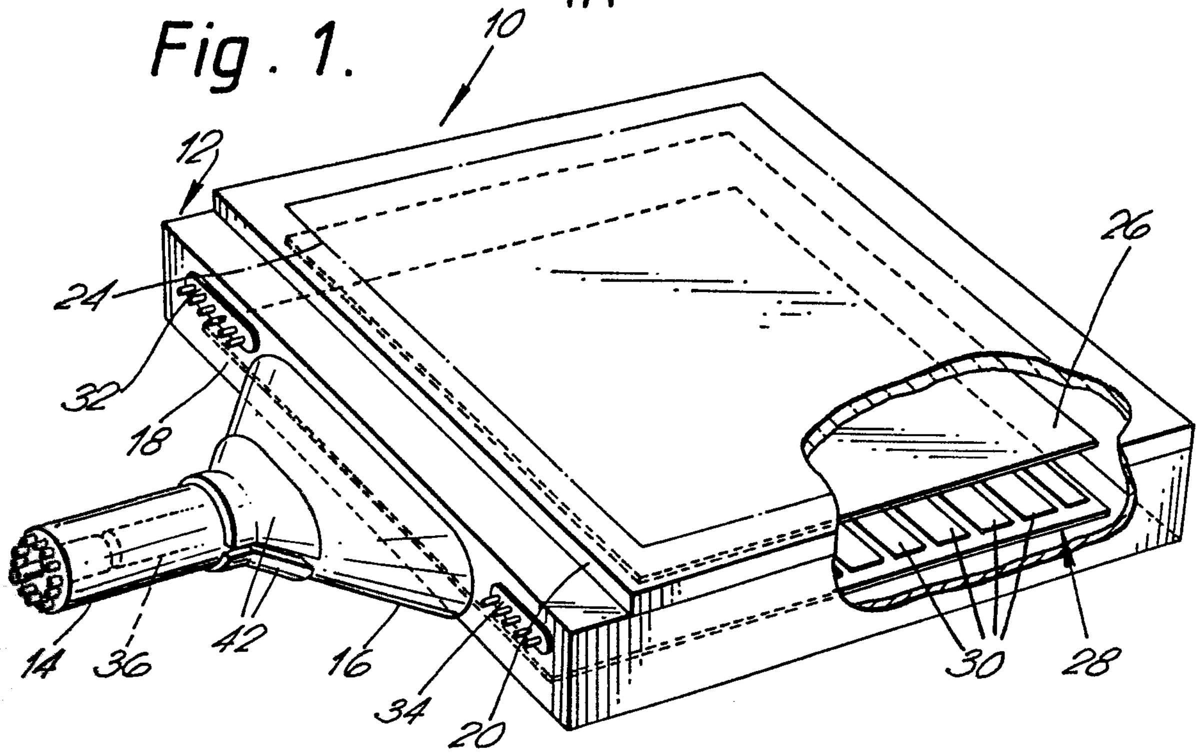


Fig. 2.

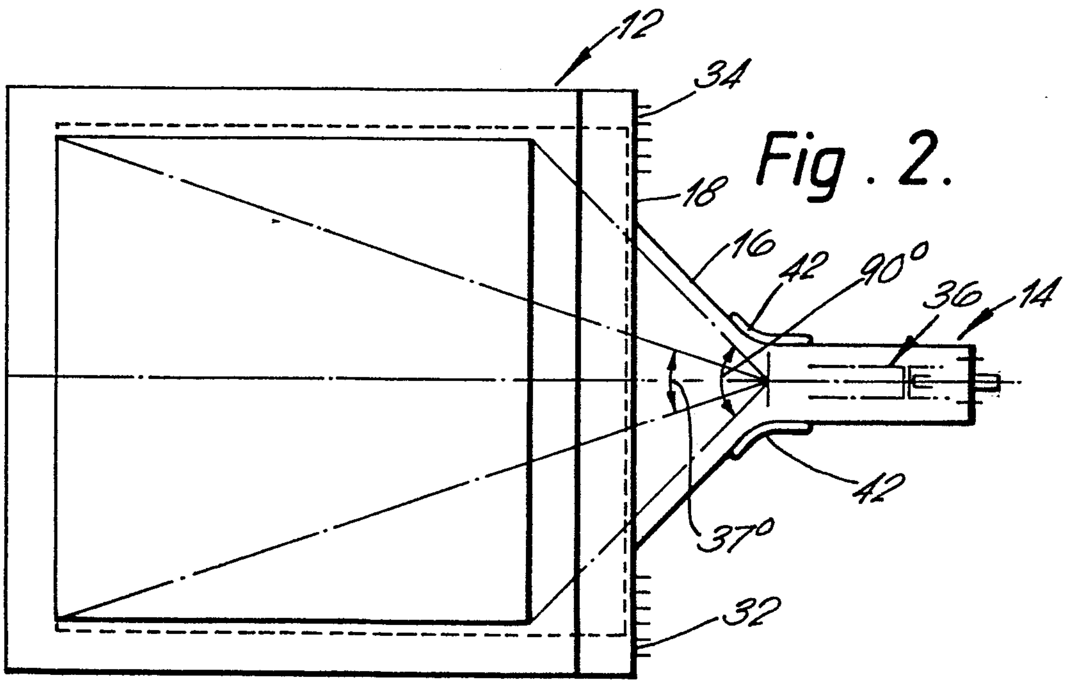
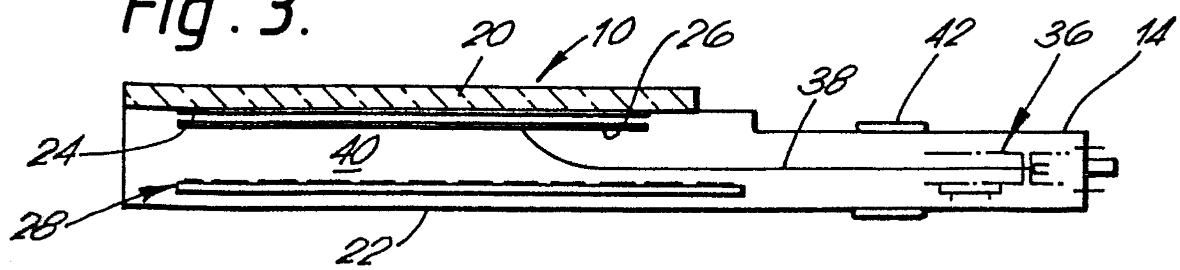


Fig. 3.



European Patent Office

EUROPEAN SEARCH REPORT

0153784

Application number

EP 85200213.8

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)
Y	ELECTRONIC ENGINEERING, vol. 55, January 1983, London "Towards the thin CRT" pages 9-10 * Page 9, column 4 - page 10, column 5 * --	1-3	H 01 J 31/12
Y	GB - A - 739 496 (NATIONAL RESEARCH DEVELOPMENT CORPORATION) * Fig. 1-3; page 3, lines 43-88; page 4, lines 65-120; claims 1-8 * --	1-3	
A	DE - A1 - 3 105 310 (SONY) * Fig. 1,2; page 9, line 26 - page 11, line 11; claims 1-2,8,24 * --	2,3	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
P,A	EP - A1 - 0 107 217 (PHILIPS) * Fig. 1; page 4, lines 22-29; page 5, lines 24-31; claims 1,7,8,12,13-15 * ----	1	H 01 J 31/00 H 01 J 29/00 H 01 J 1/00 H 01 J 3/00 H 01 J 9/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	26-04-1985	BRUNNER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document