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(54) **DISPLAY DEVICE**

(71) Applicant: **Japan Display Inc.**, Tokyo (JP)

(72) Inventor: **Masamitsu FURUIE**, Tokyo (JP)

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USPC **257/40**

(57) **ABSTRACT**

A display device includes a display area in which pixels are arranged in a matrix, and an inspection area that is formed around the display area, and has an inspection pixel, in which the display area includes plural first electrodes that are disposed in the respective pixels, a light emitting organic layer that includes plural organic material layers having a light emitting layer, and a second electrode that covers the display area, and the inspection pixel includes an inspection first electrode electrically independent from the respective first electrodes, an inspection organic layer in which at least one light emitting layer of the plural organic material layers is continuous from the display area, and comes in contact with the inspection first electrode, and an inspection second electrode that is continuous from the second electrode, and comes in contact with the inspection organic layer.

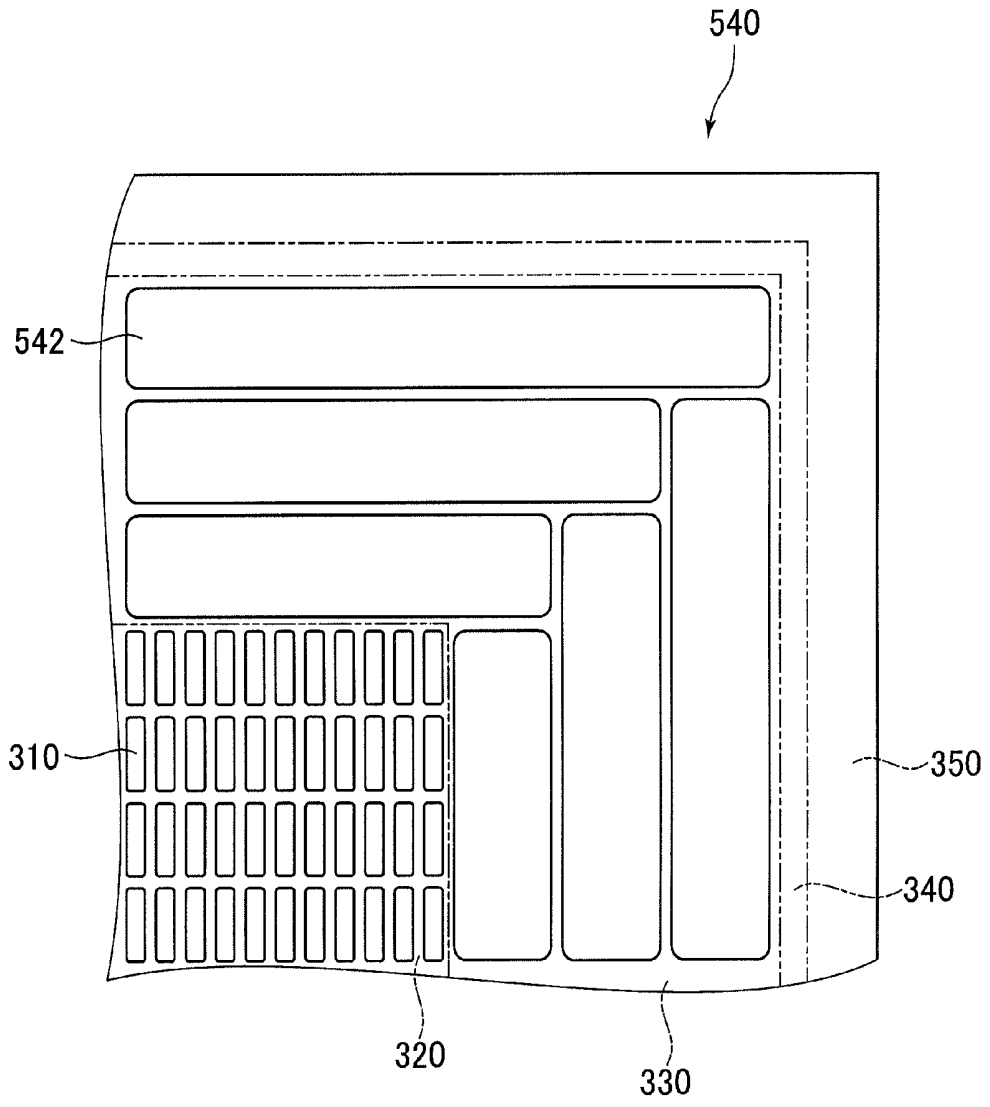


FIG.1

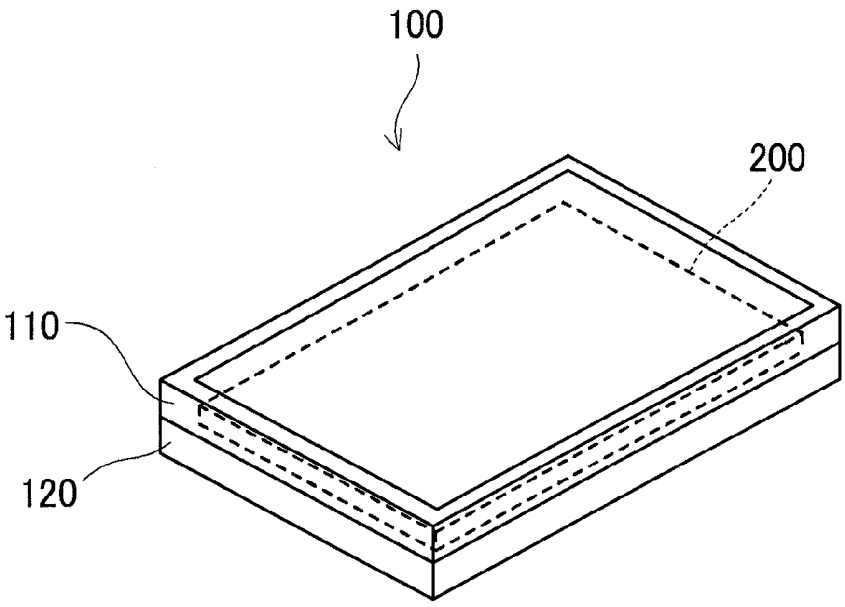


FIG.2

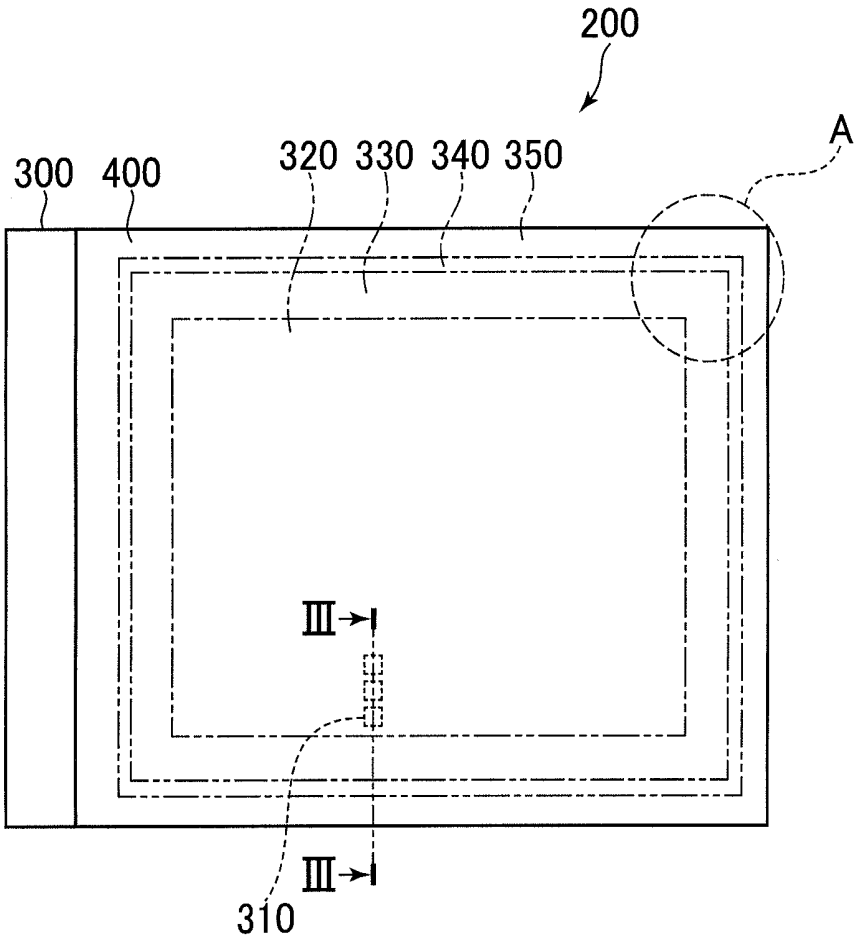


FIG.3

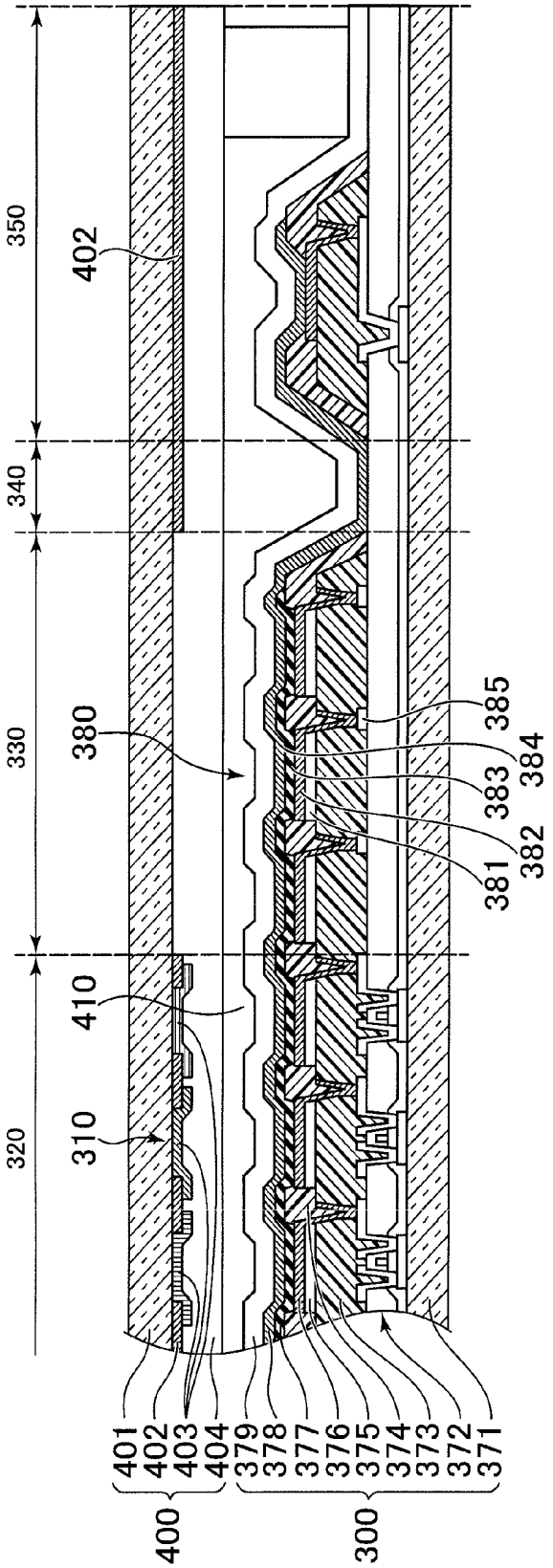

350
340
330
320
402
380
410
310
385
384
383
382
381
401
402
403
404
379
378
377
376
375
374
373
372
371
400
300

FIG.4

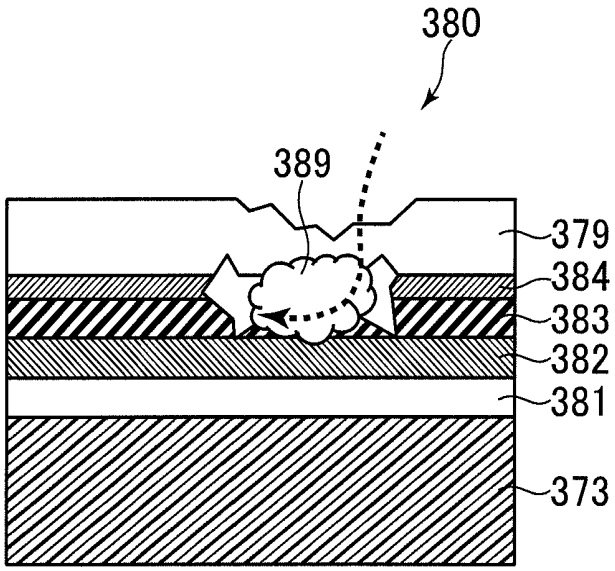


FIG.5

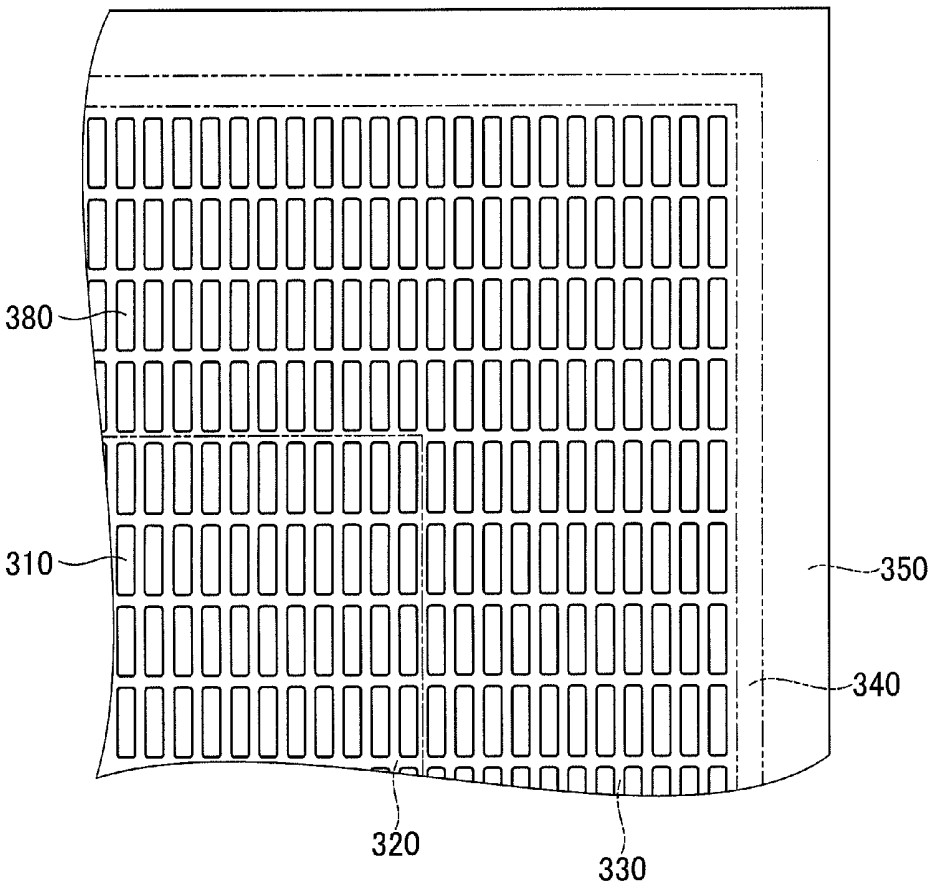


FIG.6

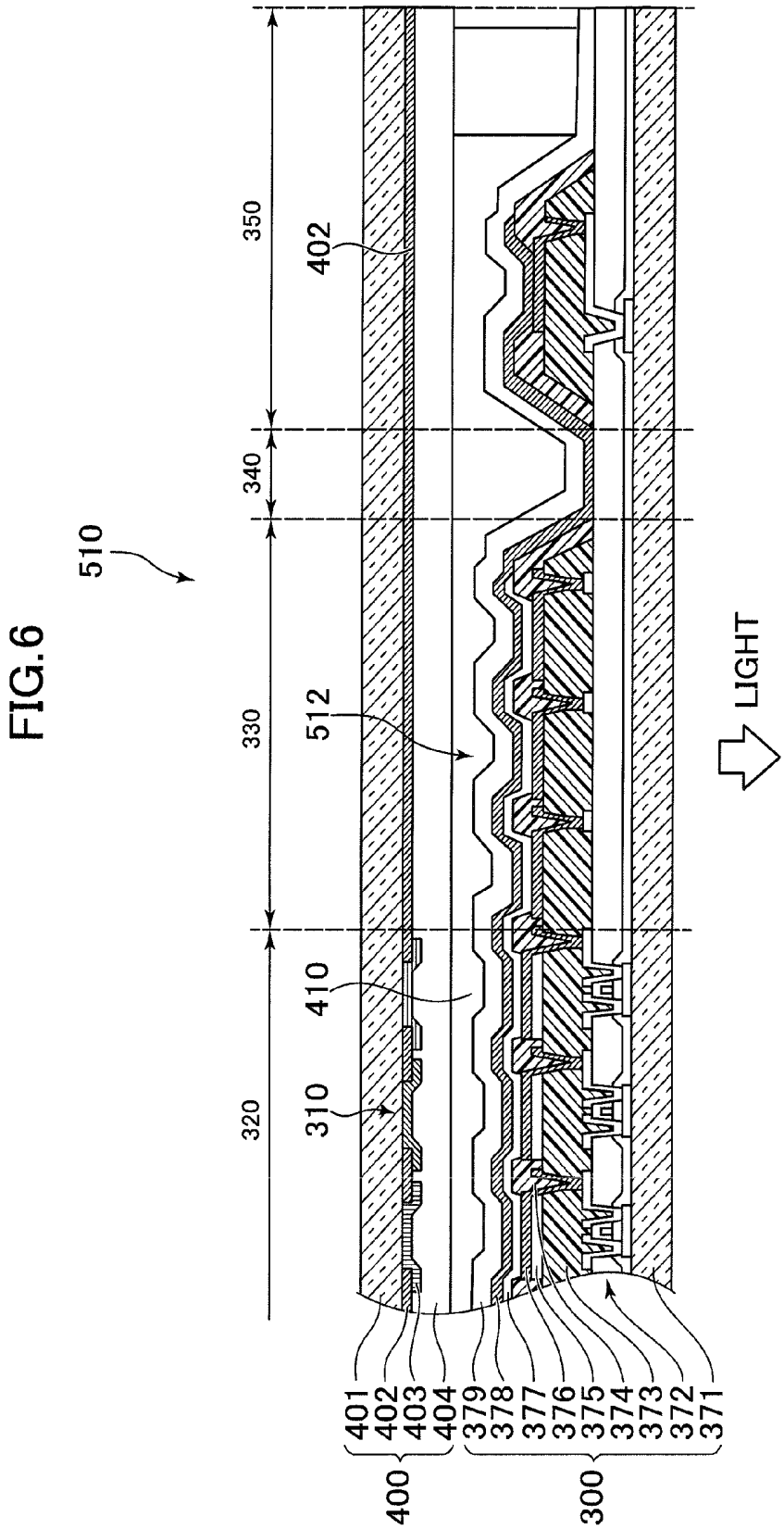

510
350
340
330
320
402
512
410
310
LIGHT
401
402
403
404
379
378
377
376
375
374
373
372
371
400
300

FIG. 7

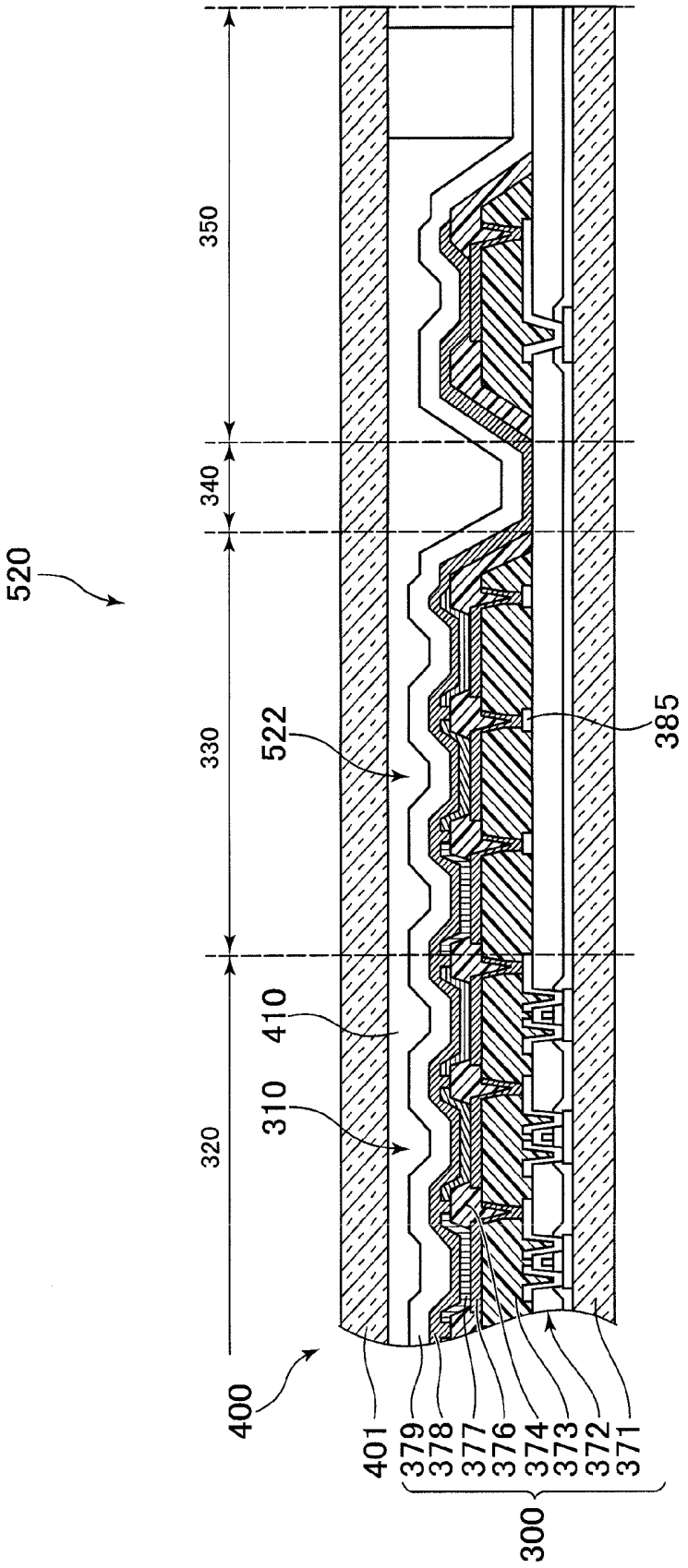

520
350
340
330
320
522
385
410
310
400
401
379
378
377
376
374
373
372
371
300

FIG.8

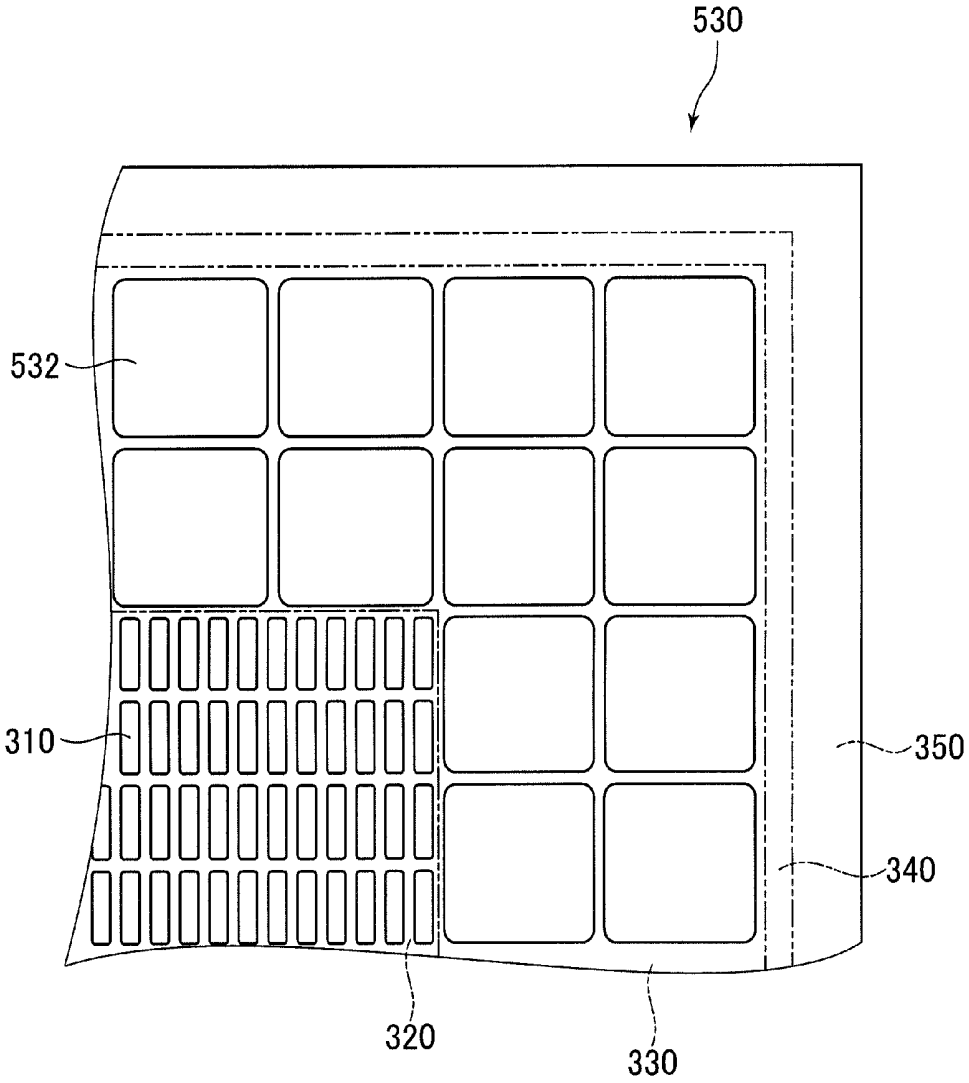
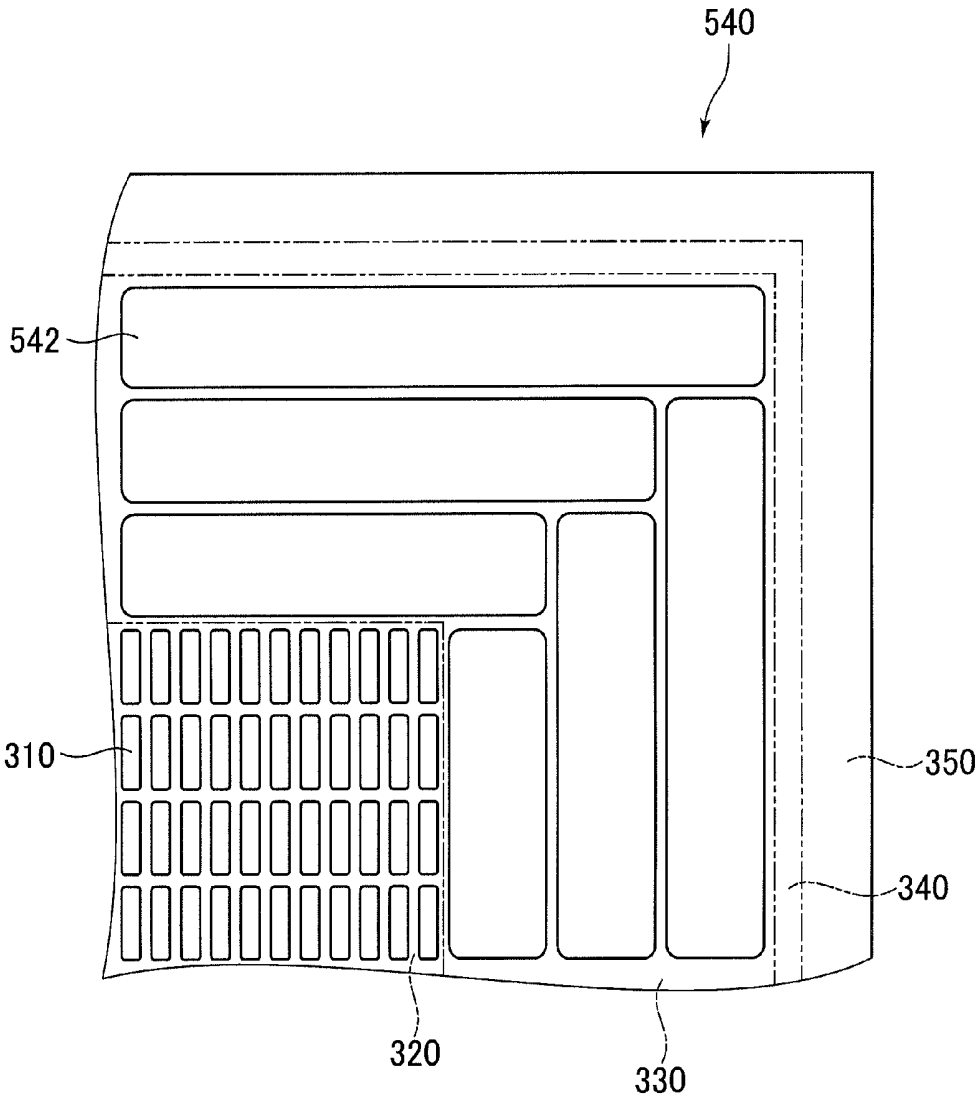


FIG.9



DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a display device.

[0003] 2. Description of the Related Art

[0004] In recent years, an image display device (hereinafter referred to as "organic EL (electro-luminescent) display device") using self-emitting bodies called "organic light emitting diodes (OLED)" has been put into a practical use. As compared with a liquid crystal display device in a related art, the organic EL display device uses the self-emitting bodies, and therefore not only is excellent in visibility and response speed, but also does not require an auxiliary lighting device such as backlight. As a result, the organic EL display device can be further thinned.

[0005] Because an organic EL element used in the organic EL display device of this type is deteriorated when absorbing moisture, measures are taken to hermetically bond a sealing glass substrate onto a TFT (thin film transistor) substrate on which a light emitting layer is formed with resin in an organic EL panel.

[0006] JP 2005-148335 A discloses that in an evaporation mask in which plural openings for forming an organic light emitting layer are formed, since a shape of openings formed outside is changed by a stress, an opening as a dummy pixel is formed in a non-display area around a display area in the evaporation mask. JP 2007-256968 A discloses that a dummy pixel area is provided outside of the display area in a manufacturing stage for the purpose of equalizing film forming conditions for pixels in the display area.

SUMMARY OF THE INVENTION

[0007] In the TFT substrate, a sealing film is formed over a surface thereof so as to cover an overall surface of the display area and a peripheral circuit area. However, there has been known that if there is a defect in the sealing film, moisture of an outside air penetrates the defect to deteriorate the light emitting layer. If the defect of the sealing film is present within the display area, the defect can be detected as a dark spot in an inspection process. However, if the defect is present outside the display area (and inside a moisture block area to be described later), the defect cannot be immediately detected as the dark spot, and has the potential for display failure which is so-called "dark edge" in which lighting failure occurs from outside of the display area with time after coming on the market.

[0008] In order to prevent the dark edge from occurring in the market, it is conceivable that an aging process is conducted in a manufacturing process to confirm whether the dark edge is present, or not. However, this may cause an increase in the manufacturing cost to rise, and throughput degradation.

[0009] The present invention has been made under the above circumstances, and therefore aims at providing a display device that suppresses the manufacturing costs, and inhibits lighting failure from occurring after shipping.

[0010] According to the present invention, there is provided a display device, including: a display area in which pixels each having a light emitting area from which light is emitted are arranged in a matrix; and an inspection area that is formed around the display area, and has at least one inspection pixel, in which the display area includes: a plurality of first electrodes that are disposed in the respective pixels; a light emitting organic layer that comes in contact with the first electrodes in the light emitting area, and includes a plurality of organic material layers having a light emitting layer; and a second electrode that comes in contact with the light emitting organic layer, and covers the display area, and in which the inspection pixel includes: an inspection first electrode of the same layer as that of the plurality of first electrodes, and electrically independent from the plurality of first electrodes; an inspection organic layer in which at least one light emitting layer of the plurality of organic material layers is continuous from the display area, and comes in contact with the inspection first electrode; and an inspection second electrode that is continuous from the second electrode, and comes in contact with the inspection organic layer.

[0011] Also, according to the present invention, the display device may further include: a peripheral circuit area that is disposed around the inspection area, in which a circuit using a metal line and a thin film transistor is arranged; and a blocking area that includes an electrode layer which is formed between the inspection area and the peripheral circuit area, and continuous from the inspection second electrode in the inspection area, and includes only an inorganic material layer between the electrode layer and an insulating substrate which is a base material.

[0012] Also, in the display device according to the present invention, the inspection pixel may have the same size and the same shape as those of the pixels in the display area, and be arranged to fill the inspection area at the same intervals as that in the display area.

[0013] Also, in the display device according to the present invention, the inspection pixel may be larger than the pixels in the display area, and may fill the inspection area.

[0014] Also, in the display device according to the present invention, the display area may further include a reflective layer that reflects light emitted by the light emitting layer, and outputs the light in a first output direction from the first electrodes toward the second electrode in a side of the first electrodes opposite to the light emitting organic layer side, and a light shielding film that blocks light output in the first output direction may be arranged in only the blocking area and the peripheral circuit area of the inspection area, the blocking area, and the peripheral circuit area.

[0015] Also, in the display device according to the present invention, the display area may further include a reflective layer that reflects light emitted by the light emitting layer, and traveling toward a side of the first electrodes opposite to the light emitting organic layer side, and outputs the light in the first output direction from the first electrodes toward the second electrode, and the inspection pixel may have no layer corresponding to the reflective layer, and output the light in the first output direction, and in a second output direction from the second electrode toward the first electrodes.

[0016] Also, in the display device according to the present invention, the inspection area may further include a light shielding film that blocks the light output toward the first output direction.

[0017] Also, in the display device according to the present invention, the inspection first electrode of the inspection pixel may be electrically connected to the inspection first electrode of another inspection pixel adjacent thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is a diagram schematically illustrating an organic EL display device according to an embodiment of the present invention;

[0019] FIG. **2** is a plan view illustrating a configuration of an organic EL panel;

[0020] FIG. **3** is a cross-sectional view taken along a line III-III of FIG. **2**;

[0021] FIG. **4** is a diagram illustrating penetration of moisture into a light emitting organic layer when a foreign matter is mixed into a blocking inside area;

[0022] FIG. **5** is an enlarged view illustrating an outline of a layout of pixels and dummy pixels in an area indicated by a mark A in FIG. **2**;

[0023] FIG. **6** is a cross-sectional view schematically illustrating an organic EL panel according to a first modification of this embodiment;

[0024] FIG. **7** is a cross-sectional view schematically illustrating an organic EL panel according to a second modification of this embodiment;

[0025] FIG. **8** is an enlarged view illustrating an organic EL panel according to a third modification of this embodiment in the same field of view as that in FIG. **5**; and

[0026] FIG. **9** is an enlarged view illustrating an organic EL panel according to a fourth modification of this embodiment in the same field of view as that in FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Hereinafter, a description will be given of embodiments of the present invention with reference to the accompanying drawings.

[0028] In the drawings, the same or equivalent elements are denoted by identical symbols, and a repetitive description will be omitted.

[0029] FIG. **1** schematically illustrates an organic EL display device **100** according to an embodiment of the present invention. As illustrated in FIG. **1**, the organic EL display device **100** includes an organic EL panel **200** fixed between an upper frame **110** and a lower frame **120**.

[0030] FIG. **2** is a plan view illustrating a configuration of the organic EL panel **200**. The organic EL panel **200** includes a TFT substrate **300**, and a sealing substrate **400** adhered to the TFT substrate **300** with a transparent resin **410** (to be described later). As illustrated in FIG. **2**, the organic EL panel **200** includes a display area **320** in which pixels **310** each having an anode electrode **376** (to be described later) arranged therein, and emitting light on the basis of a gradation value are arrayed in a matrix, a peripheral circuit area **350** that is arranged around the display area **320**, and formed with a circuit that applies a potential to various signal generator circuits for driving pixel circuits, and a cathode electrode **378** (to be described later), a blocking area **340** that is formed between the display area **320** and the peripheral circuit area **350**, and made of only an inorganic material from the cathode electrode **378** to a glass substrate **371** to thereby block the traffic of moisture, and a blocking inside area **330** formed between the display area **320** and the blocking area **340**. Because the moisture penetrated from the external progresses through an organic film, with the provision of the blocking area **340** made of only inorganic material, for example, the moisture that penetrates the peripheral circuit area **350** can be prevented from penetrating the display area **320**.

[0031] FIG. **3** is a cross-sectional view taken along a line III-III of FIG. **2**. As illustrated in FIG. **3**, the TFT substrate **300** of the organic EL panel **200** includes the glass substrate **371** which is an insulating substrate, a thin film transistor layer **372** made of, for example, LTPS (low-temperature polysilicon) on the glass substrate **371** in which pixel circuits having transistors and a peripheral circuit are formed, an organic planarizing film **373** that is an organic insulating film for planarizing mainly an area in which the thin film transistor layer **372** are formed, an organic bank **374** that is formed of an organic insulating film formed to cover an end of a conductive film such as an anode electrode **376** formed in each through-hole of the organic planarizing film **373**, a reflective film **375** that is arranged on the glass substrate **371** side of the anode electrode **376** for reflecting emitting light, a light emitting organic layer **377** including a light emitting layer that emits light, and/or a hole injection/transport layer, an electron injection/transport layer, a cathode electrode **378** which is an electrode facing the anode electrode **376**, and a sealing film **379** that is formed to cover an overall surface of the TFT substrate **300**, and formed of an inorganic film or a laminated structure of the inorganic film and an organic film. The inorganic film used for the sealing film **379** is made of SiN or SIC that does not transmit moisture, and formed through CVD (chemical vapor deposition). Also, in this embodiment, the organic bank **374** is formed of an organic insulating film, but may be formed of inorganic insulating film.

[0032] Also, the sealing substrate **400** arranged over the TFT substrate **300** through the transparent resin **410** includes a glass substrate **401** which is an insulating substrate. The sealing substrate **400** also includes mainly in the display area **320**, color filters **403** of R(red), G(green), and B(blue) that transmit light of given wavelength regions in the respective pixels **310**, a black matrix **402** that is a light shielding film for preventing a leakage light from between the respective pixels **310**, and an overcoat layer **404** made of an organic material which covers the color filters **403** and the black matrix **402**. In this embodiment, the black matrix **402** is formed in the blocking area **340** and the peripheral circuit area **350** outside of the display area **320**, and prevents light from being output from those areas, but is not formed in the blocking inside area **330**.

[0033] In this example, pixel transistors that control the light emission of the respective pixels **310** are arranged in the thin film transistor layer **372** within the display area **320**, but the pixel transistor is not arranged in each of dummy pixels **380** arranged in the blocking inside area **330**. Also, a reflective film **381**, an anode electrode **382**, a light emitting organic layer **383**, and a cathode **384** in the dummy pixel **380** are laminated on each other in the same process as that of the pixels **310** in the display area **320**.

[0034] The anode electrode **382** is connected to lines **385** of the thin film transistor layer **372** via through-holes. In this embodiment, the respective dummy pixels **380** are wired to turn on, independently from the pixels **310** in the display area **320**, as passive drive pixels. In a test in a manufacturing step, the dummy pixels **380** may sequentially turn on one by one, or plural dummy pixels **380** may turn on together. Also, all of the dummy pixels **380** may turn on at the same time to conduct a test.

[0035] In this embodiment, the dummy pixels **380** have a circuit configuration as the passive drive pixels. Alternatively, the pixel transistors are arranged in the same manner as that of the pixels **310** within the display area **320** to perform the active drive, or all of the dummy pixels **380** may be wired to turn on only in unison. Also, in this embodiment, a laminated structure of the light emitting organic layer **383** in the dummy

pixels **380** is identical with the laminated structure of the pixels **310** in the display area **320**. Alternatively, light may be emitted with a lamination different from the laminated structure of the pixels **310** in the display area.

[0036] FIG. **4** is a diagram illustrating penetration of moisture into the light emitting organic layer **383** when a foreign matter **389** is mixed into the blocking inside area **330**. As illustrated in FIG. **4**, for example, if the foreign matter **389** adheres to the TFT substrate **300** in forming the sealing film **379**, it is conceivable that the sealing film **379** or the cathode electrode **384** is broken in bonding the TFT substrate **300** to the sealing substrate **400**. If the sealing film **379** is broken, or there is a defect in the coating of the sealing film **379**, the moisture penetrates the defect, and the moisture spreads through the light emitting organic layer **383**. The light emitting organic layer **383** that absorbs the moisture is deteriorated, and becomes dark spot that does not emit light, or weakens the light emission. Therefore, the coating defect of the sealing film **379** in the blocking inside area **330** can be inspected by turning on the dummy pixels **380** in the blocking inside area **330**.

[0037] FIG. **5** is an enlarged view illustrating an outline of a layout of the pixels **310** and the dummy pixels **380** in an area indicated by a mark A in FIG. **2**. As illustrated in FIG. **5**, the pixels **310** formed in the display area **320** and the dummy pixels **380** formed in the blocking inside area **330** are formed with the same size and at the same pitches, and the dummy pixels **380** are formed to fill the blocking inside area **330** formed outside of four sides of the display area **320**.

[0038] As has been described above, in this embodiment, because the blocking inside area **330** in which the dummy pixels **380** are formed is disposed around the display area **320**, even if a penetration path of moisture such as the defect of the sealing film is present outside of the display area **320**, the penetration path can be easily found out by emitting the light from the dummy pixels **380**. As a result, because the lighting failure caused by the dark edge after shipment can be reduced, the life of shipped products can be more lengthened, and the quality can be improved. Also, an aging process for a long term in the inspection before shipping becomes unnecessary, thereby leading to a reduction in the manufacturing costs, and an improvement in the throughput.

[0039] FIG. **6** is a cross-sectional view schematically illustrating an organic EL panel **510** according to a first modification of the above embodiment. The first modification is different from FIG. **3** of the above embodiment in that the black matrix **402** on the sealing substrate **400** is also formed in the blocking inside area **330**, and the reflective film **375** is not formed in a dummy pixel **512** of the blocking inside area **330**. With the above configuration, because the overall outside of the display area **320** is covered with the black matrix **402**, a light leakage can be prevented. Also, the light emission from the dummy pixel **512** can be confirmed from the rear surface side of the organic EL panel **510**. Therefore, even in the configuration of the organic EL panel **510** in FIG. **6**, the same advantage as that in the above embodiment can be obtained. In the first modification, the black matrix **402** is formed in the blocking inside area **330** of the sealing substrate **400**. Alternatively, the light emission of the dummy pixel **512** can be visibly recognized from both of the front surface and the rear surface without the formation of the black matrix **402**.

[0040] FIG. **7** is a cross-sectional view schematically illustrating an organic EL panel **520** according to a second modification of the above embodiment. In the organic EL panel **520**, the light emitting organic layer **377** of the respective pixels **310** emit the light of the respective wavelength regions of RGB, and no color filter and no black matrix are formed on the sealing substrate **400**. Also, in the second modification, the reflective film **375** is not formed on the pixels **310** in the display area **320**, and dummy pixels **522** in the blocking inside area **330**. Even with the above configuration, because the light emission of the dummy pixels **522** can be confirmed from a front surface side or a rear surface side of the organic EL panel **520**, the same advantages as those in the above embodiment can be obtained. FIG. **7** illustrates an example in which the reflective film **375** is not formed. However, the reflective film **375** may be formed.

[0041] FIGS. **8** and **9** are enlarged view illustrating organic EL panels **530** and **540** according to third and fourth modifications of the above embodiments in the same field of view as that in FIG. **5**, which are diagrams illustrating a case in which the sizes of dummy pixels **532** and **542** are set to be larger than the pixels **310** in the display area **320**. FIG. **8** is a diagram illustrating a case of square dummy pixels **532**, and FIG. **9** is a diagram illustrating a case of rectangular dummy pixels **542**. Even with the above configuration, the same advantages as those in the above embodiment can be obtained.

[0042] When the dummy pixels **532** or **542** turn on through an active drive system in which the pixel transistors are arranged, the number of pixel transistors is suppressed, and the degree of freedom of the layout of the transistors can be enhanced. Also, even in the passive drive system, the number of through-holes for connection to the lines of the thin film transistor layer **372** can be reduced. In the third and fourth modifications, the dummy pixels are set to be larger than the pixels **310** in the display area **320**. One dummy pixel that covers the overall blocking inside area **330** can be formed with one common anode electrode whereby one dummy pixel covering the overall blocking inside area **330** may be formed.

[0043] In the above respective embodiments, the layout of the anode electrodes **376** and the cathode electrode **378** may be replaced with each other.

[0044] An ordinary skilled person can conceive various changes and modifications without departing from the spirit of the present invention, and it should be understood that the modifications and the corrections fall within a scope of the spirit of the invention.

[0045] For example, the above respective embodiments appropriately subjected to addition or deletion of components, or design changes by ordinary skilled persons, or subjected to addition or omission of steps, or condition changes also fall within the present invention without departing from the gist of the present invention.

[0046] Also, it would be understood that other advantageous effects obtained by the configurations described in the present embodiments are derived from the present invention if they would be apparent from the description of the present specification, or would be appropriately conceived by the ordinary skilled person.

What is claimed is:

1. A display device, comprising:

a display area in which pixels each having a light emitting area from which light is emitted are arranged in a matrix; and

an inspection area that is formed around the display area, and has at least one inspection pixel,

wherein the display area includes:

a plurality of first electrodes that are disposed in the respective pixels;

a light emitting organic layer that comes in contact with the first electrodes in the light emitting area, and includes a plurality of organic material layers having a light emitting layer; and

a second electrode that comes in contact with the light emitting organic layer, and covers the display area, and

wherein the inspection pixel includes:

an inspection first electrode of the same layer as that of the plurality of first electrodes, and electrically independent from the plurality of first electrodes;

an inspection organic layer in which at least one light emitting layer of the plurality of organic material layers is continuous from the display area, and comes in contact with the inspection first electrode; and

an inspection second electrode that is continuous from the second electrode, and comes in contact with the inspection organic layer.

2. The display device according to claim **1**, further comprising:

a peripheral circuit area that is disposed around the inspection area, in which a circuit using a metal line and a thin film transistor is arranged; and

a blocking area that includes an electrode layer which is formed between the inspection area and the peripheral circuit area, and continuous from the inspection second electrode in the inspection area, and includes only an inorganic material layer between the electrode layer and an insulating substrate which is a base material.

3. The display device according to claim **1**,

wherein the inspection pixel has the same size and the same shape as those of the pixels in the display area, and is arranged to fill the inspection area at the same intervals as that in the display area.

4. The display device according to claim **1**,

wherein the inspection pixel is larger than the pixels in the display area, and fills the inspection area.

5. The display device according to claim **2**,

wherein the display area further includes a reflective layer that reflects light emitted by the light emitting layer, and outputs the light in a first output direction from the first electrodes toward the second electrode in a side of the first electrodes opposite to the light emitting organic layer side, and

wherein a light shielding film that blocks light output in the first output direction is arranged in only the blocking area and the peripheral circuit area of the inspection area, the blocking area, and the peripheral circuit area.

6. The display device according to claim **1**,

wherein the display area further includes a reflective layer that reflects light emitted by the light emitting layer, and traveling toward a side of the first electrodes opposite to the light emitting organic layer side, and outputs the light in the first output direction from the first electrodes toward the second electrode, and

wherein the inspection pixel has no layer corresponding to the reflective layer, and outputs the light in the first output direction, and in a second output direction from the second electrode toward the first electrodes.

7. The display device according to claim **6**,

wherein the inspection area further includes a light shielding film that blocks the light output toward the first output direction.

8. The display device according to claim **1**,

wherein the inspection first electrode of the inspection pixel is electrically connected to the inspection first electrode of another inspection pixel adjacent thereto.

* * * * *

专利名称(译)	显示设备		
公开(公告)号	US20150060823A1	公开(公告)日	2015-03-05
申请号	US14/471063	申请日	2014-08-28
[标]申请(专利权)人(译)	株式会社日本显示器		
申请(专利权)人(译)	日本展示INC.		
当前申请(专利权)人(译)	日本展示INC.		
[标]发明人	FURUIE MASAMITSU		
发明人	FURUIE, MASAMITSU		
IPC分类号	H01L27/32		
CPC分类号	H01L27/3272 H01L27/3223 H01L27/3244 H01L2251/562		
优先权	2013178678 2013-08-29 JP		
其他公开文献	US9305981		
外部链接	Espacenet USPTO		

摘要(译)

一种显示装置，包括：像素以矩阵排列的显示区域;以及形成在显示区域周围的检查区域，并且具有检查像素，其中显示区域包括设置在各个像素中的多个第一电极，包括具有发光层的多个有机材料层的发光有机层，以及覆盖所述显示区域的第二电极，并且所述检查像素包括与各个第一电极电独立的检查第一电极，检查有机层所述多个有机材料层中的至少一个发光层与所述显示区域连续，并且与所述检查第一电极接触，以及与所述第二电极连续的检查第二电极，并且与所述检查接触有机层。

A display device includes a display area in which pixels are arranged in a matrix, and an inspection area that is formed around the display area, and has an inspection pixel, in which the display area includes plural first electrodes that are disposed in the respective pixels, a light emitting organic layer that includes plural organic material layers having a light emitting layer, and a second electrode that covers the display area, and the inspection pixel includes an inspection first electrode electrically independent from the respective first electrodes, an inspection organic layer in which at least one light emitting layer of the plural organic material layers is continuous from the display area, and comes in contact with the inspection first electrode, and an inspection second electrode that is continuous from the second electrode, and comes in contact with the inspection organic layer.