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(54) DISPLAY DEVICE, LIGHT EMITTING DEVICE, AND ELECTRONIC EQUIPMENT

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**[7] **G09G 5/00**
(52) **U.S. Cl.** **345/204**

(57) **ABSTRACT**

An AM-OLED display device is provided in which dispersion in OLED element driver currents is sufficiently suppressed is taken as an objective. The present invention places a plurality of transistors into a parallel connection state during write-in of a data current into pixels, and places the plurality of transistors into a series connection state when light emitting elements emit light. As a result, even if dispersions exist between the plurality of transistors structuring a driver element within the same pixel, the influence of the dispersions can be greatly suppressed, and therefore irregularities in the brightness of emitted light across pixels, of an order such that it causes problems in practical use, can be prevented.

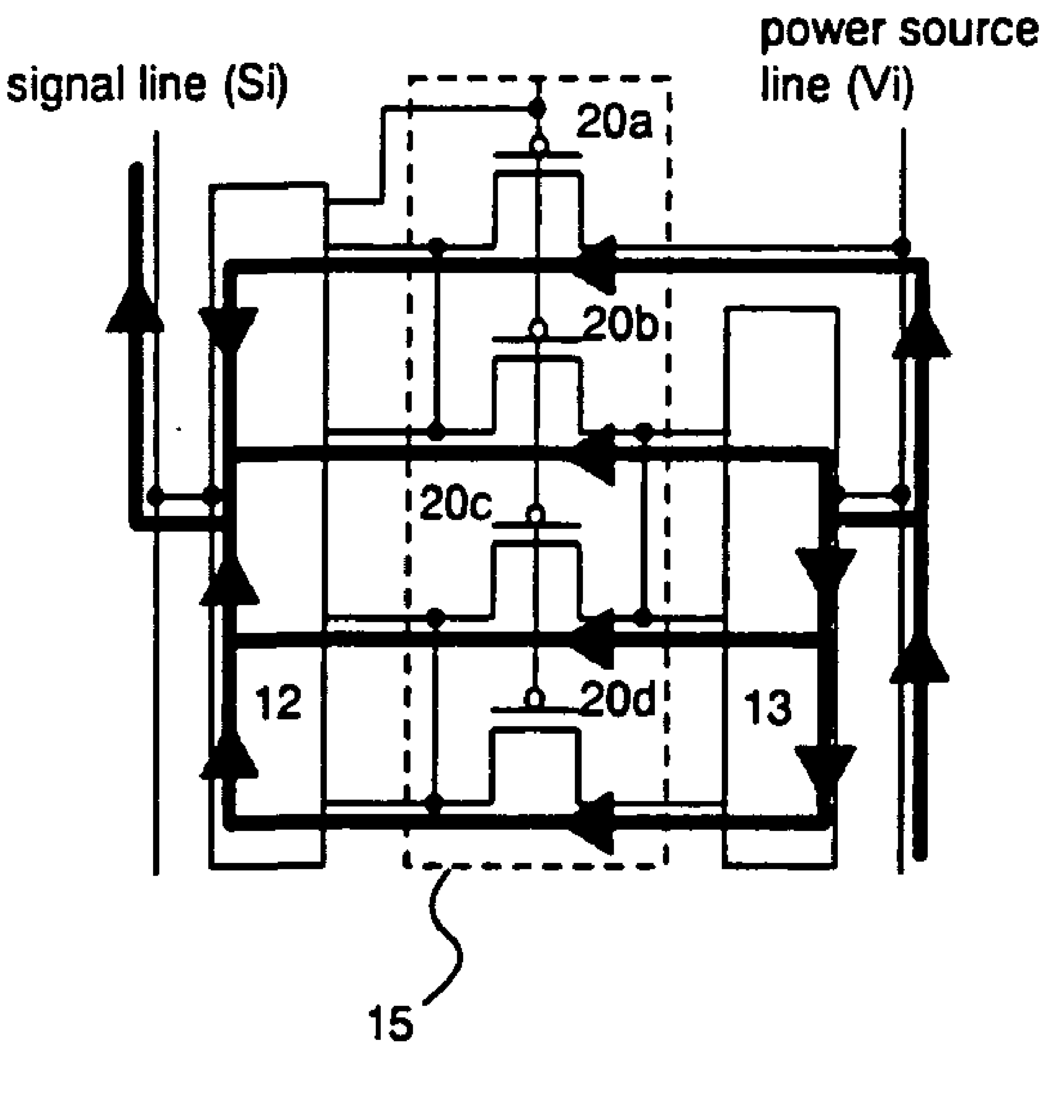


FIG. 1A

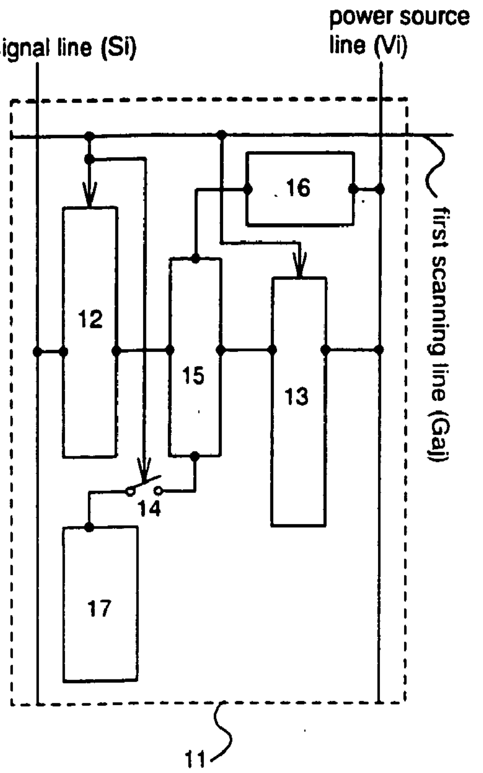


FIG. 1B

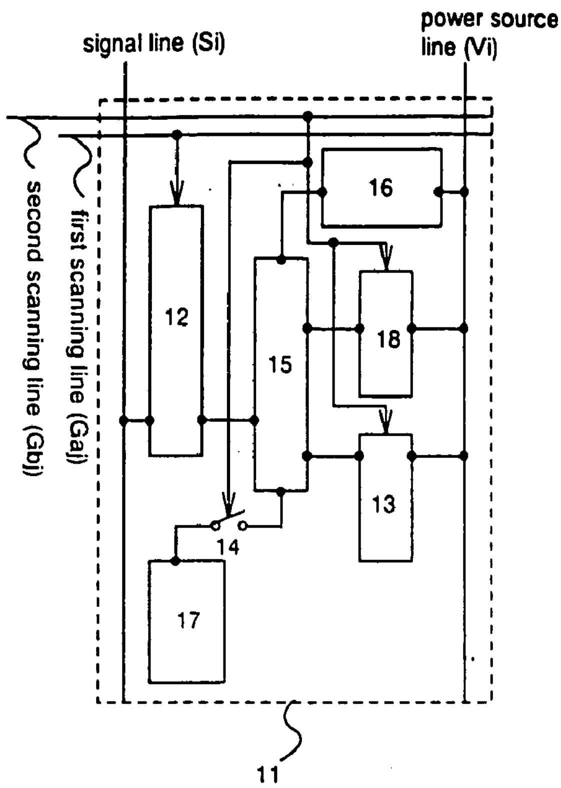


FIG. 1C

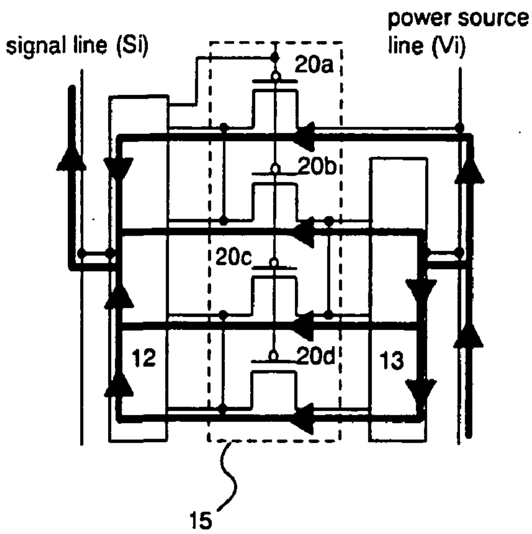


FIG. 1D

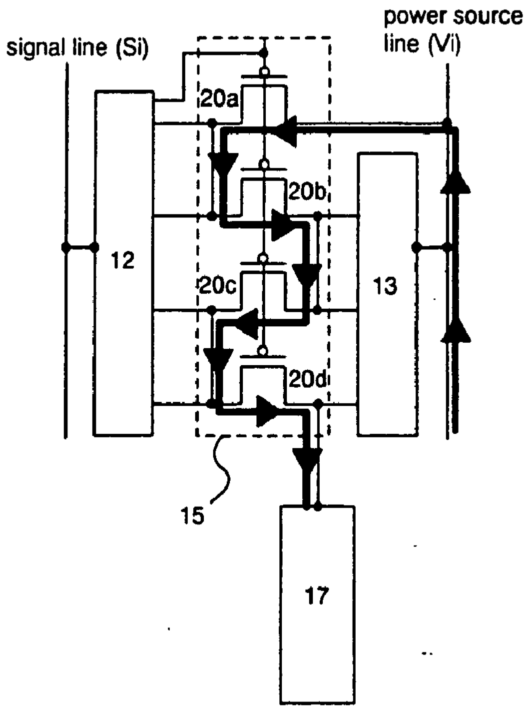


FIG. 2A

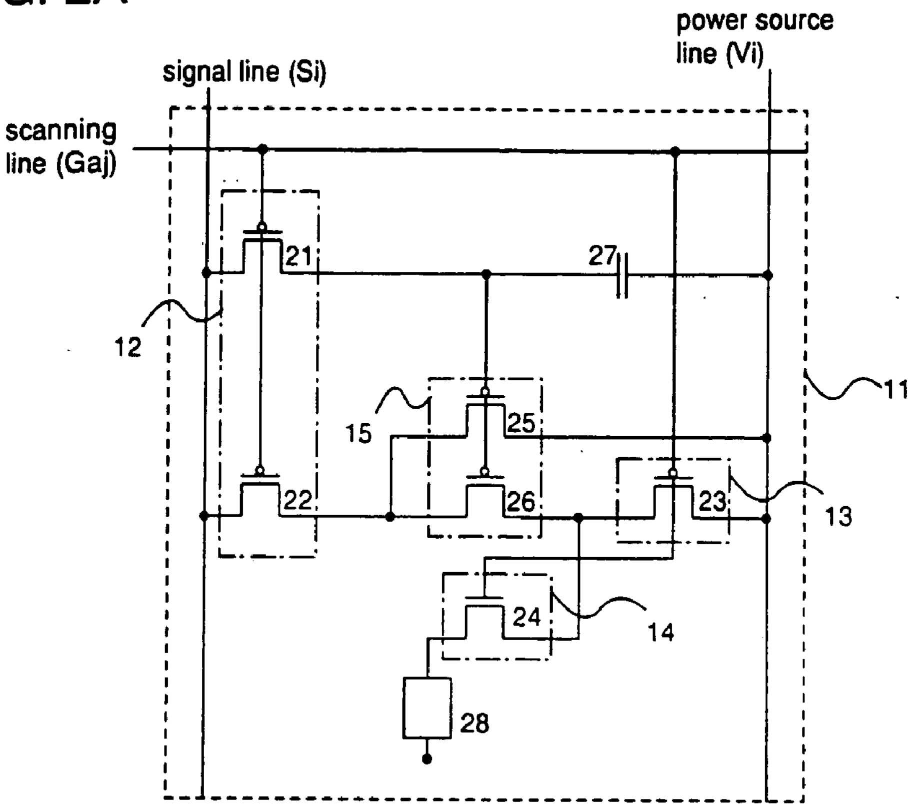

power source
line (Vi)
signal line (Si)
scanning
line (Gaj)
21
27
12
11
15
25
22
26
23
13
24
14
28

FIG. 2B

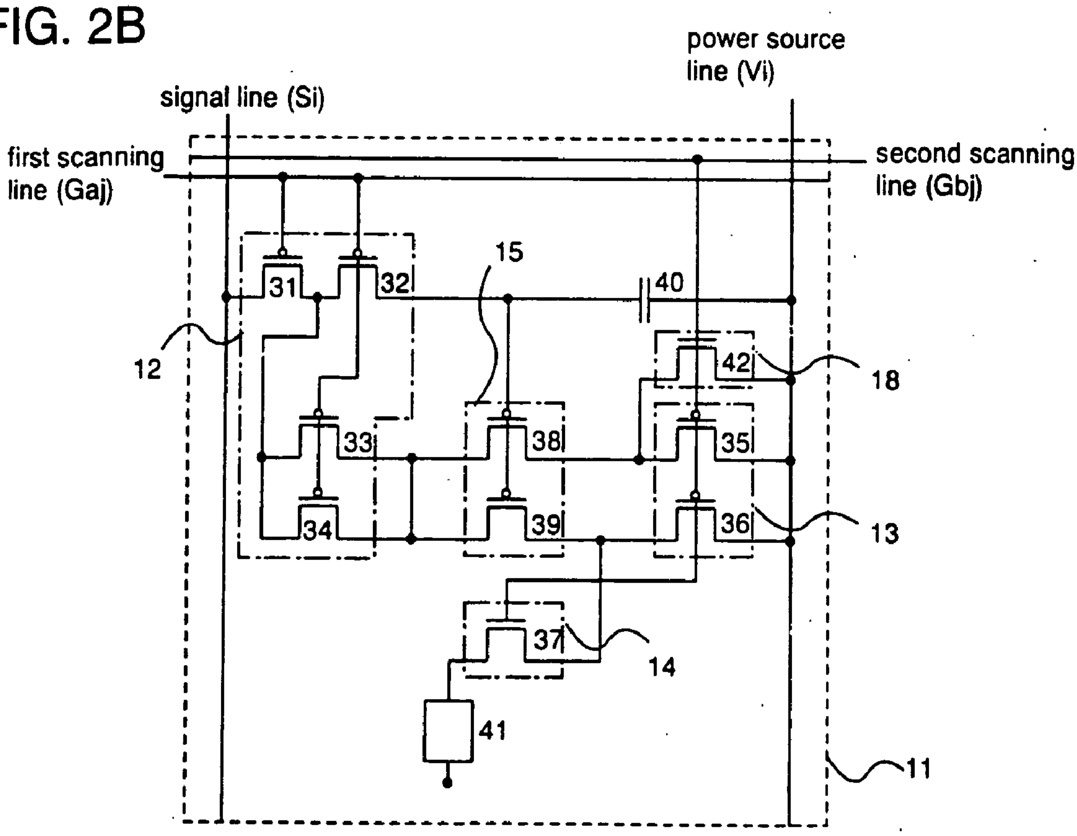

power source
line (Vi)
signal line (Si)
first scanning
line (Gaj)
second scanning
line (Gbj)
15
31
32
40
12
42
18
33
38
35
34
39
36
13
37
14
41
11

FIG. 3A

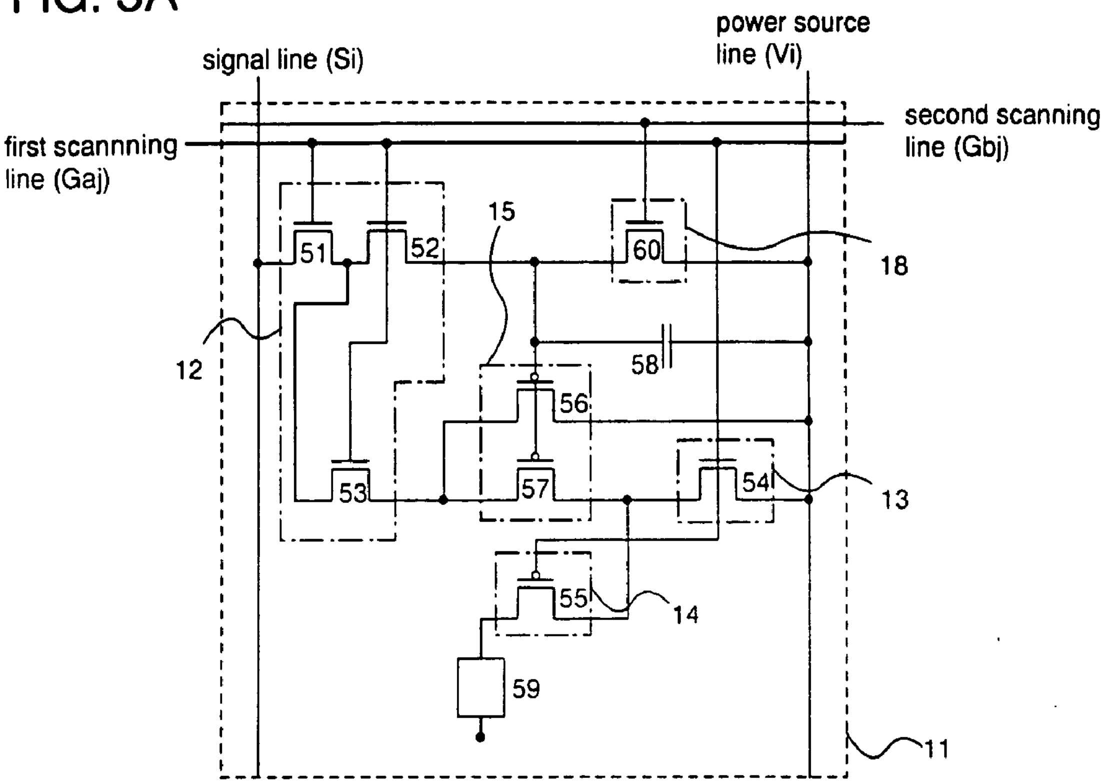

power source
line (Vi)
signal line (Si)
second scanning
line (Gbj)
first scannning
line (Gaj)
15
51
52
60
18
12
58
56
57
53
54
13
55
14
59
11

FIG. 3B

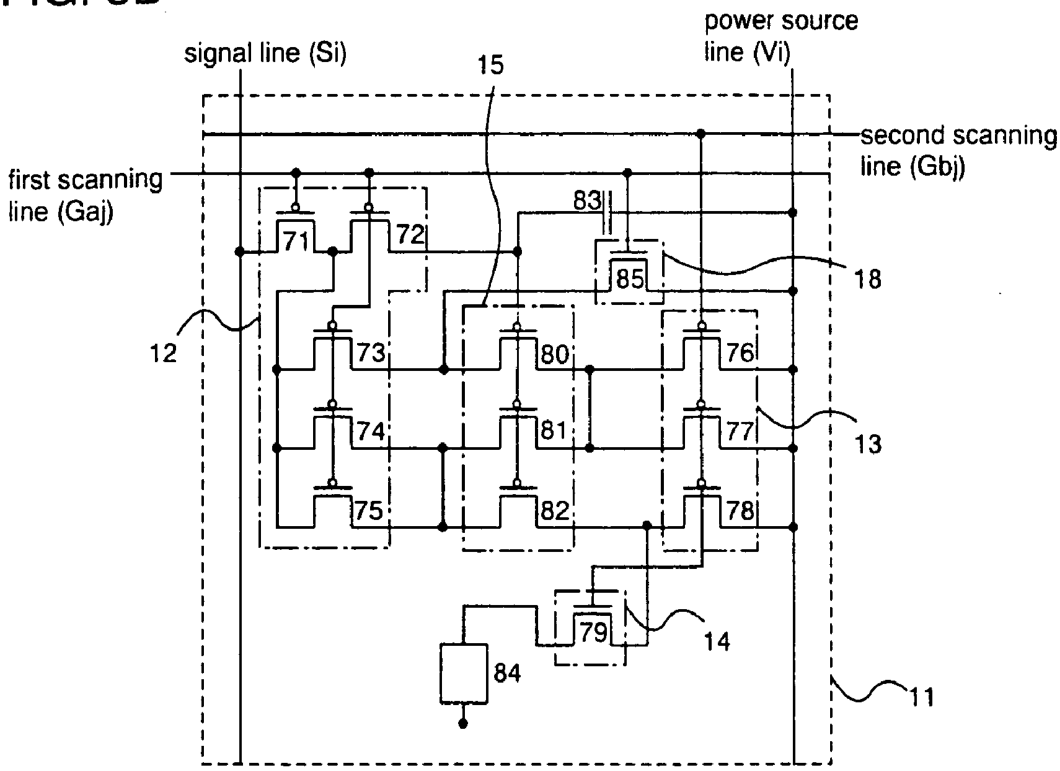
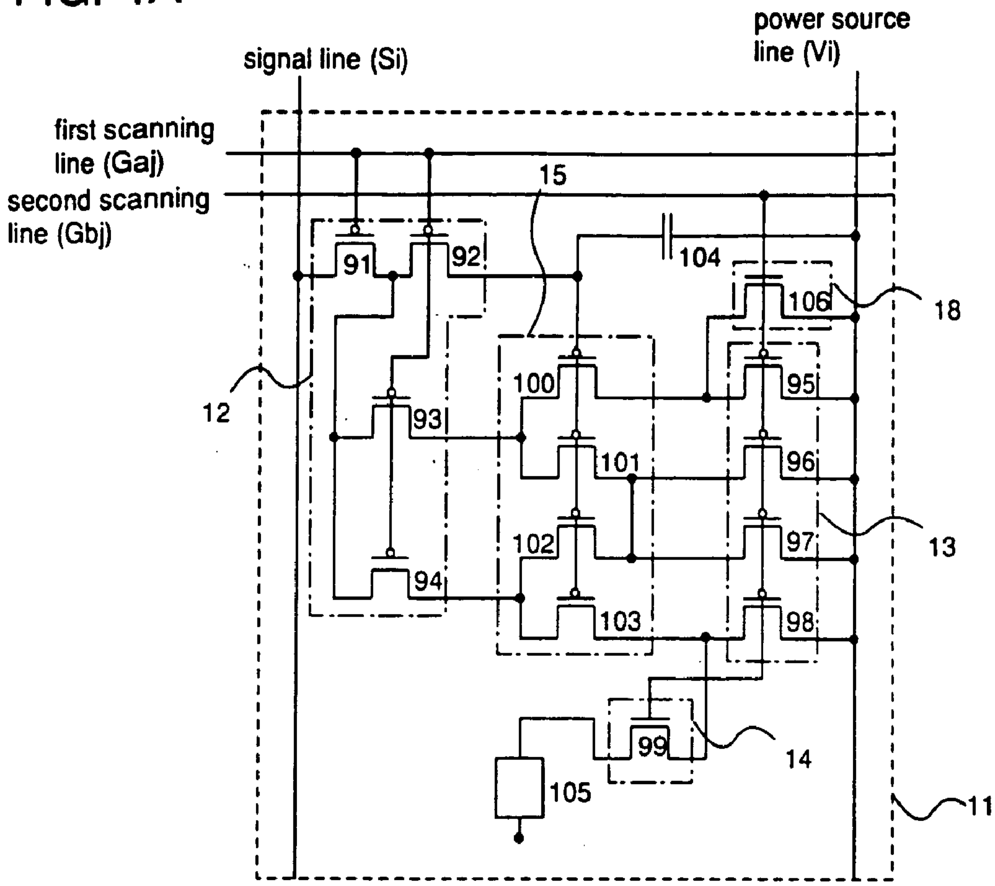
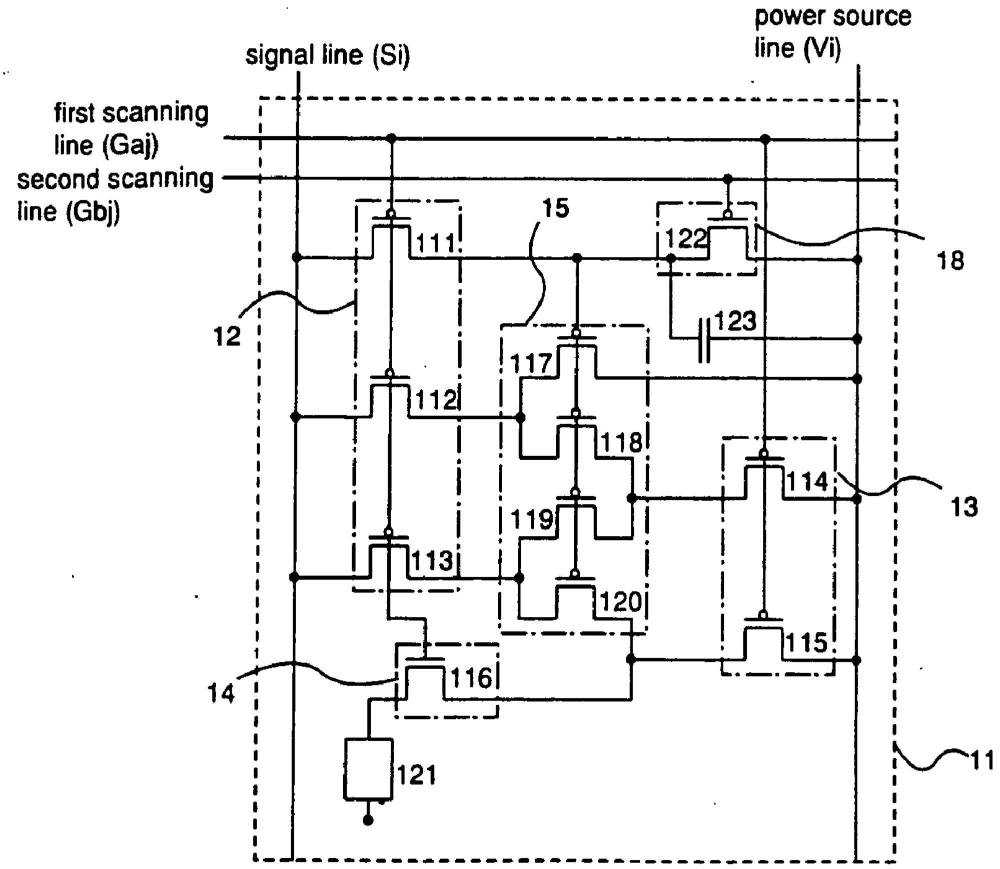

power source
line (Vi)
signal line (Si)
15
second scanning
line (Gbj)
first scanning
line (Gaj)
83
71
72
85
18
12
73
80
76
74
81
77
13
75
82
78
79
14
84
11

FIG. 4A



power source
line (Vi)
signal line (Si)
first scanning
line (Gaj)
second scanning
line (Gbj)
15
104
91
92
106
18
100
95
12
93
101
96
102
97
13
94
103
98
99
14
105
11

FIG. 4B



power source
line (Vi)
signal line (Si)
first scanning
line (Gaj)
second scanning
line (Gbj)
15
111
122
18
12
123
117
112
118
114
13
119
113
120
115
116
14
121
11

FIG. 5A

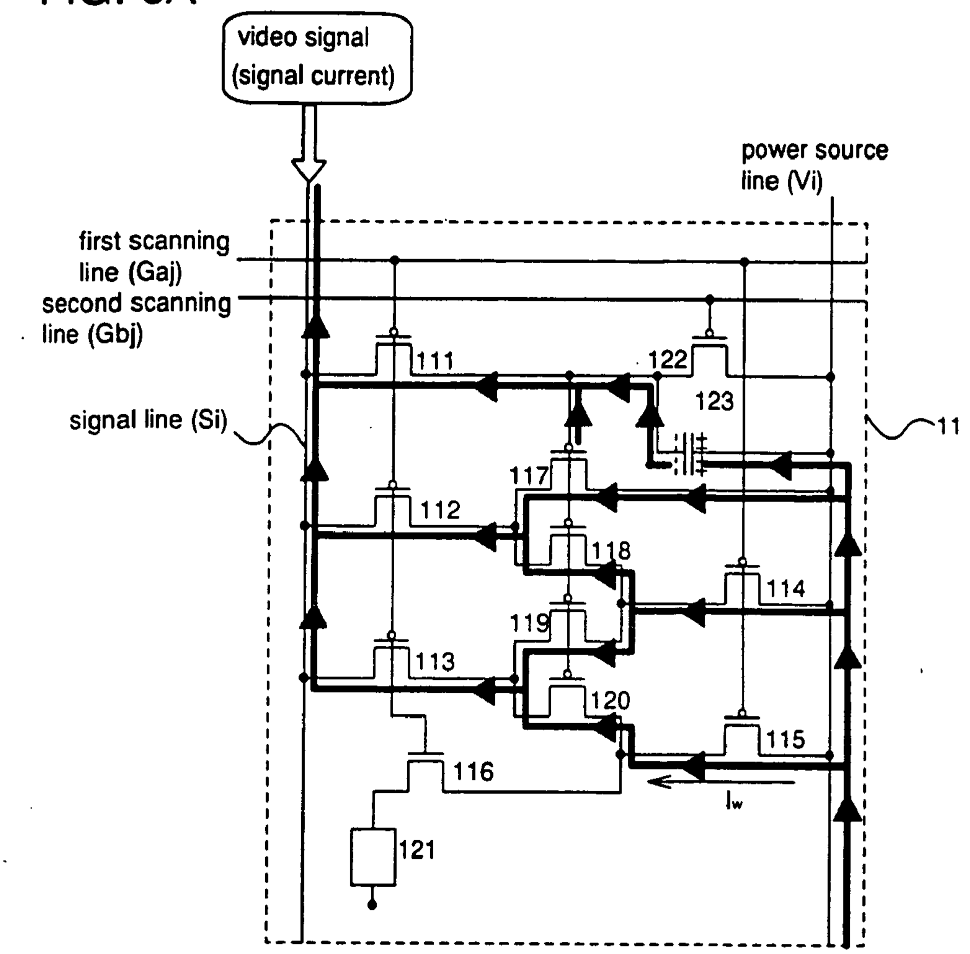

video signal
(signal current)
power source
line (Vi)
first scanning
line (Gaj)
second scanning
line (Gbj)
signal line (Si)
111
122
123
11
117
112
118
114
119
113
120
115
116
Iw
121

FIG. 5B

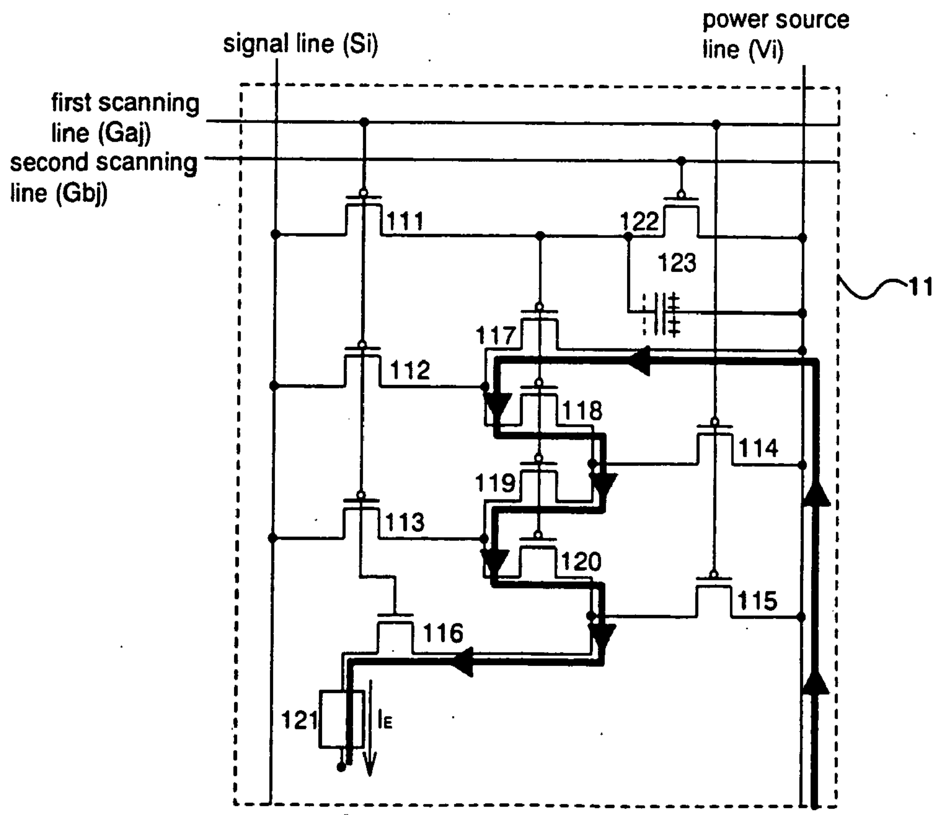

signal line (Si)
power source
line (Vi)
first scanning
line (Gaj)
second scanning
line (Gbj)
111
122
123
11
117
112
118
114
119
113
120
115
116
121
IE

FIG. 6

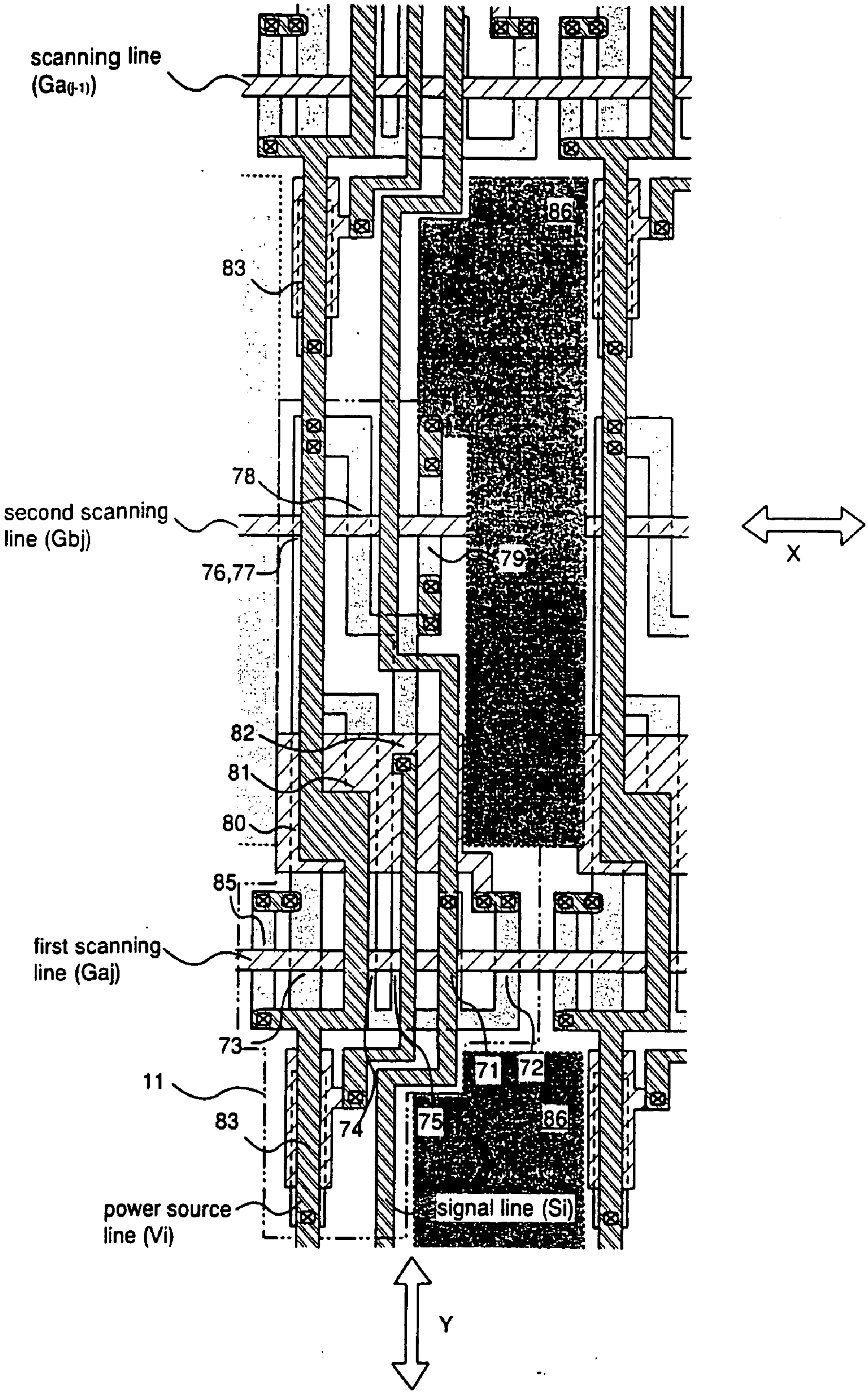

scanning line (Ga(j-1))
83
86
78
second scanning line (Gbj)
76,77
79
X
82
81
80
85
first scanning line (Gaj)
73
11
83
71
72
74
75
86
power source line (Vi)
signal line (Si)
Y

FIG. 7A

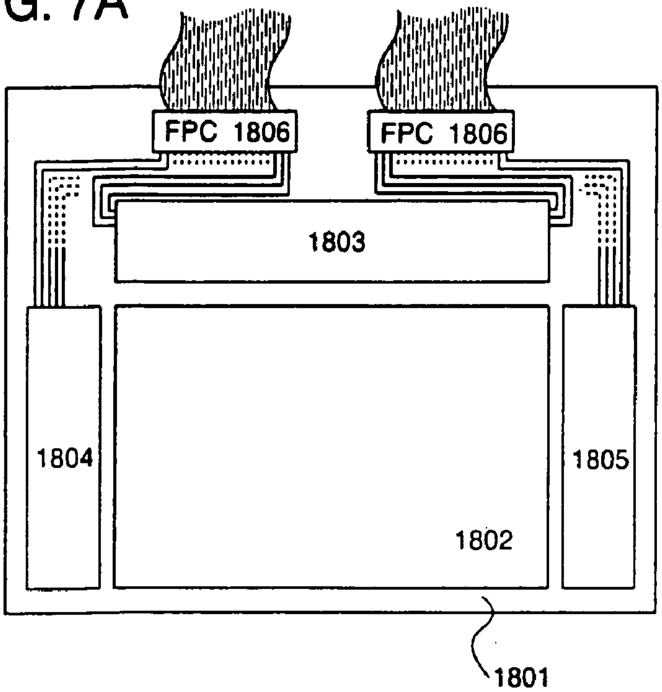


FIG. 7B

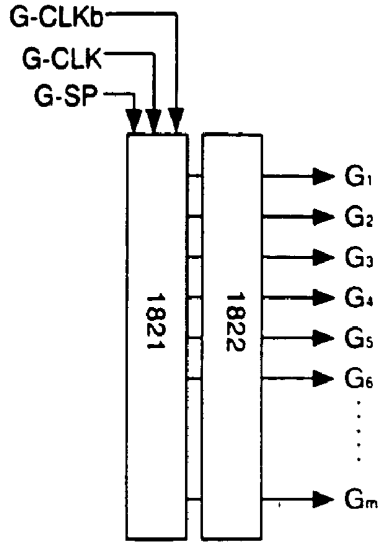


FIG. 7C

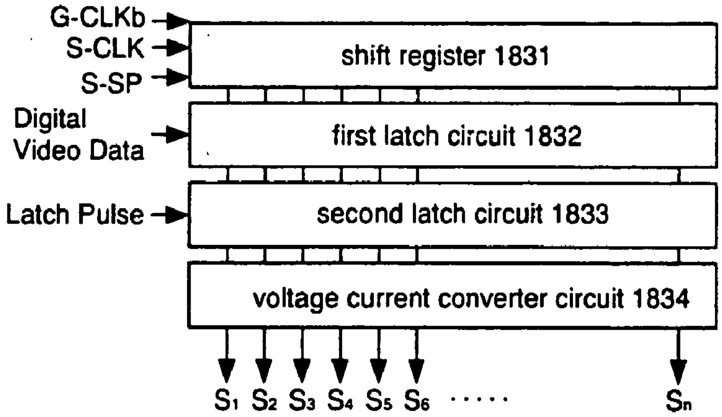


FIG. 8A

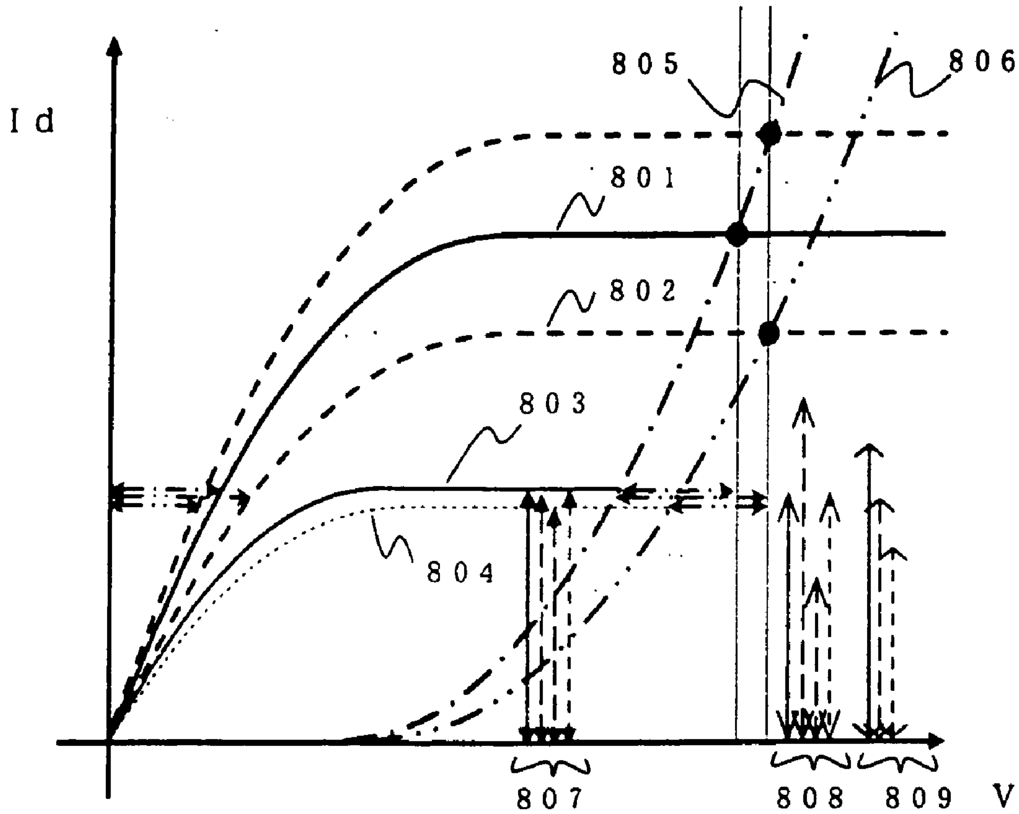

I d
805
806
801
802
803
804
807
808
809
V d

FIG. 8B

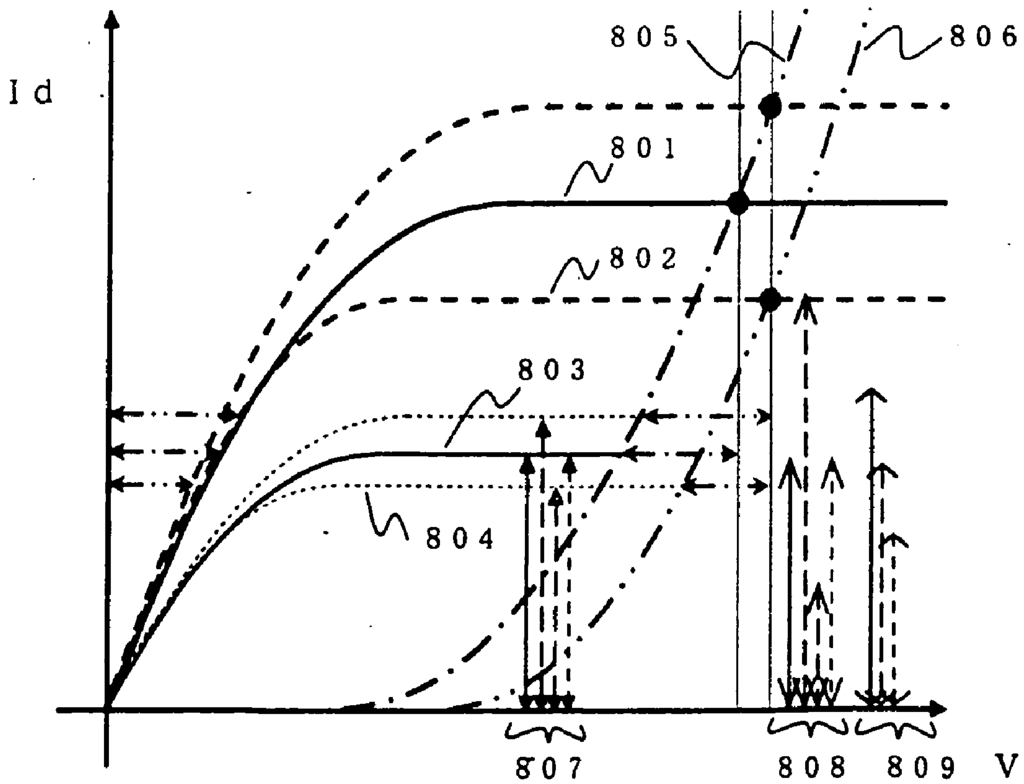

I d
805
806
801
802
803
804
807
808
809
V d

FIG. 9A

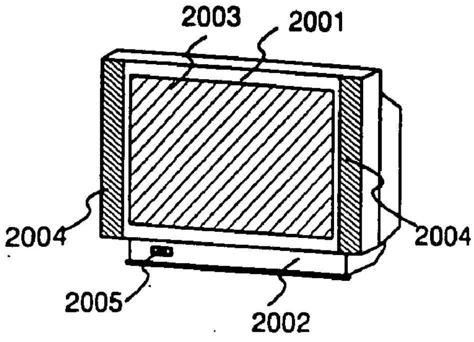


FIG. 9B

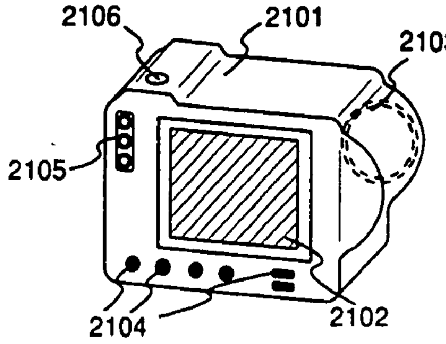


FIG. 9C

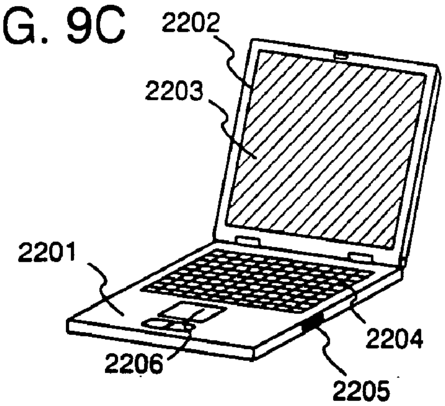


FIG. 9D

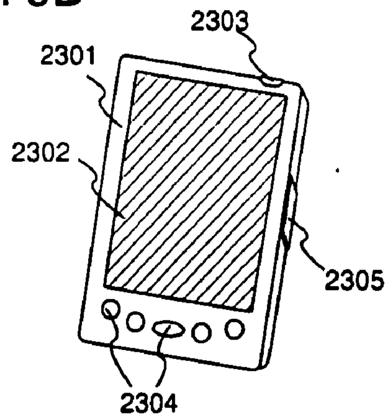


FIG. 9E

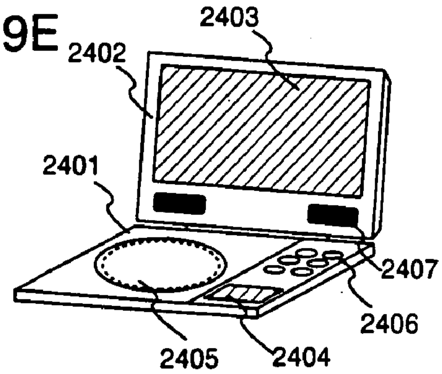


FIG. 9F

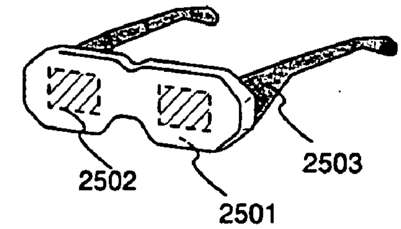


FIG. 9G

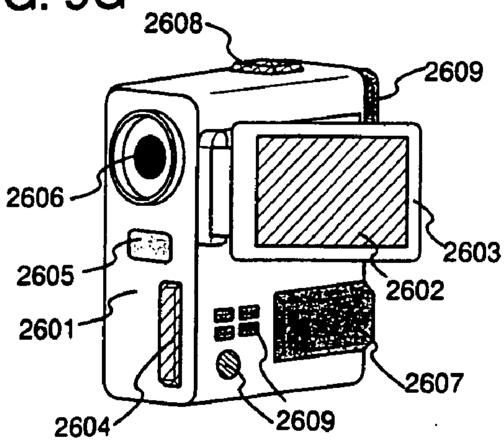


FIG. 9H

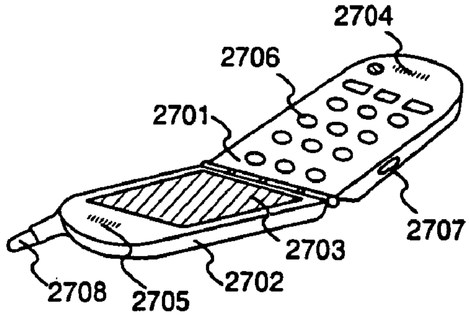


FIG. 10A Prior Art

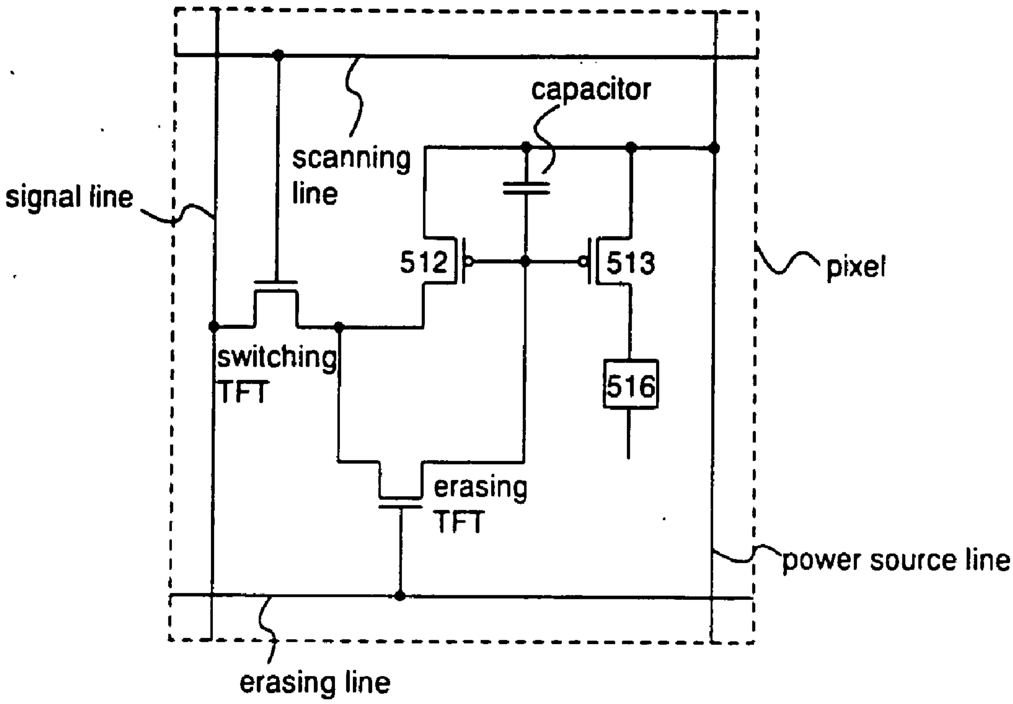


FIG. 10B Prior Art

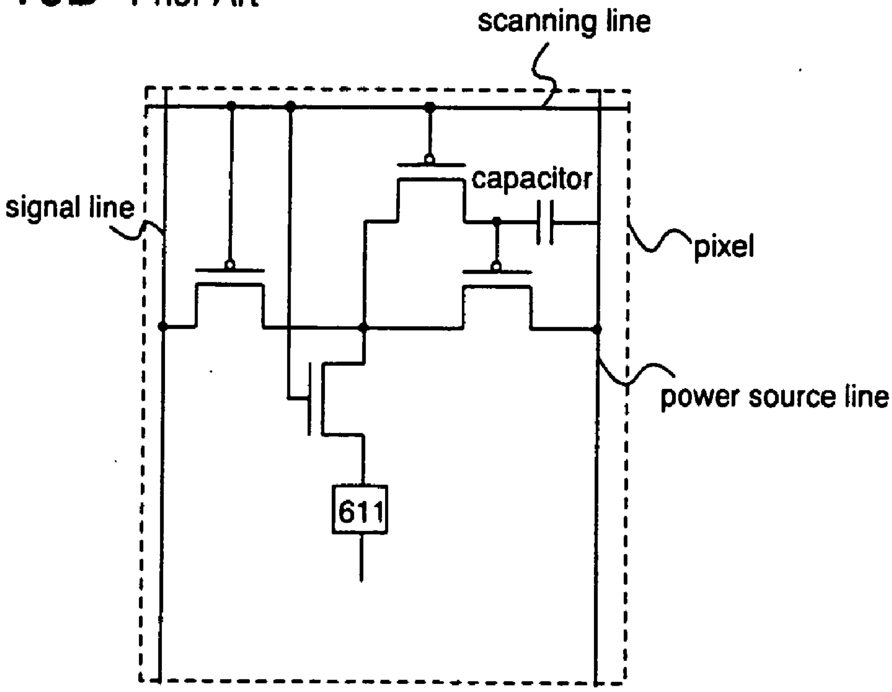


FIG. 11A

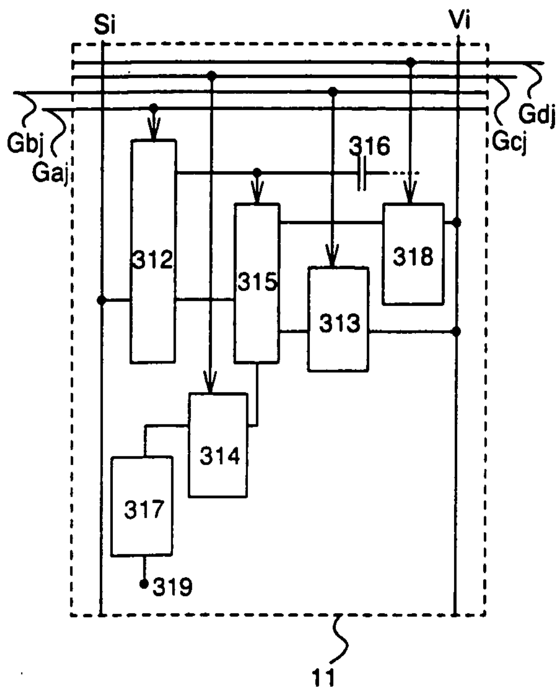


FIG. 11B

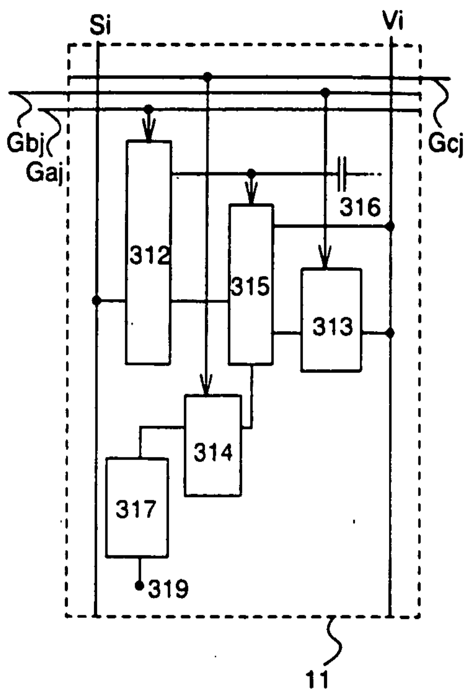


FIG. 11C

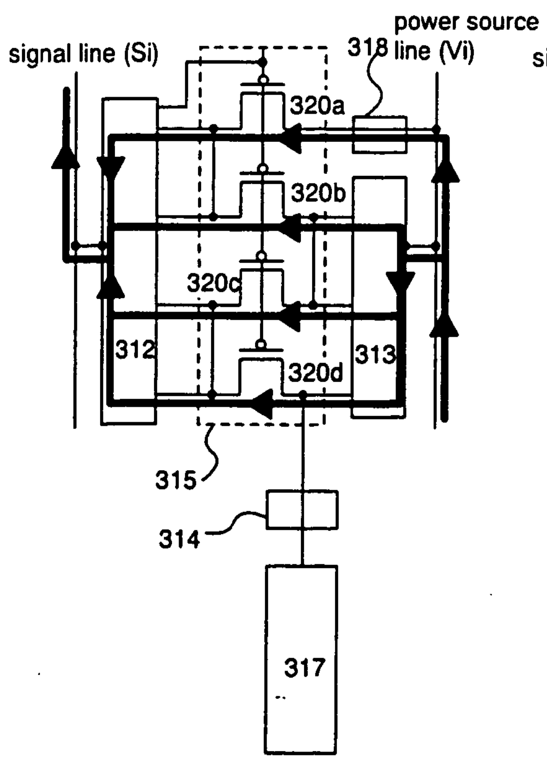


FIG. 11D

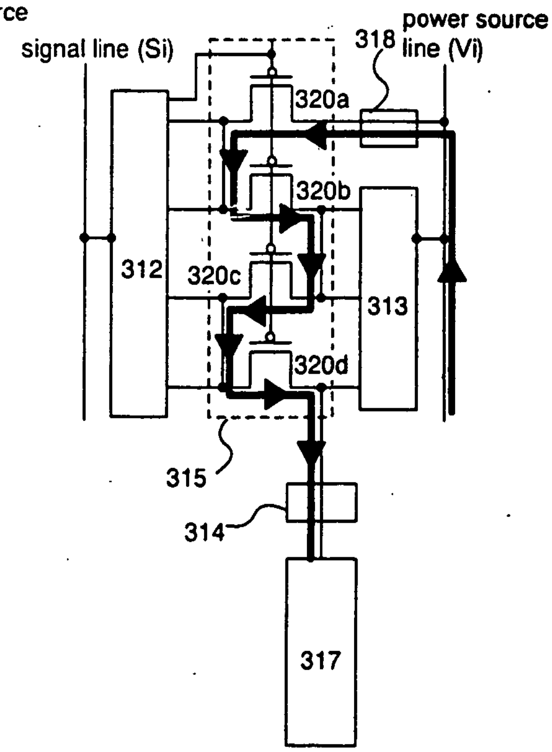


FIG. 12A

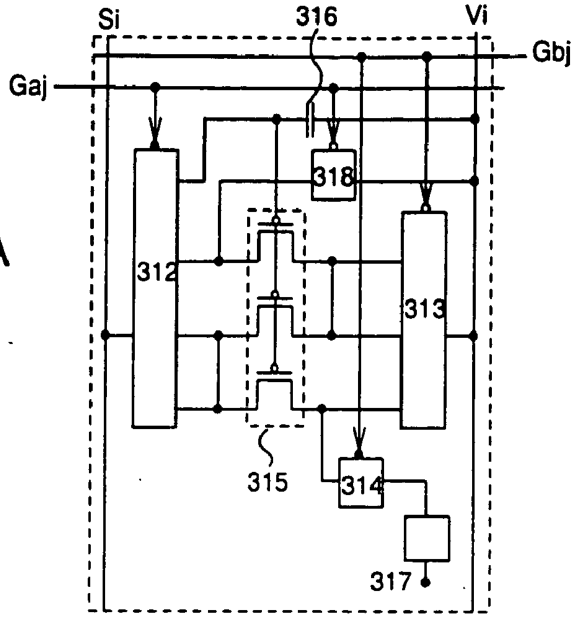


FIG. 12B

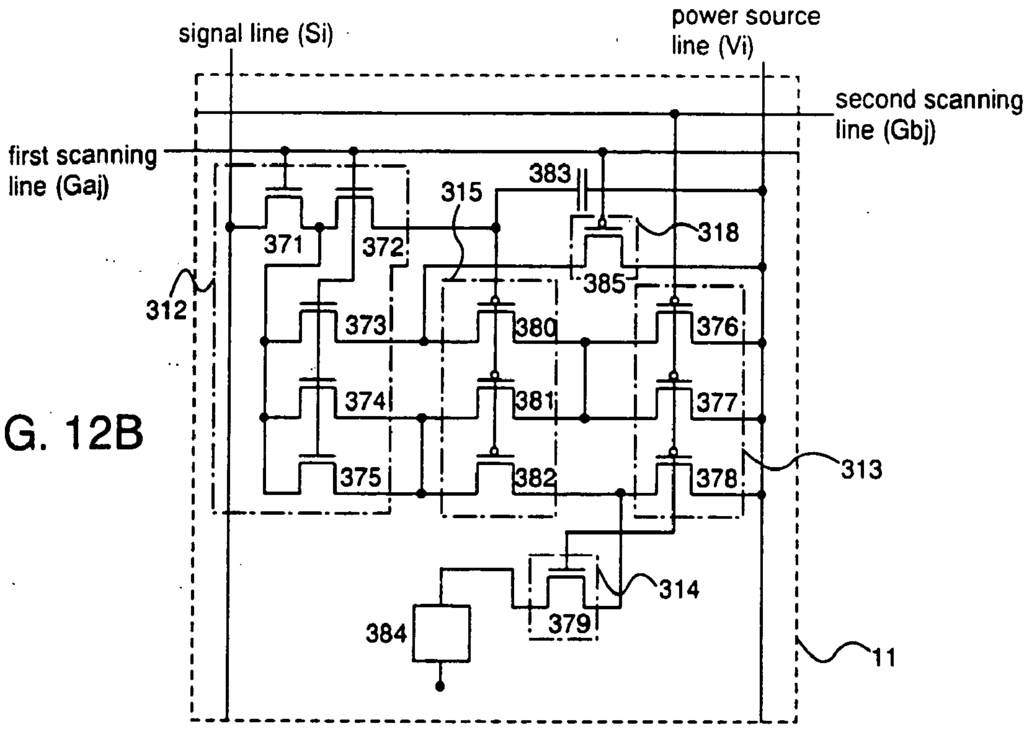


FIG. 12C

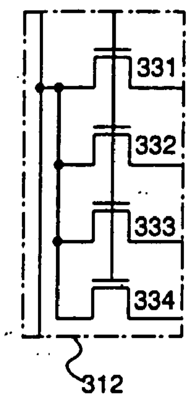


FIG. 12D

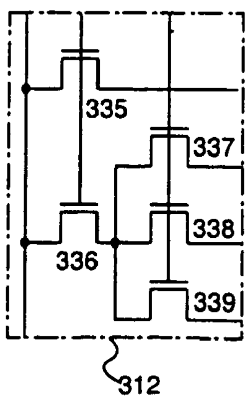


FIG. 12E

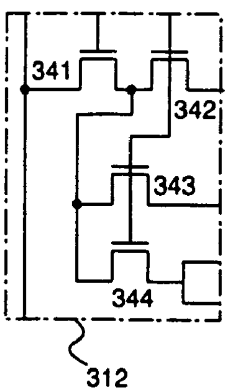


FIG. 13A

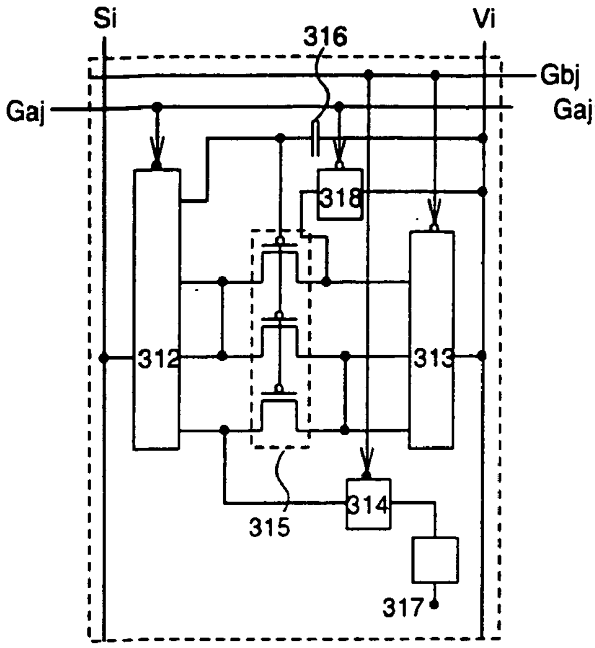


FIG. 13B

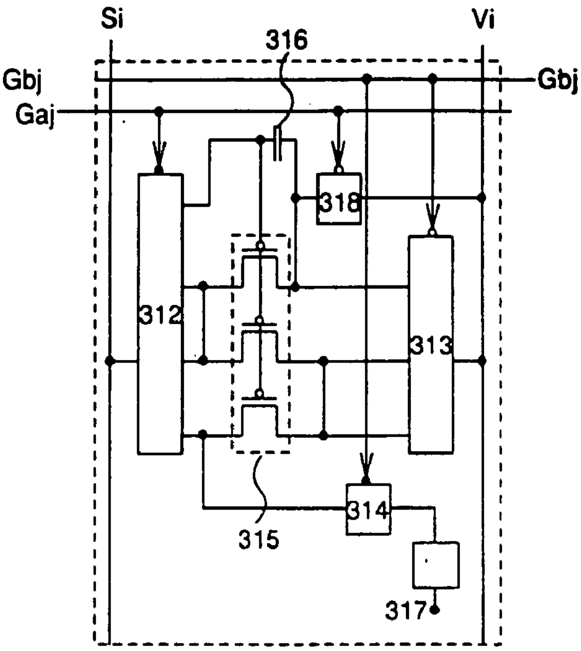


FIG. 13C

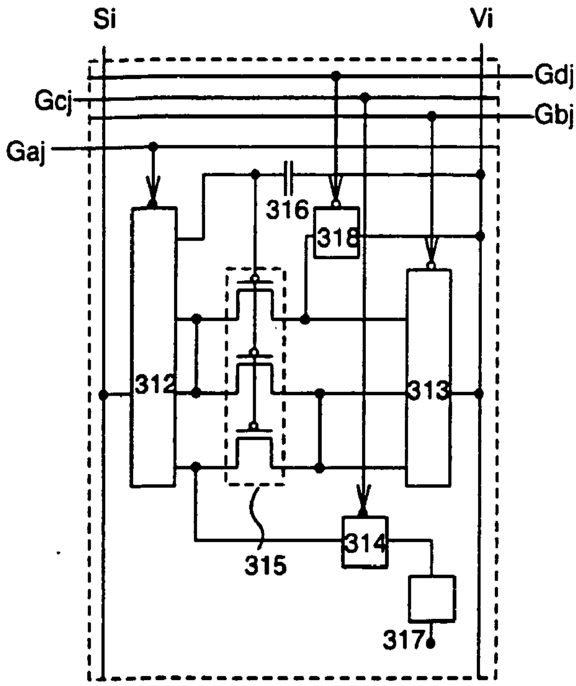


FIG. 13D

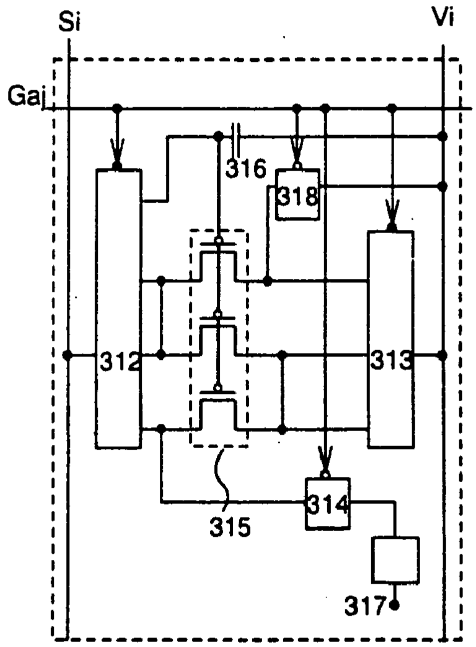


FIG. 14A

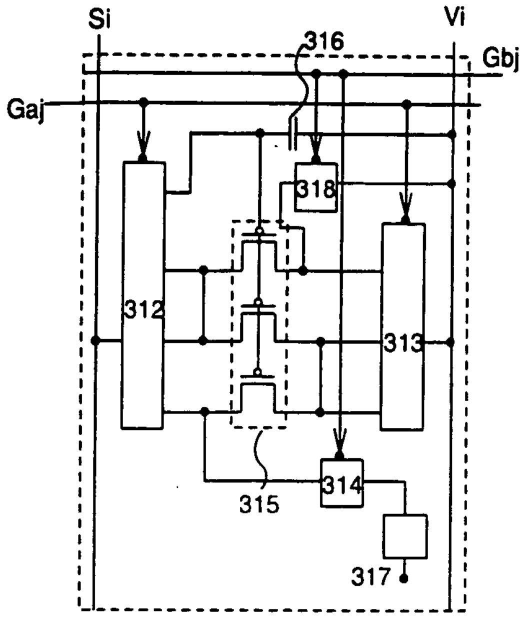


FIG. 14B

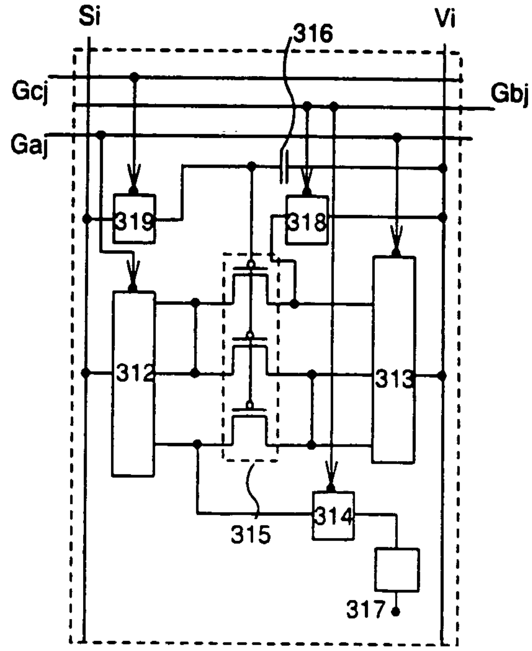


FIG. 14C

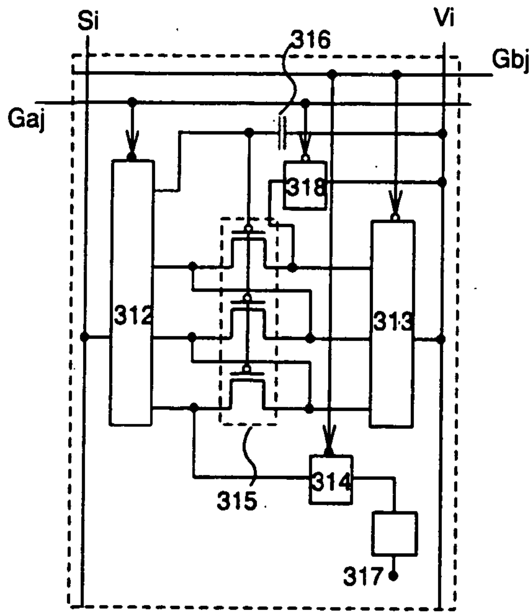


FIG. 15A

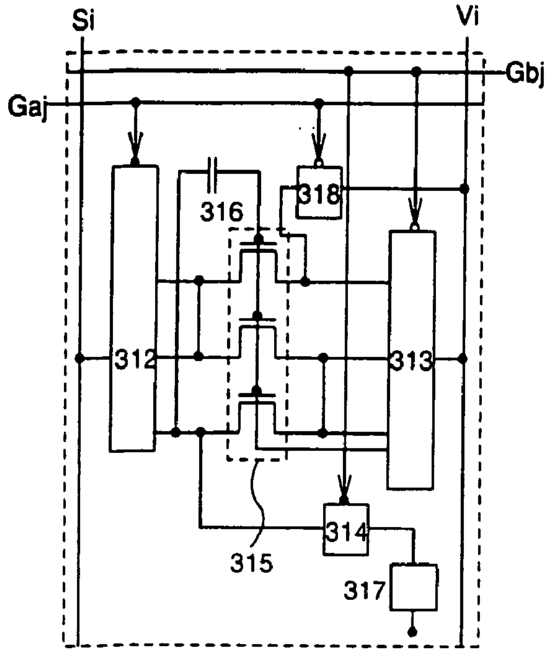


FIG. 15B

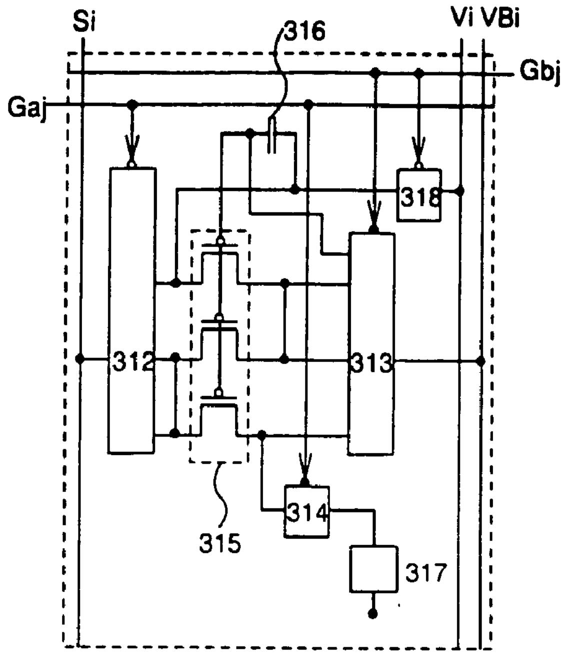


FIG. 15C

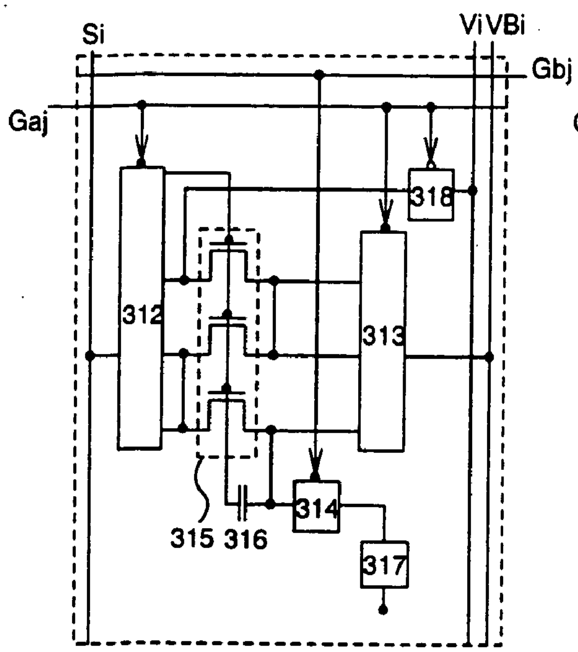


FIG. 15D

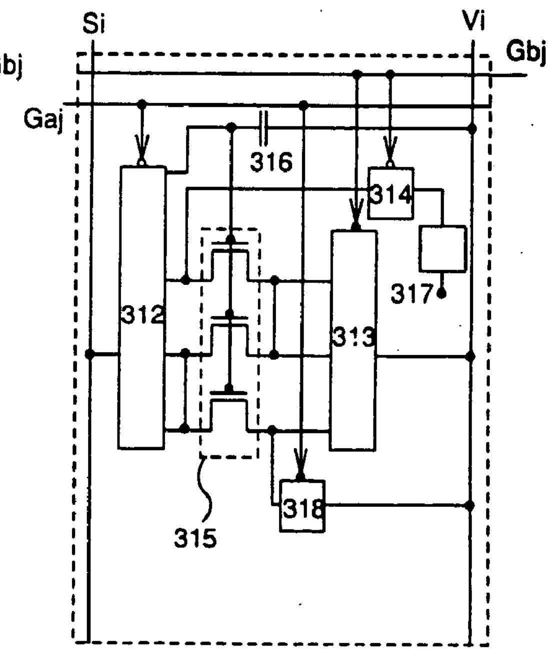


FIG. 16

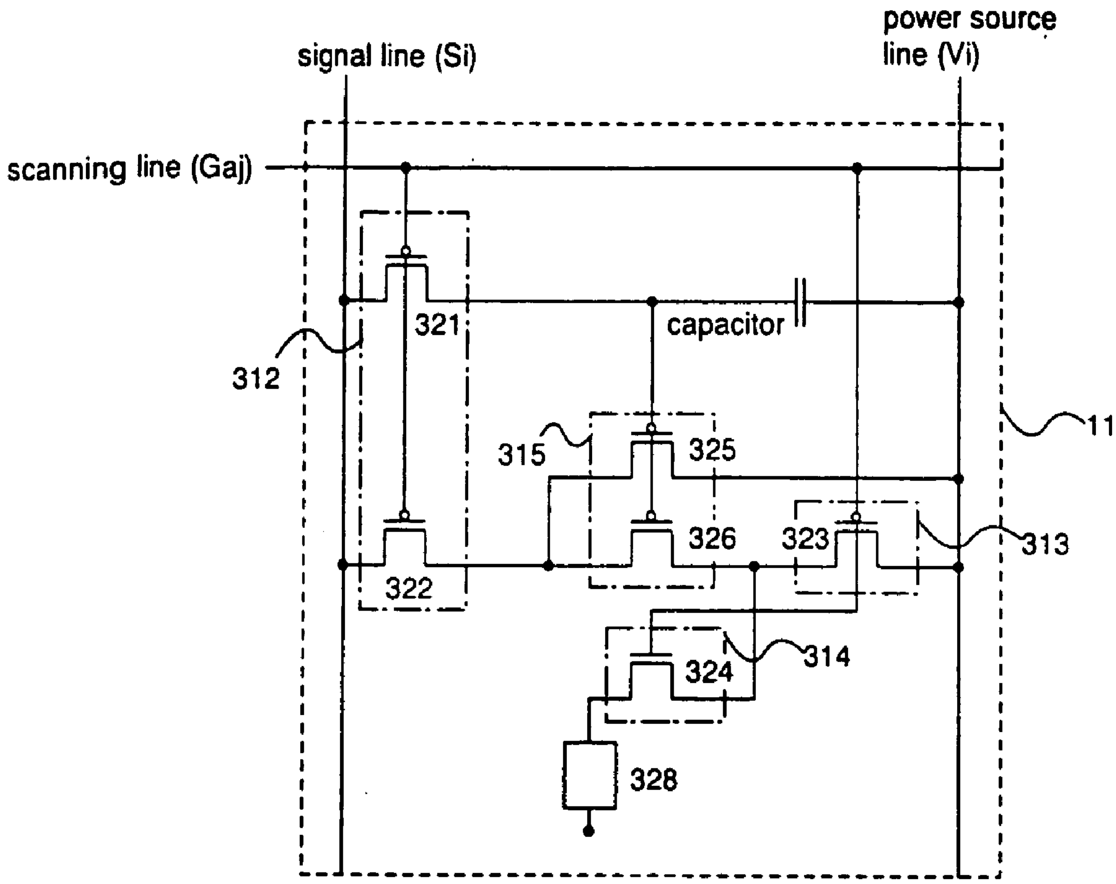

signal line (Si)
power source line (Vi)
scanning line (Gaj)
321
capacitor
312
11
315
325
326
323
313
322
324
314
328

FIG. 17A

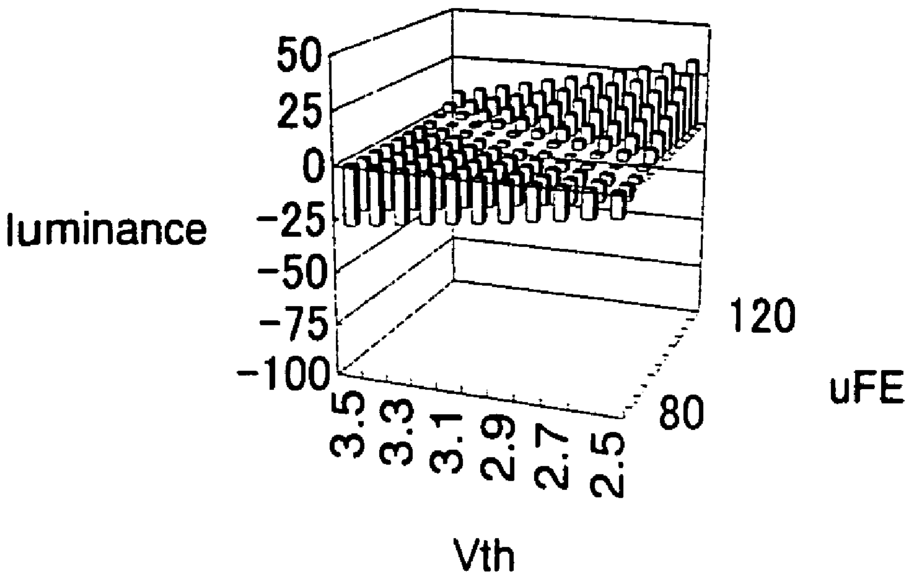
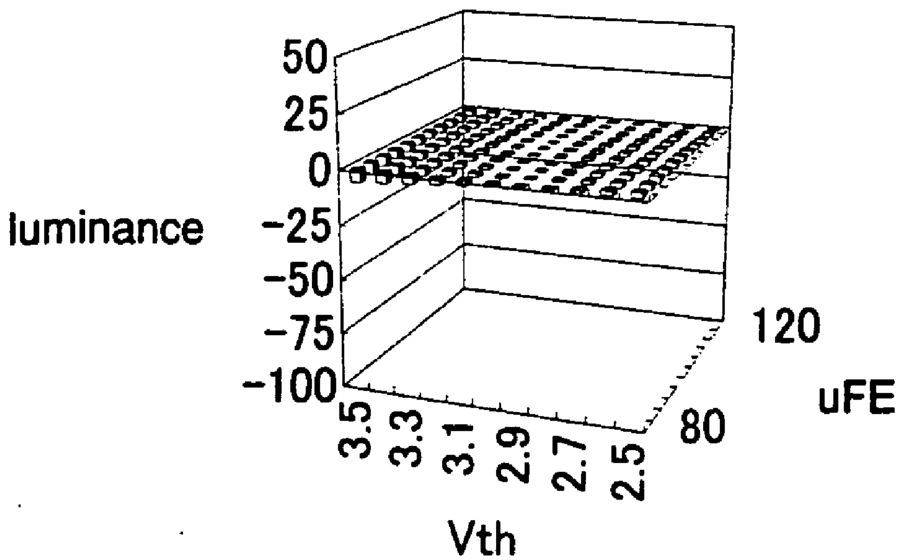


FIG. 17B



DISPLAY DEVICE, LIGHT EMITTING DEVICE, AND ELECTRONIC EQUIPMENT

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a light emitting device and to a display device. In addition, the present invention relates to electronic equipment in which the light emitting device or the display device is mounted. The term light emitting device as used in this specification indicates devices that utilize light emitted from a light emitting element. Examples of the light emitting elements include organic light emitting diode (OLED) elements, inorganic material light emitting diode elements, field emission light emitting elements (FED elements) and the like. The term display device as used in this specification indicates devices in which a plurality of pixels are arranged in a matrix shape, and image information is visually transmitted, namely displays.

[0003] 2. Description of the Related Art

[0004] The importance of display devices that perform display of images and pictures has continued to increase in recent years. Due to their advantages such as high image quality, thin size, and light weight, liquid crystal display devices that perform display of an image by using liquid crystal elements are widely utilized in various types of display devices, such as portable telephones and personal computers.

[0005] On the other hand, the development of display devices and light emitting devices that use light emitting elements is also advancing. Elements that use many different types of materials over a wide-ranging area, such as organic materials, inorganic materials, thin film materials, bulk materials, and dispersed materials exist as light emitting elements.

[0006] Organic light emitting diodes (OLEDs) are typical light emitting elements currently seen as promising for all types of display devices. OLED display devices that use OLED elements as light emitting elements are thinner and lighter than existing liquid crystal display devices, and in addition, have characteristics such as high response speed suitable for dynamic image display, a wide angle of view, and low voltage drive. A wide variety of applications are therefore anticipated, from portable telephones and portable information terminals (PDAs) to televisions, monitors, and the like. OLED display devices are under the spotlight as next generation displays.

[0007] In particular, active matrix (AM) OLED display devices are capable of high resolution (large number of pixels), high definition (fine pitch), and a large screen display, all of which are difficult for passive matrix (PM) type displays. In addition, AM-OLED display devices have high reliability at lower electric power consumption operation than that of passive matrix OLEDs, and there are very strong expectations that they will be put into practical use.

[0008] OLED elements are structured by an anode, a cathode, and an organic compound containing layer sandwiched between the anode and the cathode. Normally the brightness of light emitted from the OLED element is roughly proportional to the amount of electric current flowing in the OLED element. A driver transistor that controls the light emission brightness of a pixel OLED element is inserted in series with the OLED element in AM-OLED display device pixels.

[0009] Voltage input methods and current input methods exist as driving methods for displaying images in AM-OLED display devices. The voltage input method is a method in which a voltage value data video signal is input to the pixels as an input video signal. On the other hand, the current input method is a method in which a current value video signal is input to the pixels as an input video signal.

[0010] The video signal voltage is normally applied directly to a gate electrode of a pixel driver transistor in the voltage input method. If there is dispersion, not uniformity, in the electrical characteristics of the driver transistors across each of the pixels when the OLED elements emit light at a constant current, then dispersion will develop in the OLED element driver current of each of the pixels. Dispersion in the OLED element driver current becomes dispersion in the brightness of light emitted from the OLED elements. Dispersion in the brightness of light emitted by the OLED elements reduces the quality of the displayed image as a sandstorm state or carpet-like pattern unevenness is seen over an entire screen. Stripe shape unevenness is also found, depending upon the manufacturing process.

[0011] In particular, a relatively large electric current is necessary in order to obtain a sufficiently high brightness when OLED elements presently capable of being used, which have low light emission efficiency, are applied as a light emitting device. As a result, it is difficult to use amorphous silicon thin film transistors (TFTs), which have low current capacity, as the driver transistors. Polycrystalline silicon (polysilicon) TFTs are therefore used as the driver transistors. However, there is a problem with polysilicon in that dispersions in the TFT electrical characteristics are likely to develop due to causes such as faults in the crystal grain boundaries.

[0012] The current input method can be used as one effective means in order to prevent dispersion in the OLED element driver current that occurs in this type of voltage input method. A video signal data current value is normally stored with the current input method, and an electric current identical to, or several times as large as, the value of the stored electric current (positive real number multiples, including those less than 1) is supplied as the OLED element driver current.

[0013] A typical known example of a pixel circuit of a current input method AM-OLED display device is shown in **FIG. 10A** (refer to Non-Patent Document 1). Reference numeral **516** denotes an OLED element. This pixel circuit uses a current mirror circuit. Video signal data current values can be accurately stored as long as two transistors structuring the current mirror have identical electrical characteristics. Even if there is dispersion in the electrical characteristics of the driver transistors of different pixels, dispersion in the brightness of light emitted by the OLED elements can be prevented as long as the two transistors within the same pixel each have identical electrical characteristics.

[0014] Another typical known example of a pixel circuit of a current input method AM-OLED display device is shown in **FIG. 10B** (refer to Non-Patent Document 2).

Reference numeral **611** denotes an OLED element. This pixel circuit has a short circuit between a drain electrode, and a gate electrode, of a driver transistor itself when a voltage corresponding to a video signal is written into the gate electrode of the driver transistor: A video signal data current is made to flow in this state, and the gate electrode is then electrically insulated. By doing so, an electric current having a value identical to the data current during write-in is supplied to the OLED element by the driver transistors, provided that the driver transistors are operated in the saturated region. Dispersion in the brightness of light emitted by the OLED elements can therefore be prevented, even if dispersion exists in the electrical characteristics of the driver transistors of each pixel.

[0015] [Non-Patent Document 1] Yumoto, A., et al., Proc. Asia Display/IDW '01, pp. 1395-1398 (2001).

[0016] [Not-Patent Document 2] Hunter, I. M., et al., Proc. AM-LCD 2000, pp. 249-252 (2000).

[0017] The data current value should be able to be accurately stored with **FIGS. 10A and 10B**, as discussed above, but there are serious problems as stated below.

[0018] First, a problem with the pixel circuit of **FIG. 10A** is that there is a precondiction in which the two transistors **512** and **513** that structure the current mirror must have identical electrical characteristics. Provided that it is considered during design, it is possible to manufacture both transistors adjacently on a substrate, and dispersion can be reduced to a certain extent. However, dispersions in the electrical characteristics of TFTs, such as threshold voltage and field effect mobility, that exceed a permissible limit normally remain in present-day polysilicon due to causes such as faults in the crystal grain boundaries.

[0019] Specifically, it becomes necessary to keep brightness within a range on the order of 1%, for example, if a 64 gray scale image is displayed. However, storing the data current values at a precision of 1% with the pixel circuit of **FIG. 10A** is difficult to achieve with the polysilicon normally in use at present. In other words, a sufficiently uniform, high quality display image over an entire screen. without irregularities, cannot be obtained by only using the pixel circuit of **FIG. 10A**.

[0020] Next, the fact that the video signal data current written into the pixel has the identical value to the OLED element driver current when the OLED element emits light is a problem with the pixel circuit of **FIG. 10B**. The fact that both electric currents must have identical values is a very severe restriction in practice when manufacturing an AM-OLED display device.

[0021] Specifically, a large amount of parasitic capacitance and parasitic resistance exists in signal lines and the like in an actual AM-OLED display device. As a result, it often becomes necessary to take steps to make the video signal data current larger than the OLED element driver current. In particular, it becomes extremely difficult to write in the video signal data current of dark portions for cases in which the video signal data current is made into an analog value for gray scale expression.

SUMMARY OF THE INVENTION

[0022] The present invention has been made in view of the aforementioned problem points. First, an object of the present invention is to provide an AM-OLED display device in which the ratio between a video signal data current written into a pixel, and an OLED element driver current during OLED element light emission, is not fixed to a value of "1" differing from the pixel circuit of **FIG. 10B**. Next, the present invention is premised on the fact that it is possible for dispersion in electric characteristics to remain to a certain extent, even between transistors placed adjacently within the same pixel, differing from the pixel circuit of **FIG. 10A**. Therefore, another object of the present invention is to provide an AM-OLED display device in which dispersion in the OLED element driver currents is sufficiently inhibited compared to pixel circuits that use a current mirror like that of **FIG. 10A**.

[0023] Note that the constitution of the present invention can be effectively utilized when using current driven elements in display devices and light emitting devices that use elements other than OLED elements.

[0024] In order to solve the aforementioned objectives, the present invention is characterized in that driver elements disposed in each pixel of an AM display device or a light emitting device are structured by a plurality of transistors, the plurality of transistors are placed in a parallel connection state when a data current is written into the pixel, and the plurality of transistors are placed in a series connection state when a light emitting element emits light.

[0025] Note that the constitution of the present invention can be utilized when using current driven elements in display devices and light emitting devices that use elements other than OLED elements.

[0026] An outline of the pixel structure of this type of display device or light emitting device of the present invention is explained using **FIGS. 1A and 1B**. **FIG. 1A** shows a pixel **11** disposed in a j-th row and an i-th column in a pixel portion having a plurality of pixels. The pixel **11** has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a first switch **12** having a switching function, a second switch **13** having a switching function, a third switch **14** having a switching function, a driver element **15**, a capacitor element **16**, and a light emitting element **17**. Note that it is not always necessary to form the capacitor element **16** for cases such as those where the parasitic capacitance of a node at which the capacitor element **16** is disposed is large.

[0027] An OLED element is typically applied as the light emitting element, and therefore a diode reference symbol may also be used in this specification as a reference symbol that expresses the light emitting element. However, diode characteristics are not necessary in the light emitting element, and the present invention is not limited to light emitting elements that possess diode characteristics. In addition, the light emitting elements in this specification may be current driven display elements, and it is not necessary that the elements have a display function due to emitted light. For example, light shutters such as liquid crystals that can be controlled by electric current values, not voltage values, are also included in the category of light emitting elements in this specification.

[0028] One semiconductor element, or a plurality of semiconductor elements, having a switching function, such as a transistor can be used in the first switch **12**, the second switch **13**, and the third switch **14**. A plurality of semiconductor elements such as transistors can also be used similarly in the driver element **15**. On and off states for the first switch **12** and the second switch **13** are determined by signals imparted from the first scanning line (Gaj). It is sufficient that the first switch **12** and the second switch **13** function as switching elements, and therefore no particular limitations are placed on the conductivity type of the semiconductor elements used.

[0029] Note that the first switch **12** located between the signal line (Si) and the driver element **15**, and plays a role in controlling signal write-in to the pixel **11**. Further, the second switch **13** is located between the power source line (Vi) and the driver element **15**, and controls the supply of electric current form the power source line to the pixel **11**.

[0030] A case of additionally disposing a fourth switch **18** and a second scanning line (Gbj) in the pixel **11** of **FIG. 1A** is shown in **FIG. 1B**. One semiconductor element, or a plurality of semiconductor elements, having a switching function, such as transistors, can be used in the fourth switch **18**. On and off states for the fourth switch **18** are determined by signals imparted from the second scanning line (Gbj). It is sufficient that the first switch **12** and the second switch **13** function as switching elements, and therefore no particular limitations are placed on the conductivity type of the semiconductor elements used.

[0031] Note that the fourth switch **18** plays a role as an initialization element for the pixel **11**. Electric charge stored in the capacitor element **16** is released if the fourth switch **18** turns on, the driver element **15** turns off, and in addition, light emission by the light emitting element **17** stops.

[0032] The present invention is characterized in that the driver element **15** is structured by a plurality of transistors, and the connection between the plurality of transistors is switched to a parallel connection for cases in which a video signal data current is written into the pixel **11**, or to a serial connection for cases in which electric current flows in the light emitting element **17**, which thus emits light. On and off control of the first switch **12** and the second switch **13** by signals from the scanning line (Gaj) in **FIGS. 1A and 1B** becomes a means for switching the plurality of transistors in the driver element **15** between a parallel connection state and a series connection state.

[0033] Examples of the pixel **11** for a case of structuring the driver element **15** by using four transistors **20***a*, **20***b*, **20***c*, and **20***d* are shown in **FIGS. 1C and 1D**. Explanations of current pathways in the pixel **11** are provided below.

[0034] **FIG. 1C** shows a case of writing a data current into the pixel **11**, and **FIG. 1D** shows a case of the light emitting element emitting light. Note that elements other than the first switch **12**, the second switch **13**, the driver element **15**, the light emitting element **17**, the signal line (Si), and the power source line (Vi) are not shown in **FIGS. 1C and 1D**.

[0035] A case in which a data current is written into the pixel **11** is explained first. The first switch **12** and the second switch **13** turn on due to a signal imparted from the first scanning line (Gaj) in **FIG. 1C**. Each transistor in the driver element **15** is thus placed in a diode connected state, and all of the transistors are mutually connected in a parallel connection state. A current pathway exists from the power source line (Vi), through the second switch **13**, the driver element **15**, and the first switch **12**, to the signal line (Si). A current value I_W at this point is the data current value of the video signal, and is a predetermined current value output to the signal line (Si) by a signal line driver circuit.

[0036] A case in which the light emitting element **17** emits light is explained next. The first switch **12** and the second switch **13** are turned off by a signal imparted from the first scanning line (Gaj) in **FIG. 1D**. Each of the transistors in the driver element **15** are thus mutually connected in a series connection state. A current pathway exists from the power source line (Vi), through the transistors **20***a*, **20***b*, **20***c*, and **20***d*, to the light emitting element **17**. The brightness of light emitted by the light emitting element **17** is determined by a current value I_E at this point.

[0037] As discussed above, the transistors **20***a* to **20***d* that structure the driver element **15** are used in parallel with the present invention during write-in of the data current to the pixel (see **FIG. 1C**). In addition, the transistors **20***a* to **20***d* that structure the driver element **15** are used in series when electric current flows in the light emitting element **17** of the pixel **11**, that is when the light emitting element is driven (see **FIG. 1D**). The current value I_W during write-in therefore becomes 16 times (4^2 times) the current value I_E during light emitting element drive, if it is assumed that the electrical characteristics of the transistors **20***a* to **20***d* are identical. In general, if the number of transistors structuring the driver element **15** is considered to be n, then a relationship shown by Eq. 1 is established between the current value I_W during video signal write-in and the current value I_E during light emitting element drive, under the condition that all of the transistors have identical electrical characteristics.

$$I_W = n^2 \times I_E \quad (1)$$

[0038] Here, n is preferably between 3 and 5. Note that, in order to strictly establish Eq. 1, there is a condition that all of the transistors structuring the driver element **15** must possess identical electrical characteristics. However, it is possible in practice to treat Eq. 1 as if approximately established, even for cases involving a slight amount of mutual dispersion in the electrical characteristics of the transistors.

[0039] Thus, the present invention is characterized in that the driver element **15** is structured by the plurality of transistors, and the current value I_W during write-in, and the current value I_E during light emitting element drive, can therefore be arbitrarily set by switching the connection between the plurality of transistors between parallel and serial for cases of writing a video signal current into the pixel **11** and for cases of the light emitting element emitting light.

[0040] Further, the present invention is also characterized in that the influence of slight, mutual differences in the electrical characteristics of each of the transistors structuring the driver element **15** can be greatly reduced from being reflected in the light emitting element drive current I_E. A specific example of this is taken up and explained in an embodiment mode.

[0041] Even with a pixel circuit using a current mirror like that of **FIG. 10A**, there is a problem in that identical electrical characteristics are required for the two transistors within the pixel. However, even the transistors within the same pixel are already presupposed to have slightly different electrical characteristics in the present invention. That is, the present invention is superior compared to pixel circuits that use current input method current mirrors in that the present invention has tolerance for dispersions in the characteristics of the transistors. As a result, it becomes possible to make the light emitting element driver current I_E uniform to a level at which it can be put into practical use, even if dispersions in the electrical characteristics of polysilicon TFTs, caused by defects in crystal grain boundaries and the like, exist.

[0042] The display device and the light emitting device of the present invention are display devices provided with a plurality of pixels. The pixels each have a driver element provided with a light emitting element and a plurality of transistors. The display device and the light emitting device of the present invention are characterized by including a means capable of making, at minimum, a state in which the plurality of transistors in the driver element are connected in parallel, and a state in which the plurality of transistors in the driver element are connected in series. The term light emitting device as used in this specification indicates devices that utilize light emitted form a light emitting element. Examples of light emitting elements include organic light emitting diode (OLED) elements, inorganic material light emitting diode elements, and field emission light emitting elements (FED elements). The term display device as used in this specification indicates devices in which a plurality of pixels are arranged in a matrix shape, and image information is transferred visually, namely displays.

[0043] An outline of a pixel structure of the display device and the light emitting device of the present invention that differs from that of **FIGS. 1A and 1B** is explained here using **FIGS. 11A and 11B**. The pixel **11** disposed in the j-th row and the i-th column in the pixel portion having a plurality of pixels is shown in **FIG. 11A**. The pixel **11** of **FIG. 11A** is provided with a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), a third scanning line (Gcj), a fourth scanning line (Gdj), a first switch **312**, a second switch **313**, a third switch **314**, a fourth switch **318**, a driver element **315**, a capacitor element **316**, a light emitting element **317**, and an opposing electrode **319**, for example. However, even if the structure with the first switch, the second switch, the third switch, the fourth switch, the first scanning line (Gaj), the second scanning line (Gbj), the third scanning line (Gcj), the fourth scanning line (Gdj), and the like is changed slightly, in practice the same device can be obtained. One example of such is **FIG. 11B**. The fourth switch is removed, and the third scanning line is unified with the second scanning line in **FIG. 11B**. This is also identical in practice to **FIG. 11A**, and in the absence of any specific limitations, is taken as being included in **FIG. 11A**. Cases of adding components such as initialization elements are also similarly treated.

[0044] Note that the capacitor element **316** does not always have to be expressly formed in **FIGS. 11A and 11B** for cases in which the parasitic capacitance of a node at which the capacitor element **316** is disposed is large, and the like.

[0045] A single semiconductor element, or a plurality of semiconductor elements, having a switching function such as transistors, can be used in the first switch **312**, the second switch **313**, the third switch **314**, and the fourth switch **318**. A plurality of semiconductor elements such as transistors can also be similarly used in the driver element **315**. There are no particular limitations placed on the conductivity type (n-channel, p-channel) of the semiconductor elements used in the first switch **312**, the second switch **313**, the third switch **314**, the fourth switch **318**, and the driver element **315**. This is mostly because n-channel and p-channel types can both be used, and there are cases in which a specified conductivity type is more preferable than another conductivity type for specific applied examples.

[0046] A signal imparted from the first scanning line (Gaj) determines whether the first switch **312** is on or off. Similarly, a signal form the second scanning line (Gbj) determines whether the second switch **313** is on or off, a signal from the third scanning line (Gcj) determines whether the third switch **314** is on or off, and a signal from the fourth scanning line (Gdj) determines whether the fourth switch **318** is on or off. It is of course not necessary for all of the scanning lines, the first scanning line (Gaj), the second scanning line (Gbj), the third scanning line (Gcj), and the fourth scanning line (Gdj), to exist, and a certain scanning line can also be combined with other scanning lines, as is made clear by **FIG. 11B**.

[0047] The first switch **312** is disposed between the signal line (Si) and the driver element **315** in **FIG. 1A**, and serves a role for controlling signal write-in to the pixel **11**. Further, the second switch **313** and the fourth switch **318** are disposed between the power source line (Vi) and the driver element **315**, and perform on and off control of the supply of electric current form the power source line (Vi) to the pixel **11**. The third switch **314** is disposed between the driver element **315** and the light emitting element **317**, and performs on and off control of the supply of electric current form the driver element **315** to the light emitting element **317**.

[0048] In the present invention, the driver element **315** is structured by the plurality of transistors, and the plurality of transistors are connected in parallel when a video signal data current is written into the pixel **11**. The plurality of transistors are connected in series when electric current flows in the light emitting element **317**, and light is emitted. It becomes possible to place the plurality of transistors in the driver element **315** in a parallel connection state, and also in a series connection state, by controlling the on and off states of the first switch, the second switch, the third switch, and the fourth switch using the signals from the scanning lines (Gaj, Gbj, Gcj, and Gdj) in **FIG. 11A**.

[0049] The pixel **11** is shown in **FIGS. 11C and 11D** here as an example of a case in which the driver element **315** is structured by four transistors **320***a*, **320***b*, **320***c*, and **320***d*. Electric current pathways in the pixel **11** are explained below.

[0050] **FIG. 11C** shows a case of writing a data current into the pixel **11**, and **FIG. 11D** shows a case of the light emitting element emitting light. With **FIG. 11C**, the four transistors **320***a*, **320***b*, **320***c*, and **320***d* are in a parallel connection state, while the four transistors **320***a*, **320***b*, **320***c*, and **320***d* are in a series connection state in **FIG. 11D**. Note that element and wirings other than the first switch **312**, the second switch **313**, the driver element **315**, the light emitting element **317**, the source signal line (Si), and the power source line (Vi) are omitted from being shown in **FIGS. 11C and 11D**.

[0051] A case of writing a data current into the pixel **11** is explained first. The first switch **312** and the second switch **313** are turned on in **FIG. 11C** by signals imparted from the first scanning line (Gaj) and the second scanning line (Gbj), respectively. Each of the transistors in the driver element **315** is thus placed into a diode connected state, and the transistors are thus mutually placed in a parallel connection state. The third switch **314** and the fourth switch **318** turn off by signals input from the third scanning line (Gcj) and the fourth scanning line (Gdj), respectively. A current pathway exists from the power source line (Vi), through the second switch **313**, the driver element **315**, and the first switch **312**, to the signal line (Si) when the power source line (Vi) has a high electric potential. The opposite is naturally true if the power source line (Vi) has a low electric potential. The current value I_W is the value of the video signal data current at this point, and is a predetermined current value output to the signal line (Si) from a signal line driver circuit.

[0052] A case of the light emitting element **317** being made to emit light is explained next. The first switch **312** and the second switch **313** are turned off by signals imparted form the first scanning line (Gaj) and the second scanning line (Gbj), respectively, in **FIG. 11D**. The transistors in the driver element **315** are thus mutually placed in a series connection state. The third switch **314** and the fourth switch **318** turn off due to signals imparted form the third scanning line (Gcj) and the fourth scanning line (Gdj), respectively. A current pathway exists from the power source line (Vi), through the transistors **310***a*, **320***b*, **320***c*, and **320***d*, and to the light emitting element **317** when the power source line (Vi) has a high electric potential. The opposite is naturally true if the power source line (Vi) has a low electric potential. The current value I_E determines the brightness of light emitted by the light emitting element **317** at this point.

[0053] The transistors **320***a*, **320***b*, **320***c*, and **320***d* that structure the driver element **315** are used parallelly when writing a data current into the pixel in the present invention (see **FIG. 11C**). On the other hand, the transistors **320***a*, **320***b*, **320***c*, and **320***d* that structure the driver element **315** are used serially when electric current flows in the light emitting element **317** of the pixel **11**, that is when the light emitting element is driven (see **FIG. 11D**). The current value I_W during write-in therefore becomes 16 (4^2) times the current value I_E when the light emitting element is driven, provided that the electrical characteristics of the transistors **320***a*, **320***b*, **320***c*, and **320***d* are presumed to be identical. In general, if the number of transistors structuring the driver element **15** is considered to be n, then the relationship shown by Eq. 1 is established between the current value I_W during video signal write-in and the current value I_E during light emitting element drive, under the condition that all of the transistors have identical electrical characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

[0054] In the accompanying drawings:

[0055] **FIGS. 1A** to 1D are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0056] **FIGS. 2A and 2B** are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0057] **FIGS. 3A and 3B** are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0058] **FIGS. 4A and 4B** are diagrams showing a pixel of a display device and a light emitting device of the present invention:

[0059] **FIGS. 5A and 5B** are diagrams showing current pathways in a pixel of a display device and a light emitting device of the present invention;

[0060] **FIG. 6** is a diagram showing a planar layout of a pixel of a display device and a light emitting device of the present invention;

[0061] **FIGS. 7A** to 7C are diagrams showing a display device and a light emitting device of the present invention;

[0062] **FIGS. 8A and 8B** are diagrams showing characteristics of transistors structuring a driver element;

[0063] **FIGS. 9A** to 9H are diagrams showing electronic equipment to which a display device and a light emitting device of the present invention are applied;

[0064] **FIGS. 10A and 10B** are diagrams showing a pixel of a known display device and a known light emitting device;

[0065] **FIGS. 11A** to **11**D are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0066] **FIGS. 12A** to 12E are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0067] **FIGS. 13A** to 13D are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0068] **FIGS. 14A** to 14C are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0069] **FIGS. 15A** to 15D are diagrams showing a pixel of a display device and a light emitting device of the present invention;

[0070] **FIG. 16** is a diagram showing a pixel of a display device and a light emitting device of the present invention; and

[0071] **FIGS. 17A and 17B** are diagrams showing the display brightness of a light emitting device of the present invention for a cases in which the characteristics of transistors structuring a driver element have been changed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0072] [Embodiment Mode 1]

[0073] An outline of a pixel of a display device and a light emitting device of the present invention has been discussed above using **FIGS. 1A** to 1D. A specific example of a pixel of a display device and a light emitting device of the present invention is explained in Embodiment Mode 1 using **FIGS. 2A** to 4B. For simplification, cases in which n, the number of transistors structuring the driver element **15**, is from two to four are given as examples.

[0074] A first example is explained using **FIG. 2A**.

[0075] The pixel **11** disposed in the j-th row and the i-th column is shown in **FIG. 2A**. The pixel **11** has a signal line (Si), a power source line (Vi), a scanning line (Gaj), transistors **21** to **26**, a capacitor element **27**, and a light emitting element **28**. The pixel **11** shown in **FIG. 2A** is the pixel **11** shown in **FIG. 1A**, but shown specifically by transistors. The transistors **21** and **22**, which are p-channel, correspond to the first switch **12**. The transistor **23**, which is p-channel, corresponds to the second switch **13**, and the transistor **24**, which is n-channel, corresponds to the third switch **14**. The transistors **25** and **26**, which are p-channel, correspond to the driver element **15**.

[0076] Each gate electrode of the transistors **21** to **24** is connected to the scanning line (Gaj). The capacitor **27** performs a role in storing the voltage between a gate and a source of the transistor **25**. Note that it is not always necessary to form the capacitor element **27** for cases in which the gate capacitances of the transistors **25** and **26** are large, for cases in which the parasitic capacitance of a node is high, and the like.

[0077] A low electric potential signal is sent to the scanning line (Gaj) in the pixel **11** shown in **FIG. 2A** during write-in of a video signal data current, and the transistors **21** to **23** turn on, while the transistor **24** turns off. A parallel connection relationship between the transistors **25** and **26** is formed at this point, based on the current pathway. On the other hand, a high electric potential signal is sent to the scanning line (Gaj) when electric current flows in the light emitting element **28**, and the transistors **21** to **23** turn off, while the transistor **24** turns on. A series connection relationship is formed between the transistors **25** and **26** at this point, based on the current pathway.

[0078] Switching of the connection relationship between the transistors **25** and **26** of the driver element **15** is controlled by only the scanning line (Gaj) in the example of **FIG. 2A**. Further, the first switch is structured by only two transistors, and the second switch is structured by only one transistor, a structure having the least number of transistors. The number of scanning lines and the number of transistors are thus suppressed in the example of **FIG. 2A**, and therefore this structure is applicable to cases in which securing a large aperture ratio or reducing the proportion of structural defects generated is important.

[0079] An example that differs from that of **FIG. 2A** is explained next using **FIG. 2B**.

[0080] The pixel **11** disposed in the j-th row and the i-th column is shown in **FIG. 2B**. The pixel **11** has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), transistors **31** to **39**, and **42**, a capacitor element **40**, and a light emitting element **41**. The pixel **11** shown in **FIG. 2B** is the pixel **11** shown in **FIG. 1B**, but shown specifically by transistors. The transistors **31** to **34**, which are p-channel, correspond to the first switch **12**. The transistors **35** and **36** which are p-channel, correspond to the second switch **13**, and the transistor **37**, which is n-channel, corresponds to the third switch **14**. The transistors **38** and **39**, which are p-channel, correspond to the driver element **15**. The transistor **42**, which is n-channel, corresponds to the fourth switch **18**.

[0081] Each gate electrode of the transistors **31** to **34** is connected to the first scanning line (Gaj). Each gate electrode of the transistors **35** to **37**, and **42** is connected to the second scanning line (Gbj). The capacitor element **40** performs a role in storing the voltage between a gate and a source of the transistor **38**. Note that it is not always necessary to form the capacitor element **40** for cases in which the gate capacitances of the transistors **38** and **39** are large, for cases in which the parasitic capacitance of a node is high, and the like.

[0082] A low electric potential signal is sent to the first scanning line (Gaj) and the second scanning line (Gbj) in the pixel **11** shown in **FIG. 2B** during write-in of a video signal data current, and the transistors **31** to **36** turn on, while the transistors **37** and **42** turn off. A parallel connection relationship between the transistors **38** and **39** is formed at this point, based on the current pathway. On the other hand, a high electric potential signal is sent to the scanning line (Gaj) when electric current flows in the light emitting element **41**, and the transistors **31** to **36** turn off, while the transistors **37** and **42** turn on. A series connection relationship is formed between the transistors **38** and **39** at this point, based on the current pathway.

[0083] Switching of the connection relationship between the transistors **38** and **39** of the driver element **15** is controlled by using the first scanning line (Gaj) and the second scanning line (Gbj) with the example of **FIG. 2B**. However, the transistors controlled by the second scanning line (Gbj) are all not connected to the signal line (Si). Further, there is a characteristic that whether or not electric current flows in the light emitting element **41** to emit light can be controlled by only the electric potential of the second scanning line (Gbj), irrespective of the electric potential of the first scanning line (Gaj). The amount of time that the light emitting element **41** emits light can therefore be controlled arbitrarily by sending signals independent of the first scanning line (Gaj) to the second scanning line (Gbj) in the time other than the time of data current write-in.

[0084] This is extremely important for cases in which intermediate gray scale expression is performed by a time gray scale method. This is because sufficient multi-gray scale display is difficult without a means for stopping light emission during a column scanning period for cases in which a time gray scale method is applied to an AM-OLED having a polysilicon TFT driver circuit. Further, this is also useful for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays (refer to Kurita, T., Proc. AM-LCD 2000, pp. 1-4 (2000), for example, regarding dynamic distortions peculiar to hold type displays).

[0085] Further, the example of **FIG. 2B** is one in which storage of the video signal data current is performed very accurately. With the example of **FIG. 2A**, the transistor **25** is directly connected to the power source line (Vi) during data current write-in, while the transistor **26** is connected through the transistor **23**. An inaccuracy equal to the amount of voltage drop over the transistor **23** therefore occurs during write-in of the data current. On the other hand, the transistor

38 is connected to the power source line (Vi) through the transistor 35, and the transistor 39 is connected to the power source line (Vi) through the transistor 36 with the example of FIG. 2B. If the voltage drops caused by the transistor 35 and the transistor 36 respectively are of the same order, then storage of the video signal data current can be performed very accurately.

[0086] A third example is explained next using FIG. 3A.

[0087] The pixel 11 disposed in the j-th row and the i-th column is shown in FIG. 3A. The pixel 11 has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), transistors 51 to 57, and 60, a capacitor element 58, and a light emitting element 59. The pixel 11 shown in FIG. 3A is the pixel 11 shown in FIG. 1B, but shown specifically by transistors. The transistors 51 to 53, which are n-channel, correspond to the first switch 12. The transistor 54, which is n-channel, corresponds to the second switch 13, and the transistor 55, which is p-channel, corresponds to the third switch 14. The transistors 56 and 57, which are p-channel, correspond to the driver element 15. The transistor 60, which is n-channel, corresponds to the fourth switch 18.

[0088] Each gate electrode of the transistors 51 to 55 is connected to the first scanning line (Gaj). A gate electrode of the transistor 60 is connected to the second scanning line (Gbj). The capacitor element 58 performs a role in storing the voltage between a gate and a source of the transistor 56. Note that it is not always necessary to form the capacitor element 58 for cases in which the gate capacitances of the transistors 56 and 57 are large, for cases in which the parasitic capacitance of a node is high, and the like.

[0089] A high electric potential signal is sent to the first scanning line (Gaj) in the pixel 11 shown in FIG. 3A during write-in of a video signal data current, and the transistors 51 to 54 turn on, while the transistor 55 turns off. A parallel connection relationship between the transistors 56 and 57 is formed at this point, based on the current pathway. On the other hand, a low electric potential signal is sent to the scanning line (Gaj) when electric current flows in the light emitting element 59, and the transistors 51 to 54 turn off, while the transistor 55 turns on. A series connection relationship is formed between the transistors 56 and 57 at this point, based on the current pathway.

[0090] Note that a low electric potential signal is sent to the second scanning line (Gbj) during the aforementioned period, turning the transistor 60 off.

[0091] The amount of time that the light emitting element 59 emits light can be arbitrarily controlled by the signal sent to the second scanning line (Gbj), similar to the case of the example of FIG. 2B. Namely, if a high electric potential signal is sent to the second scanning line (Gbj) during light emission by the light emitting element 59, and the transistor 60 turns on, the transistor 56 then turns off and the light emitting element 59 stops emitting light. However, once the light emitting element 59 is made to stop emitting light, the light emitting element 59 will then not emit light unless a video signal data current is again written in, which differs from the example of FIG. 2B.

[0092] The features of the fact that the amount of time that the light emitting element 59 emits light can be arbitrarily controlled in the pixel shown by FIG. 3A is similar to the example of FIG. 2B. That is, it becomes possible to perform intermediate gray scale expression by a time gray scale method. Further, this is also useful for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays.

[0093] The transistors 51 to 54 of the first switch 12 and the second switch 13, and the transistor 60 of the fourth switch 18 are n-channel, and the transistor 55 of the third switch 14 is p-channel in the pixel 11 shown by FIG. 3A. This differs from the examples of FIGS. 2A and 2B. This is only an example, however, and the channel types of the transistors in the switches are not particularly limited to these types.

[0094] A fourth example is explained next using FIG. 3B.

[0095] The pixel 11 disposed in the j-th row and the i-th column is shown in FIG. 3B. The pixel 11 has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), transistors 71 to 82, and 85, a capacitor element 83, and a light emitting element 84. The pixel 11 shown in FIG. 3B is the pixel 11 shown in FIG. 1B, but shown specifically by transistors. The transistors 71 to 75, which are p-channel, correspond to the first switch 12. The transistors 76 to 78, which are p-channel, correspond to the second switch 13, and the transistor 79, which is n-channel, corresponds to the third switch 14. The transistors 80 to 82, which are p-channel, correspond to the driver element 15. The transistor 85, which is n-channel, corresponds to the fourth switch 18.

[0096] Each gate electrode of the transistors 71 to 75, and 85 is connected to the first scanning line (Gaj). A gate electrode of the transistors 76 to 79 is connected to the second scanning line (Gbj). The capacitor element 83 performs a role in storing the voltage between a gate and a source of the transistor 80. Note that it is not always necessary to form the capacitor element 83 for cases in which the gate capacitances of the transistors 80 to 82 are large, for cases in which the parasitic capacitance of a node is high, and the like.

[0097] A low electric potential signal is sent to the first scanning line (Gaj) and the second scanning line (Gbj) in the pixel 11 shown in FIG. 3B during write-in of a video signal data current, and the transistors 71 to 78 turn on, while the transistors 79 and 85 turn off. A parallel connection relationship between the transistors 80 to 82 is formed at this point, based on the current pathway. On the other hand, a high electric potential signal is sent to the scanning line (Gaj) when electric current flows in the light emitting element 84, and the transistors 71 to 78 turn off, while the transistors 79 and 85 turn on. A series connection relationship is formed between the transistors 80 to 82 at this point, based on the current pathway.

[0098] Switching of the transistors 80 to 82 of the driver element 15 is controlled by using the first scanning line (Gaj) and the second scanning line (Gbj) in the example of FIG. 3B. However, the transistors controlled by the second scanning line (Gbj) are not connected to the signal line (Si). Further, there is a characteristic that whether or not electric current is made to flow in the light emitting element 84 to emit light does not have relation to the electric potential of the first scanning line (Gaj), and can be controlled by only the electric potential of the second scanning line (Gbj). The amount of time during which the light emitting element **84** emits light can therefore be arbitrarily controlled by sending signals independent of the first scanning line (Gaj) to the second scanning line (Gbj) in the time other than the time of data current write-in. This is similar to the example of **FIG. 2B**.

[**0099**] The following advantages therefore can be obtained since the amount of time that the light emitting element **84** emits light can also be arbitrarily controlled in the pixel **11** shown in **FIG. 3B**. That is, first, it becomes possible to perform intermediate gray scale expression by using a time gray scale method. Further, this is also useful for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays.

[**0100**] A fifth example is explained next using **FIG. 4A**.

[**0101**] The pixel **11** disposed in the j-th row and the i-th column is shown in **FIG. 4A**. The pixel **11** has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), transistors **91** to **103**, and **106**, a capacitor element **104**, and a light emitting element **105**. The pixel **11** shown in **FIG. 4A** is the pixel **11** shown in **FIG. 1B**, but shown specifically by transistors. The transistors **91** to **94**, which are p-channel, correspond to the first switch **12**. The transistors **95** to **98** which are p-channel, correspond to the second switch **13**, and the transistor **99**, which is n-channel, corresponds to the third switch **14**. The transistors **100** to **103**, which are p-channel, correspond to the driver element **15**. The transistor **106**, which is n-channel, corresponds to the fourth switch **18**.

[**0102**] Each gate electrode of the transistors **91** to **94** is connected to the first scanning line (Gaj). A gate electrode of the transistors **95** to **99** and **106** is connected to the second scanning line (Gbj). The capacitor element **104** performs a role in storing the voltage between a gate and a source of the transistor **100**. Note that it is not always necessary to form the capacitor element **104** for cases in which the gate capacitances of the transistors **100** to **103** are large, for cases in which the parasitic capacitance of a node is high, and the like.

[**0103**] A low electric potential signal is sent to the first scanning line (Gaj) and the second scanning line (Gbj) in the pixel **11** shown in **FIG. 4A** during write-in of a video signal data current, and the transistors **91** to **98** turn on, while the transistors **99** and **106** turn off. A parallel connection relationship between the transistors **100** to **103** is formed at this point, based on the current pathway. On the other hand, a high electric potential signal is sent to the scanning line (Gaj) when electric current flows in the light emitting element **105**, and the transistors **91** to **98** turn off, while the transistors **99** and **106** turn on. A series connection relationship is formed between the transistors **100** to **103** at this point, based on the current pathway.

[**0104**] Switching of the transistors **100** to **103** of the driver element **15** is controlled by using the first scanning line (Gaj) and the second scanning line (Gbj) in the example of **FIG. 4A**. However, the transistors controlled by the second scanning line (Gbj) are not connected to the signal line (Si). Further, there is a characteristic that whether or not electric current is made to flow in the light emitting element **105** to emit light does not have relation to the electric potential of the first scanning line (Gaj), and can be controlled by only the electric potential of the second scanning line (Gbj). The amount of time during which the light emitting element **105** emits light can therefore be controlled by sending signals independent of the first scanning line (Gaj) to the second scanning line (Gbj) in the time other than the time of data current write-in. This is similar to the example of **FIG. 2B**.

[**0105**] The following advantages can be obtained since the amount of time that the light emitting element **105** emits light can also be controlled in the pixel shown by **FIG. 4A**. That is, first, it becomes possible to perform intermediate gray scale expression by using a time gray scale method. Further, this is also useful for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays.

[**0106**] A sixth example is explained next using **FIG. 4B**.

[**0107**] The pixel **11** disposed in the j-th row and the i-th column is shown in **FIG. 4B**. The pixel **11** has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), transistors **111** to **120**, and **122**, a capacitor element **123**, and a light emitting element **121**. The pixel **11** shown in **FIG. 4B** is the pixel **11** shown in **FIG. 1B**, but shown specifically by transistors. The transistors **111** to **113**, which are p-channel, correspond to the first switch **12**. The transistors **114** and **115**, which are p-channel, correspond to the second switch **13**, and the transistor **116**, which is n-channel, corresponds to the third switch **14**. The transistors **117** to **120**, which are p-channel, correspond to the driver element **15**. The transistor **122**, which is p-channel, corresponds to the fourth switch **18**.

[**0108**] Each gate electrode of the transistors **111** to **116** is connected to the first scanning line (Gaj). A gate electrode of the transistor **122** is connected to the second scanning line (Gbj). The capacitor element **123** performs a role in storing the voltage between a gate and a source of the transistor **117**. Note that it is not always necessary to form the capacitor element **123** for cases in which the gate capacitances of the transistors **117** to **120** are large, for cases in which the parasitic capacitance of a node is high, and the like.

[**0109**] A high electric potential signal is sent to the first scanning line (Gaj) in the pixel **11** shown in **FIG. 4B** during write-in of a video signal data current, and the transistors **111** to **115** turn on, while the transistor **116** turns off. A parallel connection relationship between the transistors **117** to **120** is formed at this point, based on the current pathway. On the other hand, a low electric potential signal is sent to the first scanning line (Gaj) when electric current flows in the light emitting element **121**, and the transistors **111** to **115** turn off, while the transistor **116** turns on. A series connection relationship is formed between the transistors **117** to **120** at this point, based on the current pathway.

[**0110**] Note that a low electric potential signal is sent to the second scanning line (Gbj) during the aforementioned period, turning the transistor **122** off.

[**0111**] The amount of time that the light emitting element **121** emits light can be arbitrarily controlled by the signal sent to the second scanning line (Gbj) in the pixel **11** shown in **FIG. 4B**, similar to the case of the example of **FIG. 2B**. Namely, if a high electric potential signal is sent to the second scanning line (Gbj) during light emission by the light emitting element **121**, and the transistor **122** turns on, the transistor **117** then turns off and the light emitting element **121** stops emitting light. However, once the light emitting element **121** is made to stop emitting light, the light emitting element **121** will then not emit light unless a video signal data current is again written in, which differs from the example of **FIG. 2B**.

[0112] The features of the fact that the amount of time that the light emitting element **59** emits light can be arbitrarily controlled in the pixel **11** shown by **FIG. 4B** is similar to the example of **FIG. 2B**. That is, it becomes possible to perform intermediate gray scale expression by a time gray scale method. Further, this is also useful for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays.

[0113] Six types of the pixel **11**, each having a different structure, have been explained using **FIGS. 2A** to **4B** as examples of the pixel **11** of the display device and the light emitting device of the present invention. Note that the pixel structure of the display device and the light emitting device of the present invention is not limited to these six types.

[0114] [Embodiment Mode 2].

[0115] An outline of the pixel of the display device and the led of the present invention has been discussed above using **FIGS. 2A** to **4B**. A specific example of a pixel of the display device and the light emitting device of the present invention that differs from that of Embodiment Mode 1 is explained in Embodiment Mode 2 by using **FIGS. 12A** to **16**A. Examples are given for cases in which the number of transistors n that structure a driver element **315** is three in **FIGS. 12A** to **15**D. Examples in which n is equal to 2 is given in **FIG. 16**.

[0116] A first example is explained by using **FIGS. 12A** to 12E.

[0117] The pixel **11** of the j-th row and the i-th column is shown in **FIG. 12A**. The pixel **11** has a signal line (Si), a power source line (Vi), a first scanning line (Gaj), a second scanning line (Gbj), a driver element **315**, a first switch **312**, a second switch **313**, a third switch **314**, a fourth switch **318**, a capacitor element **316**, and a light emitting element **317**. The pixel **11** shown in **FIG. 12B** is an example of the pixel **11** of **FIG. 12A** shown specifically by transistors.

[0118] A correspondence relationship between **FIG. 12A** and **FIG. 12B** is given. N-channel transistors **371** to **375** correspond to the first switch **312**. P-channel transistors **376** to **378** correspond to the second switch **313**, an n-channel transistor **379** corresponds to the third switch **314**, and a p-type transistor **385** corresponds to the fourth switch **318**. P-type transistors **380** to **382** correspond to the driver element **315**. A capacitor element **383** corresponds to the capacitor element **316**, and a light emitting element **384** corresponds to the light emitting element **317**.

[0119] Each gate electrode of the transistors **371** to **375** is connected to the first scanning line (Gaj). The capacitor element **383** performs a role in storing the voltage between a gate and a source of the transistor **380**. Note that the capacitor element **383** may not be specifically formed for cases in which the gate capacitances of the transistors **380** to **382** are large, for cases in which the parasitic capacitance of a node is high, and the like.

[0120] A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) in the pixel **11** shown in **FIG. 12B** during write-in of a video signal data current, and the transistors **371** to **378** turn on, while the transistors **379** and **385** turn off. A parallel connection relationship between the transistors **380** to **382** is formed at this point, based on the current pathway. On the other hand, a low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **384**, and the transistors **371** to **378** turn off, while the transistors **379** and **385** turn on. A series connection relationship is formed between the transistors **380** and **382** at this point, based on the current pathway.

[0121] **FIG. 12A** conceptually includes **FIG. 12B**, but the two are not identical. For example, the first switch **312** may adopt a structure with transistors **331** to **334** of **FIG. 12C**, instead of the structure with the transistors **371** to **375** of **FIG. 12B**. Further, the first switch **312** may adopt a structure with transistors **335** to **339** of **FIG. 12D**, or a structure with transistors **341** to **344** of **FIG. 12E**. Note that, whichever of the structures of **FIGS. 12B** to 12E is specifically adopted, for the first switch **312** of **FIG. 12A**, they can be said to be identical in practice. Therefore block reference symbols like those of **FIG. 12A** are mainly used in the examples below.

[0122] A second example is **FIGS. 13A and 14C**. Except for the method of connecting the three transistors that structure the driver element **315**, these are the same as **FIG. 12A**.

[0123] For example, signals sent to the first scanning line (Gaj) and the second scanning line (Gbj) in pixel circuits of **FIGS. 13A and 14C** are similar to those of **FIGS. 12A** to 12E. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0124] **FIG. 13A** and **FIG. 14C** differ from **FIG. 12A** in the method used for connecting the three transistors that structure the driver element **315**. **FIG. 13A**, **FIG. 14C**, and **FIG. 12A** can be expected to each possess identical performance provided that the three transistors have source drain symmetry (all the time in terms of electrical characteristics). However, if there is no source drain symmetry (all the time in terms of electrical characteristics), then the performance of **FIG. 13A**, **FIG. 14C**, and **FIG. 12A** will vary slightly. In this case, there is no substitution of the source and the drain (high electric potential side terminal and low electric potential side terminal) in any of the three transistors that structure the driver element **315**, both in a parallel connection and a serial connection, and **FIG. 14C** is the most preferred from in terms of circuit performance. On the other hand, however, **FIG. 13A** and **FIG. 12A**, which have the possibility of a slight inferiority in circuit performance, are superior to **FIG. 14C** in their simplicity when laying out in small pixels.

[0125] A third example shown in **FIG. 13B** differs from **FIG. 13A** only in the connection position of the capacitor element **316**.

[0126] For example, signals sent to the first scanning line (Gaj) and the second scanning line (Gbj) are similar to those of **FIG. 13A**. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0127] **FIG. 13B** also differs from **FIG. 13A** in the position at which the capacitor element **316** is connected. Firstly, the capacitor element **316** stores the voltage between the gate and the source of the transistor structuring the driver element **315**. More precisely, the voltage between the gate and the source of the transistor on the side closest to the source, among the three transistors structuring the driver element **315**, is stored. From this viewpoint, a circuit of **FIG. 13B** can be said to be more unfailing than that of **FIG. 13A**.

[0128] Note that the second switch **313** turns on during write-in of the video signal data current in the circuit of **FIG. 13A** as well, and that the third switch **314** turns on when electric current flows in the driver element **317**. As a result, in **FIG. 13A** as well, the voltage between the gate and the source of the transistors that structure the driver element **315** during write-in of the video signal data current is recreated when electric current flows in the light emitting element **317**. That is, the circuit of **FIG. 13A** and the circuit of **FIG. 13B** are the same in that they store the gate-source voltage of the transistors which structure the driver element **315**.

[0129] From the viewpoint of simplicity in the case of laying out in small pixels, **FIG. 13A** is generally superior to **FIG. 13B**.

[0130] A fourth example is **FIG. 13C**, **FIG. 13D**, **FIG. 14A**, and **FIG. 14B**. The method for controlling on/off of the first switch, the second switch, the third switch, and the fourth switch differs from that of **FIG. 13A**.

[0131] First, the circuit of **FIG. 13C** uses four scanning lines, a first scanning line (Gaj), a second scanning line (Gbj), a third scanning line (Gcj), and a fourth scanning line (Gdj), in controlling on/off of the first switch, the second switch, the third switch, and the fourth switch.

[0132] A high electric potential signal is sent to the first scanning line (Gaj) and the fourth scanning line (Gdj) and a low electric potential signal is sent to the second scanning line (Gbj) and the third scanning line (Gcj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and the fourth scanning line (Gdj) and a high electric potential signal is sent to the second scanning line (Gbj) and the third scanning line (Gcj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0133] The first scanning line (Gaj) and the fourth scanning line (Gdj) are assembled into one line, and the second scanning line (Gbj) and the third scanning line (Gcj) are assembled into one line in the circuit of **FIG. 13A**, but each is a separate scanning line with the circuit of **FIG. 13C**. This is effective in attaining stable scanning operations. Conversely, the number of scanning lines increases and therefore it is difficult to perform layout in small pixels.

[0134] The circuit of **FIG. 13D** simultaneously controls on/off of the first switch, the second switch, the third switch, and the fourth switch by using only the first scanning line (Gaj).

[0135] A high electric potential signal is sent to the first scanning line (Gaj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0136] While two scanning lines, the first scanning line (Gaj) and the second scanning line (Gbj) are used, in the circuit of **FIG. 13A**, the two are assembled into one scanning line in the circuit of **FIG. 13D**. There is an effect in that layout becomes easier in small pixels by the amount that the number of scanning lines is reduced. However, there are weaknesses with only one scanning line. For example, the amount of time that electric current flows in the light emitting element **317** cannot be controlled by devising a scheme for the scanning timing of two scanning lines.

[0137] The circuit of **FIG. 14A** is the same as the circuit of **FIG. 13A** in that control for turning the first switch, the second switch, the third switch, and the fourth switch on and off is simultaneously performed by the first scanning line (Gaj) and the second scanning line (Gbj). However, the combination of switches for controlling whether each scanning line turns on or off differs from the circuit of **FIG. 13A**. The first scanning line (Gaj) controls the first switch and the second switch with the circuit of **FIG. 14A**, while the second scanning line (Gbj) controls the third switch and the fourth switch.

[0138] A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0139] The circuit of **FIG. 14A** is one in which the switch that turns on during write-in of a video signal data current, and the switch that turns on when electric current flows in the light emitting element **317** are controlled to turn on and off by different scanning lines. This circuit is therefore superior from the standpoint of stable operation. However, while the circuit of **FIG. 13A** uses p-channel switches in the second switch **313** and the fourth switch **318**, n-channel switches are used by the circuit of **FIG. 14A**. It is therefore necessary that high electric potential signals of the first scanning line (Gaj) and the second scanning line (Gbj) in the circuit of **FIG. 14A** be higher than those used for the circuit of **FIG. 13A**.

[**0140**] The circuit of **FIG. 14B** divides the first switch **312** of **FIG. 14A**. That is, a portion for storing and releasing the gate voltage of the transistor that structures the driver element within the first switch **312** of **FIG. 14A** is divided out as a switch **319**. The switch **319** can therefore be controlled to turn on and off independently from the first switch **312** by using the third scanning line (Gcj).

[**0141**] A high electric potential signal is sent to the first scanning line (Gaj) and the third scanning line (Gcj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switches **313** and **319** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and the third scanning line (Gcj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switches **313** and **319** turn off, while the third switch **314** and the fourth switch **318** turn on.

[**0142**] The switch **319** can be turned off earlier than the first switch **312** with the circuit of **FIG. 14B** when writing in the video signal data current. It is therefore possible to stabilize operation. On the other hand, the number of scanning lines is increased, and therefore layout in small pixels becomes difficult.

[**0143**] The three transistors that structure the driver element in **FIG. 15A** are n-channel in **FIG. 15A** which corresponds to a fifth example. This point differs from **FIG. 13A**.

[**0144**] Signals sent to the first scanning line (Gaj) and the second scanning line (Gbj) are similar to those of **FIG. 13A**. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[**0145**] **FIG. 15A** also differs from **FIG. 13A** in the position at which the capacitor element **316** is connected. Firstly, the capacitor element **316** stores the voltage between the gate and the source of the transistor structuring the driver element **315**. More precisely, the voltage between the gate and the source of the transistor on the side closest to the source, among the three transistors structuring the driver element **315**, is stored. While the three transistors that structure the driver element are p-channel in **FIG. 13A**, the three transistors are n-channel in **FIG. 15A**. The position at which the capacitor element **316** is connected therefore differs with that of **FIG. 13A**.

[**0146**] The three transistors that structure the driver element in **FIG. 15A** are n-channel, and therefore **FIG. 15A** is more effective than **FIG. 13A** for cases in which the ideal transistor type is n-channel rather than p-channel due to manufacturing processes. From the standpoint of simplicity in performing laying out in small pixels, **FIG. 13A** is generally superior to **FIG. 15A**.

[**0147**] A sixth example is **FIG. 15B** and **FIG. 15C**. The direction toward which electric current flows in the driver element of **FIGS. 15B and 15C** during write-in of a video signal data current becomes opposite to that of the examples shown up through this point. In the circuits of **FIGS. 12A** to **14C**, the first switch **312** side is low electric potential, and the second switch **313** side is high electric potential during write-in of the video signal data current. In the circuits of **FIGS. 15B and 15C**, however, the first switch **312** side is high electric potential, and the second switch **313** side is low electric potential during write-in of the video signal data current. The power source line (Vi) is a high electric potential power source line, and a power source line (Vbi) is a low electric potential power source line.

[**0148**] Signals sent to the scanning lines in a pixel circuit of **FIG. 15B** are explained. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[**0149**] Signals sent to the scanning lines in a pixel circuit of **FIG. 15C** are also explained. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[**0150**] A seventh example is **FIG. 15D**. The direction toward which electric current flows in the circuit of **FIG. 15D** is opposite to that of the examples shown up through this point. In the circuits of **FIGS. 12A** to **14C**, the third switch **314** side is low electric potential, and the fourth switch **318** side is high electric potential during write-in of the video signal data current. In the circuit of **FIG. 15D**, however, the third switch **314** side is high electric potential, and the fourth switch **318** side is low electric potential during write-in of the video signal data current.

[0151] The direction toward which electric current flows in the driver element in **FIG. 15D** during write-in of the video signal data current is the same direction as that of **FIGS. 15B and 15C**, and opposite to that of **FIGS. 12A** to **14**C.

[0152] In **FIG. 15D**, a low electric potential signal is sent to the first scanning line (Gaj) and a high electric potential signal is sent to the second scanning line (Gbj) during write-in of a video signal data current, and the first switch **312** and the second switch **313** turn on, while the third switch **314** and the fourth switch **318** turn off. A high electric potential signal is sent to the first scanning line (Gaj) and a low electric potential signal is sent to the second scanning line (Gbj) when electric current flows in the light emitting element **317**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** and the fourth switch **318** turn on.

[0153] **FIG. 15D** is effective in cases of circuit disposal to a cathode side of the light emitting element **317**.

[0154] Specific examples of the pixel of the display device and the light emitting device of the present invention have been discussed by using **FIGS. 12A** to **15D** for cases in which the number of transistors n that structure the driver element **315** is three. An example of a case in which n is equal to two is explained next by using **FIG. 16** as an example in which the number of transistors n structuring the driver element **315** is not equal to three. Note that the first switch, the second switch, the third switch, and the fourth switch are denoted by transistors, not block reference symbols, in **FIG. 16**, and many variations are possible for the transistor connections, similar to **FIGS. 12A** to **15D**.

[0155] The first switch is structured by using two transistors, and the second switch is structured by using one transistor in the example of **FIG. 16**, which means that the minimum number of transistors are used. Switching of the connection relationship between transistors **325** and **326** of the driver element **315** is controlled by a scanning line (Gaj).

[0156] A low electric potential signal is sent to the scanning line (Gaj) during write-in of a video signal data current, and the first switch **312** which includes transistors **321** and **322**, and the second switch **313** which includes a transistor **323** turn on, while the third switch **314** which includes a transistor **324** turns off. A high electric potential signal is sent to the first scanning line (Gaj) when electric current flows in the light emitting element **328**, and the first switch **312** and the second switch **313** turn off, while the third switch **314** turns on.

[0157] The number of scanning lines and the number of transistors are kept small in the example of **FIG. 16**, and therefore **FIG. 16** is suitable for cases in which importance is placed on securing a large aperture ratio or reducing the proportion of structural defects generated.

[0158] Examples of the pixel **11** of the display device and the light emitting device of the present invention have been explained by using **FIGS. 12A** to **16**. However, the pixel structures of the display device and the light emitting device of the present invention are not limited to these structures.

[0159] [Embodiment Mode 3]

[0160] A method of driving the pixel **11** is explained in Embodiment Mode 2. The pixel shown in **FIG. 4B** is taken as an example, and the explanation is performed by using **FIGS. 5A and 5B**.

[0161] Video signal write-in operations and light emitting operations are explained first.

[0162] A first scanning line (Gaj) of a j-th row is first selected by a signal output from a scanning line driver circuit (not shown in the figures) formed in the periphery of the pixel **11**. That is, a low electric potential (L level) signal is output to the first scanning line (Gaj), and gate electrodes of transistors **111** to **10**( ) become low electric potential (L level). The transistors **111** to **115**, which are p-channel, turn on at this point, while the transistor **116**, which is n-channel, turns off. The video signal data current I_W is then input to the pixel **11** from a signal line driver circuit (not shown in the figures) formed in the periphery of the pixel **11**, through a signal line (Si) of an i-th column.

[0163] Transistors **117** to **120** are placed in a diode connected state, in which a drain and a gate are shorted in each of the transistors, when the transistors **111** to **113** turn on. That is, the pixel **11** becomes equivalent to a circuit in which four diodes are connected in parallel. The current I_W flows between a power source line (Vi) and the signal line (Si) in this state (refer to **FIG. 5A**).

[0164] After the current I_W flowing in the four diodes connected in parallel becomes steady state, the first scanning line (Gaj) is set to high electric potential (H level). The transistors **111** to **113** thus turn off, and the video signal data current I_W is stored in the pixel.

[0165] The p-channel transistors **111** to **115** turn off when the first scanning line (Gaj) becomes high electric potential (H level), and the n-channel transistor **116** turns on. The connection between the transistors **117** to **120** is rearranged to a series state. A driver element supplies the fixed electric current I_E to a light emitting element if the voltage conditions are set in advance so that a transistor **120** operates in the saturated region at this point.

[0166] The value of the fixed current I_E is approximately 1/16 the value of the video signal data current I_W. This is because the driver element is structured by using four transistors in Embodiment Mode 3. In general, the current I_E will become approximately $1/n^2$ of the video signal data current I_W if the driver element is structured by using n transistors.

[0167] The write-in data current I_W can be made into a large value in Embodiment Mode 3 if it is approximately 16 times the value of the light emitting element driver current I_E. Even if it is difficult to write in a very small current, on the order of the light emitting element driver current I_E, directly and smoothly to the pixel due to parasitic capacitance and the like, write-in of the video signal data current I_W becomes possible.

[0168] Note that an analog video method may be employed in Embodiment Mode 3 as a method for expressing intermediate gray scales, and a digital video method may also be employed. The data current I_W converted into an analog current is used as the video signal data current in the analog video method. For the digital video method, a unit brightness is prepared with only one data current I_W taken as a standard on current. Use of a time gray scale method in which the unit brightnesses are added over time to express gray scales is convenient (digital time gray scale method). Alternatively, the digital video method can also be performed by a surface area gray scale method, in which the unit brightness is added over a surface area to express gray scales, or a method that combines the time gray scale method and the surface area gray scale method.

[0169] Further, it is necessary that the video signal data current I_W be set to zero in Embodiment Mode 3, independent of which method is employed between the analog video method and the digital video method. However, the brightness of light emitted by the light emitting element is zero when the video signal data current I_W is set to zero, and therefore it is not necessary to accurately write in and store I_W in the pixel. A gate voltage at which the transistors **117** to **120** of the driver element turn off may therefore be output directly to the signal line (Si) in this case. That is, the video signal may be output by a voltage value, not an electric current value.

[0170] Operations for stopping light emission are explained next.

[0171] A second scanning line (Gbj) of the j-th row is selected first by a signal output from another scanning driver circuit (not shown in the figures) formed in the periphery of the pixel **11**. That is, a low electric potential (L level) signal is output to the second scanning line (Gbj). A gate electrode of a p-channel transistor **122** becomes low electric potential (L level), and the transistor **122** is placed in an on state:

[0172] The source and the gate of the transistor **117** are thus shorted, and the transistor **117** turns off. Electric current supply to a light emitting element **121** is cutoff as a result, and light emission stops.

[0173] It thus becomes possible to arbitrarily control the amount of time that the light emitting element **121** emits light, without any restrictions on the amount of time to scan one row. The largest advantage of this is that intermediate gray scale expression can be performed easily by a time gray scale method. Further, there are also advantages for cases in which intermediate gray scale expression is performed using an analog video signal data current, in application to impulse light emission and the like in order to stop dynamic distortions peculiar to hold type displays.

[0174] [Embodiment Mode 4]

[0175] An example of a planar layout (upper surface diagram) of a pixel in the display device and the light emitting device of the present invention is presented in Embodiment Mode 4. A pixel circuit of this example is the pixel circuit shown in **FIG. 3B**.

[0176] The pixel **11** of the j-th row and the i-th column is shown in **FIG. 6**. A region surrounded by a double dashed line in **FIG. 6** corresponds to the pixel **11**. A dotted pattern region is a polysilicon film. Lines slanted up to the right, and double lines slanted down to the right each denote conductive films (metal films or the like) of separate layers. X-shape marks denote interlayer connection points. A checked pattern region **86** corresponds to an anode of a light emitting element **54**.

[0177] Transistors **71** to **75** and **85** are formed below a first scanning line (Gaj). Transistors **76** to **79** are formed under a second scanning line (Gbj). A capacitor element **83** is formed below a power source line (Vi).

[0178] Three transistors **80** to **82** that structure a driver element are formed adjacent to each other with the same size. From the start, therefore, dispersion between the transistors **80** to **82** within the same pixel does not tend to become large. The "parallel write-in, series drive" structure of the present invention is a means of additionally reducing the influence of dispersion originally existing between the plurality of transistors that form the driver element. The effect of the present invention can therefore be greatly utilized, provided that the plurality of transistors used in the driver element have reduced dispersion from the beginning. Dispersion in the brightness of light emitted by the light emitting elements becomes even less significant.

[0179] Making the dispersion, which originally exists between the plurality of transistors structuring the driver element, as small as possible is preferable from the standpoint of reducing the driver voltage of the display device and the light emitting device. If the dispersion originally existing between the plurality of transistors that structure the driver element is large, then it is necessary to make the L/W ratio of the plurality of transistors large, and to increase the operation point voltage of the driver element. The driver voltage of the display device and the light emitting device therefore cannot be reduced. This becomes very important for display devices and light emitting devices used for portable equipment having a strong demand for power conservation.

[0180] Note that JP 2001-343933 A and the like can be referred to for a method of manufacturing the display device and the light emitting device of the present invention. It is preferable that the source and the drain have symmetry in the plurality of transistors structuring the driver element, but symmetry is not necessarily essential.

[0181] Further, if active layers of the transistors **80** to **82** and the like are formed by a polysilicon film, then it is usual at present to first form an amorphous silicon film, and then perform a polycrystallization process. Polycrystallization can be performed by a method such as laser irradiation, SPC (solid state growth), or a combination of laser irradiation and SPC. If irregularities in the laser light intensity and the scanning speed are not made extremely small for cases where microcrystallization is performed by irradiating linear shape laser light while scanning the light, then linear shape irregularities in the polysilicon film will appear, and linear shape irregularities will thus develop in the transistor characteristics.

[0182] In order to reduce linear shape irregularities in the transistor characteristics, a scheme may be employed for the laser light scanning direction with respect to the arrangement direction of the transistors structuring the driver element. The laser light scanning may be in a vertical direction, a horizontal direction, or a diagonal direction in the process of manufacturing the display device and the light emitting device of the present invention. Further, laser light scanning may also be performed twice, in the vertical direction and in the horizontal direction, and may also be performed twice in a diagonal direction slanting down from the upper right to the lower left and a diagonal direction slanting down from the upper left to the lower right, in the process of manufacturing the display device and the light emitting device of the present invention. Laser light scanning is performed twice with the layout of **FIG. 6**, in an x-direction and in a y-direction.

[0183] [Embodiment Mode 5]

[0184] An example of a structure of the display device and the light emitting device of the present invention is explained in Embodiment Mode 5 by using **FIGS. 7A** to 7C. An example of the general structure of the device, not the internal pixel structure, is explained.

[0185] The display device and the light emitting device of the present invention has a pixel portion **1802**, in which a plurality of pixels are arranged in a matrix shape, on a substrate **1801**. A signal line driver circuit **1803**, a first scanning line driver circuit **1804**, and a second scanning line driver circuit **1805** are disposed in a periphery portion of the pixel portion **1802**. Electric power and signals are supplied from an external portion, through an FPC **1806**, to the signal line driver circuit **1803**, and the scanning line driver circuits **1804** and **1805**.

[0186] The signal line driver circuit **1803**, and the scanning line driver circuits **1804** and **1805** are integrated in the example of **FIG. 7A**, but the present invention is not limited to this structure. For example, the second scanning line driver circuit **1805** may be omitted. Alternatively, the signal line driver circuit **1803**, and the scanning line driver circuits **1804** and **1805** may be omitted.

[0187] Examples of the first scanning line driver circuit **1804** and the second scanning line driver circuit **1805** are explained using **FIG. 7B**. The scanning line driver circuits **1804** and **1805** each have a shift register **1821** and a buffer circuit **1822** in **FIG. 7B**.

[0188] Circuit operation of **FIG. 7B** is explained. The shift register **1821** outputs pulses sequentially based on a clock signal (G-CLK), a clock inverted signal (G-CLKb), and a start pulse signal (G-SP). The pulses undergo current amplification by the buffer circuit **1822**, after which they are input to scanning lines. The scanning lines are thus placed in a selected state one row at a time.

[0189] Note that a level shifter may also be placed within the buffer circuit **1822** when necessary. The level shifter can change the voltage amplitude.

[0190] An example of the signal line driver circuit **1803** is explained next using **FIG. 7C**. The signal line driver circuit **1803** shown in **FIG. 7C** has a shift register **1831**, a first latch circuit **1832**, a second latch circuit **1833**, and a voltage current converter circuit **1834**.

[0191] Operation of the circuit of **FIG. 7C** is explained. The circuit of **FIG. 7C** is used when employing a digital time gray scale method as a method of displaying intermediate gray scales.

[0192] The shift register **1831** outputs pulses sequentially to the first latch circuit **1832** based on a clock signal (S-CLK), a clock inverted signal (S-CLKb), and a start pulse signal (S-SP). Each column of the first latch circuit **1832** successively reads in a digital video signal, in accordance with the pulse timing. When read-in of the video signal is finished through the final column in the first latch circuit **1832**, a latch pulse is then input to the second latch circuit **1833**. The video signal, which has been written into each column of the first latch circuit **1832**. is then transferred all at once to each column of the second latch circuit **1833** by the latch pulse. The video signal, which has been transferred to the second latch circuit **1833**, then undergoes suitable shape transformation processing in the voltage current converter circuit **1834**, and is transferred to the pixels. On data in the video signal is converted to a current form, and off data is left in its voltage form while undergoing current amplification. After the latch pulse, the shift register **1831** and the first latch circuit **1832** operate to read in the next row of the video signal, and the above operations are repeated.

[0193] The structure of the signal line driver circuit **1803** of **FIG. 7C** is an example, and another structure may be used if an analog gray scale method is employed. Further, other structures can also be used even if a digital time gray scale method is employed.

[0194] [Embodiment Mode 6]

[0195] Effects of the present invention are explained in Embodiment Mode 6 using **FIGS. 8A and 8B**, and **FIGS. 17A and 17B**. In order to simplify the explanation, an example of a case is explained in which the number of transistors that structure a driver element is two. The specific pixel circuit structure is taken as that shown in **FIG. 2A**. (Positive and negative directions are appropriately set in **FIGS. 8A and 8B**, and in **FIGS. 17A and 17B**. Note that the positive and negative directions will switch if the transistors are p-channel.) Further, the characteristic curve of the transistors of **FIGS. 8A and 8B** is set to an ideal curve for simplicity, and there is therefore a slight disparity with actual transistors. For example, the channel length variation is zero.

[0196] Taking the electric potential of a transistor source as a reference, a gate electric potential is taken as V_g, a drain electric potential is taken as V_d, and an electric current flowing between the source and the drain is taken as I_d. Curves **801** to **804** in **FIGS. 8A and 8B** are I_d-V_d characteristic curves under a certain fixed gate electric potential V_g. A bold dashed and dotted curve **805** shows I_d-V_d changes, under a condition that V_g and V_d are equal by shorting the gate and the drain, for one of the two transistors structuring the driver element. That is, the bold dashed and dotted curve **805** reflects the transistor specific electrical characteristics (field effect mobility, threshold voltage value). Similarly, a bold dashed and double dotted curve **806** shows I_d-V_d changes, under a condition that V_g and V_d are equal by shorting the gate and the drain, for the other one of the two transistors structuring the driver element.

[0197] **FIGS. 8A and 8B** are for graphically investigating what happens to a light emitting element driver current due to the "parallel write-in, series drive" structure of the present invention for cases in which the two transistors structuring the driver element possess different electrical characteristics. **FIG. 8A** is an example of a case in which the difference in the field effect mobility is particularly large between the two transistors. **FIG. 8B** is an example of a case in which the threshold voltage value difference is particularly large between the two transistors. The light emitting element driver current for each case is shown by the length of a triangular arrow symbol of triangular arrows **807** in conclusion. These are explained in brief below.

[0198] First, consider a case in which the characteristic curves of the transistors **38** and **39** are both equal, corresponding to the bold dashed and dotted curve **805**.

[0199] The transistors **31** to **36** of **FIG. 2B** turn on during write-in of a data current. The gate and the drain of the two transistors **38** and **39** structuring the driver element are shorted due to the transistors **31** to **34** turning on. The operation point of the transistors **38** and **39** is therefore a point on the bold dashed and dotted curve **805**, and a certain point is determined by the data current value I_W. The operation point is here taken as the intersection point of the curves **805** and **801**. That is, two times the vertical axis value I_d of the intersection point of the curves **805** and **801** is taken as the data current value I_W.

[0200] The transistors **31** to **36** of **FIG. 2B** turn off when the light emitting element emits light, while the transistors **37** and **42** turn on. The gate electric potentials of the transistors **38** and **39** are maintained as is at their values during data current write-in because the transistors **31** to **34** turn off. The transistor **39** operates in the saturated region when the light emitting element emits light, and the transistor **38** operates in the unsaturated region. The I_d-V_d curve of the transistor **38** during light emission by the light emitting element is expressed by the curve **801**, and the I_d-V_d characteristic of the transistor **39** is expressed by the curve **803**.

[0201] Each dotted line arrow mark in **FIG. 8A** is equal to the length on the ordinate. During light emission by the light emitting element, the operating point of the transistor **38** is the point of contact between the right end of the left side dotted line arrow and the curve **801**. The light emitting element driver current I_E to be found is the ordinate of the dotted line arrow, that is, the length of the solid line triangular arrow of the triangular arrows **807**. Note that similar information is also provided on **FIG. 8B**, and the light emitting element driver current I_E to be found is the length of the solid line triangular arrow of the triangular arrows **807**. If the characteristic curve of the transistor **38** and the characteristic curve of the transistor **39** are equal, then the resulting light emitting element driver current I_E to be found becomes one-fourth of the data current value I_W.

[0202] Next, consider a case in which the characteristics curve of the transistor **38** corresponds to the bold and double dotted curve **806**, and the characteristic curve of the transistor **39** corresponds to the bold dashed and dotted curve **805**. The data current value I_W is identical to the case discussed above in which the characteristic curves of the transistors **38** and **39** both correspond to the curve **805**.

[0203] The gate and the drain of each of the two transistors **38** and **39** that structure the driver element of **FIG. 2B** are shorted during data current write-in. The operating point of the transistor **38** is therefore on the bold and double dotted curve **806**, and the operating point of the transistor **39** is on the bold and dotted curve **805**. The sum of the ordinate of the operating point of the transistor **38** and the ordinate of the operating point of the transistor **39** is the data current value I_W. The operating point of the transistor **38** therefore becomes the intersection of the curves **806** and **802**. The operating point of the transistor **39** is equal to the abscissa of the operating point of the transistor **38**, and becomes a point on the curve **805**.

[0204] The transistors **31** to **34** of **FIG. 2B** turn off when the light emitting element emits light, and therefore the gate electric potentials of the transistors **38** and **39** are maintained as is at their values during data current write-in. The transistor **39** operates in the saturated region when the light emitting element emits light, and the transistor **38** operates in the unsaturated region. The I_d-V_d curve of the transistor **38** during light emission by the light emitting element is expressed by the curve **802**.

[0205] Each dotted line arrow mark in **FIG. 8A** is equal to the length on the ordinate. The above group of double dotted line arrows is a case whereby the bold double and double dotted curve **806** corresponds to the characteristic curve of the transistor **38**, and the bold and dotted curve **805** corresponds to the characteristic curve of the transistor **39** now being considered. During light emission by the light emitting element, the operating point of the transistor **38** is the point of contact between the right end of the left side double dotted line arrow and the curve **802**. The light emitting element driver current I_E to be found is the ordinate of the double dotted line arrow, namely the length of the dashed line triangular arrow (left side) of the triangular arrows **807**. Note that similar information is also provided on **FIG. 8B**, and the light emitting element driver current I_E to be found is the length of the dashed line triangular arrow (left side) of the triangular arrows **807**.

[0206] Further, investigation of a separate case in which the bold and dotted curve **805** corresponds to the characteristic curve of the transistor **38**, and the bold and double dotted curve **806** corresponds to the characteristic curve of the transistor **39** can also be performed similarly. Details are not discussed here, but the results show that the light emitting element driver current I_E to be found becomes the length of the dashed line triangular arrow (right side) of the triangular arrows **807** in both **FIG. 8A** and **FIG. 8B**.

[0207] In addition, a case in which the bold and double dotted curve **805** corresponds to the characteristic curve of both the transistors **38** and **39** can also be similarly investigated. The results show that the light emitting element driver current I_E to be found becomes the length of the short dashed line arrow of the triangular arrows **807** in both **FIG. 8A** and **FIG. 8B**.

[0208] An outline of how dispersions in the characteristics of the transistors **38** and **39** that structure the driver element are reflected in the light emitting element driver current I_E can be seen from the lengths of the triangular arrows of the triangular arrows **807** in **FIGS. 8A and 8B**.

[0209] Narrow angle arrows **808**, and wide angle arrows **809** in **FIGS. 8A and 8B** are used for comparison. The narrow angle arrows denoted by reference numeral **808** are the results of performing investigations similar to those above when the pixel circuit uses a current input method current mirror. That is, the narrow angle arrows show what happens to the light emitting element driver current I_E when dispersions in the characteristics similar to those above exist between the two transistors of the current mirror. The wide angle arrows **809** are the results of performing similar investigations for a case of a voltage input method pixel circuit. That is, the wide angle arrows show what happens to the light emitting element driver current I_E when dispersions in the characteristics similar to those above exist between light emitting element driver transistors of different pixels.

[0210] The following point can be understood by comparing the triangular arrows **807**, the narrow angle arrows **808**, and the wide angle arrows **809** in **FIGS. 8A and 8B**.

[0211] First, with the triangular shape arrows **807** and the narrow angle arrows **808**, the light emitting element driver current I_E becomes a constant whether the characteristic curve of the transistors is the curve **805** or the curve **806**, provided that there is no dispersion in the characteristics of the two transistors within the same pixel. That is, it is not necessary that the transistor characteristics be constant over an entire substrate for both pixel circuits using a current input method current mirror, and for the "parallel write-in, series drive" pixel circuit of the present invention. It is sufficient to reduce the dispersion in the characteristics between the two transistors within the same pixel. This point is extremely superior compared to the voltage input method pixel circuit.

[0212] However, if dispersion in the characteristics between the two transistors within the same pixels exists, then dispersions in the light emitting element driver current I_E become large as shown by the narrow angle arrows **808**. That is, the influence of the dispersion in the characteristics between the two transistors with the same pixel appears intensely with the pixel circuit that uses the current input method current mirror. In extreme cases, there is a danger that the dispersions in the light emitting element driver current I_E will become larger than that found with the voltage input method pixel circuit. In this point, the influence of dispersions in the characteristics between the two transistors within the same pixel is greatly suppressed with the "parallel write-in, series drive" pixel circuit of the present invention. With current day display devices and light emitting devices, dispersion in transistor characteristics over the entire substrate is more series than that within the same pixel. Dispersions in the characteristics between the two transistors within the same pixel therefore does not become a problem in practice provided that it is suppressed to a similar extent as the "parallel write-in, series drive" pixel circuit of the present invention.

[0213] **FIGS. 17A and 17B** show an example of comparing the pixel circuit using a current input method current mirror, and the "parallel write-in, series drive" pixel circuit of the present invention. First, one transistor of the two transistors within the same pixel is fixed to standard value characteristics in **FIGS. 17A and 17B**. The standard value of a field effect mobility uFE is taken as 100, and the standard value of a threshold value Vth is taken as 3 V. The value of the brightness of light emission was simulated across different values for the characteristics of the other transistor within the same pixel. Values for the field effect mobility uFE were varied in a range from 80 to 120, and values for the threshold value Vth were varied from 2.5 V to 3.5 V. The brightness value for light emission was standardized so that the brightness value is zero when the two transistors within the same pixel have standard value characteristics, and the brightness value is −100 when the pixel is turned off.

[0214] **FIG. 17A** is for the case of the pixel circuit that uses a current input method current mirror, and **FIG. 17B** is for the case of the "parallel write-in, series drive" pixel circuit of the present invention. Dispersion in the characteristics between the two transistors within the same pixel depends greatly on manufacturing processes. However, with present day standard manufacturing processes, values for the field effect mobility uFE and for the threshold value Vth as shown in **FIGS. 17A and 17B** are not unusual. In general, it can be seen that there is a possibility of display irregularities on the order of plus or minus 25% developing for the case of the pixel circuit that uses a current input method current mirror. On the other hand, it can be seen that display irregularities can be suppressed to within a range permissible for practical use with the "parallel write-in, series drive" pixel circuit of the present invention.

[0215] Note that, for convenience, the simulations of **FIGS. 17A and 17B** were performed with realistic arbitrary values for transistor structural parameters. By varying the operating transistor operating voltage by changing the transistor structural parameters, it can be seen that brightness dispersions are reduced as the operating voltage becomes higher.

[0216] The effects of the present invention for an example of a case in which the number of transistors n structuring the driver element is two are explained in Embodiment Mode 6. However, similar results are also established for cases in which the number of transistors n structuring the driver element is three or greater. Note that the effect of reducing dispersions in the TFT characteristics becomes weaker as the number of transistors n structuring the driver element increases. Conversely, the applicants of the present invention have found that, when considering the structure and characteristics (including electrical resistance and parasitic capacitance of wirings and the like, in addition to TFT characteristics) of a polysilicon TFT substrate capable of being manufactured at present, along with the light emitting characteristics of OLED elements, it is preferable for the data current value I_W to be equal to or greater than 5 times the light emitting element driver current I_E for cases in which the present invention is applied to an AM-OLED display device. Setting the number of transistors n structuring the driver element on the order of 3 to 5 therefore has a high utility value. There are cases in which a high utility can be achieved with other values of n depending upon the display device application and the driving method.

[0217] Further, in addition to the fact that ideal values for the transistor characteristics are used in Embodiment Mode 6, parasitic resistance, on resistance for transistors connected in series, and the like are ignored. In reality, these do impart some influence. However, this does not change the fact that the "parallel write-in, series drive" of the present invention is effective in suppressing display irregularities.

[0218] [Embodiment Mode 7]

[0219] In Embodiment Mode 7, electronic equipment and the like having the display devices and the light emitting devices of the present invention mounted thereon will be exemplified.

[0220] Examples of electronic equipment having the display devices and light emitting devices of the present invention mounted thereon include monitors, video cameras, digital cameras, goggle type displays (head mounted displays), navigation systems, audio reproduction devices (car audios, audio components, etc.), notebook type personal computers, game machines, portable information terminals (mobile computers, mobile telephones, portable game machines, and electronic books, etc.), image reproduction devices equipped with a recording medium (specifically, devices equipped with a display capable of reproducing the recording medium such as a digital versatile disk (DVD), etc. and displaying the image thereof), and the like. In particular, as to an electronic equipment whose screen is often viewed from a diagonal direction, since a wide angle of view is regarded as important, the light emitting device is desirably used. Specific examples of these electronic equipment are shown in **FIG. 9**.

[0221] **FIG. 9A** is a monitor which, in this example, is composed of a frame **2001**, a support base **2002**, a display portion **2003**, a speaker portion **2004**, a video input terminal **2005**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2003**. As the light emitting device is of a light emitting type, there is no need for a backlight, whereby it is possible to obtain a thinner display portion than that of a liquid crystal display device. Note that the term monitor includes all the display devices for displaying information, such as for personal computers, for receiving TV broadcasting, and for advertising.

[0222] **FIG. 9B** is a digital still camera which, in this example, is composed of a main body **2101**, a display portion **2102**, an image-receiving portion **2103**, operation keys **2104**, an external connection port **2105**, a shutter **2106**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2102**.

[0223] **FIG. 9C** is a notebook type personal computer which, in this example, is composed of a main body **2201**, a frame **2202**, a display portion **2203**, a keyboard **2204**, an external connection port **2205**, a pointing mouse **2206**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2203**.

[0224] **FIG. 9D** is a mobile computer which, in this example, is composed of a main body **2301**, a display portion **2302**, a switch **2303**, operation keys **2304**, an infrared port **2305**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2302**.

[0225] **FIG. 9E** is a portable image reproduction device provided with a recording medium (specifically, a DVD reproduction device which, in this example, is composed of a main body **2401**, a frame **2402**, a display portion A **2403**, a display portion B **2404**, a recording medium (such as a DVD) read-in portion **2405**, operation keys **2406**, a speaker portion **2407**, and the like. The display device and the light emitting device of the present invention can be used in the display portion A **2403** and in the display portion B **2404**. Note that image reproduction devices provided with a recording medium include game machines for domestic use and the like.

[0226] **FIG. 9F** is a goggle type display (head mounted display) which, in this example, is composed of a main body **2501**, a display portion **2502**, an arm **2503**, and the like. The display device and the light emitting device present invention can be used in the display portion **2502**.

[0227] **FIG. 9G** is a video camera which, in this example, is composed of a main body **2601**, a display portion **2602**, a frame **2603**, an external connection port **2604**, a remote control receiving portion **2605**, an image receiving portion **2606**, a battery **2607**, an audio input portion **2608**, operation keys **2609**, an eyepiece portion **2610**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2602**.

[0228] **FIG. 9H** is a mobile telephone which, in this example, is composed of a main body **2701**, a frame **2702**, a display portion **2703**, an audio input portion **2704**, an audio output portion **2705**, operation keys **2706**, an external connection port **2707**, an antenna **2708**, and the like. The display device and the light emitting device of the present invention can be used in the display portion **2703**. Note that by displaying white characters on a black background, the display portion **2703** can suppress the power consumption of the mobile telephone.

[0229] Note that if the light emitting intensity of the light emitting elements can be increased in the future, the light including the image information output from the display device and the light emitting device of the present invention can be enlarged and projected with a lens or the like, whereby it is possible to use the projected light in front type projectors or rear type projectors.

[0230] As has been described, the application range of the present invention is so wide that it is possible to use the present invention in electronic equipment and the like of any field.

[0231] Driver elements disposed in each pixel in an active matrix display device and in a light emitting device are structured by a plurality of transistors in the present invention. The plurality of transistors are placed in a parallel connection state during write-in of a data current to the pixels, and the plurality of transistors are placed in a series connection state when light emitting elements emit light. The connection state of the plurality of transistors structuring the driver element is thus suitably switched between parallel and series. The following effects develop as a result.

[0232] First, a very large defect with display quality in which irregularities in the brightness of emitted light appear over an entire display screen, if there are no dispersions even in the plurality of transistors structuring a driver element within the same pixel, can be avoided. Namely, the electrical characteristics of the transistors possess a great deal of dispersion when viewed across an entire substrate. This dispersion is reflected in the light emitting element driver current I_E, and irregularities in the brightness of emitted light across the entire display screen can be prevented. Note that irregularities in the brightness of emitted light across the entire display screen can also be prevented in pixel circuits that use the current mirror of **FIG. 10A**, provided that there is no dispersion in the two transistors of the current mirror within the same pixel. In this manner the present invention has an effect similar to cases of pixel circuits that use current mirrors like those of **FIG. 10A**.

[0233] However, the brightness of emitted light cannot be prevented from differing across pixels if dispersion exists between the two transistors within the same pixel with the pixel circuit that uses a current mirror like that of **FIG. 10A**. In this point, even if dispersions exist across the plurality of transistors structuring the drive element within one pixel, the influence of the dispersions can be greatly suppressed in the case of the present invention, and therefore irregularities in the brightness of emitted light across pixels, of an order such that it can cause problems during practical use, can be prevented.

[0234] Further, dispersions in the brightness of emitted light across pixels can be prevented for the case of the pixel circuit of **FIG. 10B**. However, the ratios of the pixel write-in data current I_W and the light emitting element driver current I_E during light emission by the light emitting elements must have identical values for the pixel circuit of **FIG. 10B**. This is an extremely severe restriction in practice. With the present invention, the transistors that structure the driver element are divided into a plurality, and therefore it is possible to make the pixel write-in data current I_W written into the pixels larger than the light emitting element driver current I_E.

[0235] The present invention has advantages like those stated above, and therefore is an important technique for manufacturing practical active matrix display devices and light emitting devices.

1-25. (Cancelled)

26. A camera comprising:

a display portion attached to a main body of the camera; and

a pixel in the display portion, the pixel comprising:

a plurality of transistors; and

a means for switching a connection state between the plurality of transistors to one of a series connection state and a parallel connection state.

27. A camera according to claim 26, wherein the camera is at least one of a digital camera and a video camera.

28. A personal computer comprising:

a display portion attached to a main body of the personal computer; and

a pixel in the display portion, the pixel comprising:

a plurality of transistors; and

a means for switching a connection state between the plurality of transistors to one of a series connection state and a parallel connection state.

29. An image reproduction device comprising:

a display portion attached to a main body of the image reproduction device; and

a pixel in the display portion, the pixel comprising:

a plurality of transistors; and

a means for switching a connection state between the plurality of transistors to one of a series connection state and a parallel connection state.

30. An image reproduction device according to claim 29, wherein the image reproduction device is a DVD.

31. A goggle type display comprising:

a display portion attached to a main body of the goggle type display; and

a pixel in the display portion, the pixel comprising:

a plurality of transistors; and

a means for switching a connection state between the plurality of transistors to one of a series connection state and a parallel connection state.

32. A portable information terminal comprising:

a display portion attached to a main body of the portable information terminal; and

a pixel in the display portion, the pixel comprising:

a plurality of transistors; and

a means for switching a connection state between the plurality of transistors to one of a series connection state and a parallel connection state.

33. A portable information terminal according to claim 32, wherein the portable information terminal is at least one selected from the group consisting of a mobile computer, a mobile telephone, a portable game machine, and an electronic book.

34. A camera comprising:

a display portion attached to a main body of the camera; and

a pixel in the display portion, the pixel comprising:

a driver element comprising a plurality of transistors,

wherein the plurality of transistors are placed in a series connection state to flow electric current when the pixel performs display, and

wherein the plurality of transistors are placed in a parallel connection state to flow electric current when data is written into the pixel.

35. A camera according to claim 34, wherein the camera is at least one of a digital camera and a video camera.

36. A personal computer comprising:

a display portion attached to a main body of the personal computer; and

a pixel in the display portion, the pixel comprising:

a driver element comprising a plurality of transistors,

wherein the plurality of transistors are placed in a series connection state to flow electric current when the pixel performs display, and

wherein the plurality of transistors are placed in a parallel connection state to flow electric current when data is written into the pixel.

37. An image reproduction device comprising:

a display portion attached to a main body of the image reproduction device; and

a pixel in the display portion, the pixel comprising:

a driver element comprising a plurality of transistors,

wherein the plurality of transistors are placed in a series connection state to flow electric current when the pixel performs display, and

wherein the plurality of transistors are placed in a parallel connection state to flow electric current when data is written into the pixel.

38. An image reproduction device according to claim 37, wherein the image reproduction device is a DVD.

39. A goggle type display comprising:

a display portion attached to a main body of the goggle type display; and a pixel in the display portion, the pixel comprising:

a driver element comprising a plurality of transistors,

wherein the plurality of transistors are placed in a series connection state to flow electric current when the pixel performs display, and

wherein the plurality of transistors are placed in a parallel connection state to flow electric current when data is written into the pixel.

40. A portable information terminal comprising:

a display portion attached to a main body of the portable information terminal; and

a pixel in the display portion, the pixel comprising:

a driver element comprising a plurality of transistors,

wherein the plurality of transistors are placed in a series connection state to flow electric current when the pixel performs display, and

wherein the plurality of transistors are placed in a parallel connection state to flow electric current when data is written into the pixel.

41. A portable information terminal according to claim 40, wherein the portable information terminal is at least one selected from the group consisting of a mobile computer, a mobile telephone, a portable game machine, and an electronic book.

* * * * *

patsnap

专利名称(译)	显示装置，发光装置和电子设备		
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摘要(译)

提供一种AM-OLED显示装置，其中充分抑制OLED元件驱动电流的分散作为目标。本发明在将数据电流写入像素期间将多个晶体管置于并联连接状态，并且当发光元件发光时将多个晶体管置于串联连接状态。结果，即使在构成同一像素内的驱动元件的多个晶体管之间存在分散，也可以极大地抑制分散的影响，因此可以大大抑制像素上的发光亮度的不规则性，其顺序使得它在实际使用中引起问题，可以预防。