

Description

The invention relates to a light emitting display tube, particularly as a light source of a large screen colour display apparatus.

From EP-A-311 951, to be considered under Article 54(3) EPC, a display tube for a light source is known. Figure 1 is a sectional view showing such a display tube and FIG. 2 is an exploded perspective view of the same. Referring to FIG. 1 and FIG. 2, reference numeral 1a denotes a display screen shaped in the form of a flat plate and having sixteen fluorescent display cells 8, 1b denotes a frame body forming side faces of a vacuum envelope of the light emitting display tube, 8A denote accelerating anodes disposed so as to surround the fluorescent surface of the fluorescent display cells 8, 14 denotes a planar electrode as a first control electrode made in the form of a flat plate, and 1c denotes a substrate with such components as cathodes 4, second and third control electrodes 10, 12, and their wiring leads 11, 13 disposed thereon. The light emitting display tube is constructed by providing the planar electrode 14 in the space surrounded by the frame member 1b and by fixing the display screen 1a on one end of the frame body 1b and the substrate 1c on the other end of the frame body 1b.

The display screen 1a is provided with sixteen fluorescent display cells 8 coated with phosphor and arranged in a matrix (4 rows by 4 columns) thereon. Each fluorescent display cell 8 is supplied with a high voltage and adapted to emit light by being bombarded with electrons. The planar electrode 14 is provided with sixteen openings 15 arranged in a matrix (4 rows by 4 columns) corresponding to the fluorescent display cells 8.

FIG. 3 is a plan view showing the electrode structure on the substrate 1c, in which the horizontal direction is the direction of the row and the vertical direction is the direction of the column. In the center of the substrate 1c, an exhaust hole 2 is used for the evacuation of the interior of the display tube. There are four directly heated, elongated filament cathodes 4 disposed above the substrate 1c slightly spaced from its surface. When a heater current is passed through each cathode 4, thermoelectrons are emitted from the cathode 4.

On the surface of the substrate 1c at the portions corresponding to the cathodes 4, there are disposed eight data electrodes, in an array of 2 rows by 4 columns, as the second control electrodes for controlling thermionic emission of the cathodes 4. Each data electrode 10, by being supplied with positive or negative potential relative to the potential of the cathode 4, controls thermionic emission of each corresponding cathode 4. On the surface of the substrate 1c at both sides in the direction of the column of each data electrode 10, there are disposed eight scanning elec-

trodes 12, in a matrix of 4 rows by 2 columns, as the third control electrodes for controlling the moving direction of the thermoelectrons emitted from the cathode 4.

The size of the data electrode 10 is smaller than that of the scanning electrode 12. Of the eight data electrodes 10, two each arranged in the same column are connected together to each of four wiring leads 11 arranged in the direction of the column, and of the eight scanning electrodes 12, two each in the same row are connected together to each of the four wiring leads 13 arranged in the direction perpendicular to the wiring leads 11, that is, in the direction of the row. The wiring leads 11 and the wiring leads 13 are insulated from each other by an insulating layer so as not to come into contact with each other. The data electrodes 10, scanning electrodes 12, wiring leads 11, and wiring leads 13 are formed on the substrate 1c by printing.

Operation will be explained below. Referring to FIG. 3, S1, S2, S3, and S4 indicate scanning signals applied to two each scanning electrodes 12 in the same row, and D1, D2, D3, and D4 indicate data signals applied to two each data electrodes 10 in the same column. FIG. 4 is a timing chart of the application of the signals S1 to S4, and D1 to D4. FIG. 5 is a diagram showing arrangement in a matrix of the fluorescent display cells 8 formed on the display screen 1a. Light emitted from each of the fluorescent display cells 8 is controlled by applying the signals S1 to S4, and D1 to D4.

The operation for controlling the emission of light will now be described.

ON (positive)/OFF (negative) control of each of the data electrodes 10 and ON (positive)/OFF (negative) control of each of the scanning electrodes 12 are performed at the timings of the data signals and scanning signals as shown in FIG. 4. There are four phases of periods in the combinations of the ON/OFF states of the scanning electrode 12 and the ON/OFF states of the data electrode 10 (i.e., where the state of the scanning electrode 12 and the data electrode 10 are ON and ON, ON and OFF, OFF and ON, and, OFF and OFF, respectively). The light emitting condition of the fluorescent display cell in each period will be described below. FIG. 6 and FIG. 7 are schematic diagrams showing states of potential in these four periods.

① Where both the scanning electrode 12 and the data electrode 10 are in the ON state, the vicinity of the heated cathode 4 becomes positive under the potential of the data electrode 10 and the scanning electrode 12, and hence thermoelectrons are emitted. The emitted thermoelectrons are deflected under the field of the scanning electrode 12 and accelerated by the planar electrode 14 to advance to the corresponding fluorescent display cell 8 and bombard the fluorescent dis-

play cell 8. Then, the electrons coming into contact with the phosphor material cause the fluorescent display cell 8 to emit light (FIG. 6 ①).

② where the scanning electrode 12 is in the ON state and the data electrode 10 is in the OFF state, since the data electrode 10 is disposed closer to the cathode 4, the field of the data electrode 10 affects the cathode 4 more strongly. Hence, in this case, the vicinity of the cathode 4 becomes negative so that the thermionic emission from the cathode 4 is suppressed and the fluorescent display cell 8 does not emit light (FIG. 7 ②).

③ Where the scanning electrode 12 is in the OFF state and the data electrode 10 is in the ON state, although the data electrode 10 is positive, both the scanning electrodes 12 formed on both sides of the data electrode 10 are negative, and moreover, the size of the scanning electrode 12 is larger than that of the data electrode 10, and hence the vicinity of the cathode 4 becomes negative so that the thermionic emission from the cathode 4 is suppressed and the fluorescent display cell 8 does not emit light (FIG. 6 ③).

④ Where both the scanning electrode 12 and the data electrode 10 are in the OFF state, the vicinity of the cathode 4 becomes negative so that the thermionic emission from the cathode 4 is suppressed and the fluorescent display cell 8 does not emit light (FIG. 7 ④).

In the described manner, the emission of light in each of the fluorescent display cells 8 is controlled at will by combination of the potential of the data electrode 10 and the scanning electrode 12. Since, here, the potential of the data electrode 10 and the scanning electrode 12 is controlled by the data signals D1 - D4 and the scanning signals S1 - S4, it is made possible to have each of the fluorescent display cells 8 emitting light or not at will by controlling these signals.

Now, when two data electrodes 10, as adjoining two control electrodes, are simultaneously ON, two adjoining fluorescent display cells 8 corresponding thereto emit light, and when only one data electrode 10 is ON, only one of the fluorescent display cells 8 emits light. The difference in the light emission in the fluorescent display cells 8 between these cases is shown in FIG. 8(a) and FIG. 8(b), wherein four fluorescent display cells 8a, 8b, 8c, and 8d controlled by ON/OFF states of the corresponding two data electrodes 10a and 10b and two scanning electrodes 12a and 12b are shown. When the data electrodes 10a and 10b are both turned ON (positive potential), thermoelectrons from the cathode 4 are deflected by the field of the scanning electrode 12a as shown in FIG. 8(a) and bombard the corresponding two fluorescent display cells 8a and 8b causing these two to emit light.

On the other hand, when only the data electrode 10b and the scanning electrode 12a are ON, the thermoelectrons are deflected so as to bombard only one fluorescent display cell 8b, as shown in FIG. 8(b), causing the same to emit light. In this way, by controlling the states of potential developed also by the other scanning electrodes 12a and 12b and the data electrodes 10a and 10b, one to four of the fluorescent display cells 8a to 8d can be selectively caused to emit light.

Since the prior art light emitting display tube is constructed as described above, in case of only the data electrode 10b and the scanning electrode 12a are turned ON, but the data electrode 10a is held negative, this causes the region of thermionic emission from the cathode 4 to reduce to about one half as shown in FIG. 8(b). Hence, the brightness of the fluorescent display cell 8b can fluctuate between a case of both the data electrodes 10a and 10b being turned ON and the other case of only the data electrode 10b being turned ON. There can also be a difference in brightness, though slightly, from the tolerance of assembling such as positioning of the electrodes or from the fluctuation of an input voltage.

Further, while the data signals D1 to D4 and scanning signals S1 to S4 as shown in FIG. 4 are being applied to the data electrodes 10 and the scanning electrodes 12 as shown in FIG. 6 and FIG. 7, if the polarities of adjoining sets of the electrodes 10 and 12 are as shown in FIG. 9, then the thermoelectrons emitted from one of the cathodes 4 flow normally as indicated by the arrow P, pass through the opening 15 in the control electrode 14, and bombard the predetermined fluorescent display cell 8 to cause it to emit light. However, there is the probability of a portion of the emitted thermoelectrons flowing also in the direction of the arrow Q and straying into other adjoining openings 15, whereby other than the predetermined fluorescent display cells 8 are caused to emit false light.

Furthermore, there is the probability of the electric field of a high voltage of the anode 8a penetrating through the gap between the frame body 1b and the planar electrode 14 and reaching the vicinity of the cathode 4, thereby causing electrons emitted from the cathode 4 to pass through the gap and reach the fluorescent display cells 8 at the circumference of the display screen 1a and cause them to emit false light.

An object of the present invention is to provide a display tube for light source in which the quantity of thermoelectrons emitted from the cathode when only one data electrode is turned ON, will be increased so that the brightness of the fluorescent display cell at that time is not largely lowered below the brightness thereof when two data electrodes are turned ON.

Another object of the present invention is to provide a display tube for light source in which the flow of thermoelectrons from a cathode is restrained so

that other than the predetermined fluorescent display cell designated as the picture element are not allowed to emit false light.

A further object of the present invention is to provide a display tube for light source in which stray electrons travelling from cathodes to the display screen 1a are fully prevented.

In order to achieve the above enumerated objects, a light emitting display tube according to the present invention comprises

- a vacuum envelope;
- a planar display screen with fluorescent display cells arranged thereon in a matrix;
- cathodes of elongated form for emitting electrons, each cathode being disposed so as to correspond to four respective fluorescent display cells;
- a first, planar control electrode disposed between said cathodes and said display screen with openings made therein, the latter corresponding to said fluorescent display cells;
- an insulating planar substrate located opposite to said display screen with respect to said cathodes;
- pairs of second control electrodes (so-called "data-electrodes") disposed on said substrate, each of said pairs being directly under a respective cathode;
- third control electrodes (so-called "scanning electrodes") disposed on said substrate, oriented along the cathodes and being at each side of said pair of second control electrodes;
- shield electrodes provided on or extending from the substrate, functionally separating adjacent display cells from each other, so as to prevent electrons released by the cathode of one display cell to stray into adjacent cells.

Preferable embodiments are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view showing a prior art light emitting display tube;

FIG. 2 is an exploded perspective view of FIG. 1;

FIG. 3 is a plan view showing an electrode structure;

FIG. 4 is a diagram schematically showing the timing of signals;

FIG. 5 is a plan view schematically showing a display screen;

FIG. 6 and FIG. 7 are diagrams schematically showing the potentials in the vicinity of the cathodes;

FIG. 8 is an explanatory drawing showing relationships in the prior art between polarities of data electrodes and scanning electrodes and the distribution of thermoelectrons from a cathode;

FIG. 9 is a sectional view of a prior art light emitting display tube showing the flow of thermoelectrons from a cathode;

FIG. 10 is a perspective view showing a substrate of a display tube according to a first embodiment of the present invention;

FIG. 11 is an explanatory drawing showing relationships between polarities of data electrodes and scanning electrodes and the distribution of thermoelectrons from a cathode;

FIG. 12 is a sectional view showing the flow of thermoelectrons emitted from a cathode in a display tube according to a second embodiment of the present invention;

FIG. 13 is a sectional view showing a principal portion of a display tube according to a third embodiment of the present invention; and

FIG. 14 is a sectional view showing a display tube according to a fourth embodiment of the present invention.

A preferred embodiment of the present invention will be described below in detail with reference to the accompanying drawings.

Referring to FIG. 10, reference numeral 1d denotes a substrate, and on the substrate 1d, there are disposed cathodes 4, data electrodes 10a, 10b as second control electrodes, scanning electrodes 12a, 12b as third control electrodes, and electrodes 21, located between the data electrodes 10a and 10b, and between the scanning electrodes 12a and 12b as fourth control electrodes supplied with potential at a predetermined level for reducing fluctuation in brightness. Above the substrate 1c, there are provided a planar electrode 14 as first control electrode and a display screen 1a with predetermined spacings between one another, and these are contained in a frame body 1b as in the prior art. FIG. 11 is an explanatory drawing showing a difference in emission of light between the periods where both data electrodes are turned ON and where one data electrode is turned ON in a display tube for light source with the electrode arrangement as described above.

Operation will be described below.

In the region of thermionic emission of the cathode 4, when both the data electrodes 10a, 10b and the scanning electrode 12a are turned ON, the thermoelectrons are deflected as shown in FIG. 11(a), virtually in the same way as in the case shown in FIG. 8(a), whereby the corresponding two fluorescent display cells 8a, 8b are both bombarded by the electrons to emit light. On the other hand, when only one data electrode 10b and the scanning electrode 12a are turned ON, the region of thermionic emission of the cathode 4 includes the portion corresponding to the fourth control electrode 21, and therefore, it is expanded, as shown in FIG. 11(b), to virtually two times larger than that in the prior art. As a result, the thermoelectrons from such a wider region are deflected

to bombard one fluorescent display cell 8b causing it to emit light. Hence, its brightness becomes much higher than that in the prior art as shown in FIG. 8(b), reducing the difference in brightness of the fluorescent display cells in the case where the fluorescent display portions 8a, 8b are both allowed to emit light, and thus an improvement is obtained such that the difference in brightness is made virtually undetectable by vision. Similarly, when using other fluorescent display cells 8c, 8d separately from or jointly with the fluorescent display cells 8a, 8b to selectively cause one to four of them to emit light, it becomes possible to reduce the difference in brightness by holding the fourth control electrode 21 ON and thereby obtain a well-balanced and good image display.

Such a fourth control electrode 21 also has a performance to reduce the differences in brightness resulting from tolerances of electrode positioning or assembling.

FIG. 12 is a drawing showing a second embodiment of the present invention. Referring to FIG. 12, reference numeral 22 denotes a back shield electrode provided on the substrate 1c. Defining a unit as composed of one cathode 4, two data electrodes 10 as second control electrodes positioned under and facing the cathode 4, and two scanning electrodes 12 as third control electrodes disposed on both sides in the direction of the column of the data electrodes, four back shield electrodes 22 are disposed between each two adjoining units of four such units. The back shield electrodes 22 are, for example, formed out of carbon by screen-printing on the substrate 1c. Other components corresponding to those shown in FIG. 3 are denoted by corresponding reference numerals and duplicated explanation thereof is omitted here.

Operation will be described below.

In the present embodiment, as described above, there are disposed the back shield electrodes 22 between each of adjoining units. Hence, by keeping the potential of the back shield electrode 22 at a zero or negative potential level at all times, the thermoelectrons emitted from the cathode 4 in one unit likely straying into the adjoining unit are affected by the zero or negative potential of the back shield electrode and thereby deflected as shown by the arrow P'. Thus, it does not occur that the thermoelectrons emitted from the cathode 4 of one unit stray into the opening 15 in the planar electrode 14 corresponding to other units as was the case in the prior art, and therefore, the emission of false light at the fluorescent display cells 8 in other units due to such stray electrons can be thus eliminated. As a result, each of the adjoining units effects the emission of light on the fluorescent display cell 8 by its own thermoelectrons and a good image display is ensured.

FIG. 13 is a drawing showing a third embodiment of the present invention. Referring to FIG. 13, side shield electrodes 23 extending between the control

electrode 14 and the substrate 1c are erected between the cathodes 4. The side shield electrodes 23 may be electrically connected at their top edge to the control electrode 14 or isolated therefrom to connect to an earth line instead.

Operation will be described below.

First, the data signals D1 to D4 and the scanning signals S1 to S4 as shown in FIG. 4 are supplied to the data electrodes 10 and the scanning electrodes 12 as shown in FIG. 6 and FIG. 7. Supposing now that these electrodes 10, 12 have obtained polarities as shown in FIG. 13, the thermoelectrons emitted from one cathode 4 are allowed to flow normally in the direction indicated by the arrow P and further to pass through the opening 15 in the control electrode 14. Thereby, the fluorescent display cell 8 corresponding to the opening 15 is bombarded by the electrons and emit light.

Some of the thermoelectrons emitted from the cathode 4 moving toward another opening 15 are deflected by the effect, for example, of zero potential or negative potential of the side shield electrodes 23 and flow in the direction of the arrow R, and thereby, caused to pass through the opening 15 and be lead onto the same fluorescent display cell 8 as above via the normal route. Consequently, all the thermoelectrons emitted from the cathode 4 are concentrated on the designated fluorescent display cell 8 causing the same to emit light effectively. Thus, deterioration of brightness at the predetermined fluorescent display cell 8 due to straying electrons or emission of false light at other fluorescent display cells 8, can be prevented for certain.

FIG. 14 is a drawing showing a fourth embodiment of the present invention. Referring to FIG. 14, reference numeral 1c denotes an insulating substrate provided within the vacuum envelope in a manner floating above a back plate 24. The insulating substrate 1c is formed out of a ceramic plate, a glass plate, or the like. On the insulating substrate 1c, there are provided the cathodes 4, the data electrodes 10, and the scanning electrodes 12 in the same arrangement as in the previous examples. Reference numeral 14A denotes a first control electrode which as a whole has a square form and its circumferential portions are bent so that the thus made bent pieces 14b together with the control electrode 14A have a cross-section in a U-shape.

The first control electrode 14A also has openings 15 made therein. The edge portion 14b of the first control electrode 14A is arranged to extend past the periphery of the floating insulating substrate 1c as far as the vicinity of the back plate 24.

Although not shown in the drawing, leads from the cathodes 4 and electrodes 10, 12, and 14A are arranged to be taken out on the back side of the back plate 24 through a cut made in the edge portion 14b of the first control electrode 14A, a cut groove made

in the back plate 24, or the like. The first control electrode 14A is provided with zero potential or negative potential.

Operation will be described below.

First, a heater voltage is applied to the cathode 4 so that thermoelectrons are emitted therefrom and a voltage, for example, at 8 kV is applied to the anode 8A. Thereby, an electric field of high-voltage is developed within the vacuum envelope between the fluorescent display cell 8 and the first control electrode 14A, around the anode 8A as the center. At this time, the electric field partly tends to penetrate into the vicinity of the cathode 4 taking the route passing through the minute gap between the edge portion 14b of the first control electrode 14A and the back plate 24 and the minute gap between this first control electrode 14A and the periphery of the insulating substrate 1c.

However, since the route is passing through such minute gaps and the route itself is bent and long, the high-voltage potential is sufficiently attenuated on the midway of the route, so that it hardly reaches the vicinity of the cathode 4. As a result, the stray electrons passing through this route from the cathode 4 to the anode 8A and the fluorescent display cell 8 can be prevented and hence there is no probability of emission of false light at the fluorescent display cells 8.

Although the above described embodiments were all of a four-dot type in which one cathode 4 makes four fluorescent display cells 8 emit light, the same effects as obtained from the above described embodiments can be obtained even if the device is of a two-dot type in which one cathode 4 makes two fluorescent display cells 8 emit light.

Claims

1. A light emitting display tube having
 - a vacuum envelope;
 - a planar display screen (1a) with fluorescent display cells (8) arranged thereon in a matrix;
 - cathodes (4) of elongated form for emitting electrons, each cathode being disposed so as to correspond to four respective fluorescent display cells (8);
 - a first, planar control electrode (14; 14A) disposed between said cathodes (4) and said display screen (1a) with openings (15) made therein, the latter corresponding to said fluorescent display cells (8);
 - an insulating planar substrate (1c) located opposite to said display screen (1a) with respect to said cathodes (4);
 - pairs of second control electrodes, so-called "data-electrodes" (10), disposed on

said substrate (1c), each of said pairs being directly under a respective cathode (4);

- third control electrodes, so-called "scanning electrodes" (12), disposed on said substrate (1c), oriented along the cathodes and being at each side of said pair of second control electrodes (10);
- shield electrodes (22, 23) provided on or extending from the substrate (1c), functionally separating adjacent display cells (8) from each other, so as to prevent electrons released by the cathode (4) of one display cell (8) to stray into adjacent cells.

2. A light emitting display tube according to claim 1, where the shield electrodes consist of back shield electrodes (22) being disposed on the substrate (1c) between units, with a unit defined as composed of one of said cathodes (4) and its corresponding second (10) and said third (12) control electrodes (Fig. 12).
3. A light emitting display tube according to claim 2, wherein said back shield electrodes (22) are formed out of carbon on the substrate by screen printing.
4. A light emitting display tube according to claim 2, wherein said back shield electrodes (22) are held at a zero potential or negative potential level at all times.
5. A light emitting display tube according to claim 1, where the shield electrodes consist of side shield electrodes (23) extending from the substrate (1c) to the first control electrode (14) and located between the units, with a unit being defined as composed of one of said cathodes (4) and its corresponding second (10) and third (12) control electrodes (Fig. 12).
6. A light emitting display tube according to claim 5, wherein said side shield electrodes (23) are electrically connected to said first control electrode (14).
7. A light emitting display tube according to claim 5, wherein said side shield electrodes (23) are electrically connected to an earth line.
8. A light emitting display tube according to claim 1, where said substrate (1c) is arranged floating above a back plate (24) of said vacuum envelope and where said first control electrode (14A) has an U-shaped cross-section, with the edge portions (14b) extending beyond said substrate (1c) so as to reach the vicinity of said back plate (24; Fig. 14).



in the back plate 24, or the like. The first control electrode 14A is provided with zero potential or negative potential.

Operation will be described below.

First, a heater voltage is applied to the cathode 4 so that thermoelectrons are emitted therefrom and a voltage, for example, at 8 kV is applied to the anode 8A. Thereby, an electric field of high-voltage is developed within the vacuum envelope between the fluorescent display cell 8 and the first control electrode 14A, around the anode 8A as the center. At this time, the electric field partly tends to penetrate into the vicinity of the cathode 4 taking the route passing through the minute gap between the edge portion 14b of the first control electrode 14A and the back plate 24 and the minute gap between this first control electrode 14A and the periphery of the insulating substrate 1c.

However, since the route is passing through such minute gaps and the route itself is bent and long, the high-voltage potential is sufficiently attenuated on the midway of the route, so that it hardly reaches the vicinity of the cathode 4. As a result, the stray electrons passing through this route from the cathode 4 to the anode 8A and the fluorescent display cell 8 can be prevented and hence there is no probability of emission of false light at the fluorescent display cells 8.

Although the above described embodiments were all of a four-dot type in which one cathode 4 makes four fluorescent display cells 8 emit light, the same effects as obtained from the above described embodiments can be obtained even if the device is of a two-dot type in which one cathode 4 makes two fluorescent display cells 8 emit light.

Claims

1. A light emitting display tube having

- a vacuum envelope;
- a planar display screen (1a) with fluorescent display cells (8) arranged thereon in a matrix;
- cathodes (4) of elongated form for emitting electrons, each cathode being disposed so as to correspond to four respective fluorescent display cells (8);
- a first, planar control electrode (14; 14A) disposed between said cathodes (4) and said display screen (1a) with openings (15) made therein, the latter corresponding to said fluorescent display cells (8);
- an insulating planar substrate (1c) located opposite to said display screen (1a) with respect to said cathodes (4);
- pairs of second control electrodes, so-called "data-electrodes" (10), disposed on

said substrate (1c), each of said pairs being directly under a respective cathode (4);

- third control electrodes, so-called "scanning electrodes" (12), disposed on said substrate (1c), oriented along the cathodes and being at each side of said pair of second control electrodes (10);
- shield electrodes (22, 23) provided on or extending from the substrate (1c), functionally separating adjacent display cells (8) from each other, so as to prevent electrons released by the cathode (4) of one display cell (8) to stray into adjacent cells.

2. A light emitting display tube according to claim 1, where the shield electrodes consist of back shield electrodes (22) being disposed on the substrate (1c) between units, with a unit defined as composed of one of said cathodes (4) and its corresponding second (10) and said third (12) control electrodes (Fig. 12).

3. A light emitting display tube according to claim 2, wherein said back shield electrodes (22) are formed out of carbon on the substrate by screen printing.

4. A light emitting display tube according to claim 2, wherein said back shield electrodes (22) are held at a zero potential or negative potential level at all times.

5. A light emitting display tube according to claim 1, where the shield electrodes consist of side shield electrodes (23) extending from the substrate (1c) to the first control electrode (14) and located between the units, with a unit being defined as composed of one of said cathodes (4) and its corresponding second (10) and third (12) control electrodes (Fig. 12).

6. A light emitting display tube according to claim 5, wherein said side shield electrodes (23) are electrically connected to said first control electrode (14).

7. A light emitting display tube according to claim 5, wherein said side shield electrodes (23) are electrically connected to an earth line.

8. A light emitting display tube according to claim 1, where said substrate (1c) is arranged floating above a back plate (24) of said vacuum envelope and where said first control electrode (14A) has an U-shaped cross-section, with the edge portions (14b) extending beyond said substrate (1c) so as to reach the vicinity of said back plate (24; Fig. 14).



9. A light emitting display tube according to claim 8, wherein said first control electrode (14A) is held at a zero potential or negative potential level with respect to the cathodes (4).
10. A light emitting display tube according to claim 8, wherein leads from said cathodes (4) and said first to third control electrodes (14A, 10, 12) are taken out to the back side of said back plate (1c) through a cut made in the edge portion of said first control electrode (14A) and a cut groove made in said back plate (1c).
11. A light emitting display tube according to any preceding claim, wherein for every display cell, a fourth control electrode (21) is provided on the substrate between said two second control electrodes (10a, 10b), for providing reducing fluctuation in brightness.
12. A light emitting display tube according to claim 11, wherein said fourth control electrode (21) is supplied with potential at a predetermined level.
13. A light emitting display tube according to claim 11, where said display cells (8) are arranged in a matrix of 2m rows by 2n columns (m, n being natural numbers), and where the cathodes (4) are arranged in a matrix of m rows by n columns, shaped in a filar form, with each cathode corresponding to four of said display cells (8), a first control electrode (14, 14A) having 2m x 2n openings corresponding to said display cells, pairs of second control electrodes (10) arranged in an array of m rows by 2n columns, pairs of third control electrodes (12) arranged in an array of 2m rows by n columns.

Patentansprüche

1. Lichtemittierende Anzeigeröhre mit

- einem Vakuumkolben;
- einem planaren Anzeigeschirm (1a) mit darauf in einer Matrix angeordneten, fluoreszierenden Anzeigezellen (8);
- länglichen Kathoden (4) zum Emittieren von Elektronen, wobei jede Kathode vier entsprechenden fluoreszierenden Anzeigezellen (8) zugeordnet ist;
- einer ersten, planaren Steuerelektrode (14, 14A), die zwischen den Kathoden (4) und dem Anzeigeschirm (1a) angeordnet ist und Öffnungen (15) aufweist, die den fluoreszierenden Anzeigezellen (8) zugeordnet sind;
- einem isolierenden, planaren Substrat (1c), das in bezug auf die Kathoden (4) dem An-

zeigeschirm (1a) gegenüber angeordnet ist;

- Paaren von zweiten Steuerelektroden, sogenannten "Datenelektroden" (10), die auf dem Substrat (1c) angeordnet sind, wobei jedes Paar direkt unter einer zugeordneten Kathode (4) liegt;
- dritten Steuerelektroden, sogenannten "Abtastelektroden" (12), die auf dem Substrat (1c) in Richtung entlang der Kathoden an jeder Seite des Paares von zweiten Steuerelektroden (10) angeordnet sind;
- Abschirmelektroden (22, 23), die auf dem Substrat (1c) angeordnet sind oder sich von diesem erstrecken und die funktional nebeneinander liegende Anzeigezellen (8) voneinander trennen, damit von der Kathode (4) freigegebene Elektronen einer Anzeigezelle (8) nicht in daneben liegende Zellen streuen.

2. Lichtemittierende Anzeigeröhre nach Anspruch 1,

bei der die Abschirmelektroden aus Rückschirmelektroden (22) bestehen, die auf dem Substrat (1c) zwischen Einheiten angeordnet sind, wobei eine Einheit als eine solche definiert ist, die aus einer der Kathoden (4) und den zugehörigen zweiten (10) und dritten (12) Steuerelektroden besteht (Fig. 12).

3. Lichtemittierende Anzeigeröhre nach Anspruch 2,

bei der die Rückschirmelektroden (22) aus Kohlenstoff bestehen und auf das Substrat durch Siebdruck aufgebracht sind.

4. Lichtemittierende Anzeigeröhre nach Anspruch 2,

bei der die Rückschirmelektroden (22) zu allen Zeiten auf Nullpotential oder auf negativem Potential gehalten werden.

5. Lichtemittierende Anzeigeröhre nach Anspruch 1,

bei der die Abschirmelektroden aus Seitenschirmelektroden (23) bestehen, die sich von dem Substrat (1c) bis zu der ersten Steuerelektrode (14) erstrecken und zwischen den Einheiten liegen, wobei eine Einheit als eine solche definiert ist, die aus einer der Kathoden (4) und den zugehörigen zweiten (10) und dritten (12) Steuerelektroden besteht (Fig. 12).

6. Lichtemittierende Anzeigeröhre nach Anspruch 5,

bei der die Seitenschirmelektroden (23) elektrisch mit der ersten Steuerelektrode (14) verbun-

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20

25

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35

40

45

50

55

7



den sind.

7. Lichtemittierende Anzeigeröhre nach Anspruch 5,
bei der die Seitenschirmelektroden (23) elektrisch mit einer Erdungsleitung verbunden sind. 5
8. Lichtemittierende Anzeigeröhre nach Anspruch 1,
bei der das Substrat (1c) freischwebend über einer Rückplatte (24) des Vakuumkolbens angeordnet ist, und bei der die erste Steuerelektrode (14A) einen U-förmigen Querschnitt aufweist, wobei die Kantenbereiche (14b) sich über das Substrat (1c) hinaus erstrecken, um bis in die Nähe der Rückplatte (24; Fig. 14) zu reichen. 10 15
9. Lichtemittierende Anzeigeröhre nach Anspruch 8,
bei der die erste Steuerelektrode (14A) gegenüber den Kathoden (4) auf Nullpotential oder negativem Potential gehalten wird. 20
10. Lichtemittierende Anzeigeröhre nach Anspruch 8,
bei der Anschlußleitungen von den Kathoden (4) und den ersten bis dritten Steuerelektroden (14A, 10, 12) zu der Rückseite der Rückplatte (1c) durch eine Kerbe im Kantenbereich der ersten Steuerelektrode (14A) und eine Nut in der Rückplatte (1c) herausgeführt sind. 25 30
11. Lichtemittierende Anzeigeröhre nach einem der vorstehenden Ansprüche,
bei der für jede Anzeigezelle eine vierte Steuerelektrode (21) auf dem Substrat zwischen den beiden zweiten Steuerelektroden (10a, 10b) vorgesehen sind, um Helligkeitsschwankungen zu reduzieren. 35 40
12. Lichtemittierende Anzeigeröhre nach Anspruch 11,
bei der die vierte Steuerelektrode (21) an ein Potential bestimmter Höhe gelegt ist. 45
13. Lichtemittierende Anzeigeröhre nach Anspruch 11,
bei der die Anzeigezellen (8) in einer Matrix von 2m Zeilen und 2n Spalten (m, n sind natürliche Zahlen) angeordnet sind, und bei der die Kathoden (4) in einer Matrix von m Zeilen und n Spalten angeordnet sind und Fadenform aufweisen, wobei jede Kathode vier Anzeigezellen (8) zugeordnet ist, eine erste Steuerelektrode (14, 14A) 2m x 2n Öffnungen entsprechend den Anzeigezellen aufweist, sowie Paare von zweiten Steuerelektroden (10) in einer Anordnung von m Zeilen und 2n Spalten und Paare von dritten Steuerelektro-

den (12) in einer Anordnung von 2m Zeilen und n Spalten vorgesehen sind.

5 Revendications

1. Tube image luminescent, comprenant :

- une enveloppe sous-vide;
- un écran d'affichage planaire (1a) ayant des cellules d'affichage (8) fluorescentes, disposées sur lui en formant une matrice;
- des cathodes (4) de forme allongée servant à émettre des électrons, chaque cathode étant disposée de manière à correspondre à quatre cellules d'affichage (8) fluorescentes respectives;
- une première électrode de commande (14; 14A) planaire disposée entre lesdites cathodes (4) et ledit écran d'affichage (1a), ayant des ouvertures (15) réalisées en son sein, ces dernières correspondant auxdites cellules d'affichage fluorescentes (8);
- un substrat planaire (1c) isolant, situé à l'opposée dudit écran d'affichage (1a) par rapport auxdites cathodes (4);
- des couples de deuxième électrodes de commande que l'on appelle "électrodes de données" (10), disposées sur ledit substrat (1c), chacun desdits couples étant directement placé au-dessous d'une cathode (4) respective;
- des troisième électrodes de commande, que l'on appelle "électrodes de balayage" (12), disposées sur ledit substrat (1c), orientées le long des cathodes et situées de chaque côté dudit couple de deuxième électrodes de commande (10);
- des électrodes de protection (22, 23) prévues sur, ou s'étendant depuis, le substrat (1c), séparant fonctionnellement des cellules d'affichage (8) adjacentes les unes des autres, de manière à empêcher des électrons libérés par la cathode (4) d'une cellule d'affichage (8) d'avoir un effet parasite dans les cellules adjacentes.

2. Tube image luminescent selon la revendication 1, dans lequel les électrodes de protection consistent en des électrodes de protection arrière (22) disposées sur le substrat (1c) entre les ensembles, avec un ensemble défini comme étant composé de l'une desdites cathodes (4) et de ses deuxième (10) et troisième (12) électrodes de commande correspondantes (figure 12).

3. Tube image luminescent selon la revendication 2, dans lequel lesdites électrodes de protection arrière (22) sont composées de carbone, appli-



qué sur le substrat par sérigraphie.

4. Tube image luminescent selon la revendication 2, dans lequel lesdites électrodes de protection arrière (22) sont maintenues à tout moment à un potentiel nul ou à un niveau de potentiel négatif.
5. Tube image luminescent selon la revendication 1, dans lequel les électrodes de protection consistent en des électrodes de protection (23) latérales, s'étendant depuis le substrat (1c) vers la première électrode de commande (14) et situées entre les ensembles, un ensemble étant défini comme étant composé de l'une desdites cathodes (4) et de ses deuxième (10) et troisième (12) électrodes de commande correspondantes (figure 12).
6. Tube image luminescent selon la revendication 5, dans lequel lesdites électrodes de protection (23) latérales sont reliées électriquement à ladite première électrode de commande (14).
7. Tube image luminescent selon la revendication 5, dans lequel lesdites électrodes de protection (23) latérales sont reliées électriquement à une ligne de masse.
8. Tube image luminescent selon la revendication 1, dans lequel ledit substrat (1c) est disposé flottant au-dessus d'une plaque arrière (24) constituée de ladite enveloppe sous-vide et dans lequel ladite première électrode de commande (14A) à une section transversale en forme de U, les parties bords (14b) s'étendant au-delà dudit substrat (1c) de manière à atteindre le voisinage de ladite plaque arrière (24; figure 14).
9. Tube image luminescent selon la revendication 8, dans lequel ladite première électrode de commande (14A) est maintenue à un potentiel nul ou à un niveau de potentiel négatif par rapport aux cathodes (4).
10. Tube image luminescent selon la revendication 8, dans lequel des conducteurs partant desdites cathodes (4) et lesdites première à troisième électrodes de commande (14A, 10, 12), sont extraites vers la face arrière de ladite plaque arrière (1c), à travers une découpe réalisée dans la partie bord de ladite première électrode de commande (14a) et d'une gorge découpée ménagée dans ladite plaque arrière (1c).
11. Tube image luminescent selon l'une quelconque des revendications précédentes, dans lequel, pour chaque cellule d'affichage, une quatrième électrode de commande (21) est prévue sur le

substrat, entre lesdites deux deuxièmes électrodes de commande (10a, 10b) afin d'obtenir une réduction de la fluctuation de la luminosité.

- 5 12. Tube image luminescent selon la revendication 11, dans lequel ladite quatrième électrode de commande (21) reçoit un potentiel à un niveau prédéterminé.
- 10 13. Tube image luminescent selon la revendication 11, dans lequel lesdites cellules d'affichage (8) sont disposées selon une matrice de $2m$ lignes par $2n$ colonnes (m, n étant des nombres entiers) et dans lequel des cathodes (4) sont disposées en formant une matrice de m lignes par n colonnes, ayant une forme de fil, chaque cathode correspondant à quatre desdites cellules (8), une première électrode de commande (14, 14A) ayant des ouvertures de $2m \times 2n$ correspondant auxdites cellules d'affichage, des couples de deuxièmes électrodes de commande (10) sont disposées en formant une matrice de $2m$ lignes par $2n$ colonnes, des couples de troisièmes électrodes de commande (12) sont disposées en formant une matrice de $2m$ lignes par n colonnes.