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Ozawa

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(54) **DISPLAY DEVICE AND METHOD OF
MANUFACTURING THE SAME**

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(30) **Foreign Application Priority Data**

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H01L 51/00 (2006.01)

(52) **U.S. Cl.**
USPC **257/40**; 257/E51.022; 438/35; 438/99

(58) **Field of Classification Search**
USPC 257/40, E51.022, E27.121, E33.065; 438/34, 438/35, 99

See application file for complete search history.

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Primary Examiner — Julio J. Maldonado

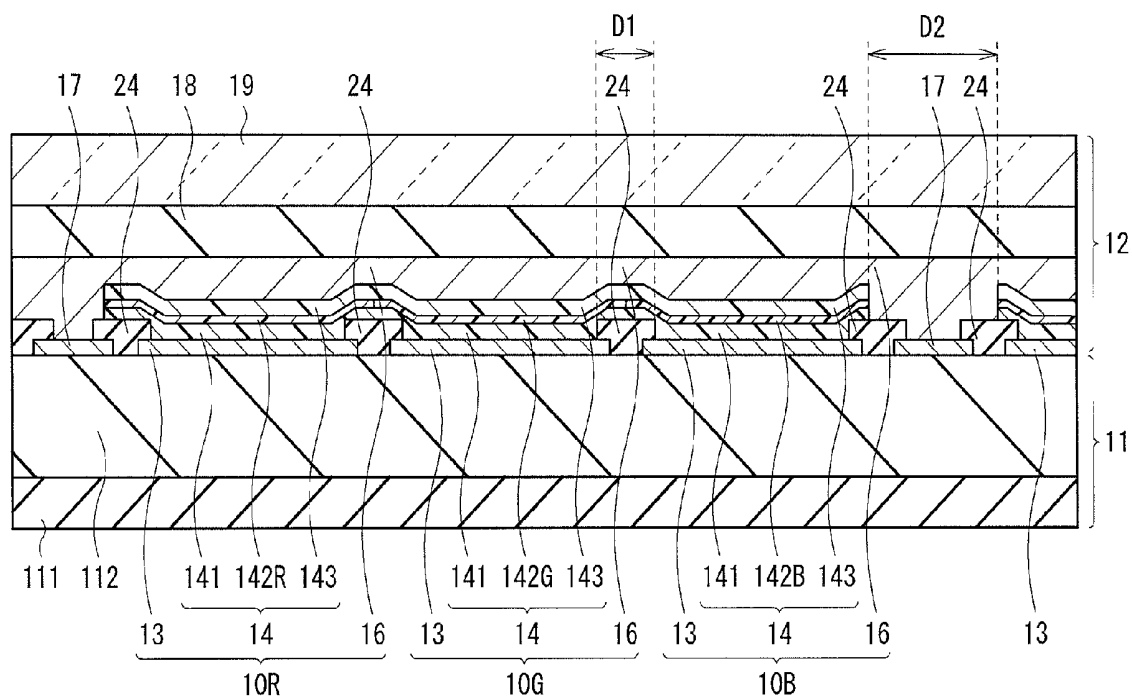
Assistant Examiner — Daniel Shook

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(57) **ABSTRACT**

A display device includes: a pixel including a plurality of light emitting elements each formed by sequentially stacking a first electrode layer, an organic layer, and a second electrode layer, spaced apart from each other in a first direction orthogonal to the stacking direction thereof, and emitting light emission colors different from each other; and an auxiliary wiring layer electrically connected to the second electrode layer. A plurality of the pixels are aligned in the first direction so as to include a gap which is larger than a gap between the light emitting elements adjacent to each other, and the auxiliary wiring layer is provided between the pixels adjacent to each other.

10 Claims, 19 Drawing Sheets



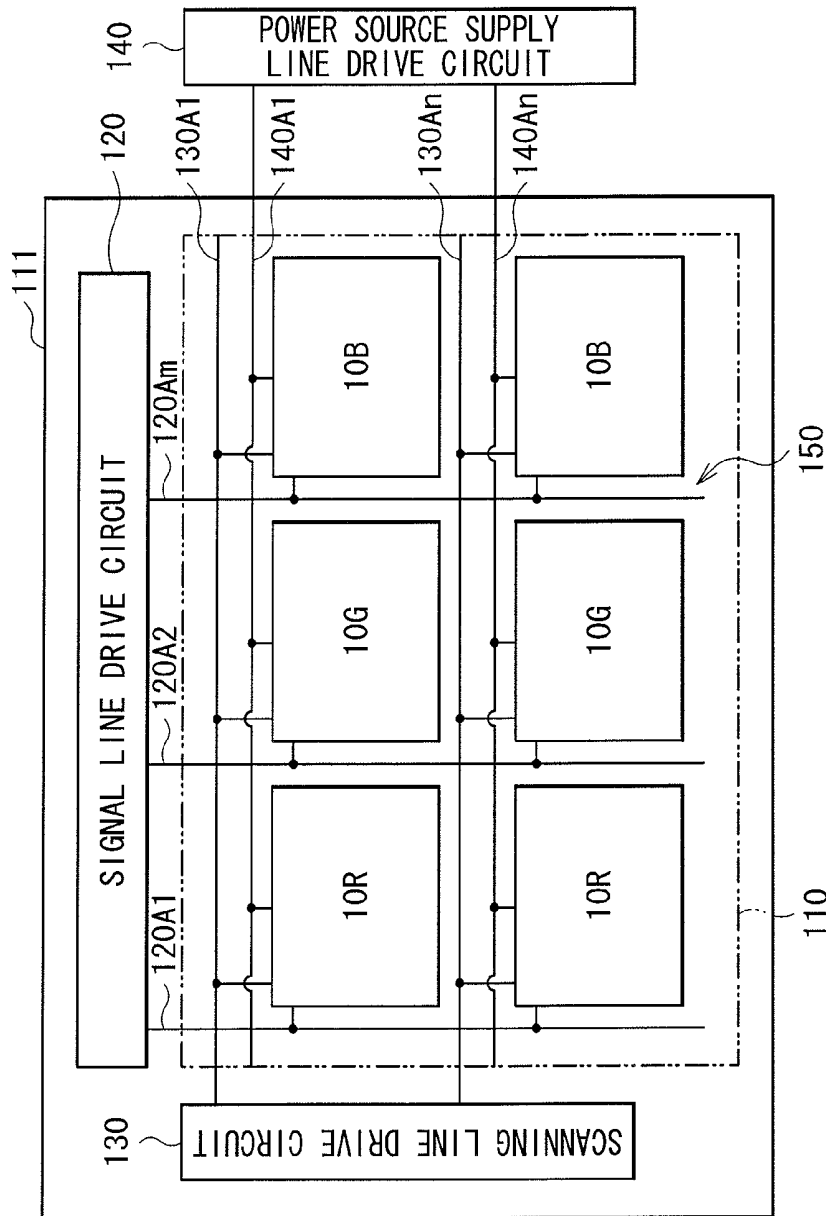


FIG. 1

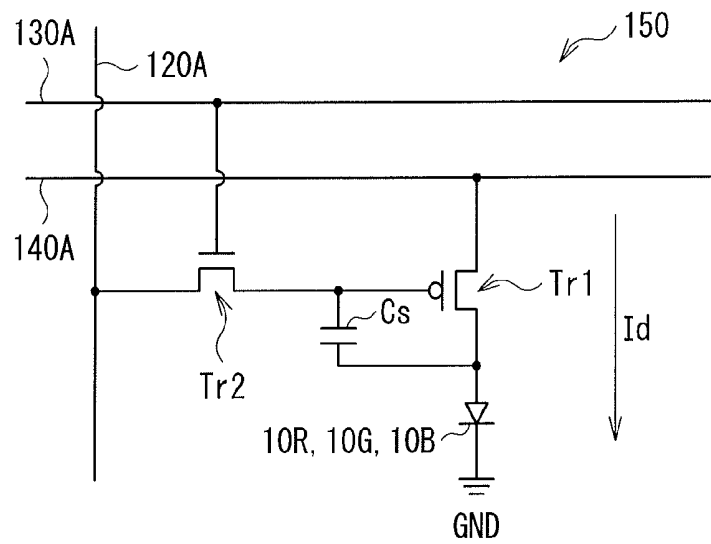


FIG. 2

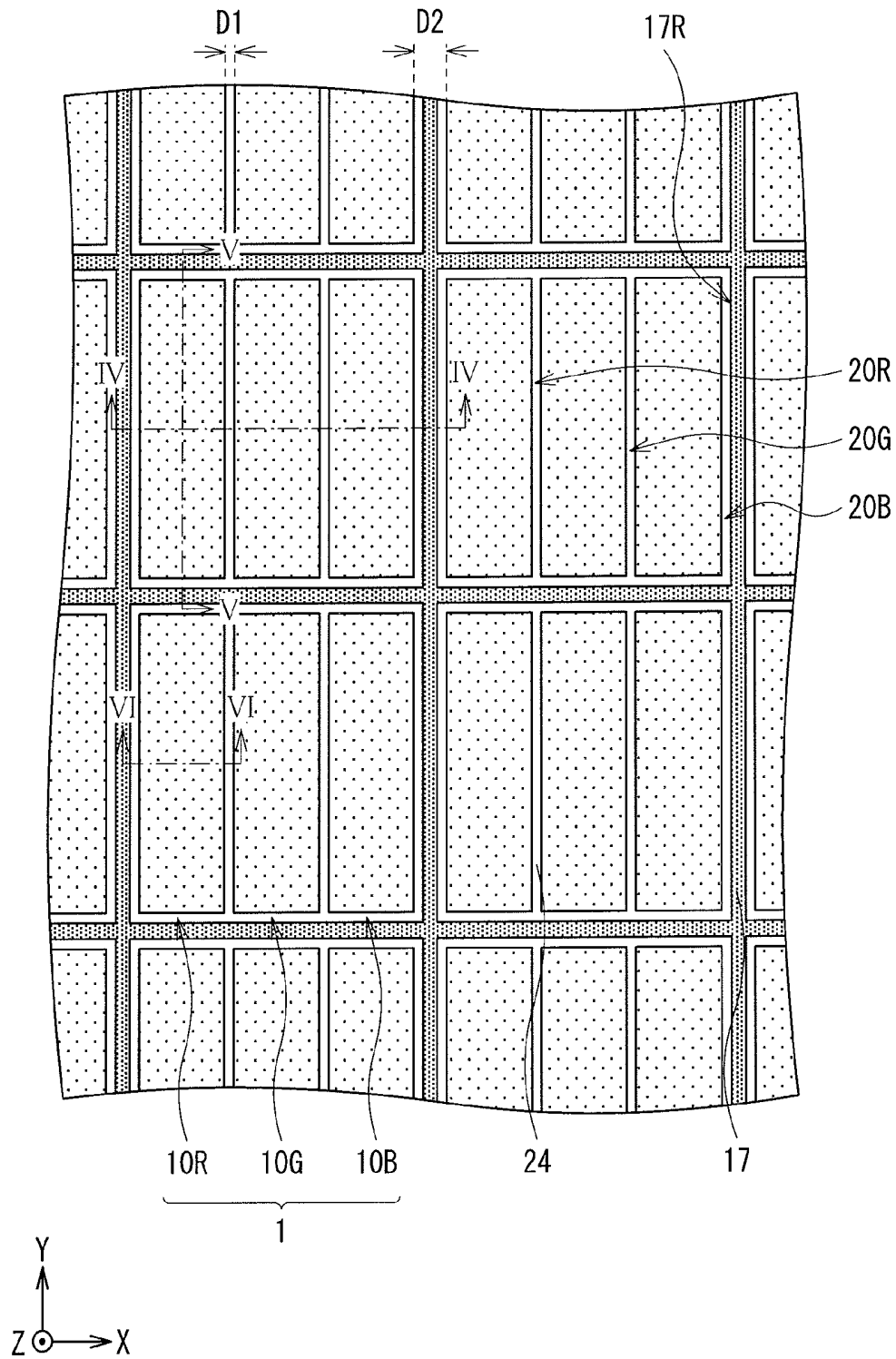


FIG. 3

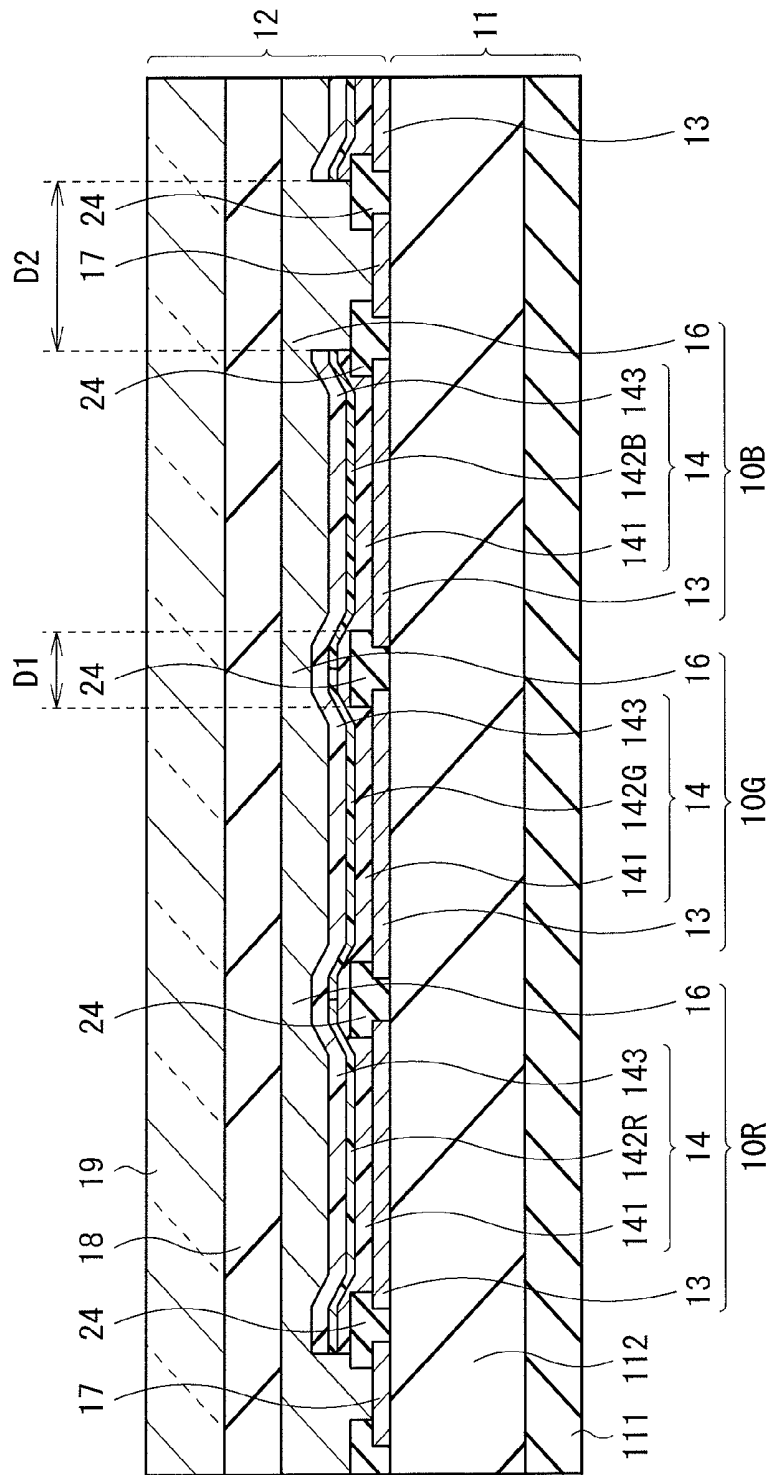


FIG. 4

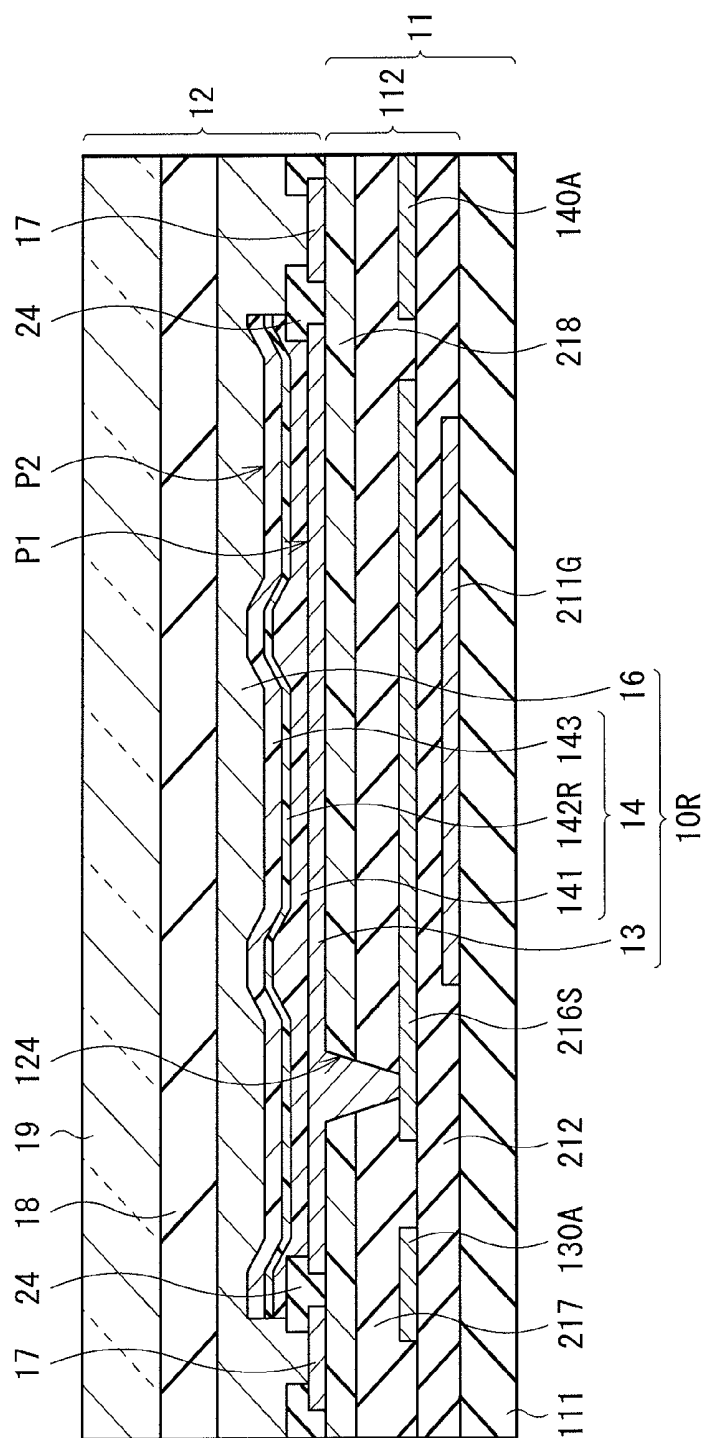


FIG. 5

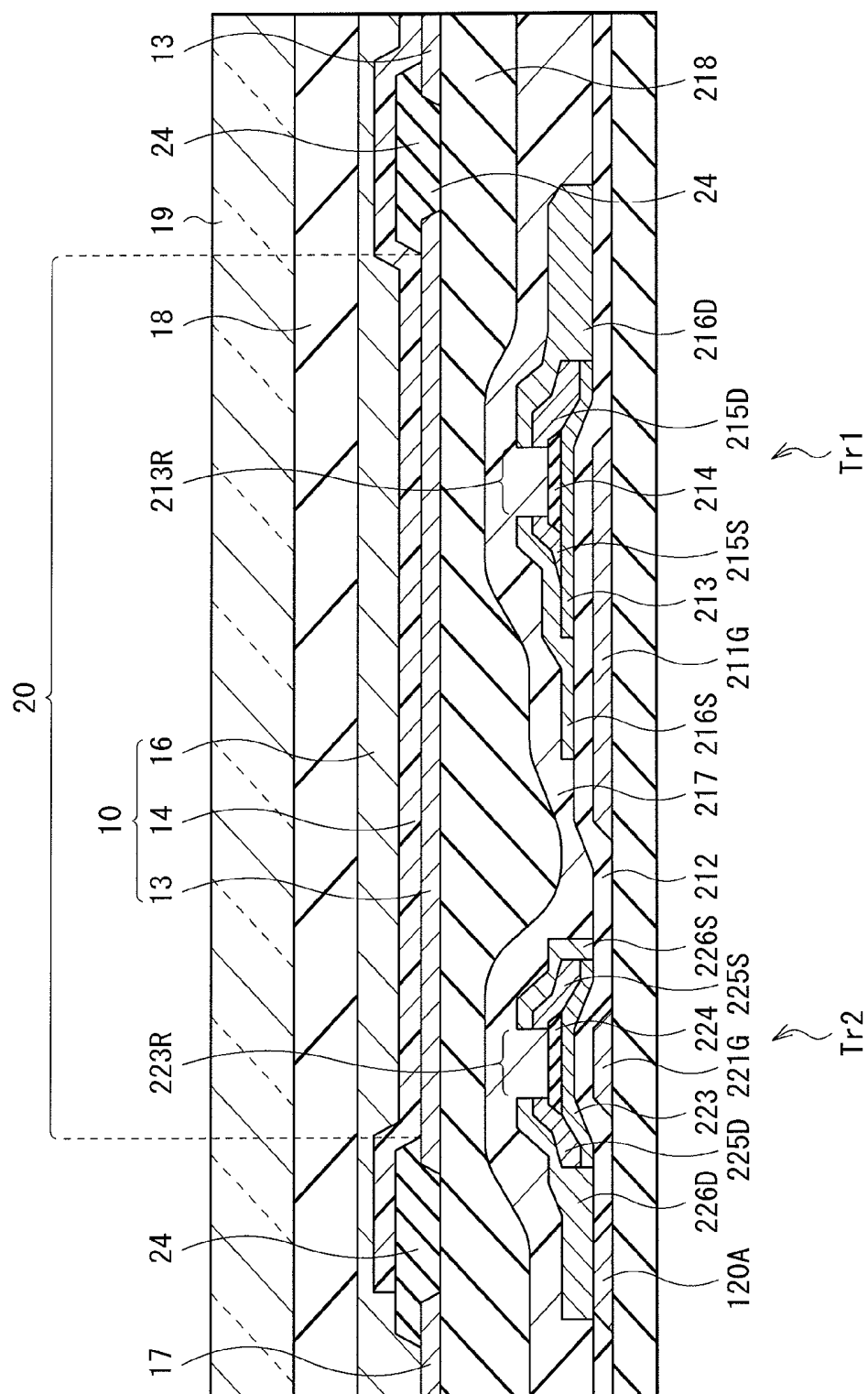


FIG. 6

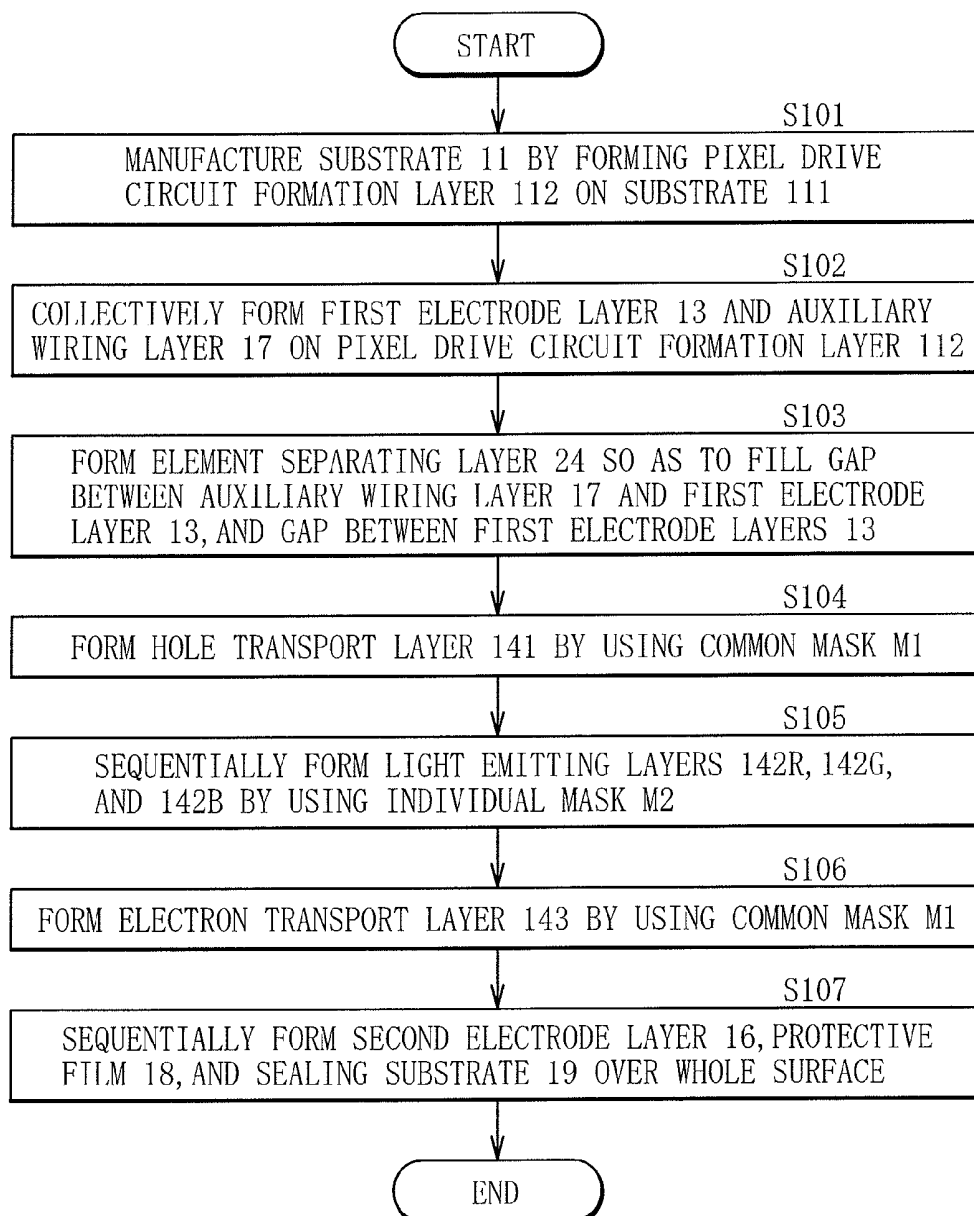


FIG. 7

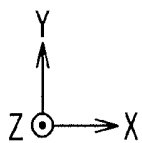
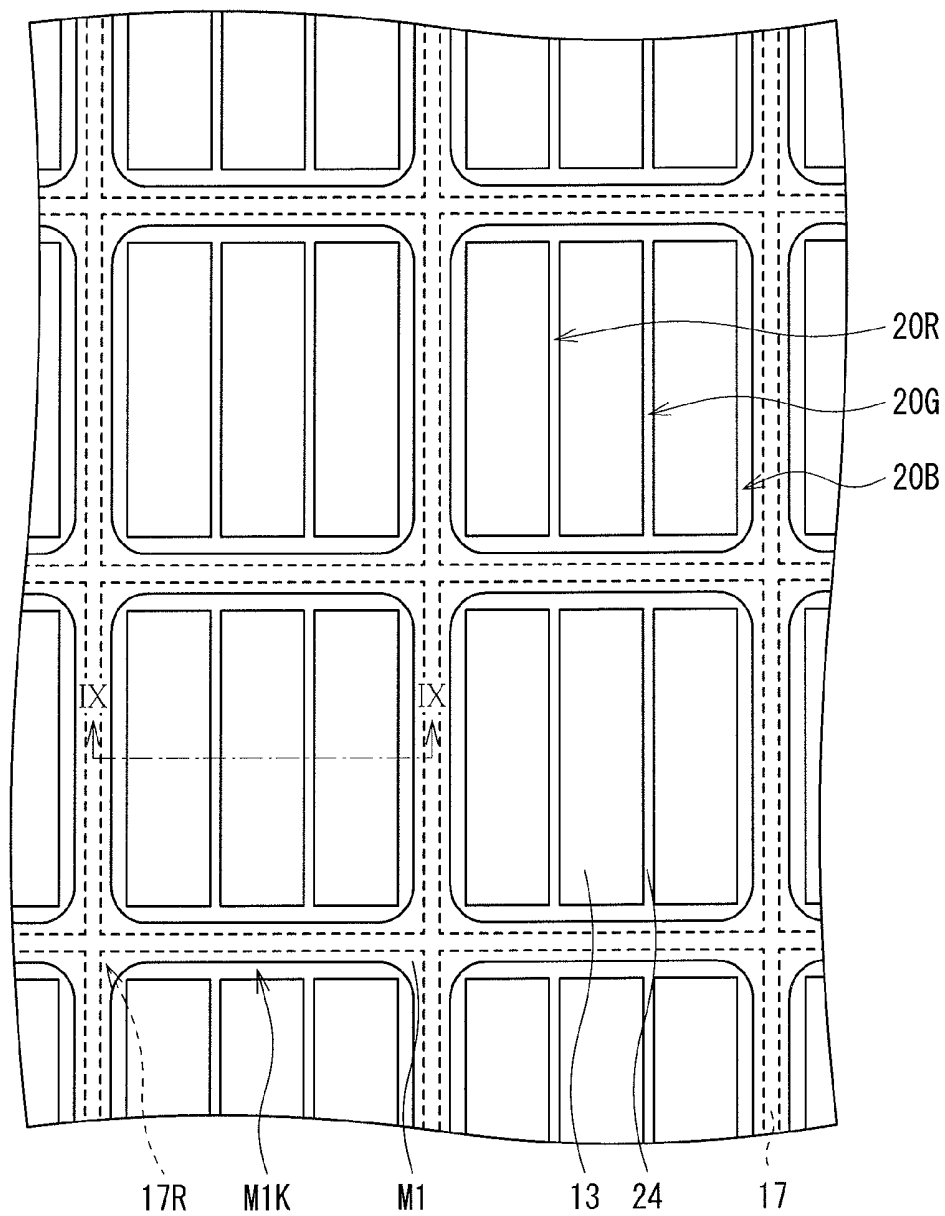


FIG. 8

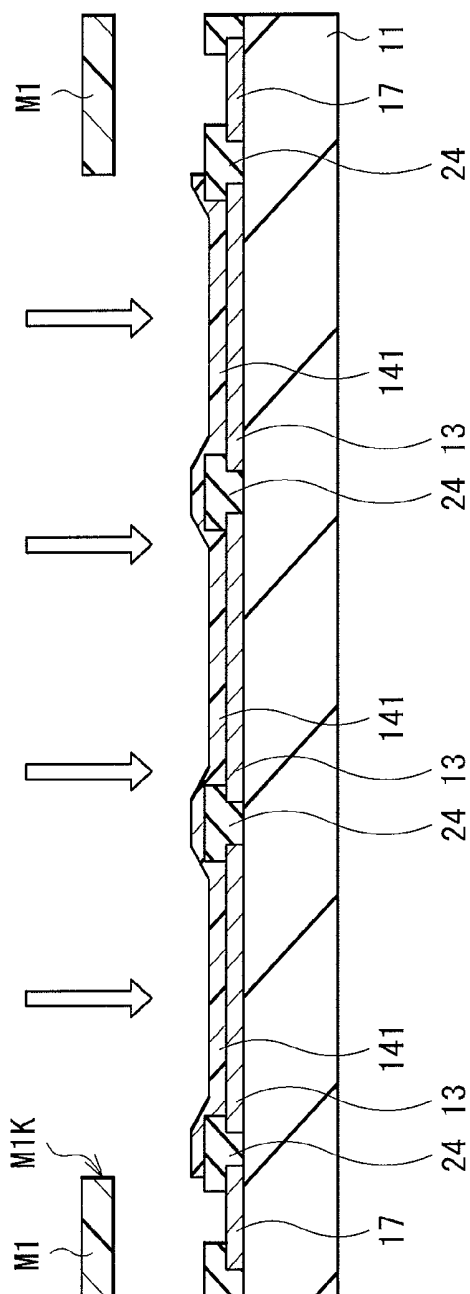


FIG. 9

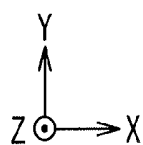
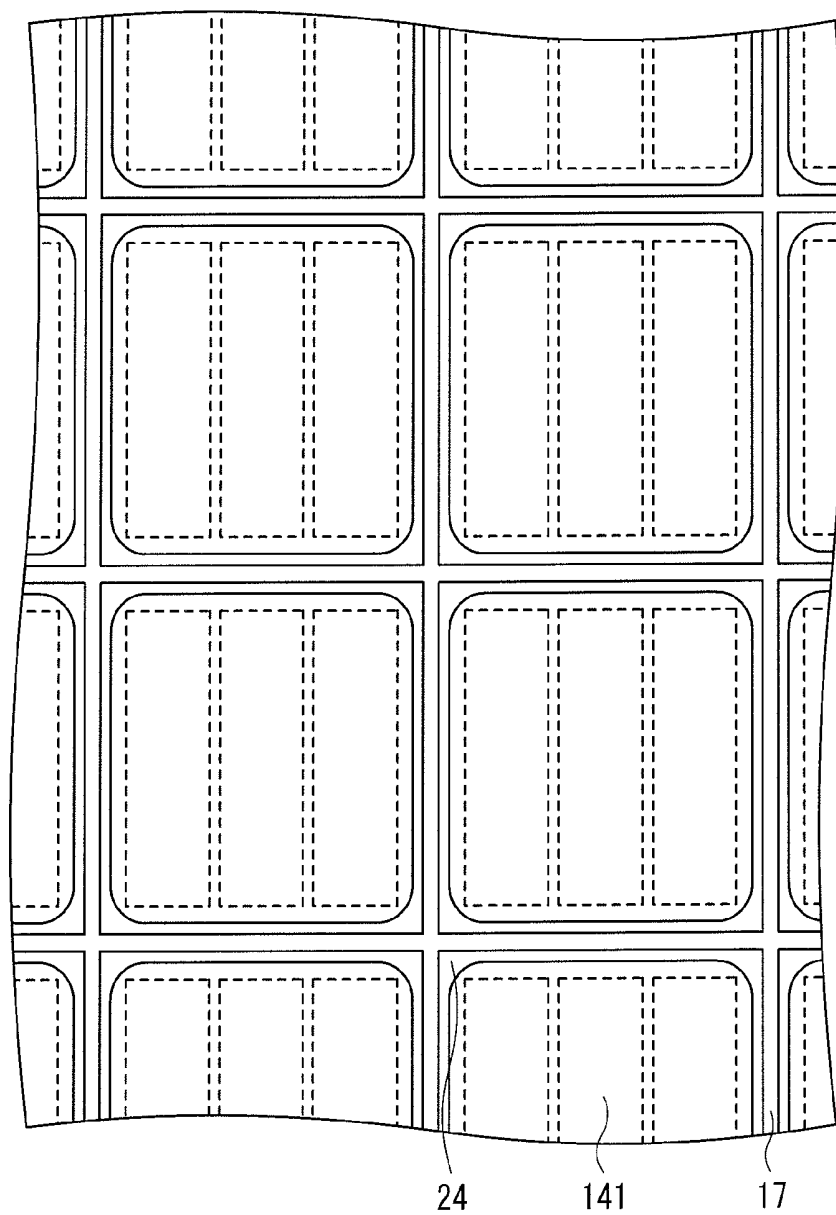


FIG. 10

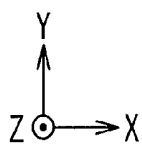
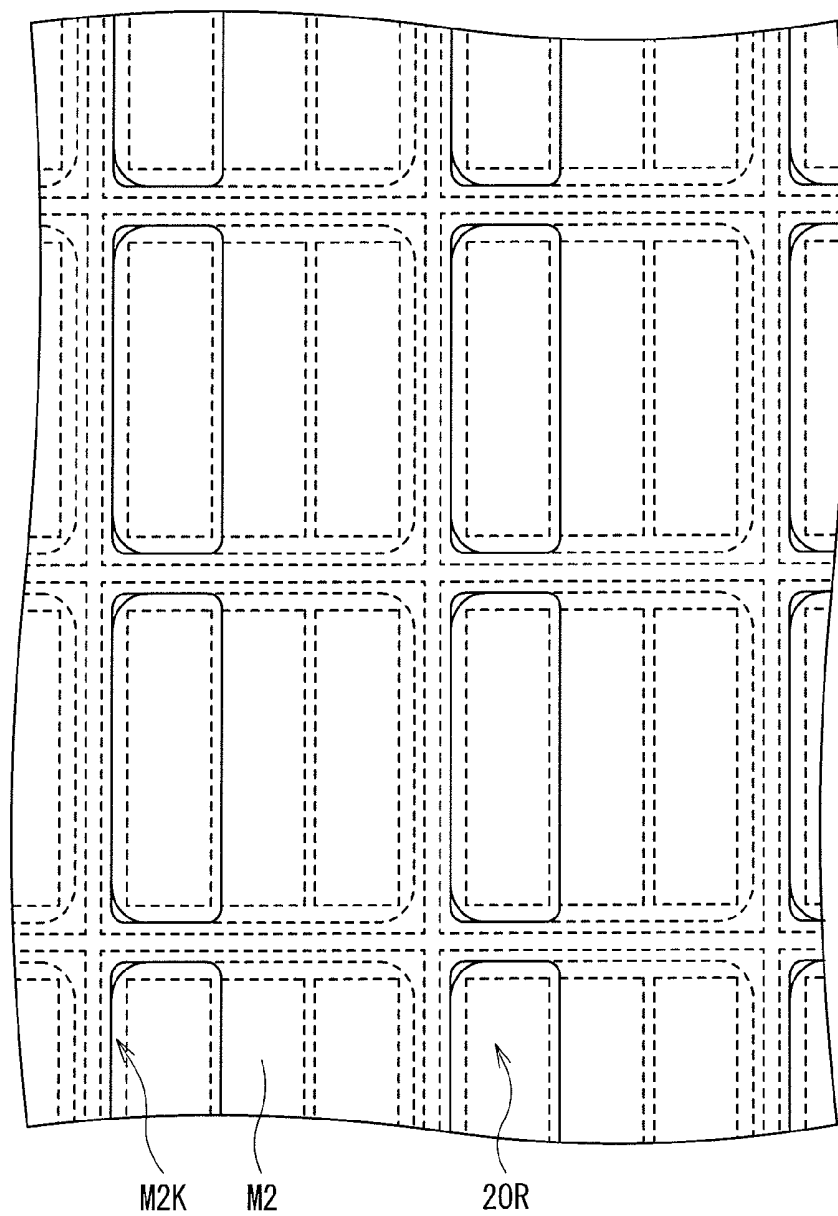


FIG. 11

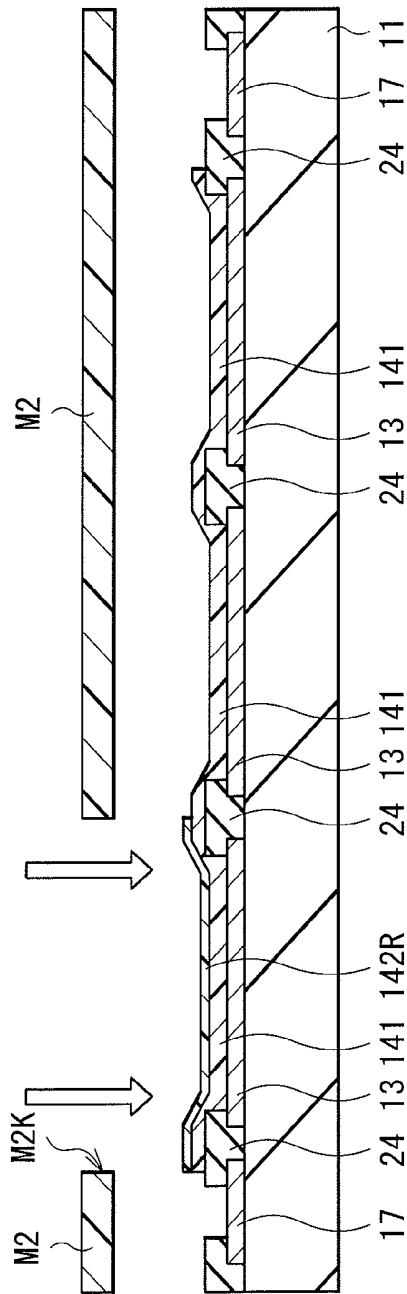


FIG. 12

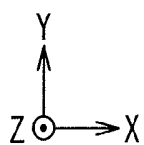
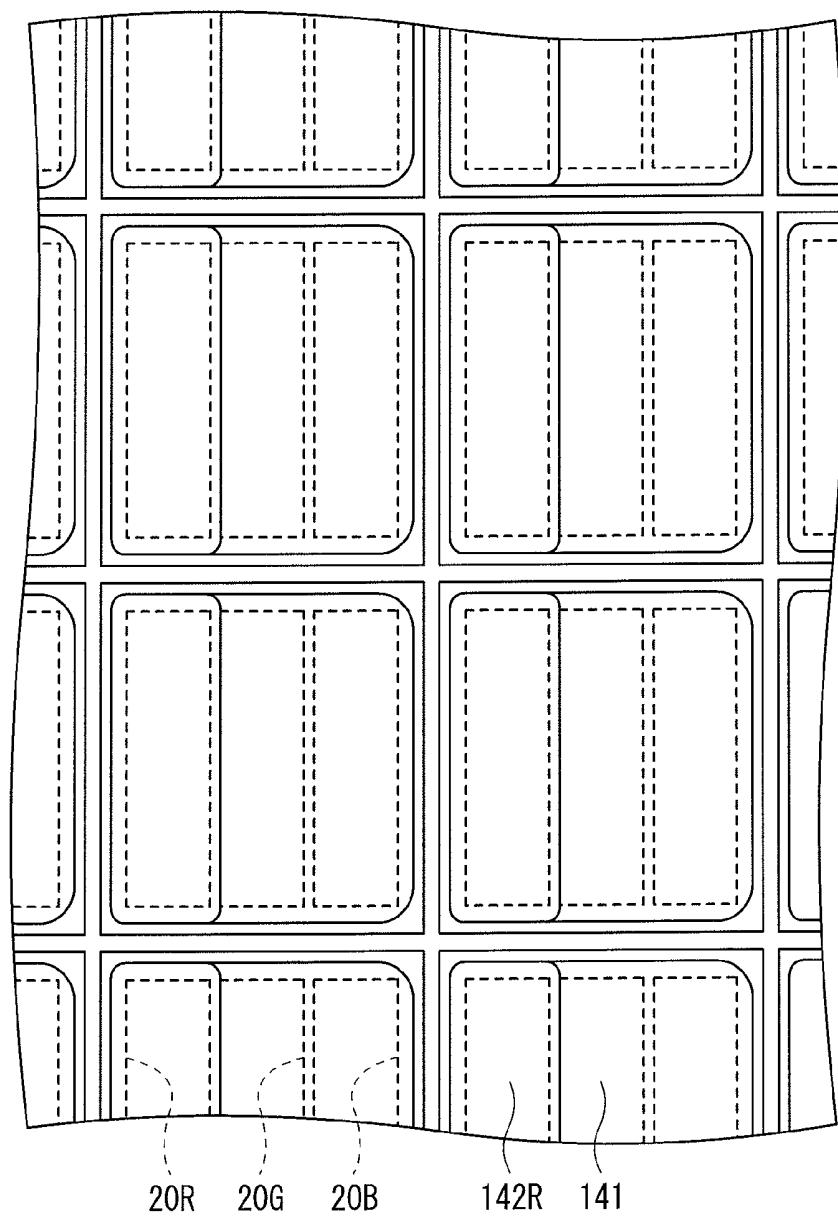


FIG. 13

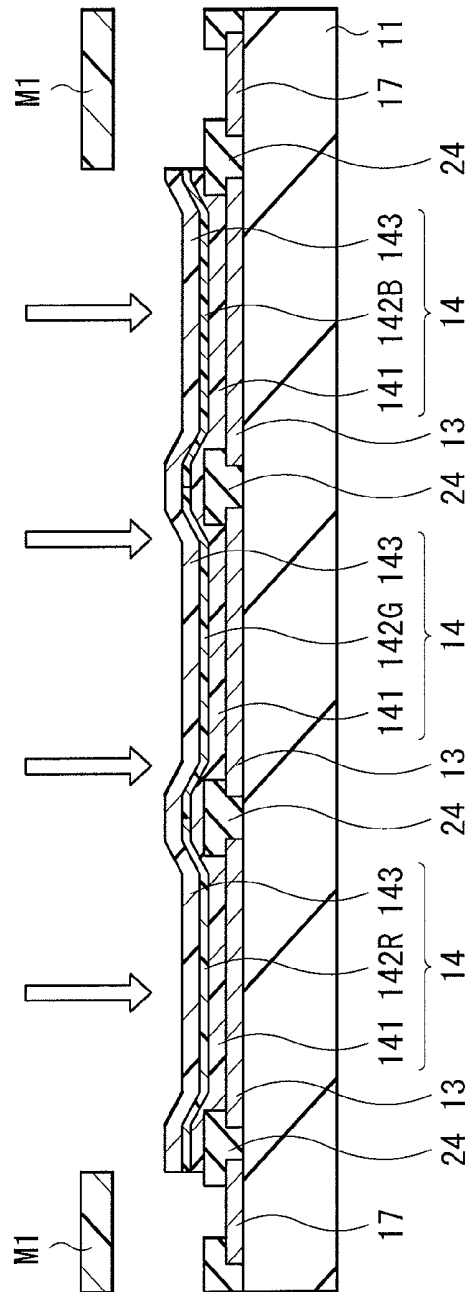


FIG. 14

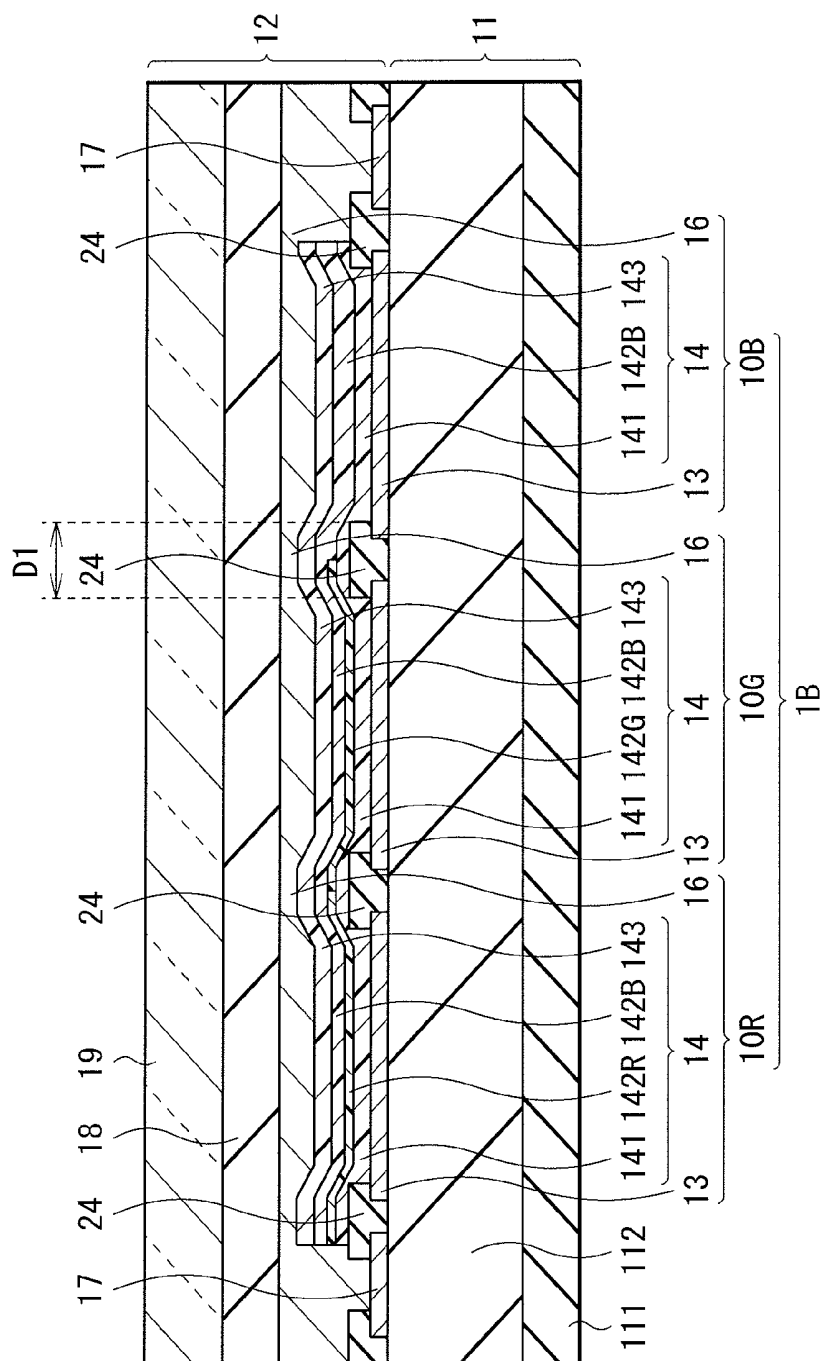


FIG. 15

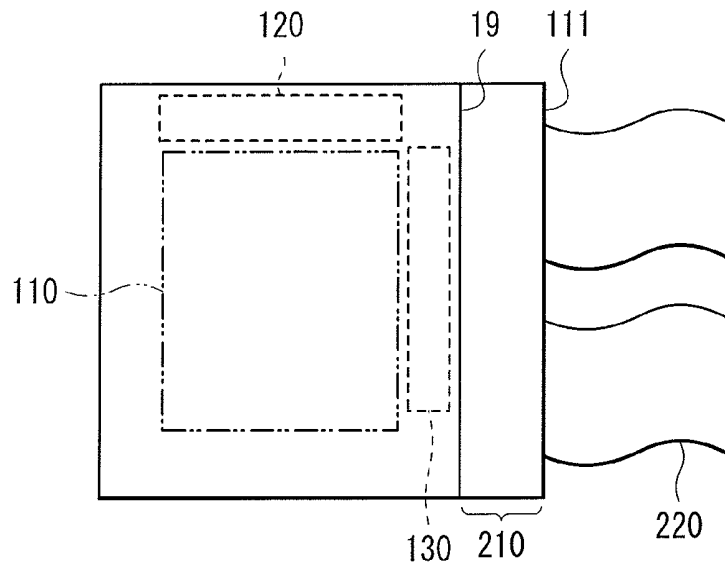


FIG. 16

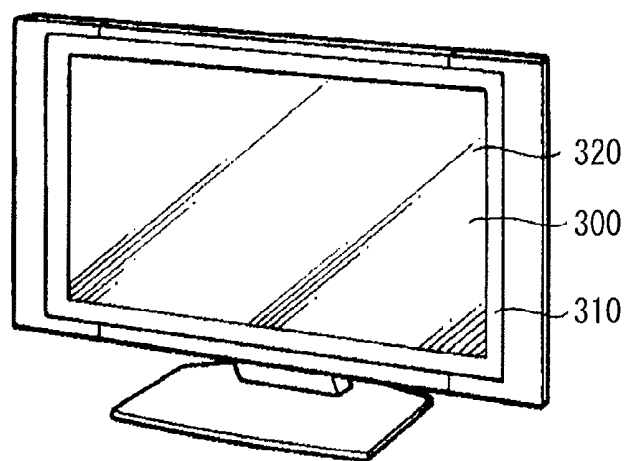


FIG. 17

FIG. 18A

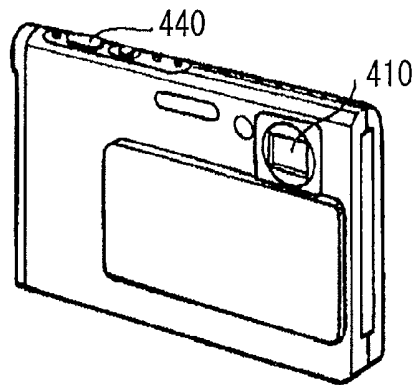
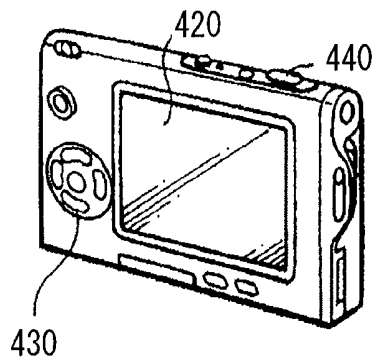


FIG. 18B



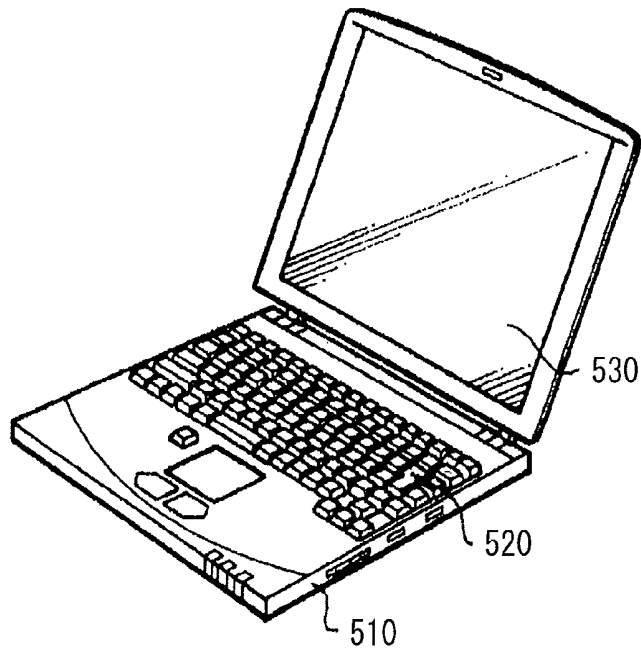


FIG. 19

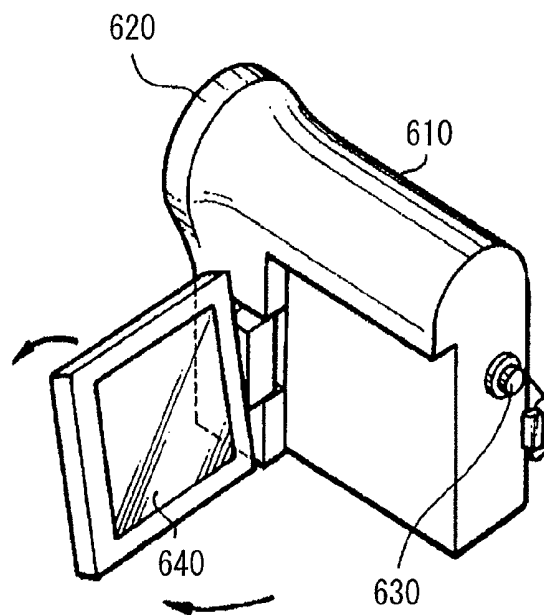


FIG. 20

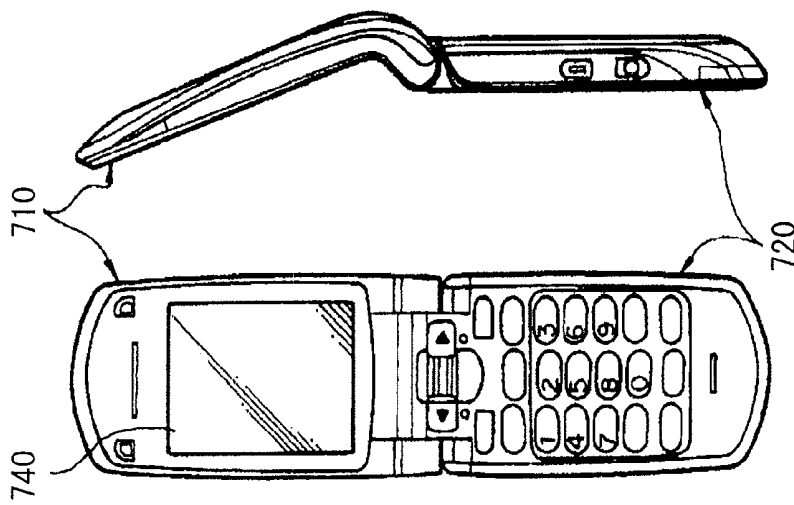


FIG. 21A

FIG. 21B

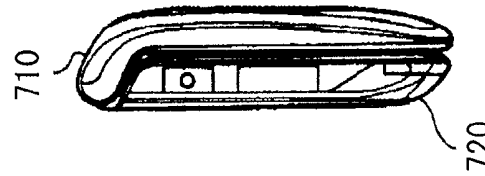


FIG. 21D

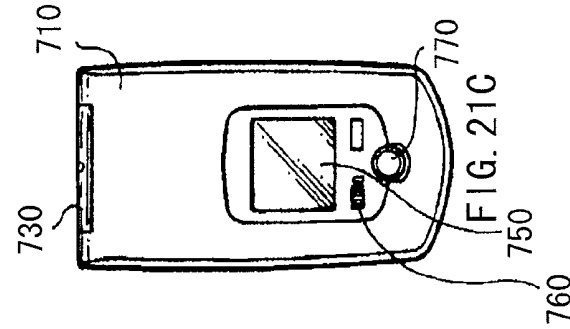


FIG. 21E

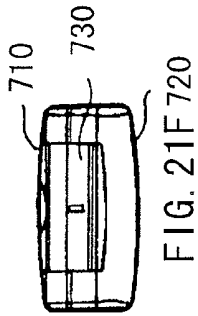


FIG. 21F

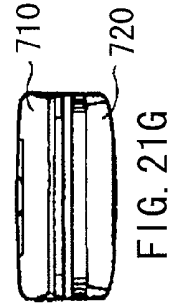


FIG. 21G

DISPLAY DEVICE AND METHOD OF MANUFACTURING THE SAME

CROSS REFERENCES TO RELATED APPLICATIONS

The present application claims priority to Japanese Patent Application JP 2009-186732 filed on Aug. 11, 2009, the entire contents of which is hereby incorporated by reference.

BACKGROUND

The present disclosure relates to a display device including a self-luminous light emitting element which includes an organic layer, and a method of manufacturing the same.

In recent years, as a display device in substitution for a liquid crystal display, an organic EL display device using a self-luminous organic EL (electro luminescence) element which includes an organic layer has been put into practical use. Since the organic EL display device is self-luminous, the organic EL display device has a wide viewing angle in comparison with liquid crystal or the like. Further, the organic EL display device has sufficient response characteristics to a high-definition and high-speed video signal.

In driving methods of the organic EL display device, an active matrix method in which a thin film transistor (TFT) is used as a drive element is superior in terms of response characteristics and resolution, in comparison with a passive matrix method. Thus, the active matrix method is regarded as an especially-appropriate drive method in the organic EL display device having the above-described features. The organic EL display device employing the active matrix method includes a drive panel in which an organic EL element including an organic light emitting layer, and a drive element (the above-described thin film transistor) for driving the organic EL element are disposed. Further, the drive panel and a sealing panel are bonded to each other by an adhesive layer so as to sandwich the organic EL element in between. The organic EL element has a structure in which the organic light emitting layer is formed between a pair of electrodes.

The organic EL display device is classified into a bottom emission method type in which light from each organic EL element is emitted to the drive panel side, and a top emission method type in which the light is emitted to the sealing panel side in reverse. In the case where the both methods are compared, the top emission method is advantageous in that the aperture ratio may be further improved.

Here, in the organic EL display device employing the top emission method, an electrode on light extraction side, that is, an electrode on the sealing panel side is an electrode used in common to each of the organic EL elements, and is, for example, composed of a light transmissive conductive material such as ITO (indium tin oxide). However, in such a light transmissive conductive material, the resistance is approximately double-digit or triple-digit higher in comparison with a typical metal material. Thus, since a voltage applied to the electrode on the light extraction side becomes non-uniform in the plane, the variation of the light emission luminance depending on the position is generated among each of the organic EL elements, and there is an issue that the display quality is lowered.

As a display device to solve this issue, for example, there is known organic EL display devices disclosed in Japanese Unexamined Patent Publication Nos. 2004-207217, and 2005-11810. In those organic EL display devices, an auxiliary wiring connected to an electrode (upper electrode) on the light extraction side which is on the same layer level as an

electrode (lower electrode) on the drive panel side is formed, and a voltage drop is suppressed in the in-plane direction of the lower electrode.

SUMMARY

In Japanese Unexamined Patent Publication No. 2004-207217, after forming the lower electrode and the auxiliary wiring, pixels composed of a red light emitting element, a green light emitting element, and a blue light emitting element are sequentially formed by using individual evaporation masks for coloring organic layers with each light emission color. At this time, the organic layer is not deposited in a part of a region on the auxiliary wiring, and the auxiliary wiring and the upper electrode are connected in that region. However, in such a manufacturing method, it is necessary to evaporate and deposit an organic material for each light emission color, and the pixels are separately formed by using the individual evaporation masks even when the organic material is the same kind. Thus, the manufacture tact is long, and the total amount of the used organic material is drastically increased.

Further, in Japanese Unexamined Patent Publication No. 2005-11810, after forming the lower electrode and the auxiliary wiring, the organic layer is deposited over the whole surface, and the organic layer deposited on the auxiliary wiring is selectively removed through the use of laser irradiation, thereby realizing the connection between the auxiliary wiring the upper electrode. However, in the manufacturing method described above, the step of removing the organic material by laser is added, and the manufacturing process is complicated. Further, there is an issue of the cost increase of equipment such as a laser light source.

In view of the foregoing, it is desirable to provide a display device having a structure which is more simply manufacturable, while ensuring favorable display characteristics, and a method of manufacturing the same.

According to an embodiment, there is provided a display device including: a pixel including a plurality of light emitting elements each formed by sequentially stacking a first electrode layer, an organic layer, and a second electrode layer, spaced apart from each other in a first direction orthogonal to the stacking direction thereof, and emitting light emission colors different from each other; and an auxiliary wiring layer electrically connected to the second electrode layer. Here, a plurality of the pixels are aligned in the first direction so as to include a gap which is larger than a gap between the light emitting elements adjacent to each other, and the auxiliary wiring layer is provided between the pixels adjacent to each other.

In the display device according to the embodiment, the plurality of the pixels are aligned in the first direction so as to include the gap which is larger than the gap between the light emitting elements in each of the pixels, and the auxiliary wiring layer is provided between the pixels adjacent to each other. Thus, it is advantageous to set a width of the auxiliary wiring layer large, while reducing a distance between the light emitting elements emitting the different light emission colors.

According to an embodiment, there is provided a method of manufacturing a display device comprising steps of: forming a plurality of auxiliary wiring layers spaced apart from each other in a first direction on a substrate; and forming a pixel between the auxiliary wiring layers adjacent to each other, respectively, the pixel having a stacked structure of a first electrode layer, an organic layer, and a second electrode layer connected to the auxiliary wiring layer, and including a

plurality of light emitting elements emitting light emission colors different from each other. Here, the plurality of light emitting elements are aligned so as to include a gap which is smaller than a gap between the pixels adjacent to each other in the first direction.

In the method of manufacturing a display device according to the embodiment, in the first direction, the auxiliary wiring layer is provided between the pixels adjacent to each other, and the gap between the pixels adjacent to each other is set to be larger than the gap between the light emitting elements in each of the pixels. Thus, it is easy to set a width of the auxiliary wiring layer large, while reducing a distance between the light emitting elements emitting different light emission colors.

According to the display device of the embodiment, in the first direction, the gap between the pixels is set to be larger than the gap between the light emitting elements, and the plurality of auxiliary wiring layers are provided between the pixels adjacent to each other. Thus, it is possible to display an image in which luminance is more homogenized, while realizing high integration without reducing an aperture ratio. Further, even in the case where the display device is highly integrated, for example, by using a common mask covering a region corresponding to the auxiliary wiring layer, and including an aperture corresponding to a region other than the region corresponding to the auxiliary wiring layer, it is possible to form layers used in common to the plurality of light emitting elements in the organic layer. Therefore, the display device is more efficiently manufacturable without deteriorating high-precision dimensions.

According to the method of manufacturing a display device, in the first direction, the gap between the pixels is set to be larger than the gap between the light emitting elements, and the plurality of auxiliary wiring layers are provided between the pixels adjacent to each other. Thus, even in the case where the display device is highly integrated, by using the common mask covering the region corresponding to the auxiliary wiring layer, and including the aperture corresponding to the region other than the region corresponding to the auxiliary wiring layer, it is possible to form layers used in common to the plurality of light emitting elements in the organic layer. Therefore, it is possible to more efficiently manufacture the display device having higher-precision dimensions, and exhibiting favorable display characteristics.

Additional features and advantages are described herein, and will be apparent from the following Detailed Description and the figures.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a view illustrating the structure of a display device according to an embodiment.

FIG. 2 is a view illustrating an example of a pixel drive circuit illustrated in FIG. 1.

FIG. 3 is a plan view illustrating the structure of a display region illustrated in FIG. 1.

FIG. 4 is a cross-sectional view illustrating the structure of a pixel region illustrated in FIG. 3.

FIG. 5 is a cross-sectional view illustrating the structure of an organic light emitting element illustrated in FIG. 4.

FIG. 6 is another cross-sectional view illustrating the structure of the organic light emitting element illustrated in FIG. 4.

FIG. 7 is a flow chart illustrating procedures for explaining a manufacturing method of the display device illustrated in FIG. 1.

FIG. 8 is a plan view illustrating a step for explaining the manufacturing method of the display device illustrated in FIG. 1.

FIG. 9 is a cross-sectional view illustrating a step subsequent to FIG. 8.

FIG. 10 is a plan view illustrating a step subsequent to FIG. 9.

FIG. 11 is a plan view illustrating a step subsequent to FIG. 10.

FIG. 12 is a cross-sectional view illustrating a step subsequent to FIG. 11.

FIG. 13 is a plan view illustrating a step subsequent to FIG. 12.

FIG. 14 is a cross-sectional view illustrating a step subsequent to FIG. 13.

FIG. 15 is a cross-sectional view illustrating a modification of the organic light emitting element illustrated in FIG. 4.

FIG. 16 is a plan view illustrating the schematic structure of a module including the display device of the embodiment.

FIG. 17 is a perspective view illustrating an appearance of a first application example of the display device of the embodiment.

FIGS. 18A and 18B are perspective views illustrating an appearance of a second application example.

FIG. 19 is a perspective view illustrating an appearance of a third application example.

FIG. 20 is a perspective view illustrating an appearance of a fourth application example.

FIGS. 21A to 21G are schematic views illustrating an appearance of a fifth application example.

DETAILED DESCRIPTION

An embodiment will be described in detail with reference to the drawings.

(Overall Structure of Display Device)

FIG. 1 illustrates the structure of a display device using an organic light emitting element according to an embodiment. This display device is used as an ultra thin organic light emitting color display device or the like. In this display device, a display region 110 is formed on a substrate 111. In the vicinity of the display region 110 on the substrate 111, for example, a signal line drive circuit 120, a scanning line drive circuit 130, and a power source supply line drive circuit 140 as drivers for video display are formed.

In the display region 110, a plurality of organic light emitting elements 10 (10R, 10G, and 10B) two-dimensionally arranged in matrix, and a pixel drive circuit 150 for driving these organic light emitting elements 10 are formed. In the pixel drive circuit 150, a plurality of signal lines 120A (120A1, 120A2, . . . , 120Am, . . .) are arranged in the column direction, and a plurality of scanning lines 130A (130A1, 130A2, . . . , 130An, . . .), and a plurality of power source supply lines 140A (140A1, 140A2, . . . , 140An, . . .) are arranged in the row direction. In each intersection of each signal line 120A and each scanning line 130A, one of the organic light emitting elements 10R, 10G, and 10B is disposed correspondingly. Each signal line 120A is connected to the signal line drive circuit 120, each scanning line 130A is connected to the scanning line drive circuit 130, and each power source supply line 140A is connected to the power source supply line drive circuit 140.

The signal line drive circuit 120 supplies a signal voltage of a video signal corresponding to luminance information which is supplied from a signal supply source (not illustrated in the figure), to the organic light emitting elements 10R, 10G, and 10B selected through the signal line 120A.

The scanning line drive circuit **130** is composed of a shift resistor or the like sequentially shifting (transferring) a start pulse in synchronization with an input clock pulse. At the time of writing the video signal onto each of the organic light emitting elements **10R**, **10G**, and **10B**, the scanning line drive circuit **130** scans those organic light emitting elements **10R**, **10G**, and **10B** line by line, and sequentially supplies the scanning signal to each scanning line **130A**.

The power source supply line drive circuit **140** is composed of a shift resistor or the like sequentially shifting (transferring) the start pulse in synchronization with the input clock pulse. In synchronization with line-by-line scanning by the scanning line drive circuit **130**, the power source supply line drive circuit **140** appropriately supplies one of a first potential and a second potential which are different from each other to each power source supply line **140A**. Thereby, the conductive state or the non-conductive state of a drive transistor **Tr1** which will be described later is selected.

The pixel drive circuit **150** is provided on a layer level (a pixel drive circuit formation layer **112** which will be described later) between the substrate **111** and the organic light emitting element **10**. FIG. **2** illustrates a structural example of the pixel drive circuit **150**. As illustrated in FIG. **2**, the pixel drive circuit **150** is an active drive circuit including the drive transistor **Tr1**, a write transistor **Tr2**, a capacitor (retention capacity) **Cs** between the drive transistor **Tr1** and the write transistor **Tr2**, and the organic light emitting element **10**. The organic light emitting element **10** is connected in series to the drive transistor **Tr1** between the power source supply line **140A** and a common power source supply line (**GND**). The drive transistor **Tr1** and the write transistor **Tr2** are composed of a typical thin film transistor (TFT), and the structure of the **Tr1** and **Tr2** may be, for example, an unstaggered structure (so-called bottom gate type) or a staggered structure (top gate type), and is not specifically limited.

For example, a drain electrode of the write transistor **Tr2** is connected to the signal line **120A**, and the video signal from the signal line drive circuit **120** is supplied to the drain electrode. A gate electrode of the write transistor **Tr2** is connected to the scanning line **130A**, and the scanning signal from the scanning line drive circuit **130** is supplied to the gate electrode. Further, a source electrode of the write transistor **Tr2** is connected to a gate electrode of the drive transistor **Tr1**.

For example, a drain electrode of the drive transistor **Tr1** is connected to the power source supply line **140A**, and the drive transistor **Tr1** is set to one of the first electrode and the second electrode by the power source supply line drive circuit **140**. A source electrode of the drive transistor **Tr1** is connected to the organic light emitting element **10**.

The retention capacity **Cs** is formed between the gate electrode of the drive transistor **Tr1** (the source electrode of the write transistor **Tr2**), and the source electrode of the drive transistor **Tr1**.

(Structure of Display Region)

FIG. **3** illustrates a structural example of the display region **110** spread in an **XY** plane. Here, the plan structure of the display region **110** in the state where a second electrode layer **16**, a protective film **18**, and a sealing substrate **19** (all will be described later) are removed is illustrated as viewed from the upper side. In the display region **110**, a plurality of pixels **1** are sequentially aligned so as to form a matrix as a whole. For more detail, an auxiliary wiring layer **17** is provided in a lattice pattern, and thereby the pixel **1** is provided one by one in each of the pixel regions **17R** which are divided by the auxiliary wiring layer **17**. Each pixel **1** includes a set of the organic light emitting elements **10R**, **10G**, and **10B** including light emitting regions **20** (**20R**, **20G**, and **20B**) whose con-

tours are defined by an element separating layer **24**. The organic light emitting element **10R** emits red light, the organic light emitting element **10G** emits green light, and the organic light emitting element **10B** emits blue light. Each of the organic light emitting elements **10R**, **10G**, and **10B** has a rectangular flat shape whose length in the **Y** direction is in the longitudinal direction. Here, the organic light emitting elements **10** emitting the same color are aligned on a line in the **Y** direction, and these organic light emitting elements **10** are sequentially repeatedly arranged in the **X** direction. That is, in each pixel **1**, the organic light emitting elements **10R**, **10G**, and **10B** are, for example, aligned in this order in the **X** direction so as to include a gap **D1** in between, respectively. The plurality of pixels **1** are aligned in the **X** direction so as to leave a gap **D2** in between. The gap **D2** is larger than the gap **D1** which is located between the organic light emitting elements adjacent to each other.

In FIG. **3**, the rectangular shaped light emitting regions **20R**, **20G**, and **20B** illustrated with solid lines in each pixel region **17R** correspond to the shape of a first electrode layer **13** (which will be described later) which constitutes each of the organic light emitting elements **10R**, **10G**, and **10B**. In FIG. **3**, although a total of the four pixels **1** aligned in two rows and two columns are illustrated, the number of the pixels **1** aligned in the **X** direction and the **Y** direction is not limited to this.

FIG. **4** illustrates the schematic structure of the **XZ** cross section of the display region **110** along line **IV-IV** illustrated in FIG. **3**. As illustrated in FIG. **4**, in the display region **110**, a light emitting element formation layer **12** including the organic light emitting elements **10R**, **10G**, and **10B** is formed on a base **11** which is formed by providing the pixel drive circuit formation layer **112** on the substrate **111**. On the organic light emitting elements **10R**, **10G**, and **10B**, the protective film **18** and the sealing substrate **19** are sequentially provided. Each of the organic light emitting elements **10R**, **10G**, and **10B** is, for example, formed by sequentially stacking, from the substrate **111** side, the first electrode layer **13** as an anode electrode, an organic layer **14** including a light emitting layer **142** (**142R**, **142G**, and **142B**) and the like, and the second electrode layer **16** as a cathode electrode. The organic layer **14** and the first electrode layer **13** are separated for each of the organic light emitting elements **10R**, **10G**, and **10B** by the element separating layer **24**. Meanwhile, the second electrode layer **16** is provided in common to all the pixels **1**. The auxiliary wiring layer **17** is connected to the second electrode layer **16**. In addition, in FIG. **4**, the detailed structure of the drive transistor **Tr1**, the write transistor **Tr2**, and the like in the pixel drive circuit formation layer **112** is omitted in the illustration.

The element separating layer **24** is provided so as to fill the gap between the first electrode layers **13** and between the organic layers **14** in the organic light emitting elements **10** adjacent to each other. The element separating layer **24** is, for example, composed of an organic material having electrical insulating properties such as polyimide so as to ensure the electrical insulation among the first electrode layer **13**, the second electrode layer **16**, and the auxiliary wiring layer **17**, and is intended to accurately define the light emitting region **20** in the organic light emitting element **10** into a desirable shape.

The protective film **18** covering the organic light emitting element **10** is composed of an insulating material such as silicon nitride (**SiNx**). The sealing substrate **19** provided on the protective film **18** is intended to seal the organic light emitting element **10** in cooperation with the protective film **18**, an adhesive layer (not illustrated in the figure), and the

like, and is composed of a material such as transparent glass which transmits light generated in the light emitting layer **142**.

(Structure of Substrate and Organic Light Emitting Element)

Next, with reference to FIGS. **4** to **6**, the detailed structure of the base **11** and the organic light emitting element **10** will be described. In addition, since the organic light emitting elements **10R**, **10G**, and **10B** have the structures common to each other except that a part of the structure of the organic layer **14** is different from each other, the description will be collectively given, hereinafter.

FIG. **5** is a cross-sectional view of the display region **110** along line V-V illustrated in FIG. **3**, and FIG. **6** is a cross-sectional view along line VI-VI illustrated in FIG. **3**.

In the base **11**, the pixel drive circuit formation layer **112** including the pixel drive circuit **150** is provided on the substrate **111** which is made of glass, silicon (Si) wafer, resin or the like. On the surface of the substrate **111**, a metal layer **211G** serving as the gate electrode of the drive transistor Tr1, a metal layer **221G** serving as the gate electrode of the write transistor Tr2, and the signal line **120A** (FIG. **6**) are provided as metal layers on a first layer level, respectively. The metal layers **211G** and **221G**, and the signal line **120A** are covered with a gate insulating film **212** made of silicon nitride, silicon oxide, or the like. On the gate insulating film **212**, in a region corresponding to the metal layers **211G** and **221G**, channel layers **213** and **223** made of a semiconductor thin film of amorphous silicon or the like are provided. On the channel layers **213** and **223**, insulating channel protective films **214** and **224** are provided so as to occupy channel regions **213R** and **223R** as being middle regions of the channel layers **213** and **223**. In regions on both sides of the channel protective films **214** and **224**, drain electrodes **215D** and **225D**, and source electrodes **215S** and **225S** made of an n-type semiconductor thin film of n-type amorphous silicon or the like are provided. The drain electrodes **215D** and **225D**, and the source electrodes **215S** and **225S** are separated from each other by the channel protective films **214** and **224**, and end faces thereof are spaced apart from each other with the channel regions **213R** and **223R** in between. Further, metal layers **216D** and **226D** serving as drain wirings, and metal layers **216S** and **226S** serving as source wirings are provided as metal layers on a second layer level so as to cover the drain electrodes **215D** and **225D**, and the source electrodes **215S** and **225S**, respectively. Each of the metal layers **216D** and **226D**, and the metal layers **216S** and **226S** has, for example, a structure in which a titanium (Ti) layer, an aluminum (Al) layer, and a titanium layer are stacked in this order. In addition to the metal layers **216D** and **226D**, and the metal layers **216S** and **226S**, the scanning line **130A**, and the power source supply line **140A** (FIG. **5**) are provided as the metal layers on the second layer level. Here, although the drive transistor Tr1 and the write transistor Tr2 having the unstaggered structure (so-called bottom gate type) has been described, the drive transistor Tr1 and the write transistor Tr2 may have the staggered structure (so-called top gate type). Further, the signal line **120A** may be provided in a region on the second layer level, instead of being provided in the intersection of the scanning line **130A** and the power source supply line **140A**.

The pixel drive circuit **150** is entirely covered with a protective film (passivation film) **217** made of silicon nitride or the like, and a planarizing film **218** having insulating properties is provided on the protective film **217**. The surface of the planarizing film **218** desirably has extremely-high flatness. In a part of the region of the planarizing film **218** and the protective film **217**, a fine connection hole **124** is provided (refer

to FIG. **5**). In particular, since the planarizing film **218** has a thickness larger than that of the protective film **217**, the planarizing film **218** is preferably composed of a material having favorable pattern accuracy, for example, an organic material such as polyimide.

The first electrode layer **13** formed on the planarizing film **218** also serves as a reflecting film, and is desirably composed of a material having as high reflectance as possible to improve the light emission efficiency. The first electrode layer **13** has, for example, a thickness from 100 nm to 1000 nm both inclusive, and is composed of a simple substance of a metal element such as silver (Au), aluminum (Al), chrome (Cr), titanium (Ti), iron (Fe), cobalt (Co), nickel (Ni), molybdenum (Mo), copper (Cu), tantalum (Ta), tungsten (W), platinum (Pt), neodymium (Nd), or gold (Au), or an alloy of those. The first electrode layer **13** covers the surface of the planarizing film **218**, and is formed so as to fill the connection hole **124**. Thereby, the first electrode layer **13** is rendered conductive to the drive transistor Tr1 (which will become the metal layer **216S** later) through the connection hole **124**.

The organic layer **14** is formed without a gap over the whole surface of the light emitting region **20** demarcated by the element separating layer **24**. For example, as illustrated in FIGS. **4** to **6**, the organic layer **14** has a stacked structure in which a hole transport layer **141**, the light emitting layer **142** (**142R**, **142G**, and **142B**), and an electron transport layer **143** are stacked in this order from the first electrode layer **13** side. The hole transport layer **141** is intended to improve the hole transport efficiency to the light emitting layer **142**. The light emitting layer **142** generates recombination of an electron and a hole by applying an electric field so as to generate light of a color corresponding to the material. The electron transport layer **143** is intended to improve the electron transport efficiency to the light emitting layer **142**.

The organic layer **14** includes the light emitting layer **142** which is different depending on the light emission colors of the organic light emitting elements **10R**, **10G**, and **10B**. On the other hand, the hole transport layer **141**, and the electron transport layer **143** are used in common to the organic light emitting elements **10R**, **10G**, and **10B**, and are regarded as integrated common layers.

In the organic layer **14**, layers other than the hole transport layer **141**, the light emitting layer **142**, and the electron transport layer **143** may be provided, if necessary. For example, between the first electrode layer **13** and the hole transport layer **141**, for example, a hole injection layer made of 4,4',4"-tris (3-methyl phenyl phenyl amino) triphenyl amine (m-MTDATA), 4,4',4"-tris (2-naphthyl phenyl amino) triphenyl amine (2-TNATA), or the like may be provided. The hole injection layer also serves as a buffer layer for improving the hole injection efficiency and preventing leakage. Further, between the electron transport layer **143** and the second electrode layer **16**, an electron injection layer (not illustrated in the figure) made of LiF, Li₂O, or the like may be provided. In the case where the hole injection layer and the electron injection layer are provided, it is desirable to form the hole injection layer and the electron injection layer as common layers shared by the organic light emitting elements **10R**, **10G**, and **10B**.

In the organic light emitting elements **10R**, **10G**, and **10B**, the hole transport layer **141** is, for example, composed of bis [(N-naphthyl)-N-phenyl]benzidine (α -NPD), and preferably has, for example, a thickness from 5 nm to 300 nm both inclusive. The electron transport layer **143** has, for example, a thickness from 5 nm to 300 nm both inclusive, and is preferably composed of Alq₃.

The (red) light emitting layer **142R** of the organic light emitting element **10R** is, for example, composed by mixing 40 volume % of 2,6-bis [4-[N-(4-methoxyphenyl)-N-phenyl] aminostyryl]naphthalene-1,5-dicarbonitrile (BSN-BCN) into Alq_3 . The (green) light emitting layer **142G** of the organic light emitting element **10G** is, for example, composed by mixing 3 volume % of Coumarin 6 into Alq_3 . The (blue) light emitting layer **142B** of the organic light emitting element **10B** is, for example, composed of spiro 6 ϕ . All of the light emitting layers **142R**, **142G**, and **142B** have a thicknesses from 10 nm to 100 nm both inclusive.

The second electrode layer **16** has, for example, a thickness from 5 nm to 50 nm both inclusive, and is composed of a simple substance of a metal element of aluminum (Al), magnesium (Mg), calcium (Ca), sodium (Na), or the like, or an alloy of those. Among them, an alloy of magnesium and silver (MgAg alloy), or an alloy of aluminum (Al) and lithium (Li) (AlLi alloy) is preferable. The second electrode layer **16** is, for example, provided in common to all of the organic light emitting elements **10R**, **10G**, and **10B**, and is arranged so as to face the first electrode layer **13** of each of the organic light emitting elements **10R**, **10G**, and **10B**. Further, the second electrode layer **16** is formed so as to cover not only the organic layer **14**, but also the element separating layer **24** and the auxiliary wiring layer **17**. Therefore, as described above, the second electrode layer **16** is electrically connected to the auxiliary wiring layer **17**.

The auxiliary wiring layer **17** is formed on the surface of the planarizing film **218**, in the same manner as the first electrode layer **13**, and functions as a main electrode compensating a voltage drop generated in the second electrode layer **16**. As a material constituting the auxiliary wiring layer **17**, for example, a highly-conductive metal material which is the same type as the material of the first electrode layer **13** is preferable.

In the case where the auxiliary wiring layer **17** is not existed, due to a voltage drop generated in accordance with a distance from a power source (not illustrated in the figure) to each of the organic light emitting elements **10R**, **10G**, and **10B**, the potential of the second electrode layer **16** connected to the common power source supply line GND (refer to FIG. 2) is not uniform among each of the organic light emitting elements **10R**, **10G**, and **10B**, and a significant variation is likely to be generated. Such a potential variation of the second electrode layer **16** causes luminance unevenness in the display region **110**, and thus it is not preferable. The auxiliary wiring layer **17** functions to suppress generation of such luminance unevenness while minimizing the voltage drop from the power source to the second electrode layer **16**, even in the case where the display device has a large screen.

In the organic light emitting element **10**, the first electrode layer **13** exhibits the function as a reflecting layer, meanwhile the second electrode layer **16** exhibits the function as a semi-transmissive reflecting layer. The light generated in the light emitting layer **142** included in the organic layer **14** is multiply-reflected by the first electrode layer **13** and the second electrode layer **16**. That is, when an end face on the organic layer **14** side of the first electrode layer **13** is regarded as a first end portion **P1**, an end face on the organic layer **14** side of the second electrode layer **16** is regarded as a second end portion **P2**, and the organic layer **14** is regarded as a resonator, the organic light emitting element **10** has a resonator structure in which the light generated in the light emitting layer **142** is resonated and extracted from the second end portion **P2** side. By having such a resonator structure, the light generated in the light emitting layer **142** is multiply-reflected, and operates as a kind of narrow band filter. Thereby, the half value width

of the spectrum of the extracted light is reduced, and it is possible to improve the color purity. Further, it is possible to attenuate external light incident from the sealing substrate **19** side by the multiple reflection, and it is possible to extremely reduce the reflectance of the external light in the organic light emitting element **10** by using a combination of a phase difference plate and a polarizing plate (not illustrated in the figure).

(Method of Manufacturing Display Device)

The display device may be manufactured, for example, in the following way. Hereinafter, in addition to FIGS. **1** to **6**, FIGS. **7** to **14** are referred for describing a method of manufacturing the display device of this embodiment. FIG. **7** is a flow chart illustrating procedures in the method of manufacturing the display device of this embodiment.

First, by forming the pixel drive circuit formation layer **112** on the substrate **111** made of the above-described material, the base **11** is manufactured (step **S101**). Specifically, first, the pixel drive circuit **150** including the drive transistor **Tr1** and the write transistor **Tr2** is formed on the substrate **111**. Here, a metal film is formed on the substrate **111**, for example, through the use of sputtering. After that, the metal film is patterned, for example, through the use of photolithography method, dry etching, or wet etching, and thereby the metal layers **211G** and **221G**, and the signal line **120A** are formed on the substrate **111**. Next, the whole surface is covered with the gate insulating film **212**. Further, on the gate insulating film **212**, the channel layers **213** and **223**, the channel protective films **214** and **224**, the drain electrodes **215D** and **225D**, the source electrodes **215S** and **225S**, the metal layers **216D** and **226D**, and the metal layers **216S** and **226S** are formed into predetermined shapes in this order. Here, in addition to formation of the metal layers **216D** and **226D**, and the metal layers **216S** and **226S**, the scanning line **130A** and the power source supply line **140A** are formed as the metal layers on the second layer level, respectively. At that time, a connection section connecting the metal layer **221G** and the scanning line **130A**, a connection section connecting the metal layer **226D** and the signal line **120A**, and a connection section connecting the metal layer **226S** and the metal layer **211G** are formed in advance. After that, by covering the whole with the protective film **217**, the pixel drive circuit **150** is completed. At this time, an aperture is formed in a predetermined position on the metal layer **216S** in the protective film **217** through the use of dry etching or the like.

After forming the pixel drive circuit **150**, for example, a photosensitive resin containing polyimide as a major component is applied over the whole surface through the use of spin coat method or the like. Next, photolithography treatment is provided onto the photosensitive resin, and thereby the planarizing film **218** including the connection hole **124** is formed. Specifically, the connection hole **124** communicated with the aperture provided in the protective film **217** is, for example, formed through the use of selective exposure and development by using a mask having an aperture in a predetermined position. After that, the planarizing film **218** may be burned, if necessary. Thereby, the pixel drive circuit formation layer **112** is obtained, and the manufacture of the base **11** is completed.

Further, the first electrode layer **13** and the auxiliary wiring layer **17** made of the predetermined materials described above are collectively formed (step **S102**). Specifically, the metal film made of the above-described material is deposited over the whole surface, for example, through the use of sputtering, and then a resist pattern (not illustrated in the figure) having a predetermined shape is formed on the metal film by using a predetermined mask. Further, by using the resist pat-

tern as a mask, etching is selectively provided onto the metal film. At that time, the first electrode layer **13** is formed so as to cover the surface of the planarizing film **218** and to fill the connection hole **124**. On the surface of the planarizing film **218**, the auxiliary wiring layer **17** is formed into a lattice pattern so as to surround the first electrode layers **13** by three. The auxiliary wiring layer **17** is desirably formed of the same type of material as the first electrode layer **13**. At this time, the gap between the first electrode layers **13** which will constitute the one pixel **1** later is set to be larger than the gap between the pixels **1** adjacent to each other in the X direction.

After this, the element separating layer **24** is formed so as to fill the gap between the auxiliary wiring layer **17** and the first electrode layer **13**, and the gap between the first electrode layers **13** (step **S103**). At this time, in each pixel region **17R** (FIG. **3**) divided by the auxiliary wiring layer **17**, the gap **D1** between the light emitting regions **20** defined by the aperture of the element separating layer **24** is set to be smaller than the gap **D2** between the other pixels **1** which are adjacent to each other in the X direction.

Next, as illustrated in FIGS. **8** to **10**, by using a common mask **M1**, the hole transport layer **141** is formed as one of the common layers in the organic layer **14** (step **S104**). FIGS. **8** to **10** are a plan view or a cross-structural view illustrating a step in the method of manufacturing the display device of this embodiment. FIGS. **8** and **10** correspond to FIG. **3**, and FIG. **9** corresponds to FIG. **4**. In addition, in FIG. **9**, the detail of the base **11** is omitted in the illustration. Here, first, as illustrated in FIG. **8**, the common mask **M1** including a plurality of apertures **M1K** corresponding to (having shapes and dimensions corresponding to that of) each pixel region **17R** in which the pixel **1** is formed is arranged in a predetermined position. After that, as illustrated in FIG. **9**, the hole transport layer **141** made of the predetermined material and having the predetermined thickness as described above is formed so as to completely cover the exposed portion through the use of, for example, vacuum evaporation method. Finally, by removing the common mask **M1**, as illustrated in FIG. **10**, the hole transport layer **141** commonly covering three of the first electrode layers **13** which will later become the organic light emitting elements **10R**, **10G**, and **10B** appears in each pixel region **17R**. In this embodiment, in comparison with the structure of the existing technique (structure in which the auxiliary wiring layer individually surrounds the organic light emitting element), the gap **D2** between the pixels **1** is set to be large. Thus, the common mask **M1** has a sufficient intensity, and deflection is not generated. Therefore, the alignment accuracy may be extremely improved.

After forming the hole transport layer **141**, the light emitting layers **142R**, **142G**, and **142B** are sequentially formed by using an individual mask **M2** (step **S105**). First, as illustrated in FIG. **11**, the individual mask **M2** including a plurality of apertures **M2K** which have shapes and dimensions corresponding to those of the first electrode layers **13** is arranged in a predetermined position. Here, the individual mask **M2** is, for example, arranged so as to align the aperture **M2K** to the position corresponding to the light emitting region **20R** in the organic light emitting element **10R** which will be formed later. After that, as illustrated in FIG. **12**, the light emitting layer **142R** made of the predetermined material and having the predetermined thickness as described above is formed so as to completely cover the exposed portion, for example, through the use of vacuum evaporation method. Finally, by removing the individual mask **M2**, as illustrated in FIG. **13**, the light emitting layer **142R** covering a part of the hole transport layer **141** appears in the light emitting region **20R**. The light emitting layers **142G** and **142B** are sequentially

formed in the same manner. At that time, the individual mask **M2** is arranged so that the aperture **M2K** is arranged in a position corresponding to those of the light emitting regions **20G** and **20B**, respectively. In addition, FIGS. **11** to **13** are a plan view or a cross-sectional view illustrating a step subsequent to FIGS. **8** to **10**. FIGS. **11** and **13** correspond to FIG. **3**, and FIG. **12** corresponds to FIG. **4**. In FIG. **12**, the detail of the base **11** is omitted in the illustration.

Next, by using the common mask **M1** again, the electron transport layer **143** is formed on the light emitting layers **142R**, **142G**, and **142B** (step **S106**). Here, as illustrated in FIG. **14**, the electron transport layer **143** is formed as a common layer covering all of the light emitting layers **142R**, **142G**, and **142B**. Thereby, the organic layer **14** is completed.

Further, after removing the common mask **M1**, the second electrode layer **16** is formed so as to cover the whole by using the predetermined material, and thereby the organic light emitting elements **10R**, **10G**, and **10B** are completed. Finally, the protective film **18** is formed so as to cover the whole, and the sealing substrate is bonded onto the protective film **18** through the adhesive layer. Thereby, the display device is completed (step **S107**).

(Action of Display Device)

In the display device obtained in this manner, the scanning signal is supplied from the scanning line drive circuit **130** to each pixel through the gate electrode (the metal layer **221G**) of the write transistor **Tr2**, and the video signal from the signal line drive circuit **120** is retained in the retention capacity **Cs** through the write transistor **Tr2**. Meanwhile, in synchronization with line-by-line scanning by the scanning line drive circuit **130**, the power source supply line drive circuit **140** supplies the first potential which is higher than the second potential to each power source supply line **140A**. Thereby, the conductive state of the drive transistor **Tr1** is selected, and a drive current **I_d** is injected into each of the organic light emitting elements **10R**, **10G**, and **10B**. Thus, the light emission is generated by recombination of the electron and the hole. This light is multiply-reflected between the first electrode layer **13** and the second electrode layer **16**, and transmits the second electrode layer **16**, the protective film **18**, and the sealing substrate **19** to be extracted from the top face.

As described above, in the display device of this embodiment, the plurality of pixels **1** are aligned in the X direction so as to include the gap **D2** which is larger than the gap **D1** between the organic light emitting elements **10** in each pixel **1**, and the auxiliary wiring layer **17** is provided between the pixels **1** adjacent to each other. Thus, in the case where the aperture ratio is set to be fixed, it is possible to set the width of the auxiliary wiring layer **17** large, while reducing the distance in the X direction between the organic light emitting elements **10** which emit different light emission colors. Therefore, it is possible to display an image in which the luminance is more homogenized in the display region **110**, while realizing high integration without reducing the aperture ratio. In addition, in the present invention, although the gap **D2** has a value larger than that of the gap **D1**, this does not become a direct factor of deterioration of the display characteristics. By homogenizing the alignment pitch of the pixels **1**, and the alignment pitch of each of the organic light emitting elements **10**, it is possible to obtain an image having superior homogeneity.

Further, according to the method of manufacturing the display device of this embodiment, by using the high-intensity common mask **M1** covering the region corresponding to the auxiliary wiring layer **17**, and including the aperture **M1K** corresponding to the pixel region **17R**, it is possible to collectively form the hole transport layer **141** and the electron

transport layer **143** which are used in common to the organic light emitting elements **10R**, **10G**, and **10B**, respectively. Thus, even in the case where the display device is highly integrated, it is possible to efficiently manufacture the display device having high-accuracy dimensions, and exhibiting favorable display characteristics.

2. Modification

Next, with reference to FIG. **15**, a modification of the foregoing embodiment will be described. Same reference numerals as in the foregoing embodiment are used to indicate substantially identical components, and thereby the description is appropriately omitted.

FIG. **15** illustrates the cross-sectional structure of a pixel **1B** included in the display device of this modification, and corresponds to FIG. **4**. Although the hole transport layer **141** and the electron transport layer **143** are collectively formed as the common layers used in common to the organic light emitting elements **10R**, **10G**, and **10B** in the foregoing embodiment, the (blue) light emitting layer **142B** is also used as the common layer in this modification.

When such a pixel **1B** is formed, first, the hole transport layer **141**, the (red) light emitting layer **142R**, and the (green) light emitting layer **142G** are sequentially formed in the same manner as the foregoing embodiment. After that, by using the common mask **M1**, the organic layer **14** is manufactured by sequentially forming the (blue) light emitting layer **142B** and the electron transport layer **143** which entirely cover the hole transport layer **141**, the (red) light emitting layer **142R**, and the (green) light emitting layer **142G**.

According to this modification, the production efficiency is improved by further simplifying the manufacture process, and it is possible to reduce the total amount of the organic material necessary for manufacturing the organic layer **14**.

An example of the present invention will be described.

By using the method of manufacturing the display device of the foregoing embodiment, the display device in which the diagonal dimension of the display region (screen) was 26 inches (660 mm), and the pixel number (resolution) was 1920×1080 dots was manufactured. In this case, the pixel pitch in the X direction was approximately 300 μm on an average.

In this example, as the common mask **M1** and the individual mask **M2**, masks having a dimension accuracy of $\pm 15 \mu\text{m}$ were used. Here, the term "dimension accuracy" is a concept including all of the processing accuracy when the common mask **M1** and the individual mask **M2** are manufactured, the position accuracy of the apertures **M1K** and **M2K**, and the alignment accuracy when the organic layer **14** is deposited. Further, the width in the X direction of the auxiliary wiring layer **17** was set to be 6 μm . The dimension of each of the manufactured organic light emitting elements **10** was set to be 58 mm×234 mm. The dimension of the aperture **M2K** of the individual mask **M2** was set to be 88 μm ×264 μm from reference to the dimension of each of the organic light emitting elements **10** and the dimension accuracy of the individual mask **M2**. Further, the dimension of the aperture **M1K** of the common mask **M1** was set to be 264 μm ×264 μm from reference to the dimension of each of the organic light emitting elements **10** and the dimension accuracy of the common mask **M1**. In the common mask **M1**, the gap between the apertures **M1K** was 36 μm , and thus it was possible to ensure sufficient intensity.

As a result of the above, it was possible to set the gap **D1** between the organic light emitting elements **10** to be 30 μm , and to set the gap **D2** between the pixels **1** to be 66 μm . Further, the aperture ratio was 45%, and it was confirmed that

the sufficient aperture size was able to be ensured, even in the case where the common mask **M1** was used.

3. Module and Application Examples

A description will be made on application examples of the display device described in the foregoing embodiment. The display device of the foregoing embodiment is applicable to display devices in electronic appliances in various fields, in which a video signal input from outside, or a video signal generated inside the display device is displayed as an image or a video, such as a television device, a digital camera, a notebook personal computer, a mobile terminal device such as a mobile phone, and a video camera.

Module

The display device of the foregoing embodiment is, for example, installed as a module as illustrated in FIG. **16** in various electronic appliances such as first to fifth application examples which will be described later or the like. In the module, for example, a region **210** exposed from the sealing substrate **19** is provided in one side of the substrate **111**, and an external connection terminal (not illustrated in the figure) is formed in the exposed region **210** by extending wirings of a signal line drive circuit **120** and a scanning line drive circuit **130**. The external connection terminal may be provided with a flexible printed circuit (FPC) **220** for inputting and outputting a signal.

First Application Example

FIG. **17** illustrates an appearance of a television device to which the display device of the foregoing embodiment is applied. The television device includes, for example, a video display screen section **300** including a front panel **310** and a filter glass **320**. The video display screen section **300** is composed of the display device according to the foregoing embodiment.

Second Application Example

FIG. **18A** and FIG. **18B** illustrate an appearance of a digital camera to which the display device of the foregoing embodiment is applied. The digital camera includes, for example, a light emitting section for a flash **410**, a display section **420**, a menu switch **430**, and a shutter button **440**. The display section **420** is composed of the display device according to the foregoing embodiment.

Third Application Example

FIG. **19** illustrates an appearance of a notebook personal computer to which the display device of the foregoing embodiment is applied. The notebook personal computer includes, for example, a main body **510**, a keyboard **520** for operation of inputting characters and the like, and a display section **530** for displaying an image. The display section **530** is composed of the display device according to the foregoing embodiment.

Fourth Application Example

FIG. **20** illustrates an appearance of a video camera to which the display device of the foregoing embodiment is applied. The video camera includes, for example, a main body **610**, a lens for capturing an object **620** provided on the front side face of the main body **610**, a start/stop switch in capturing **630**, and a display section **640**. The display section **640** is composed of the display device according to the foregoing embodiment.

Fifth Application Example

FIGS. **21A** to **21G** illustrate an appearance of a mobile phone to which the display device of the foregoing embodiment is applied. In the mobile phone, for example, an upper package **710** and a lower package **720** are jointed by a joint section (hinge section) **730**. The mobile phone includes a display **740**, a sub-display **750**, a picture light **760**, and a

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camera 770. The display 740 or the sub-display 750 is composed of the display device according to the foregoing embodiment.

The material, the thickness, the film-forming method, the film-forming conditions and the like of each layer are not limited to those described in the foregoing embodiment, but other material, other thickness, other film-forming method, and other film-forming conditions may be adopted. For example, the first electrode layer 13 may be composed of ITO or IZO (indium-zinc composite oxide). Further, the first electrode layer 13 may include a dielectric multilayer film.

In the foregoing embodiment, although both of the hole transport layer 141 and the electron transport layer 143 are used as the common layers, respectively, only one of them may be used as the common layer. Further, the auxiliary wiring layer 17 is not limited to the case where the auxiliary wiring layer 17 and the lower electrode (the first electrode layer 13) are collectively formed, but the auxiliary wiring layer 17 and the metal layer constituting the drive transistor Tr1 and the write transistor Tr2 may be collectively formed. Alternatively, the auxiliary wiring layer 17 may be formed in an independent step. Further, all of the organic light emitting elements 10R, 10G, and 10B may have the same dimensions, or may have dimensions different from each other.

In addition, in the foregoing embodiment, although the description has been specifically made with reference to the structure of the organic light emitting elements 10R, 10G, and 10B, it is not always necessary to include all the layers, and other layers may be additionally included. For example, between the first electrode layer 13 and the organic layer 14, a thin film layer for hole injection composed of chrome oxide (III) (Cr_2O_3), ITO (indium-tin oxide: oxide mixed film of indium (In) and tin (Sn)), or the like may be included.

In addition, in the foregoing embodiment, although the description has been made on the case of the active matrix display device, the present invention is applicable to a passive matrix display device. Further, the structure of the pixel drive circuit for the active matrix drive is not limited to that described in the foregoing embodiment and the like, and a capacitance element and a transistor may be added, if necessary. In that case, according to the change of the pixel drive circuit, a necessary drive circuit may be added in addition to the signal line drive circuit 120 and the scanning line drive circuit 130 described above.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present subject matter and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

The invention is claimed as follows:

1. A display device comprising:

a pixel including a plurality of light emitting elements each formed by sequentially stacking a first electrode layer, an organic layer, and a second electrode layer, spaced apart from each other in a first direction orthogonal to the stacking direction thereof, and emitting light emission colors different from each other,

wherein a plurality of the pixels are aligned in the first direction so as to include a larger gap which is larger than a gap between the light emitting elements adjacent to each other, and

a wiring layer is provided between the pixels adjacent to each other, and

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wherein an isolation layer is provided to fill the gap between the light emitting elements adjacent to each other and to fill the larger gap between first electrode layers of adjacent pixels, the isolation layer having a concave portion in the larger gap that exposes the wiring layer.

2. The display device according to claim 1, wherein the organic layer includes a stacked structure of a hole transport layer, a light emitting layer, and an electron transport layer, and

at least one of the hole transport layer and the electron transport layer is formed as a common layer shared by the plurality of light emitting elements which constitute each of the pixels.

3. The display device according to claim 1, wherein, in the light emitting element, a dimension of a second direction orthogonal to the first direction is set to be larger than the dimension of the first direction.

4. The display device according to claim 1, wherein the plurality of light emitting elements are composed of a red light emitting element including a red light emitting layer which emits a red light, a green light emitting element including a green light emitting layer which emits a green light, and a blue light emitting element including a blue light emitting layer which emits a blue light, and

the blue light emitting layer is formed as a common layer shared by the red light emitting element, the green light emitting element, and the blue light emitting element.

5. The display device according to claim 1, wherein the plurality of pixels are aligned in the second direction orthogonal to the first direction, and the wiring layer is arranged so as to surround each of the plurality of pixels.

6. A method of manufacturing a display device comprising steps of:

forming a wiring layer including a plurality of wiring layer portions spaced apart from each other in a first direction on a substrate; and

forming a pixel between the wiring layer portions adjacent to each other, respectively, the pixel having a stacked structure of a first electrode layer, an organic layer, and including a plurality of light emitting elements emitting light emission colors different from each other,

wherein the plurality of light emitting elements are aligned so as to include a gap which is smaller than a larger gap between the pixels adjacent to each other in the first direction, and

wherein an isolation layer is provided to fill the gap between the light emitting elements adjacent to each other and to fill the larger gap between first electrode layers of adjacent pixels, the isolation layer having a concave portion in the larger gap that exposes the wiring layer.

7. The method of manufacturing a display device according to claim 6, wherein

the organic layer is formed so as to sequentially include a hole transport layer, a light emitting layer, and an electron transport layer, and

at least one of the hole transport layer and the electron transport layer is formed as a common layer shared by the plurality of light emitting elements which constitute each of the pixels.

8. The method of manufacturing a display device according to claim 6, wherein at least one of the hole transport layer and the electron transport layer is formed by using a mask cover-

ing a region corresponding to the wiring layer, and including an aperture in a region corresponding to the pixel.

9. The method of manufacturing a display device according to claim 6, wherein

a red light emitting element including a red light emitting layer which emits a red light, a green light emitting element including a green light emitting layer which emits a green light, and a blue light emitting element including a blue light emitting layer which emits a blue light are formed as the plurality of light emitting elements, and

the blue light emitting layer is formed as a common layer shared by the red light emitting element, the green light emitting element, and the blue light emitting element.

10. The method of manufacturing a display device according to claim 6, wherein

the plurality of pixels are aligned to be spaced apart from each other in the second direction orthogonal to the first direction, and

the wiring layer is arranged so as to surround each of the plurality of pixels.

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专利名称(译)	显示装置及其制造方法		
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[标]申请(专利权)人(译)	索尼公司		
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摘要(译)

一种显示装置，包括：像素，包括多个发光元件，每个发光元件通过依次堆叠第一电极层，有机层和第二电极层而形成，所述第一电极层，有机层和第二电极层在与其堆叠方向垂直的第一方向上彼此间隔开，并发出彼此不同的发光颜色；以及与第二电极层电连接的辅助布线层。多个像素在第一方向上排列，以包括间隙，该间隙大于彼此相邻的发光元件之间的间隙，并且辅助配线层设置在彼此相邻的像素之间。

