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(54) **ELECTRO-OPTICAL DEVICE, MATRIX SUBSTRATE, AND ELECTRONIC EQUIPMENT**

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(57) **ABSTRACT**

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An electro-optical device according to the present invention includes a pixel area 11 including electro-optical elements driven by power supplied from power-supply circuits 14-1 to 14-10. The electro-optical device includes basic power-supply lines 16-1 to 16-6, which receive a power-supply voltage output from the power-supply circuits 14-1 to 14-10 and which are formed on the upper portion of a substrate, and includes main power-supply lines V_R , V_G , and V_B , which intersect the basic power-supply lines 16-1 to 16-6 and which are formed on the upper portion of the substrate. The power-supply voltage is supplied to the electro-optical elements via the main power-supply lines V_R , V_G , and V_B .

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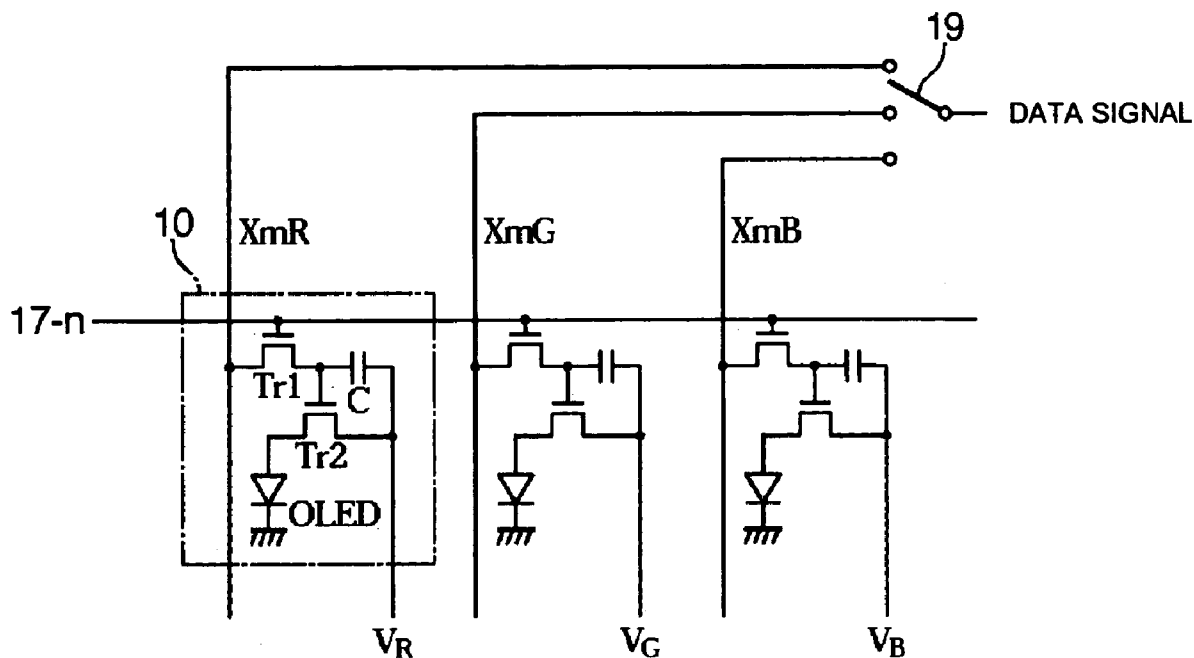


FIG. 1

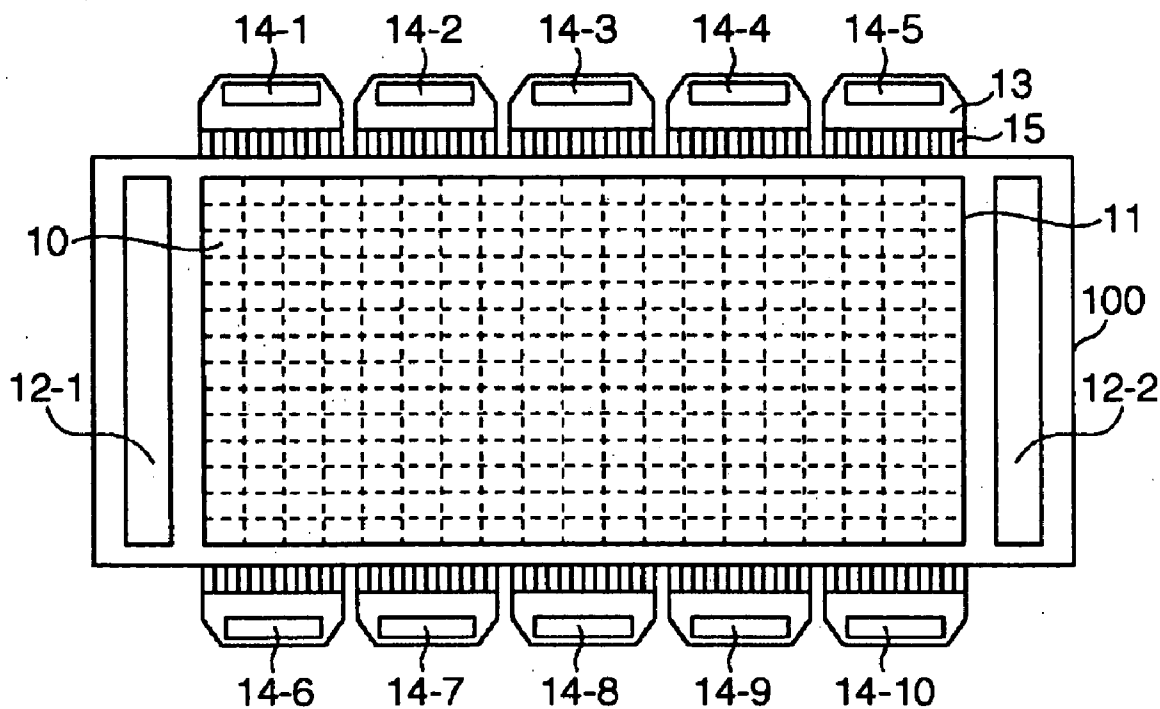
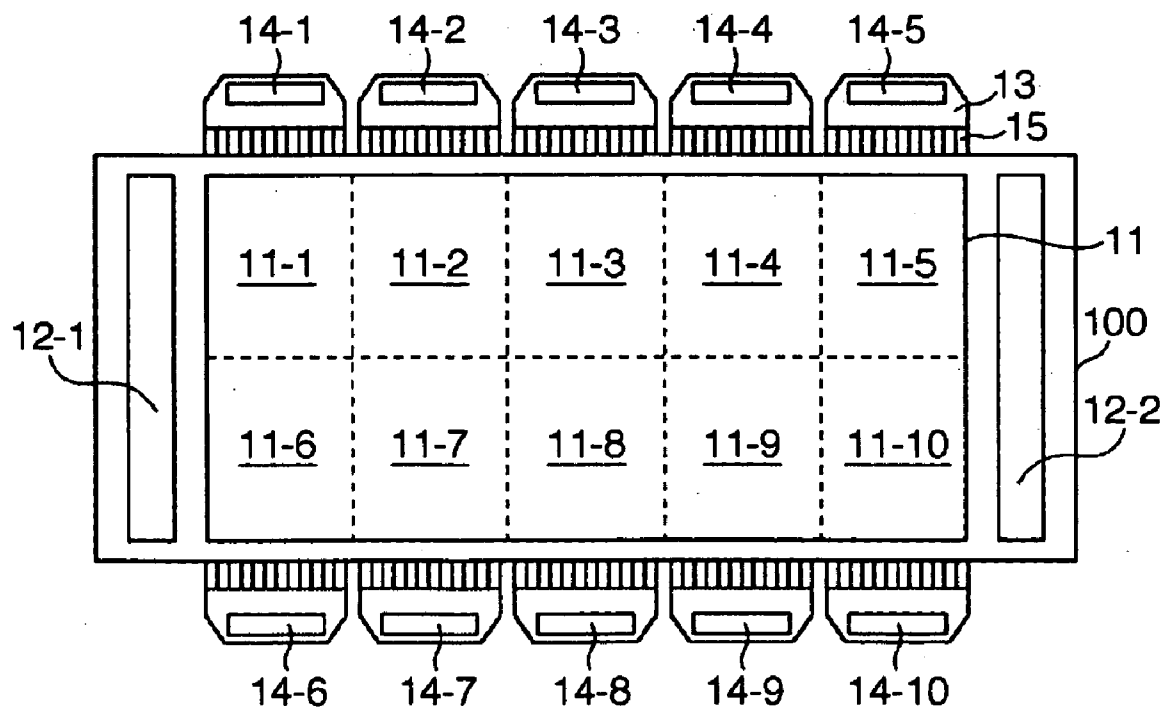


FIG. 2



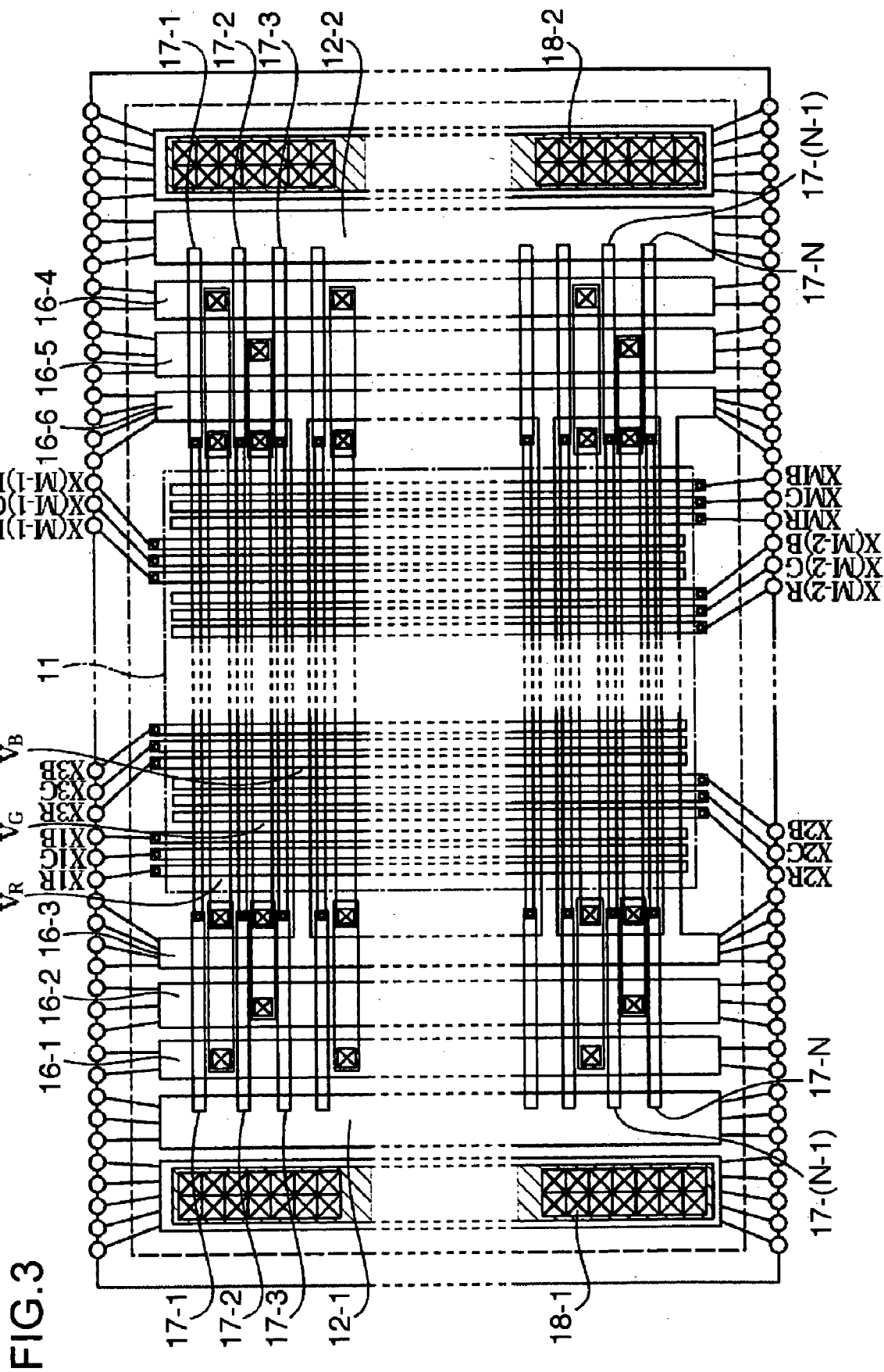


FIG. 3

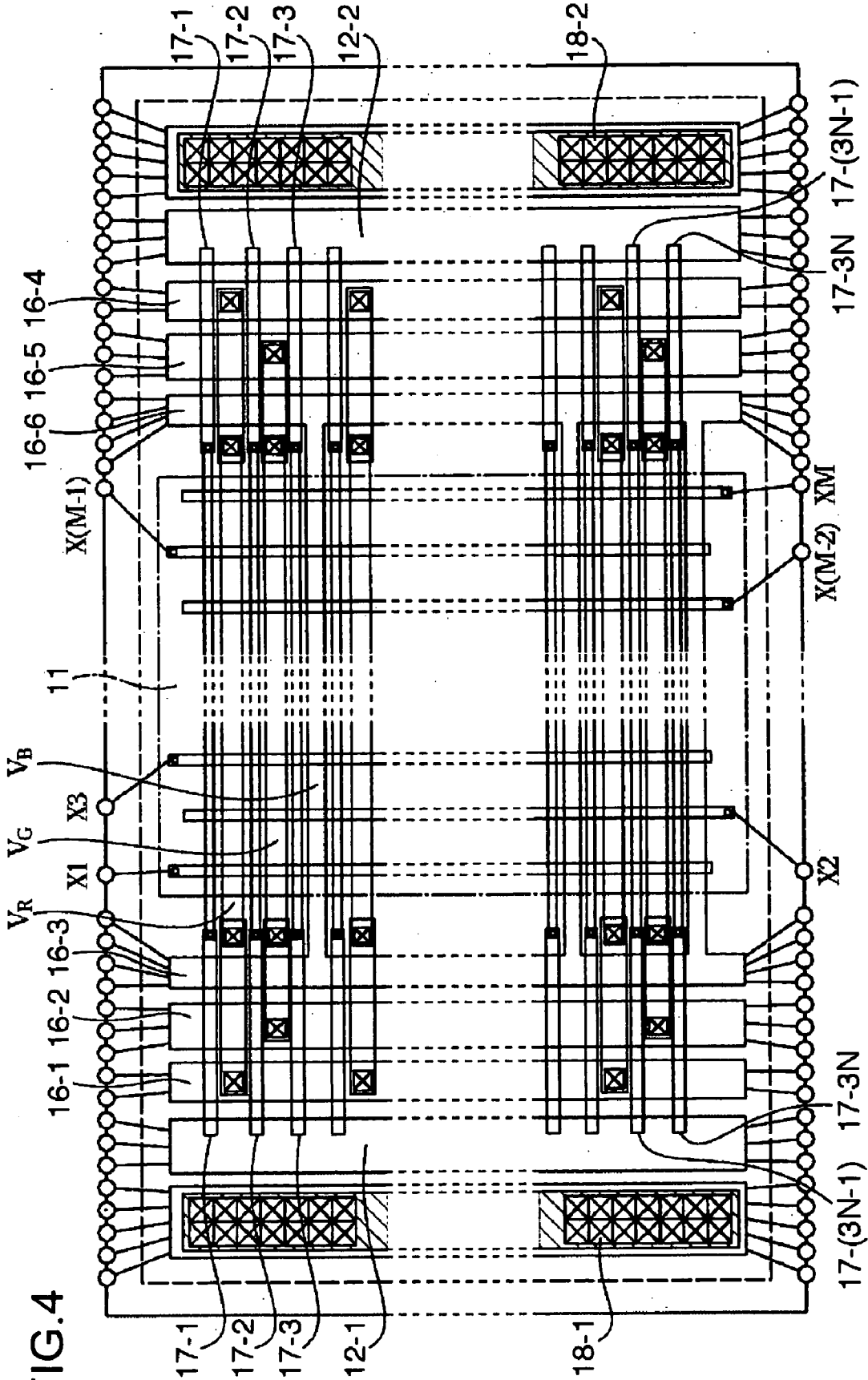


FIG. 4

FIG.5

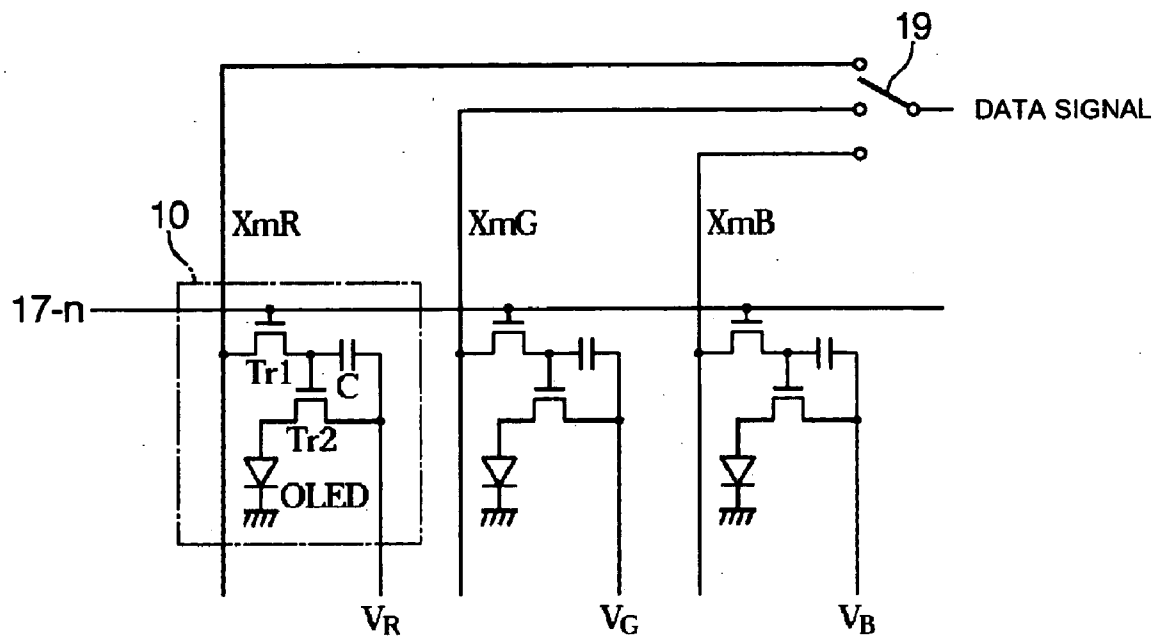


FIG.6

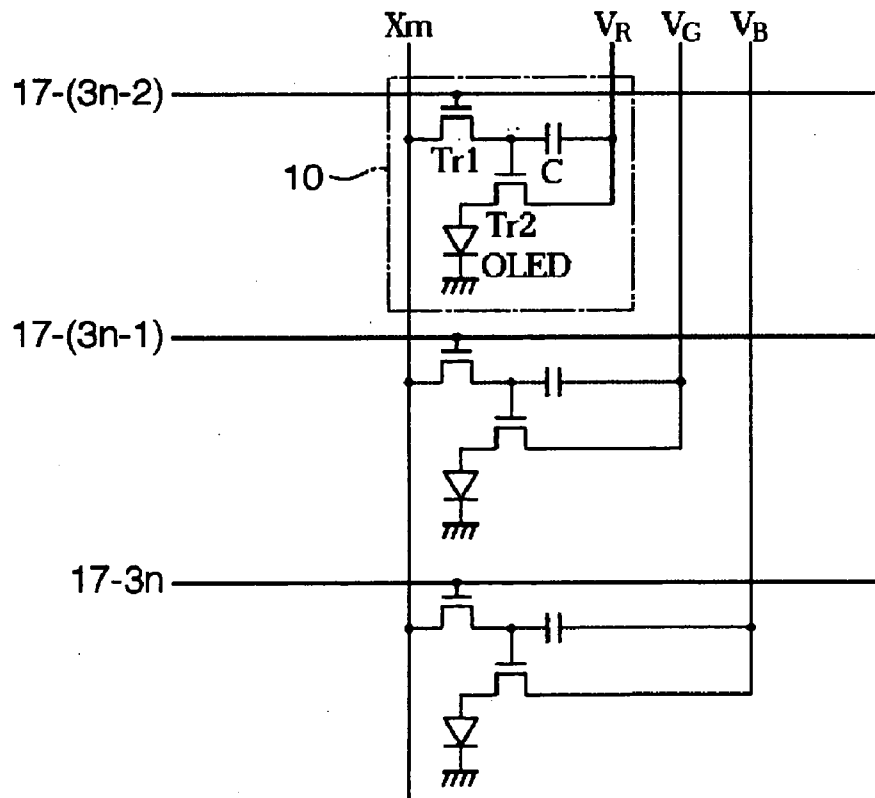


FIG. 7

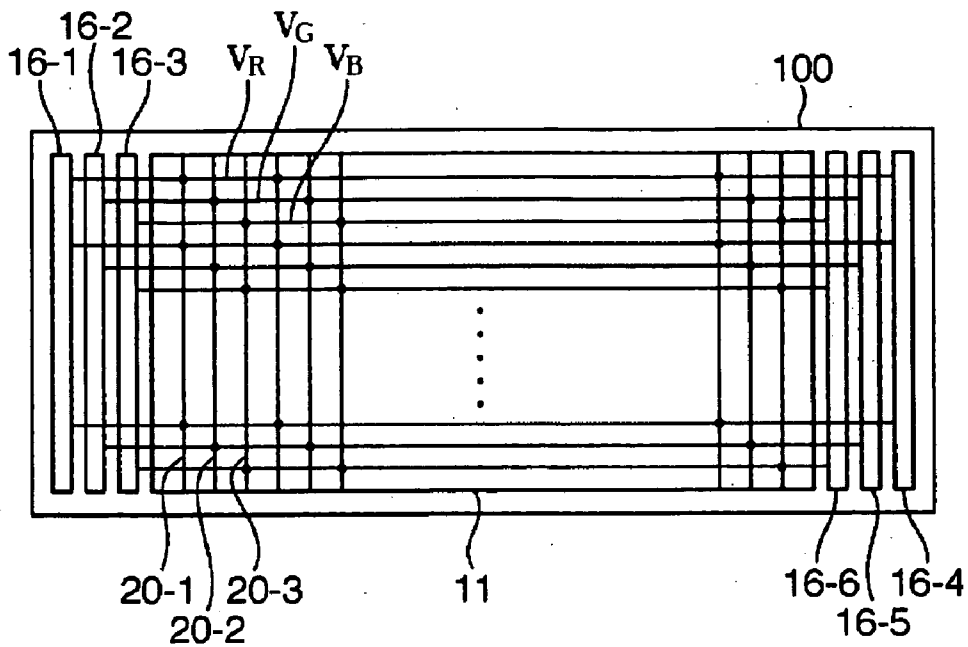
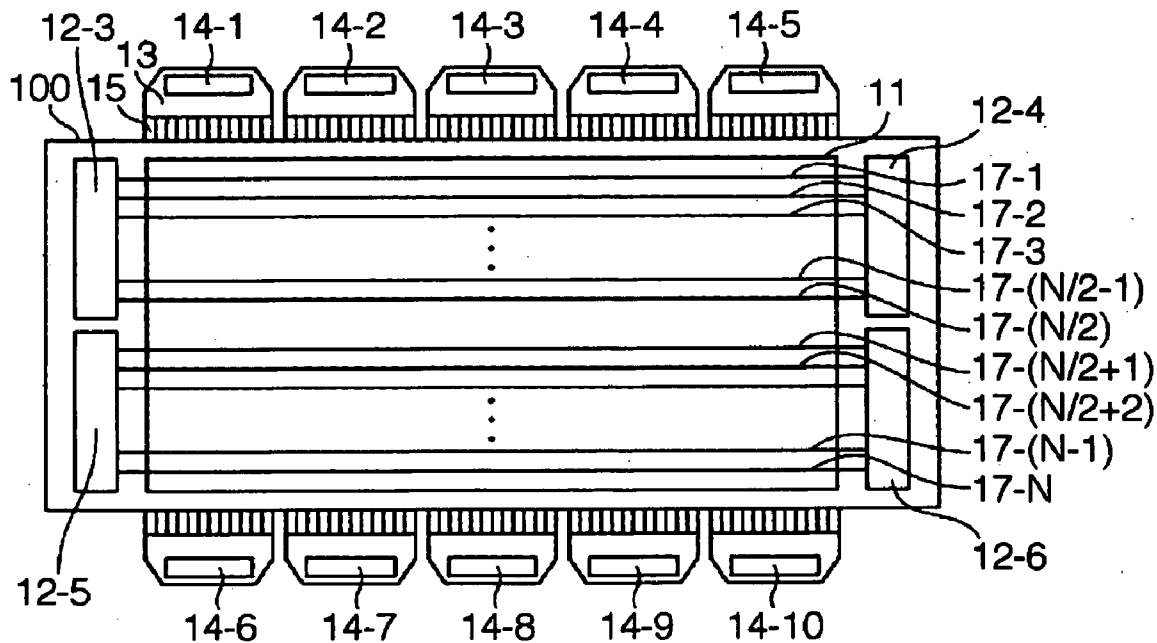


FIG. 8



ELECTRO-OPTICAL DEVICE, MATRIX SUBSTRATE, AND ELECTRONIC EQUIPMENT

TECHNICAL FIELD

[0001] The present invention relates to an arrangement of power-supply wiring of an electro-optical device suitable for a large display panel.

BACKGROUND ART

[0002] Since organic EL elements are electrically driven light-emitting elements, a backlight is not needed. Additional advantages are their low electrical power consumption, wide field of view, and high contrast ratio. Organic EL elements are used for small and medium size displays for devices such as cellular phones and personal digital assistants. An organic EL element is an electro-optical element with a light-emitting layer including fluorescent material interposed between an anode and a cathode. Supplying a forward biased current between the two types of electrodes causes holes injected from the anode and electrons injected from the cathode to recombine. The recombination energy generated causes the organic EL element to emit light. In known active-matrix-driven organic EL display panels, in general, anode power-supply lines are wired in on a pixel area of the active matrix substrate where pixels are arranged in a matrix, while a cathode film, which is a common electrode, is disposed over the entire pixel area. An improvement with an objective to lower the electrical power consumption and improve the light-emitting efficiency of a display apparatus by optimizing the wiring arrangement is known from, for instance, Japanese Unexamined Patent Application Publication No. 11-24606 (Patent Document 1).

[0003] [Patent Document 1]

[0004] Japanese Unexamined Patent Application Publication No. 11-24606

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] When using electrically driven light-emitting elements such as organic EL elements for large displays, preventing an increase in electrical power consumption due to the resistance of the power-supply wiring and maintaining an even display become issues. When the distribution of the electrical current supplied to the entire screen is not uniform, the display becomes uneven and the display performance is lowered.

[0006] As the display becomes large, the number of pixels needed for the display increases exponentially, causing the number of data lines and scanning lines to become enormous. The problem that must be solved to provide a large organic EL display panel is how to mount the data line drivers and the scanning line drivers.

[0007] An object of the present invention is to provide power-supply wiring technology suitable for large displays. Another object of the present invention is to provide techniques for mounting suitable driver circuits for large displays.

[0008] Means for Solving the Problems

[0009] To solve the above problem, the electro-optical device according to the present invention has a pixel area consisting of electro-optical elements driven by electrical power received from power-supply circuits. The electro-optical device comprises basic power-supply lines disposed on the upper portion of the substrate, which receive a power-supply voltage from the power-supply circuits, and main power-supply lines disposed on the upper portion of the substrate, which intersect and connect with the basic power-supply lines. The power-supply voltage is supplied to the electro-optical elements via the main power-supply lines.

[0010] By forming power-supply wiring so that the power-supply voltage is received by the basic power-supply lines with low resistance and by supplying the power-supply voltage to the electro-optical elements from the main power-supply lines connected to the basic power-supply lines, the power-supply voltage is evenly supplied to each pixel within the pixel area. As a result, an even display is provided for the electro-optical device.

[0011] For the electro-optical device according to the present invention, desirably, the main power-supply lines are arranged in a direction that intersects the basic power-supply lines in a strip pattern. By arranging the main power-supply lines in a strip pattern, a desired amount of electrical power may be supplied to each electro-optical element.

[0012] For the electro-optical device according to the present invention, desirably, the main power-supply lines are arranged in a direction that intersects substantially orthogonally the basic power-supply lines. By arranging the main power-supply lines in a substantially orthogonal direction with respect to the basic power-supply lines, electrical power may efficiently be supplied to the electro-optical elements, which are arranged in two directions perpendicular to each other.

[0013] For the electro-optical device according to the present invention, desirably, the line thickness of the main power-supply lines is smaller than the line thickness of the basic power-supply lines. By making the line thickness of the basic power-supply lines larger than the line thickness of the main power-supply lines, the resistance of the basic power-supply lines can be reduced.

[0014] For the electro-optical device according to the present invention, desirably, the basic power-supply lines are arranged on the outside edges of the pixel area, and the main power-supply lines are arranged in a direction that intersects the basic power-supply lines. By arranging the basic power-supply lines on the outside edges of the pixel area, the main power-supply lines may be formed from the basic power-supply lines to the entire pixel area.

[0015] For the electro-optical device according to the present invention, desirably, the basic power-supply lines are arranged in linearly symmetrical pairs on the outside edges of the pixel area. By arranging the basic power-supply lines linearly symmetrically, electrical power may be supplied to each electro-optical element disposed on the pixels area over a large area.

[0016] For the electro-optical device according to the present invention, desirably, the main power-supply lines are

arranged so that the arrangement pitch is substantially equal. By arranging the main power-supply lines with equal pitch, electrical power may be supplied to each electro-optical element in a well-balanced manner.

[0017] For the electro-optical device according to the present invention, desirably, auxiliary power-supply lines that intersect the main power-supply lines are further provided. By newly forming auxiliary power-supply lines that intersect the main power-supply lines, the resistance of the entire power-supply wiring may be reduced.

[0018] For the electro-optical device according to the present invention, desirably, the auxiliary power-supply lines are arranged in a direction that intersects the main power-supply lines in a strip pattern. By arranging the auxiliary power-supply lines in a strip pattern, the resistance of the power-supply wiring may be reduced.

[0019] For the electro-optical device according to the present invention, desirably, the auxiliary power-supply lines are arranged in a direction that substantially orthogonally intersects the main power-supply lines. By arranging the auxiliary power-supply lines in a substantially orthogonal direction with respect to the main power-supply lines, a desired amount of electrical power may be supplied to the electro-optical elements, which are arranged in two directions perpendicular to each other in a well-balanced manner.

[0020] For the electro-optical device according to the present invention, desirably, the power-supply wiring is arranged so that the electro-optical elements are disposed on the pixel area and the pixel area is sectioned into a plurality of pixel groups each including at least one of the electro-optical elements, and the pixel groups receive power from different power-supply circuits. By supplying electrical power to pixel groups from different power-supply circuits, the power-supply voltage may be corrected, and, as a result, any difference between power-supply circuits may be corrected.

[0021] For the electro-optical device according to the present invention, desirably, the power-supply circuits are enclosed in tape carrier packages and are contained in driver IC chips bonded to the substrate. Using external circuits as the power-supply circuits is suitable for a large display.

[0022] For the electro-optical device according to the present invention, desirably, scanning lines for selecting a group of electro-optical elements lined up in one direction are arranged, and scanning line drivers for simultaneously driving at least two scanning lines are provided. By simultaneously driving two or more scanning lines, the driving frequency for the scanning line drivers may be reduced and this is suitable for a large display.

[0023] For the electro-optical device according to the present invention, desirably, data lines for transmitting data signals, which regulate the gradation of the light emitted from the electro-optical element, are further provided, and the data signals are supplied from the driver IC chips. Disposing data line drivers in the external circuits of the substrate is suitable for a large display.

[0024] For the electro-optical device according to the present invention, desirably, analog switches for switching the output of the data signals supplied from the driver IC chips to the data lines are provided. By providing the analog

switches for switching the data line output to the data lines, the number of data lines supplied from the driver IC chips to the substrate may be reduced, and, as a result, this is suitable for simplifying the circuit board.

[0025] The electro-optical device according to the present invention has, on the substrate, electro-optical elements driven by electrical power supplied from power-supply circuits. The electro-optical device has, on the edge of the substrate, external driver circuits for driving and controlling the electro-optical elements. Each pixel group consisting of a plurality of electro-optical elements is driven and controlled by each driver circuit. Driving and controlling the pixels with the external driver circuits is suitable for a large display.

[0026] For the electro-optical device according to the present invention, desirably, the driver circuits that are driver IC chips enclosed in tape carrier packages are provided. By enclosing the driver circuits in the tape carrier packages, the driver circuits may easily be mounted on the circuit board.

[0027] For the electro-optical device according to the present invention, desirably, the driver IC chips that are the data line drivers are provided.

[0028] For the electro-optical device according to the present invention, desirably, the electro-optical elements that are electroluminescent elements are provided. By using the electroluminescent elements, electrically driven light-emitting elements that emit light may be provided.

[0029] The electronic apparatus according to the present invention has the above electro-optical device. The electronic apparatus is not limited to a particular apparatus as long as it has a display device. The electronic apparatus, for instance, may be a cellular phone, a video camera, a personal computer, a head-mounted display, a projector, a facsimile machine, a digital camera, a portable television, a DSP device, a PDA, or an electronic databook.

[0030] The matrix substrate according to the present invention has a pixel area for disposing the electro-optical elements driven by power supplied from the power-supply circuits. The matrix substrate has basic power-supply lines, which are disposed on the upper portion of the substrate and which receive a power-supply voltage output from the power-supply circuits, and main power-supply lines, which intersect and connect with the basic power-supply lines and are disposed on the upper portion of the substrate. The main power-supply lines supply the power-supply voltage to the electro-optical elements.

[0031] Arranging the power-supply wiring so that the basic power-supply lines with low resistance receive a power-supply voltage and the main power-supply lines connect to the basic power-supply lines, which supply the power-supply voltage to the electro-optical elements, provides a uniform power supply to the pixel in the pixel area. Thus the matrix substrate will provide a display without unevenness. Here, the term 'matrix substrate' refers to a wiring board on which electro-optical elements are not yet mounted.

[0032] For the matrix substrate according to the present invention, desirably, the main power-supply lines are arranged in a strip pattern in a direction that intersects the

basic power-supply lines. By arranging the main power-supply lines in a strip pattern, a desired amount of electrical power may be supplied to each electro-optical element.

[0033] For the matrix substrate according to the present invention, desirably, the main power-supply lines are arranged in a direction that is substantially orthogonal to the basic power-supply lines. By arranging the main power-supply lines in a direction that is substantially orthogonal to the basic power-supply lines, electrical power may be supplied efficiently to the electro-optical elements arranged in two directions perpendicular to each other.

[0034] For the matrix substrate according to the present invention, desirably, the line thickness of the main power-supply lines is smaller than the line thickness of the basic power-supply lines. By making the line thickness of the basic power-supply lines larger than that of the main power-supply lines, the resistance of the basic power-supply lines may be reduced.

[0035] For the matrix substrate according to the present invention, desirably, the basic power-supply lines are wired on the outside edges of the pixel area, and the main power-supply lines are arranged in a direction that intersects the basic power-supply lines. By arranging the basic power-supply lines on the outside edges of the pixel area, the main power-supply lines may be arranged from the basic power-supply lines to the entire pixel area.

[0036] For the matrix substrate according to the present invention, desirably, the basic power-supply lines are linearly symmetrically arranged in pairs on the outside edges of the pixel area. By linearly symmetrically arranging the basic power-supply lines, electrical power may be supplied, in a well-balanced manner, to each electro-optical optical element arranged in the pixel area over a large area.

[0037] For the matrix substrate according to the present invention, desirably, the wiring of the main power-supply lines is arranged with equal pitch. By arranging the main power-supply lines with equal pitch, electrical power may be supplied, in a well-balanced manner, to each electro-optical element.

[0038] For the matrix substrate according to the present invention, desirably, the auxiliary power-supply lines intersecting the main power-supply lines are further provided. By newly forming auxiliary power-supply lines that intersect the main power-supply lines, the resistance of the entire power-supply wiring may be reduced.

[0039] For the matrix substrate according to the present invention, desirably, the auxiliary power-supply lines are arranged in a strip pattern in a direction that intersects the main power-supply lines. By arranging the auxiliary power-supply lines in a strip pattern, the resistance of the power-supply wiring may be reduced.

[0040] For the matrix substrate according to the present invention, desirably, the auxiliary power-supply lines are arranged in a direction that intersects substantially orthogonally the main power-supply lines. By arranging the auxiliary power-supply lines in a direction that intersects substantially orthogonally the main power-supply lines, a desired amount of electrical power may be supplied, in a well-balanced manner, to the electro-optical elements, arranged in two directions perpendicular to each other.

[0041] For the matrix substrate according to the present invention, desirably, the power-supply wiring is arranged so that the electro-optical elements are disposed on the pixel area and the pixel area is sectioned into a plurality of pixel groups each including at least one of the electro-optical elements, and the pixel groups receive power from different power-supply circuits. By supplying electrical power to pixel groups from different power-supply circuits, the power-supply voltage may be corrected, and, as a result, the difference between power-supply circuits may be corrected.

BEST MODE FOR CARRYING OUT THE INVENTION

[0042] [Embodiment 1]

[0043] This embodiment will now be described by referring to the drawings.

[0044] FIG. 1 is a block diagram of an overview of an organic EL display panel. The panel includes a plurality of pixels **10** arranged in a matrix with N rows and M columns. The panel has a pixel area **11** that forms a pixel matrix, an active matrix substrate **100** including scanning line drivers **12-1** and **12-2** that output scanning line signals to each pixel **10**, and ten driver IC chips **14-1** to **14-10** lead-bonded to the outside edges of the active matrix substrate **100**. The driver IC chips **14-1** to **14-10** each include a data line driver that sends data signals to each pixel **10**. The driver IC chips **14-1**, **14-5**, **14-6**, and **14-10**, which are each located on the corners of the active matrix substrate **100**, have power-supply circuits for supplying power to the active matrix substrate **100**. The driver IC chips **14-1** to **14-10** are disposed by tape automated bonding (TAB) enclosed on tape carrier packages **13** with output leads **15** connected to electrode terminals (not shown in the drawings) of the active matrix substrate **100** via anisotropic conductive films. Data signals and electrical power are supplied to the active matrix substrate **100** from the driver IC chips **14-1** to **14-10** via the output leads **15**.

[0045] FIG. 3 is a drawing describing in detail the structure of the power-supply wiring inside the active matrix substrate **100**. For convenience, the pixels **10** are not shown in the drawing. In a preferred embodiment of the present invention, the anode power supply to each pixel **10** is provided by forming on the periphery of the outside edges of the pixel area **11** power supply wiring with a relatively large line thickness (hereinafter referred to as 'basic power-supply lines'), which receives a power-supply voltage from an external power supply and which forms a basic power-supply wiring system for distributing the power-supply voltage to each pixel **10**. Then, from the basic power-supply lines, power-supply wiring with a relatively small line thickness (hereinafter referred to as main power-supply lines), which branches off from the basic power-supply lines in a strip pattern, are densely wired within the pixel matrix. Directly supplying the power-supply voltage from the driver IC chips **14-1**, **14-5**, **14-6**, and **14-10** to each pixel **10** via the output leads **15** using power-supply wiring with a small line thickness causes the resistance of the power-supply wiring of a large area display to become very large and causes the electrical power consumption to increase. However, by forming basic power-supply lines with a relatively low resistance, which are basic lines for supplying power, in the periphery of the outside edges of pixel area **11** and then

supplying power from the basic power-supply lines to each pixel **10** via the main power-supply lines, the wiring resistance of the power-supply wiring can be reduced. Since the amount of electrical power needed for light-emitting of an organic EL element differs for each color, it is desirable to change the line thickness of the basic power-supply line for each color.

[0046] The terms ‘basic power-supply line’ and ‘main power-supply line’ used in this document are used only to distinguish between the two power-supply lines. They are both the same type of power-supply wiring. Therefore, unless otherwise specified, when the term ‘power-supply wiring’ is used, this includes both the basic and the main power-supply lines. This is also true for the term ‘auxiliary power-supply line’ used later.

[0047] The power-supply wiring preferably has, but not limited to, the following arrangement: basic power-supply lines form pairs in the periphery of the outside edges of the pixel area **11**, while the main power-supply lines are wired in strip pattern in a direction that intersects the basic power-supply lines. The desirable location for arranging the basic power-supply lines is the periphery of the outside edges of the pixel area **11**. The location, however, is not limited to this, and the basic power-supply wiring may be arranged inside the pixel area **11**. In the example shown in the above-described drawing, the basic power-supply lines **16-1** to **16-6** are linearly and symmetrically arranged so that the basic power-supply lines **16-1** to **16-3**, which receive power from the driver IC chips **14-1** and **14-6**, are arranged in the vicinity of the outside edge of the pixel area **11** shown on the left side of the drawing, while the basic power-supply lines **16-4** to **16-6**, which receive power from the driver IC chips **14-5** and **14-10**, are arranged in the vicinity of the outside edge of the pixel area **11** shown on the right side of the drawing. In other words, the basic power-supply lines **16-1** and **16-4** are symmetrically arranged, and, similarly, the basic power-supply lines **16-2** and **16-5**, and **16-3** and **16-6** are also symmetrically arranged. The basic power-supply lines **16-1** and **16-4** are power-supply wiring for supplying an anode power to the red organic EL elements and are connected to main power-supply lines V_R , which are formed on the pixel area **11** in the row direction in a strip pattern with equal pitch. Similarly, the basic power-supply lines **16-2** and **16-5** are power-supply wiring for supplying an anode power to the green organic EL elements and are connected to main power-supply lines V_G , which are formed on the pixel area **11** in the row direction in a strip pattern with equal pitch. The basic power-supply lines **16-3** and **16-6** are power-supply wiring for supplying an anode power to the blue organic EL elements, and are connected to main power-supply lines V_B , which are formed on the pixel area **11** in the row direction in a strip pattern with equal pitch. These main power-supply lines V_R , V_G , and V_B are arranged in the pixel area **11** in a direction substantially orthogonal to the basic power-supply lines **16-1** to **16-6**. Specifically, the main power-supply lines V_R , V_G , and V_B are arranged so that they are linearly symmetrical to any row in the pixel matrix.

[0048] In the column direction of the pixel area **11**, data lines X_mR , X_mG , and X_mB ($1 \leq m \leq M$) are arranged to form one group. For convenience, if the N and M are even numbers, the data lines X_mR , X_mG , and X_mB ($m=2i-1$ ($1 \leq i \leq M/2$)) of the odd numbered columns supply the data

signals sent from the driver IC chips **14-1** to **14-5** to the pixels **10** and are arranged from the top to the bottom of the drawing of the active matrix substrate **100**. Conversely, the data lines X_mR , X_mG , and X_mB ($m=2i$ ($1 \leq i \leq M/2$)) of the even numbered columns supply the data signals sent from the driver IC chips **14-6** to **14-10** to the pixels **10** and are arranged from the bottom to the top of the drawing of the active matrix substrate **100**. Furthermore, on the outer sides of the substrate of the basic power-supply lines **16-1** to **16-3** and **16-4** to **16-6**, the scanning line drivers **12-1** and **12-2** are mounted, respectively. Both of the scanning line drivers **12-1** and **12-2** simultaneously drive each of the N number of scanning lines **17-1**, **17-2**, **17-3**, . . . , and **17-N**. In this way, by driving the scanning lines **17-1**, **17-2**, **17-3**, . . . , and **17-N** with a pair consisting of left and right scanning line drivers **12-1** and **12-2**, it is possible to take measures against the disconnection of wires in a large display.

[0049] Although not shown in the above diagram, in the direction perpendicular to the paper surface, a cathode film, which is a common electrode for each pixel **10**, is disposed on the upper layer of the active matrix substrate **100**. It is desirable to compose the cathode of a material that can inject as many electrons as possible, i.e. a material with a small work function. For such a conductive material, a metal thin-film such as calcium, lithium, or aluminum is suitable. The structure described in the above drawing is a so-called bottom-emission structure, which emits light from the active matrix substrate **100** side. The present invention, however, is not limited to this, and the structure may be a so-called top-emission structure, which uses a light-transmitting conductive film as a cathode to emit light. When adopting a top-emission structure, the cathode may be a light-transmitting conductive material such as ITO or a semi-transparent conductive metal thin layer consisting of a metal such as calcium, lithium, or aluminum, which is thin enough to transmit light. Using a semi-transparent conductive metal layer reduces the resistance of the cathode. On the outermost side of the active matrix substrate **100**, there are contacting portions **18-1** and **18-2** for making contact with the cathode.

[0050] FIG. 5 is a block diagram of the main circuit of the pixel **10** located in row n , column m . Taking a close look at the red pixel **10**, this pixel **10** includes a switching transistor $Tr1$, whose gate terminal connects to the scanning line **17-n**, a capacitor C , which maintains the data signal sent from the data line X_mR for one frame period, a light emitting portion OLED composed of an organic EL element, and a driving transistor $Tr2$, which receives power from the main power line V_R and supplies driving power to the light-emitting portion OLED. One pixel is composed of three sub-pixels, R , G , and B . Therefore, in the example described in the above drawing, each pixel needs one scanning line **17-n** and three data lines, X_mR , X_mG , and X_mB . Since large displays have a great number of pixels, using three data lines for one pixel causes the total number of data lines to become enormous. Thus, the present invention preferably has, but not limited to, the following arrangement: analog switches **19** for switching the data signal output from the driver IC chips to data lines, X_mR , X_mG , or X_mB may be provided to reduce the number of data lines from the driver IC chips. The analog switches **19**, however, are not essential and may be provided if required.

[0051] This embodiment is structured so that driver IC chips drive and control the pixels **10**, providing a driver

circuit suitable for a large display panel. Furthermore, on the periphery of the outer edges of the pixel area **11**, the thick basic power-supply lines **16-1** to **16-6** are disposed in the column direction and the thin main power-supply lines are disposed in a strip pattern in the row direction from the basic power-supply lines **16-1** to **16-6** to the pixel area **11**. This structure lowers the resistance of the anode power-supply wiring, providing an electro-optical device suitable for a large display. In the example above, the basic power-supply lines **16-1** to **16-6** are arranged in the column direction, while the main power-supply lines are arranged in the row direction. The present invention, however, is not limited to this arrangement, and the basic power-supply lines **16-1** to **16-6** may be arranged in the row direction, while the main power-supply lines are arranged in the column direction.

[0052] [Embodiment 2]

[0053] **FIG. 4** is an explanatory drawing of the arrangement of power-supply wiring related to a second embodiment according to the present invention. **FIG. 6** is a block diagram showing the main circuit of a pixel **10** located in row *n*, column *m* according to this embodiment. Within the drawing, reference numerals that are the same as **FIGS. 3 and 5** represent the same elements as those of **FIGS. 3 and 5** and the descriptions are omitted. In **FIG. 6**, taking a close look at a red pixel **10**, this pixel **10** includes a switching transistor **Tr1**, whose gate terminal connects to a scanning line **17-(3n-2)**, a capacitor **C**, which maintains a data signal sent from a data line **Xm** for one frame period, a light emitting portion **OLED** composed of an organic EL element, and a driving transistor **Tr2**, which receives power from a main power line V_R and supplies driving power to a light-emitting portion **OLED**. Green and blue pixels **10** also have the same circuit structure, receive power from main power-supply lines V_G and V_B respectively, and have a common data line **Xm**. One pixel is composed of three sub-pixels, **R**, **G**, and **B**. Therefore, in the example shown in the above drawing, each pixel needs three scanning lines **17-(3n-2)**, **17-(3n-1)**, and **17-3n** and one data line **Xm**. In other words, the number of scanning lines of example described in this embodiment is three times more than that of embodiment 1, requiring a driving frequency for scanning line drivers **12-1** and **12-2** three times more than that of the embodiment 1. However, as shown in **FIG. 4**, the number of data lines **Xm** required for this embodiment is $\frac{1}{3}$ of that required for embodiment 1. The basic arrangement of the power-supply wiring of this embodiment is the same as embodiment 1. Therefore, the same effect as in embodiment 1 may be obtained for this embodiment as well.

[0054] [Embodiment 3]

[0055] **FIG. 7** is an explanatory drawing of the arrangement of power-supply wiring related to a third embodiment. In the drawing, only the power-supply wiring is shown and data lines, scanning lines, and cathode contacting portion are not shown to simplify the description. This embodiment is similar to embodiment 1 in that basic power-supply lines **16-1** to **16-3** are arranged in the vicinity of the outside edge of pixel area **11** shown on the left side of the drawing and basic power-supply lines **16-4** to **16-6** are arranged in the vicinity of the outside edge of the pixel area **11** shown on the right side of the drawing. The basic power-supply lines **16-1** and **16-4** are power-supply lines for supplying an anode power supply to red organic EL elements and are connected

to main power-supply lines V_R arranged on the pixel area **11** in the row direction in a strip pattern. Similarly, the basic power-supply lines **16-2** and **16-5** are power-supply lines for supplying an anode power to green organic EL elements and are connected to main power-supply lines V_G arranged on the pixel area **11** in the row direction in a strip pattern. The basic power-supply lines **16-3** and **16-6** are power-supply lines for supplying an anode power to blue organic EL elements and are connected to main power-supply lines V_B arranged on the pixel area **11** in the row direction in a strip pattern.

[0056] Within the pixel area **11**, auxiliary power-supply lines **20-1**, **20-2**, **20-3**, . . . , are further arranged in the column direction so that they intersect the main power-supply lines V_R , V_G , and V_B . The auxiliary power-supply line **20-1** is electrically connected to *n* number of main power-supply lines V_R to reduce the resistance of the power-supply wiring. Also, the auxiliary power-supply lines **20-2** and **20-3** are electrically connected to *n* number of main power-supply lines V_G and V_B , respectively. In this embodiment, the anode power-supply wiring is wired within the pixel area **11** in a matrix to reduce the wiring resistance of the power-supply wiring. As a result, in a large display that uses electrically driven light-emitting elements as light-emitting sources, a uniform current is supplied to each pixel. Thus, an electro-optical device with a high-quality display performance, which enables an even display, is provided.

[0057] [Embodiment 4]

[0058] **FIG. 2** is a block diagram of an overview of an organic EL display panel for describing a fourth embodiment according to the present invention. In this diagram, reference numerals that are the same as in **FIG. 1** represent the same elements as those of **FIG. 1** and the descriptions are omitted. The organic EL display panel includes a pixel area **11** composed of a plurality of pixels arranged in a matrix with *N* rows and *M* columns, an active matrix substrate **100** including scanning line drivers **12-1** and **12-2** that output scanning line signals to each pixel **10**, and ten driver IC chips **14-1** to **14-10** lead-bonded to the periphery of the active matrix substrate **100**.

[0059] The pixel area **11** is sectioned into pixel groups (blocks) **11-1** to **11-10**, which each include a plurality of pixels. These pixel blocks **11-1** to **11-10** receive an anode power-supply from respective driver IC chips **14-1** to **14-10**. In other words, a pixel group **11-k** ($1 < k < 10$) receives an anode power-supply from a driver IC chip **14-k**, enabling uniform and substantial power-supply to a large display panel with a large area. The arrangement of power-supply wiring of each pixel group **11-k** is not limited to this embodiment. For example, as in embodiments 1, 2, and 3 described above, the basic power-supply lines may be arranged in the row and/or column directions, the thin main power-supply lines connected to the basic power-supply lines may be arranged in a strip pattern, and, the auxiliary power-supply lines may be arranged in a matrix to reduce the resistance of the wiring of the anode power-supply, if necessary.

[0060] This embodiment finely adjusts the power-supply voltage of the driver IC chips **14-1** to **14-10** to correct the difference in properties among these driver IC chips. As a result, an electro-optical device suitable for a large display panel with a high quality display performance is provided.

[0061] [Embodiment 5]

[0062] FIG. 8 is a block diagram of an overview of an organic EL display panel for describing a fifth embodiment according to the present invention. In this diagram, reference numerals that are the same as FIG. 1 represent the same elements as those of FIG. 1 and the descriptions are omitted. The organic EL display panel includes a pixel area 11 composed of a plurality of pixels arranged in a matrix with N rows and M columns, an active matrix substrate 100 including scanning line drivers 12-3 to 12-6 that output scanning line signals to each pixel 10, and ten driver IC chips 14-1 to 14-10 lead-bonded to the periphery of the active matrix substrate 100. The left and right scanning line drivers 12-3 and 12-4 make up a pair and simultaneously drive N/2 scanning lines 17-1 to 17-(N/2), which are arranged on the upper half of the screen. The left and right scanning line drivers 12-5 and 12-6 make up another pair and simultaneously drive N/2 scanning lines 17-(N/2+1) to 17-N, which are arranged on the lower half of the screen.

[0063] By adopting the above structure, the scanning line drivers 12-5 and 12-6 drive the scanning lines 17-(j+N/2) while the scanning line drivers 12-3 and 12-4 drive the scanned lines 17-j (1<j<N/2). As a result, the driving frequency for each of scanning line drivers 12-3 to 12-6 may be reduced to 1/2. The value of N is large for a large display, and, therefore, the number of scanning lines that can be scanned for one frame period is limited. By adopting the above structure, however, the driving frequency of the scanning line drivers 12-3 to 12-6 can be reduced so as to be suitable for a large display.

[0064] The arrangement of power-supply wiring within the pixel area 11 may be any arrangement described in the embodiments 1 to 4. The number of scanning lines simultaneously driven is not limited to two lines; it may be 3 lines or more.

BRIEF DESCRIPTION OF THE DRAWINGS

[0065] [FIG. 1] FIG. 1 is a block diagram of an overview of an organic EL display according to embodiment 1.

[0066] [FIG. 2] FIG. 2 is a block diagram of an overview of an organic EL display according to embodiment 4.

[0067] [FIG. 3] FIG. 3 is an explanatory drawing of the arrangement of the power-supply wiring according to embodiment 1.

[0068] [FIG. 4] FIG. 4 is an explanatory drawing of the arrangement of the power-supply wiring according to embodiment 2.

[0069] [FIG. 5] FIG. 5 is block diagram of the main pixel circuit of the pixels according to embodiment 1.

[0070] [FIG. 6] FIG. 6 is block diagram of the main pixel circuit of the pixels according to embodiment 2.

[0071] [FIG. 7] FIG. 7 is a block diagram of an overview of an organic EL display according to embodiment 3.

[0072] [FIG. 8] FIG. 8 is a block diagram of an overview of an organic EL display according to embodiment 5.

REFERENCE NUMERALS

- [0073] 10: pixels
- [0074] 11: pixel area

[0075] 12: scanning line drivers

[0076] 13: tape carrier packages

[0077] 14: driver IC chips

[0078] 15: output leads

[0079] 16: basic power-supply lines

[0080] 17: scanning lines

[0081] 18: cathode contacting portions

[0082] 19: analog switches

[0083] 20: auxiliary power-supply lines

[0084] 100: active matrix substrate

1. An electro-optical device having a pixel area including electro-optical elements driven by power supplied from power-supply circuits, comprising:

basic power-supply lines arranged on the upper portion of a substrate and receiving a power-supply voltage output from the power-supply circuits; and

main power-supply lines arranged on the upper portion of the substrate and intersecting and connecting to the basic power-supply lines;

wherein the electro-optical device supplies the power-supply voltage to the electro-optical elements via the main power-supply lines.

2. The electro-optical device according to claim 1, wherein the main power-supply lines are arranged in a strip pattern in a direction intersecting the basic power-supply lines.

3. The electro-optical device according to claim 1 or 2, wherein the main power-supply lines are substantially orthogonal to the basic power-supply lines.

4. The electro-optical device according to one of claims 1 to 3, wherein the line thickness of the main power-supply lines is smaller than that of the basic power-supply lines.

5. The electro-optical device according to one of claims 1 to 4, wherein the basic power-supply lines are arranged on the outside edges of the pixel area and the main power-supply lines are arranged in a direction intersecting the basic power-supply lines.

6. The electro-optical device according to one of claims 1 to 5, wherein the basic power-supply lines are symmetrically arranged in pairs on the outside edges of the pixel area.

7. The electro-optical device according to one of claims 1 to 6, wherein the main power-supply lines are arranged with substantially equal pitch.

8. The electro-optical device according to one of claims 1 to 7, further comprising auxiliary power-supply lines intersecting the main power-supply lines.

9. The electro-optical device according to claim 8, wherein the auxiliary power-supply lines are arranged in a strip pattern in a direction intersecting the main power-supply lines.

10. The electro-optical device according to claim 8 or 9, wherein the auxiliary power-supply lines are substantially orthogonal to the main power-supply lines.

11. The electro-optical device according to one of claims 1 to 10 having a power-supply wiring arrangement, wherein the electro-optical elements are disposed on the pixel area and the pixel area is sectioned into a plurality of pixel groups

each including at least one of the electro-optical elements, and wherein the pixel groups receive power from different power-supply circuits.

12. The electro-optical device according to one of claims 1 to 11, wherein the power-supply circuits are built-in driver IC chips bonded onto the substrate while enclosed in tape carrier packages.

13. The electro-optical device according to one of claims 1 to 12, further comprising scanning lines for selecting a group of electro-optical elements lined up in one direction and scanning line drivers for simultaneously driving at least two of the scanning lines.

14. The electro-optical device according to claim 12 or 13, further comprising data lines for transmitting data signals regulating the gradation of the light emitted from the electro-optical elements, wherein the data signals are supplied from the driver IC chips.

15. The electro-optical device according to claim 14, further comprising analog switches for switching the data signals sent from the driver IC chips to the data lines.

16. An electro-optical device, comprising electro-optical elements on a substrate driven by receiving power from power-supply circuits, and

external driver circuits on the edges of the substrate for driving and controlling the electro-optical elements,

wherein pixel groups including the electro-optical elements are driven and controlled by respective driver circuits.

17. The electro-optical device according to claim 16, wherein the driver circuits are driver IC chips enclosed in tape carrier packages.

18. The electro-optical device according to claim 17, wherein the driver IC chips are data line drivers.

19. The electro-optical device according to one of claims 1 to 18, wherein the electro-optical elements are electroluminescence elements.

20. An electronic apparatus having the electro-optical device according to one of claims 1 to 19.

21. A matrix substrate having a pixel area for arranging electro-optical elements driven by receiving power supplied from power-supply circuits, comprising:

basic power-supply lines arranged on the upper portion of the substrate and receiving a power-supply voltage output from the power-supply circuits;

main power-supply lines arranged on the upper portion of the substrate and intersecting and connecting to the basic power-supply lines;

wherein the main power-supply lines supply the power-supply voltage to the electro-optical elements.

22. The matrix substrate according to claim 21, wherein the main power-supply lines are arranged in a strip pattern in a direction intersecting the basic power-supply lines.

23. The matrix substrate according to claim 21 or 22, wherein the main power-supply lines are substantially orthogonal to the basic power-supply lines.

24. The matrix substrate according to one of claims 21 to 23, wherein the line thickness of the main power-supply lines is smaller than that of the basic power-supply lines.

25. The matrix substrate according to one of claims 21 to 24, wherein the basic power-supply lines are arranged on the outside edges of the pixel area and the main power-supply lines are arranged in a direction intersecting the basic power-supply lines.

26. The matrix substrate according to one of claims 21 to 25, wherein the basic power-supply lines are symmetrically arranged in pairs on the outside edges of the pixel area.

27. The matrix substrate according to one of claims 21 to 26, wherein the main power-supply lines are arranged with substantially equal pitch.

28. The matrix substrate according to one of claims 21 to 27, further comprising auxiliary power-supply lines intersecting the main power-supply lines.

29. The matrix substrate according to claim 28, wherein the auxiliary power-supply lines are arranged in a strip pattern in a direction intersecting the main power-supply lines.

30. The matrix substrate according to claim 28 or 29, wherein the auxiliary power-supply lines are substantially orthogonal to the main power-supply lines.

31. The matrix substrate according to one of claims 21 to 30 having a power-supply wiring arrangement, wherein the electro-optical elements are disposed on the pixel area and the pixel area is sectioned into a plurality of pixel groups each including at least one of the electro-optical elements, and wherein the pixel groups receive power from different power-supply circuits.

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