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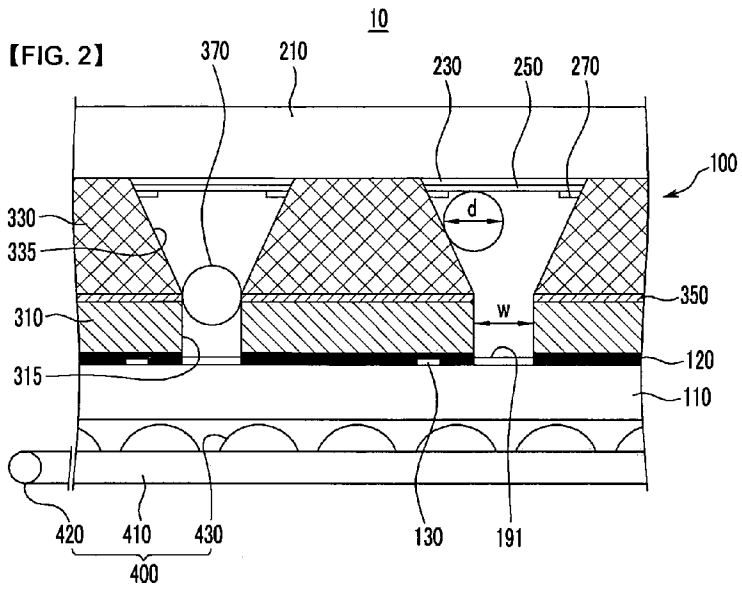
(54) **Title:** DISPLAY DEVICE DRIVEN BY ELECTRIC FIELD AND METHOD FOR MANUFACTURING THE SAME

【FIG. 2】



(57) **Abstract:** The present invention relates to an electric field driving display device and a manufacturing process of the electric field driving display device. The electric field driving display device according to the present invention includes: a first substrate; a first electrode formed on the first substrate; a first barrier rib formed on the first substrate and having a fixing groove; a second barrier rib formed on the first barrier rib, and having a plurality of driving grooves that are respectively connected to the respective fixing grooves; a plurality of driven bodies respectively disposed in the respective driving grooves; and a light reflector disposed between the first barrier rib and the second barrier rib. Accordingly, luminance of the electric field driving display device can be improved.

WO 2009/005232 A1

DISPLAY DEVICE DRIVEN BY ELECTRIC FIELD AND METHOD FOR MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2007-0066981 filed in the Korean Intellectual Property Office on July 4, 2007, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a display device. More particularly, it relates to an electric field driving display device.

(b) Description of the Related Art

A liquid crystal display (LCD), a plasma display panel (PDP), a field emission display (FED), a vacuum fluorescent display (VFD), an organic light emitting display (OLED), and an electrophoretic display (ED) are among widely used display devices.

The LCD has been used for monitors and televisions, the PDP plasma display device has been used for large-scale televisions, and the OLED display has been used for a window of a mobile phone, and application of the OLED to a large-scaled display device has been actively studied. Application of the FED and the ED to monitors, television, and electronic papers has also been actively studied.

SUMMARY OF THE INVENTION

The present invention has been made in an effort to provide an electric field driving display device that is different from a conventional display device, and a manufacturing process of the electric field driving display device.

An exemplary electric field driving display device according to an embodiment of the present invention includes: a first substrate; a first electrode formed on the first substrate; a first barrier rib formed on the first substrate and having a fixing groove; a second barrier rib formed on the first barrier rib, and having a plurality of driving grooves that are respectively connected to the respective fixing grooves; a plurality of driven bodies respectively disposed in the respective driving grooves; and a light reflector disposed between the first barrier rib and the second barrier rib.

The first electrode may be exposed to the fixing groove.

The electric field driving display device may further include a light blocking unit disposed between the first substrate and the first barrier rib. The first electrode and the light blocking unit may be disposed to cross each other.

The electric field driving display device may further include a second substrate placed on the second barrier rib, and a second electrode formed on the second substrate.

The size of a cross-section of the driving groove may be gradually increased away from the first substrate.

The second electrode is exposed to the driving groove, and may be placed at an edge of the cross-section of the driving groove.

The driven body may have a spherical shape. The diameter of the driven body may marginally greater than the width of the fixing groove. A location of the driven body may be determined by a voltage applied to the first and second electrodes. The driven body may contact the second substrate due to an attraction force with the second electrode, and the second electrode may be interposed between a contact area of the driven body and the second substrate and an edge of the driving groove.

The electric field driving display device may further include a color filter formed on the second substrate.

The first and second electrodes may be made of a transparent conductive material.

A cross-section of the driving groove may have a circular shape or a polygonal shape. The driven body may have one color among a group of black, white, red, green, blue, yellow, magenta, and cyan.

The fixing groove and the driving groove may be filled with at least one of inert gas, nitrogen, and dry air. The fixing groove and the driving groove may be in a vacuum state.

The electric field driving display device may further include a backlight unit that supplies light for displaying on the first substrate. The backlight unit may include a lamp that emits light, and a light guide that changes light emitted from the lamp to planar light. The backlight unit may further include a condenser lens that focuses light from the lamp and the light guide to each of the driving grooves.

The electric field driving display device may further include a switch

formed on the first substrate, connected with the first electrode, and controlling a voltage applied to the first electrode. The switch may include a thin film transistor.

An exemplary manufacturing process of an electric field driving display device according to an embodiment of the present includes: forming a first electrode on a first substrate; forming a first barrier rib having a fixing groove on the first substrate and the first electrode; forming a second barrier rib having a plurality of driving grooves on the first barrier rib; vacuumizing the fixing groove and the plurality of driving grooves; providing driven bodies to each of the plurality of driving grooves; and removing residual driven bodies from each of the driving grooves.

The forming of the first barrier rib includes spin-coating a photosensitive material on the first substrate and the first electrode, and forming the fixing groove by exposing and developing. The photosensitive material may include a negative photoresist.

The forming of the second barrier rib may include disposing a dry photosensitive material on the first barrier rib, and forming the plurality of driving grooves that are connected with the fixing groove through exposing and developing.

The manufacturing process may further include forming a light reflector between the first barrier rib and the second barrier rib.

The manufacturing process may further include forming a light blocking unit that is disposed to cross the first electrode on the first substrate.

The forming of the light blocking unit and the first barrier rib may include:

forming a light blocking material layer on the first substrate and the first electrode; forming a photosensitive material layer on the light blocking material layer; exposing and developing the photosensitive material layer; and etching an exposed portion of the light blocking material layer by using the developed photosensitive material layer as an etching mask.

The forming of the light blocking unit and the first barrier rib may include: forming a first photosensitive film that includes a light blocking material on the first substrate and the first electrode; forming a second photosensitive film on the first photosensitive film; and forming the first barrier rib and the light blocking unit by exposing and developing the second and first photosensitive films.

The manufacturing process may further include combining the second substrate on the second barrier rib. The manufacturing process may further include forming a second electrode exposed to the driving groove on the second substrate.

The removing of the residual driven bodies may include disposing openings of the fixing groove and the plurality of driving grooves toward the gravity direction, and removing the residual driven bodies, except one driven body in each of the driving grooves, by injecting high-pressure air thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of an electric field driving display device according to an exemplary embodiment of the present invention.

FIG. 2 is a cross-sectional view of the electric field driving display device of FIG. 1 taken along the line Ⅱ-Ⅱ.

FIG. 3 is a top plan view of an electric field driving display device

according to another exemplary embodiment of the present invention.

FIG. 4 is a cross-sectional view for describing driving of the electric field driving display device of FIG. 1 and FIG. 2.

FIG. 5 is a cross-sectional view of an electric field driving display device according to another exemplary embodiment of the present invention.

FIG. 6 to FIG. 15 sequentially show a manufacturing process of the electric field driving display device of FIG. 1 and FIG. 2.

<Description of Reference Numerals Indicating Primary Elements in the Drawings>

10, 20: electric field driving display device 100: display panel

110: lower substrate 120: light blocking unit

130: switch 191: pixel electrode

210: upper substrate 230: color filter

250: insulating layer 270: common electrode

310: fixed barrier rib 315: fixing groove

330: driving barrier rib 335: driving groove

350: light reflector 370, 390: driven body

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention.

In the drawings, the thickness of layers, films, panels, regions, etc., are exaggerated for clarity. Like reference numerals designate like elements throughout the specification. It will be understood that when an element such as a layer, film, region, or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

An electric field driving display device according to an exemplary embodiment of the present invention will be described with reference to FIG. 1 to FIG. 3.

FIG. 1 is a top plan view of the electric field driving display device of FIG. 1, FIG. 2 is a cross-sectional view of the electric field driving display device of FIG. 1 taken along the line Ⅱ-Ⅱ, and FIG. 3 is a top plan view of an electric field driving display device according to another exemplary embodiment of the present invention.

Referring to FIG. 1 and FIG. 2, an electric field driving display device 10 includes a display panel 100 and a backlight unit 400.

The display panel 100 that displays an image thereon by controlling the amount of light includes a lower substrate 110 on which pixel electrodes 191 are formed, an upper substrate 210 on which a common electrode 270 is formed, a fixed barrier rib 310 having fixing grooves 315, a driving barrier rib 330 having driving grooves 335, a light reflector 350 interposed between the fixed barrier rib 310 and the driving barrier rib 330, and a driven body 370 disposed in each driving groove 335.

The pixel electrodes 191 extending in one direction are arranged in parallel on the lower substrate 110 that is made of transparent glass. The pixel electrodes 191 can be made of a transparent conductive material such as indium tin oxide (ITO) or indium zinc oxide (IZO). As shown in FIG. 3, each pixel electrode 191 may have a quadrangular shape and may be formed to correspond to each driving groove 335.

In addition, a switch 130 is formed on each pixel electrode 191 to individually switch a voltage applied to each pixel electrode 191, and is connected with the pixel electrode 191. A thin film transistor may be used as the switch 130, and when the thin film transistor is used as the switch 130, a gate line (not shown) that transmits a scan signal for turning on/off the thin film transistor and a data line (not shown) that transmits a grayscale voltage applied to the pixel electrode 191 may be formed to cross each other on the lower substrate 110. Each thin film transistor may include a gate electrode, a source electrode, a drain electrode, and a semiconductor. Unlike the pixel electrodes 191 individually formed in each driving groove 335 as shown in FIG. 3, the pixel electrodes 191 of FIG. 1 extends in one direction and therefore the number of switches 130 can be reduced.

A light blocking unit 120 is formed on a part of the lower substrate 110 where the pixel electrodes 191 are not formed. That is, the light blocking unit 120 scarcely overlaps the pixel electrodes 191. However, an end portion of the light blocking unit 120 may partially overlap the pixel electrodes 191. The light blocking unit 120 blocks light of adjacent pixels from being mixed.

The fixed barrier rib 310 having the fixing grooves 335 is formed on the

light blocking unit 120. The fixed barrier rib 310 can be formed by coating, exposing, and developing a photosensitive material. The fixed barrier rib 310 may be made of an opaque material that does not transmit light. When the fixed barrier rib 310 is made of a black color material, unexpected light is prevented from passing through the fixed barrier rib 310 or is prevented from being reflected by the fixed barrier rib 310 such that deterioration of display quality can be prevented. If the fixed barrier rib 310 can replace the function of the light blocking unit 120, the light blocking unit 120 can be omitted. Each fixing groove 315 fixes a driven body 370. Each pixel electrode 191 is exposed to a fixing groove 315.

The light reflector 350 is formed on the fixed barrier rib 310. The light reflector 350 induces scattered light to a display area of the upper substrate 210.

The driving barrier rib 330 having the driving grooves 335 is formed on the light reflector 350. A cross-section of each driving groove 335 is formed in a circular shape, and the width of the cross-section becomes gradually wider toward the upper substrate 210 from the lower substrate 110. That is, the driving groove 335 is shaped as an upside-down truncated circular cone. The cross-section of the driving groove 335 may have a quadrangular shape, and in this case, the driving groove 335 may have an upside-down quadrangular pyramid shape. The driving barrier rib 330 may be made of a dry photosensitive material having good transmittance.

A sphere-shaped driven body 370 of which location is determined by electrical power is disposed in each driving groove 335. The driven body 370 has a positive or negative charge. The driven body 370 may have a

multi-layered structure. For example, an external side of the driven body 370 may be made of an organic film for preserving the charge, and an internal side of the driven body 370 may be made of a metal layer for total reflection. In addition, the driven body 370 may be made of an opaque material for blocking reflected light.

The diameter d of the driven body 370 may be equal to or greater than the width w of the fixing groove 315. Accordingly, the driven body 370 can freely move in the driving groove 335, but cannot fit into the fixing groove 315. If the driven body 370 is interposed between the light reflector 350 and/or the fixing groove 315 due to an attraction force with the pixel electrode 191 so that the fixing groove 315 is blocked, light emitted from the backlight unit 400 is blocked and thus a completely black state can be realized.

In the present exemplary embodiment, the driven body 370 cannot contact the pixel electrode 191 because it cannot completely fit into the fixing groove 315. Therefore, an insulation layer for protecting the pixel electrode 191 is not required to be formed on the pixel electrode 191.

The driving groove 335 includes an inert gas (not shown) such as argon, neon, and helium, together with the driven body 370. The inert gas may be replaced with another gas that can properly preserve the charges of the driven body 370, such as a nitride gas or dry air. In addition, the driving groove 335 can be maintained in a vacuum state.

The upper substrate 210 is combined with the driving barrier rib 330.

A color filter 230 for red, green, and blue is formed on the upper substrate 210, and an insulating layer 250 is formed on the color filter 230 for

protection. The common electrode 270 is formed on the insulating layer 250. The common electrode 270 may be formed of a transparent conductor such as ITO or IZO.

The insulating layer 250 and the common electrode 270 are exposed to the driving groove 335. In addition, the common electrode 270 is located at an edge of the driving groove 335. In further detail, when the driven body 370 contacts the insulating layer 250 due to an attraction force with the common electrode 270, the common electrode 270 is located between the contact area of the driven body 370 and the common electrode 270 and a circumference of the driving barrier rib 330 that partitions the driving groove 335. Therefore, an insulating layer for protecting against contact between the driven body 370 and the common electrode 270 can be omitted because the driven body 370 does not directly contact the common electrode 270.

The backlight unit 400 that supplies light to the display panel 100 includes a lamp 420 that emits light, a light guide 410 that changes linear light or point light emitted from the lamp 420 to planar light, and a condenser lens 430 that focuses light from the light guide 410 to a display area (i.e., the fixing groove 315 and the driving groove 335). A linear light source such as a cold cathode fluorescent lamp (CCFL) and an external electrode fluorescent lamp (EEFL) or a point light source such as a light emitting diode (LED) can be used as the lamp 420. When a planar light source is used as the lamp 420, the light guide 410 can be omitted. The condenser lens 430 may be directly formed in the surface of the light guide 410 or may be formed as a single layer on the surface of the light guide 410. In addition, the condenser lens 430 may be separately formed

as a film, or may be formed as a single layer on the display panel 100.

The backlight unit 400 can be disposed either on the lower substrate 110 or the upper substrate 210.

Such an electric field driving display device moves a location of the driven body 370 in the driving groove 335 by application of electrical power or gravity, and controls the transmittance of light provided from the backlight unit 400 through the movement of the driven body 370 so as to obtain a desired image.

Driving of the above-described electric field driving display device 10 will now be described with reference to FIG. 4.

In general, a display screen of a display device is formed perpendicular to the horizontal plane. Therefore, the circumference of the driving groove 335 that is partitioned by the driving barrier rib 330 forms a sloped surface toward the horizontal plane. The driven body 370 rolls down the sloped surface due to gravity. However, when a voltage is applied between the pixel electrode 191 and the common electrode 270, an electric field is formed therebetween so that the charged driven body 370 overcomes gravity and rolls up the sloped surface by electrical power. The electrical power supplied to the driven body 370 can be controlled by controlling the voltage applied between the pixel electrode 191 and the common electrode 270 so that the location of the driven body 370 can be controlled. For this purpose, the sloped surface of the driving groove 335 may have a constant inclination as shown in FIG. 4, or the inclination of the sloped surface may be gradually increased upwardly. In addition, the strength of the electrical power applied to the driven body 370 in order to overcome

gravitational force is changed in accordance with an angle of the sloped surface toward the horizontal plane, and accordingly, the driving voltage can be determined properly for each case.

An area of the driving groove 335 through which the light supplied from the backlight unit 400 can be passed is changed as the location of the driven body 370 changes. That is, when the driven body 370 contacts the bottom of the sloped surface, i.e., when the driven body 370 contacts the upper substrate 210, the area of the driving groove 330 through which the light can be passed is maximized, and the area is gradually decreased as the driven body 370 rolls up the sloped surface. When the driven body 370 rolls up to the top of the sloped surface and fills in the fixing groove 315, the light is completely blocked. As described, the amount of light can be controlled by controlling the voltage applied between the pixel electrode 191 and the common electrode 270.

When the light supplied from the backlight unit 400 passes through the driving groove 335, the light may be partially scattered by the driven body 370 so that luminance can be deteriorated. In this case, the light reflector 350 induces the scattered light to the upper substrate 210 in order to prevent the luminance deterioration.

A color image can be realized by using the color filter 230.

Although the light amount can be controlled by controlling the location of the driven body 370 in the driving groove 335 according to the above-described embodiment of the present invention, the light amount can also be controlled by controlling light blocking time.

The driven body 370 can be driven by several tens of millivolts (mV) to

several volts (V) at a very high speed since the size of the driven body 370 is several to several tens of micrometers, and therefore the display device can be provided with fast response speed and precise control. Operation speed of the driven body 370 is proportional to the weight of the driven body 370, and therefore the weight can be reduced by forming pores in the driven body 370.

Although the driven body 370 is driven by using gravity and electrical power in the above-described exemplary embodiment of the present invention, electrical power that is applied in the opposite direction to the existing electrical power may be used as a substitute for or to supplement the gravity. That is, the driven body 370 can reciprocate without depending on gravity by inverting the voltage applied between the pixel electrode 191 and the common electrode 270.

An electric field driving display device according to another exemplary embodiment of the present invention will be described with reference to FIG. 5.

FIG. 5 is a cross-sectional view of an electric field driving display device according to another exemplary embodiment of the present invention, and reference numerals that are the same as those of the electric field driving display device 10 of FIG. 4 will be given to similar or the same parts of the electric field driving display device of FIG. 5.

Referring to FIG. 5, an electric field driving display device 20 according to the present exemplary embodiment includes a display panel 100.

The display panel 100 includes a lower substrate 110 on which pixel electrodes 191 and switches 130 are formed, an upper substrate 210 on which a common electrode 270 is formed, a fixed barrier rib 310 having fixing grooves 315, a driving barrier rib 330 having driving grooves 335, a light reflector 350

interposed between the fixed barrier rib 310 and the driving barrier rib 330, and a driven body 390 disposed in each driving groove 335. Each driven body 390 has positive or negative charge, and reflects light. The driven body 390 may be one of white, red, green, and blue, yellow, magenta, and cyan, and can realize a color image by using these colors.

Unlike the electric field driving display device of FIG. 1 to FIG. 4, the electric field driving display device 20 according to the present exemplary embodiment does not include a color filter 230, an insulating layer 250, or a backlight unit 400, and displays an image by using external light. In addition, the pixel electrode 191 may be made of ITO, IZO, a conductive polymer, or a metal.

Driving of the electric field driving display device 20 of FIG. 5 will now be described.

As shown in FIG. 5, a driven body 390 in a first driving groove 335a is located at the top of the sloped surface by an electric field formed between the pixel electrode 191 and the common electrode 270, a driven body 390 in a second driving groove 335b is located at the middle of the sloped surface by an electric field formed between the pixel electrode 191 and the common electrode 270, and a driven body 390 in a third driving groove 335c is located at the bottom of the sloped surface by an electric field formed between the pixel electrode 191 and the common electrode 270 or by gravity. The amount of reflected light or incident light on the driving groove 335 varies as the location of the driven body 390 changes. The driven body 390 in the third driving groove 335c is the closest to the upper substrate 210, and therefore incident light from the external

source may be completely reflected by the driven body 390. The driven body 390 in the second driving groove 335b is at a predetermined distance from the upper substrate 210, and therefore incident light from the external source is partially reflected, thereby expressing an intermediate grayscale. The driven body 390 in the first driving groove 335a is farthest from the upper substrate 210 so that the incident light from the external source is hardly reflected. In this way, an image can be displayed by controlling the location of the driven body 390 in the driving groove 335.

A manufacturing process of the electric field driving display device according to an exemplary embodiment of the present invention will now be described with reference to FIG. 6 to FIG. 15.

FIG. 6 to FIG. 15 sequentially show a manufacturing process of the electric field driving display device 10 of FIG. 1 and FIG. 2.

First, as shown in FIG. 6, the pixel electrode 191 and the switch 130 are formed on the lower substrate 110 that is made of a transparent material such as glass or plastic. The switch 130 may be a thin film transistor. In this case, a gate line, and a data line having a source electrode, a drain electrode, and a semiconductor, are also formed on the lower substrate 110.

As shown in FIG. 7, a light blocking material layer 121 is formed on the lower substrate 110, the pixel electrode 191, and the switch 130. Subsequently, as shown in FIG. 8, a photosensitive material layer 311 is formed by coating a photosensitive material on the light blocking material layer 121. For coating the photosensitive material, a spin coating method can be used. The photosensitive material includes a negative photoresist.

Exposing and developing processes are sequentially performed on the photosensitive material layer 311, and an exposed portion of the light blocking material layer 121 is etched by using the developed photosensitive material layer 311 as an etching mask. Then, as shown in FIG. 9, the fixed barrier rib 310 having the fixing groove 315 and the light blocking unit 120 are formed. The light blocking unit 120 is formed between the lower substrate 110 and a lower plane of the fixed barrier rib 310, and is minutely exposed to the fixing groove 315.

The light blocking unit 120 can be made of a photosensitive material. In this case, a first photosensitive film that includes a light blocking material is formed on the lower substrate 110, the pixel electrode 191, and the switch 130, and the photosensitive material layer 311 is formed on the first photosensitive film. Subsequently, exposing and developing processes are simultaneously performed on the first photosensitive film and the photosensitive material layer 311 such that the light blocking unit 120 and the fixed barrier rib 310 are completed.

Next, as shown in FIG. 10, the light reflector 350 is formed on the fixed barrier rib 310. The light reflector 350 contacts an upper plane of the fixed barrier rib 310.

Then, as shown in FIG. 11, a dry photosensitive material 331 is disposed on the light reflector 350. The dry photosensitive material 331 in the form of a film is attached to the light reflector 350, and does not occupy the space of the fixing groove 315. Subsequently, exposing and developing processes are performed on the dry photosensitive material 331. During these processes, the

dry photosensitive material 331 does not block the fixing groove 315. Then, as shown in FIG. 12, the driving barrier rib 330 having the driving groove 335 is formed.

Next, the fixing groove 315 and the driving groove 335 are vacuumized by using various vacuuming devices. The vacuumized driving groove 335 is then provided with the driven body 370 as shown in FIG. 13.

As shown in FIG. 14, residual driven bodies 370 are removed by turning over the lower substrate 110 on which the above-stated elements are formed. At this point, a single driven body 370 is maintained in a single driving groove 335, and the remaining driven bodies 370, that is, all of the residual driven bodies 370, are removed by using a high-pressure air injecting nozzle 500. The single driven body 370 given to the single driving groove 335 is fit in the fixing groove 315 so that it is not removed by high-pressure air injection. Unlike FIG. 14, the residual driven bodies 370 can be removed by using the high-pressure air injecting nozzle 500 without turning over the lower substrate 110.

As shown in FIG. 15, the display panel 100 is completed by combining the upper substrate 210 on which the color filter 230, the insulating layer 250, and the common electrode 270 are formed to the driving barrier rib 330, and the electric field driving display device 10 is completed by combining the backlight unit 400 to the first substrate 110.

As described, the electric field driving display device according to the exemplary embodiment of the present invention can control the location of the driven body by using gravity and electrical power, and the control of the driven

body's location enables the amount of light transmittance to be controlled, thereby displaying a desired image. Further, the electric field driving display device includes the light reflector that induces scattered light to a display area, and therefore luminance can be improved.

In addition, a display device with high luminance can be simply manufactured by the manufacturing method of the electric field driving display device according to the exemplary embodiment of the present invention, and a single driven body can be easily disposed in a single driving groove.

While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. An electric field driving display device comprising:

a first substrate;

a first electrode formed on the first substrate;

a first barrier rib formed on the first substrate and having a fixing groove;

a second barrier rib formed on the first barrier rib, and having a plurality of driving grooves that are respectively connected to the respective fixing grooves;

a plurality of driven bodies respectively disposed in the respective driving grooves; and

a light reflector disposed between the first barrier rib and the second barrier rib.

2. The electric field driving display device of claim 1, wherein the first electrode is exposed to the fixing groove.

3. The electric field driving display device of claim 1, further comprising a light blocking unit disposed between the first substrate and the first barrier rib.

4. The electric field driving display device of claim 3, wherein the first electrode and the light blocking unit are disposed to cross each other.

5. The electric field driving display device of anyone of claim 1 to claim 4, further comprising:

a second substrate placed on the second barrier rib; and

a second electrode formed on the second substrate.

6. The electric field driving display device of claim 5, wherein the size of a cross-section of the driving groove is gradually increased away from the first substrate.

7. The electric field driving display device of claim 6, wherein the second electrode is exposed to the driving groove.

8. The electric field driving display device of claim 7, wherein the second electrode is placed at an edge of the cross-section of the driving groove.

9. The electric field driving display device of claim 5, wherein the driven body has a spherical shape.

10. The electric field driving display device of claim 9, wherein the diameter of the driven body is equal to or greater than the width of the fixing groove.

11. The electric field driving display device of claim 9, wherein a location of the driven body is determined by a voltage applied to the first and

second electrodes.

12. The electric field driving display device of claim 11, wherein the driven body contacts the second substrate due to attraction force with the second electrode, and the second electrode is interposed between a contact area of the driven body and the second substrate and an edge of the driving groove.

13. The electric field driving display device of claim 5, further comprising a color filter formed on the second substrate.

14. The electric field driving display device of claim 5, wherein the first and second electrodes are made of a transparent conductive material.

15. The electric field driving display device of claim 1, wherein a cross-section of the driving groove has a circular shape or a polygonal shape.

16. The electric field driving display device of claim 1, wherein the driven body has one color among a group of black, white, red, green, blue, yellow, magenta, and cyan.

17. The electric field driving display device of claim 1, wherein the fixing groove and the driving groove are filled with at least one of inert gas, nitrogen, and dry air.

18. The electric field driving display device of claim 1, wherein the fixing groove and the driving groove are in a vacuum state.

19. The electric field driving display device of claim 1, further comprising a backlight unit that supplies light for displaying on the first substrate.

20. The electric field driving display device of claim 19, wherein the backlight unit comprises a lamp that emits light and a light guide that changes light emitted from the lamp to planar light.

21. The electric field driving display device of claim 20, wherein the backlight unit further comprises a condenser lens that focuses light from the lamp and the light guide to each of the driving grooves.

22. The electric field driving display device of claim 1, further comprising a switch formed on the first substrate, connected with the first electrode, and controlling a voltage applied to the first electrode.

23. The electric field driving display device of claim 22, wherein the switch comprises a thin film transistor.

24. A manufacturing process of an electric field driving display device, comprising:

forming a first electrode on a first substrate;

forming a first barrier rib having a fixing groove on the first substrate and the first electrode;

forming a second barrier rib having a plurality of driving grooves on the first barrier rib;

vacuumizing the fixing groove and the plurality of driving grooves;

providing driven bodies to each of the plurality of driving grooves; and

removing residual driven bodies from each of the driving grooves.

25. The manufacturing process of claim 24, wherein the forming of the first barrier rib comprises:

spin-coating a photosensitive material on the first substrate and the first electrode; and

forming the fixing groove by exposing and developing.

26. The manufacturing process of claim 25, wherein the photosensitive material includes a negative photoresist.

27. The manufacturing process of claim 24, wherein the forming of the second barrier rib comprises:

disposing a dry photosensitive material on the first barrier rib; and

forming the plurality of driving grooves that are connected with the fixing groove through exposing and developing.

28. The manufacturing process of claim 24, further comprising forming a light reflector between the first barrier rib and the second barrier rib.

29. The manufacturing process of claim 24, further comprising forming a light blocking unit that is disposed crossing the first electrode on the first substrate.

30. The manufacturing process of claim 29, wherein the forming of the light blocking unit and the first barrier rib comprises:

forming a light blocking material layer on the first substrate and the first electrode;

forming a photosensitive material layer on the light blocking material layer;

exposing and developing the photosensitive material layer; and

etching an exposed portion of the light blocking material layer by using the developed photosensitive material layer as an etching mask.

31. The manufacturing process of claim 29, wherein the forming of the light blocking unit and the first barrier rib comprises:

forming a first photosensitive film that includes a light blocking material on the first substrate and the first electrode;

forming a second photosensitive film on the first photosensitive film; and

forming the first barrier rib and the light blocking unit by exposing and developing the second and first photosensitive films.

32. The manufacturing process of claim 24, further comprising combining the second substrate on the second barrier rib.

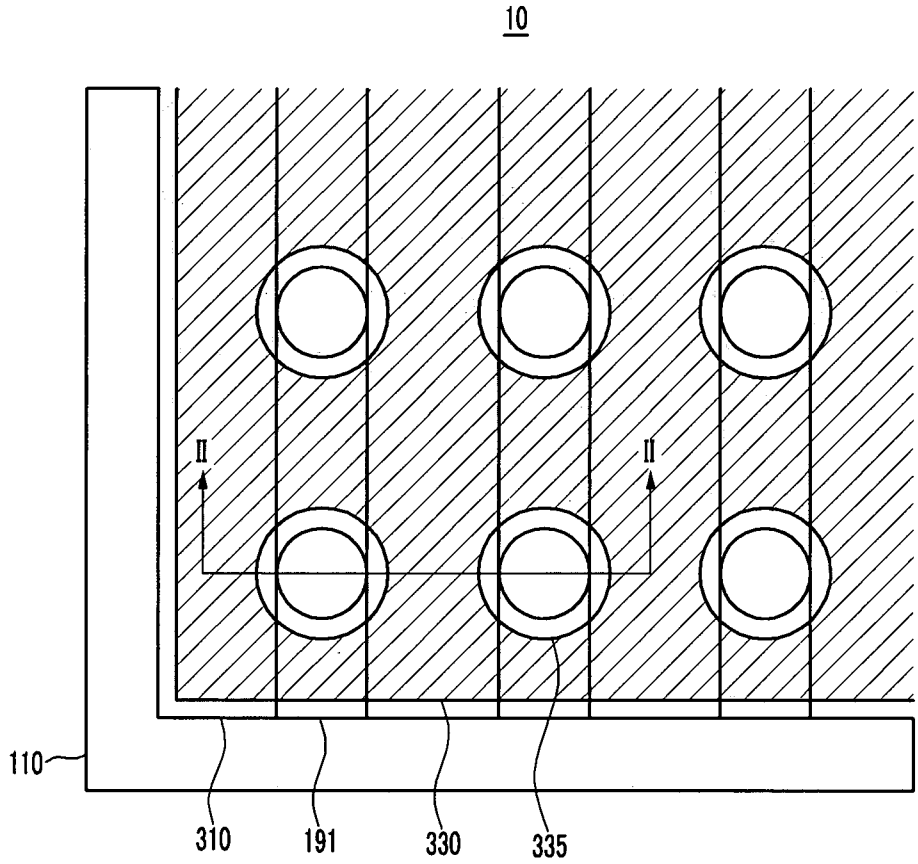
33. The manufacturing process of claim 32, further comprising forming a second electrode exposed to the driving groove on the second substrate.

34. The manufacturing process of claim 24, wherein the removing of the residual driven bodies comprises:

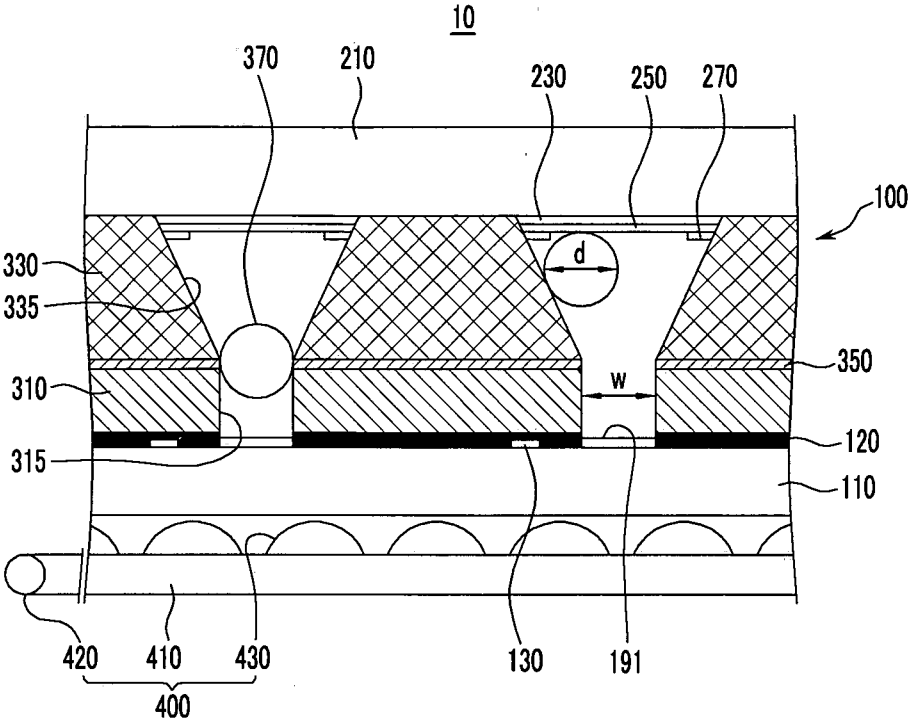
disposing openings of the fixing groove and the plurality of driving grooves toward the gravity direction; and

removing the residual driven bodies, except one driven body in each of the driving grooves, by injecting high-pressure air thereto.

【FIG. 1】



【FIG. 2】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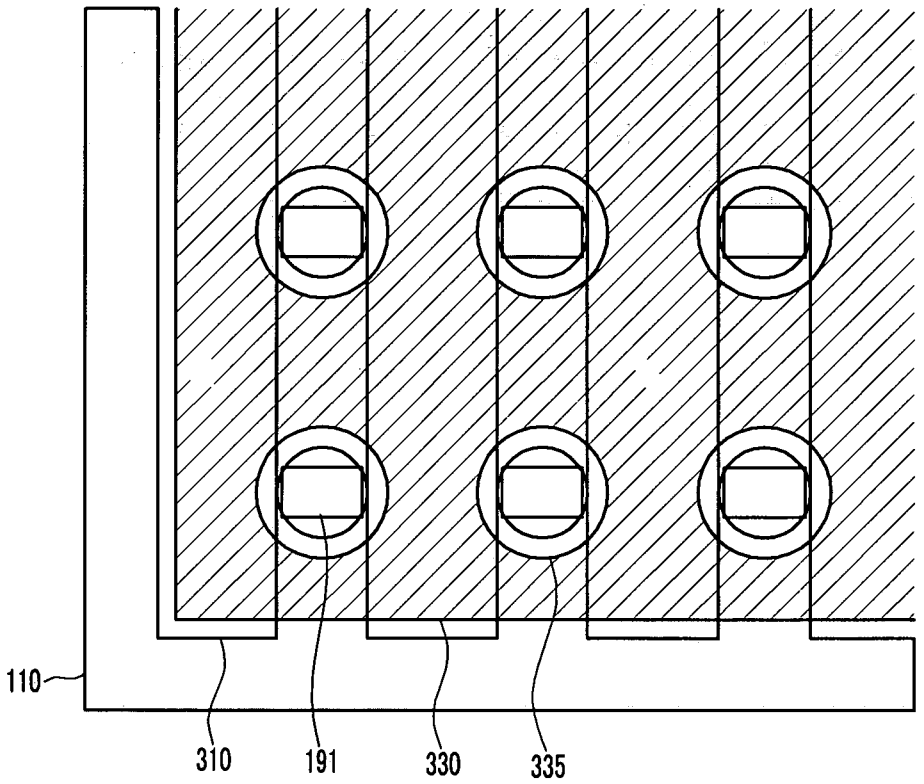
【FIG. 3】



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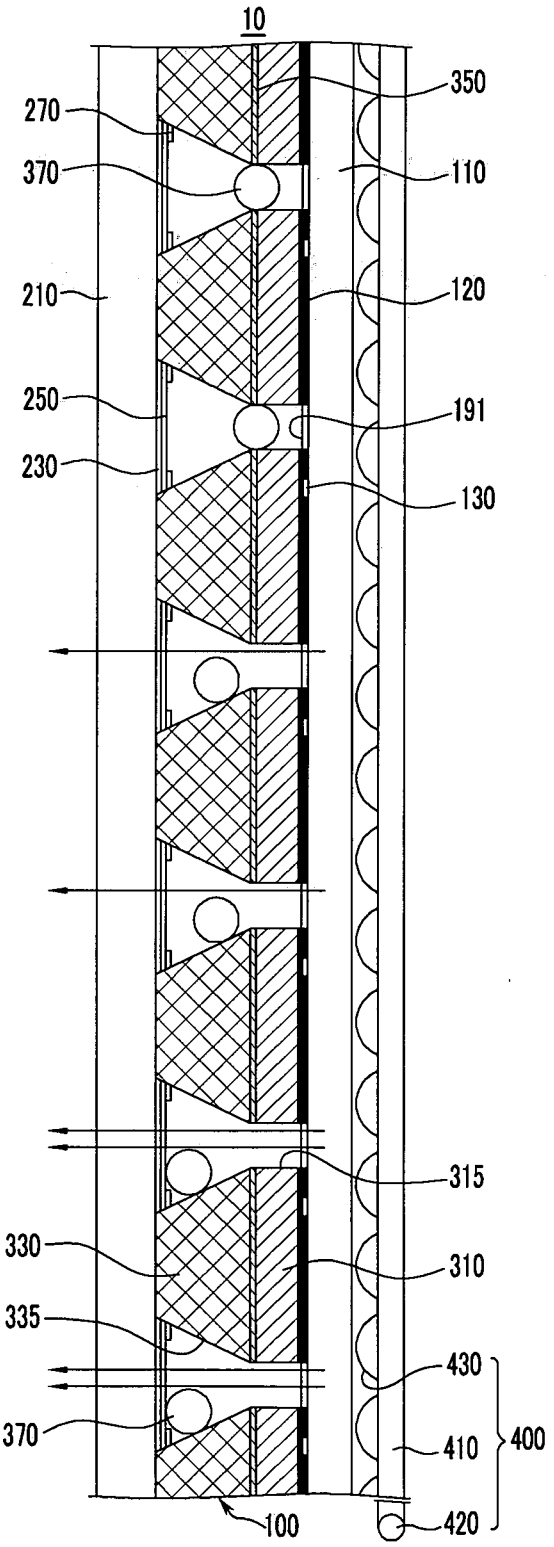
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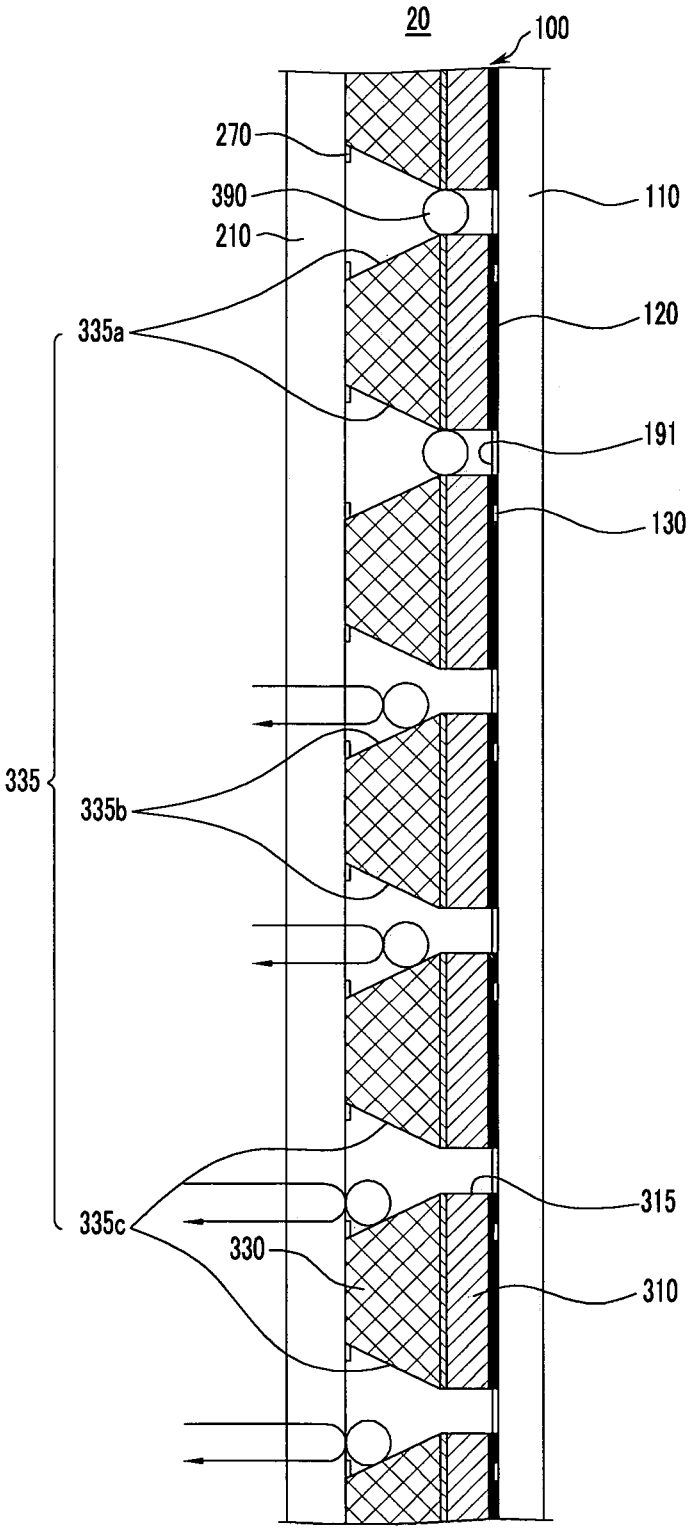
【FIG. 5】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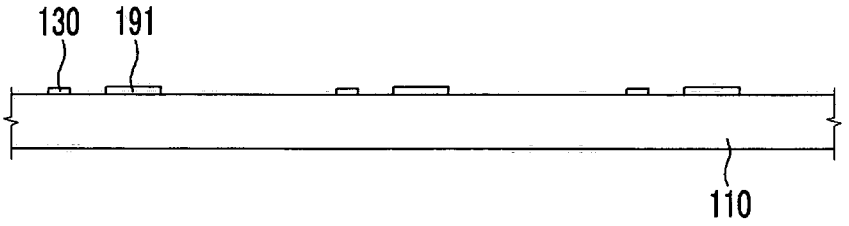
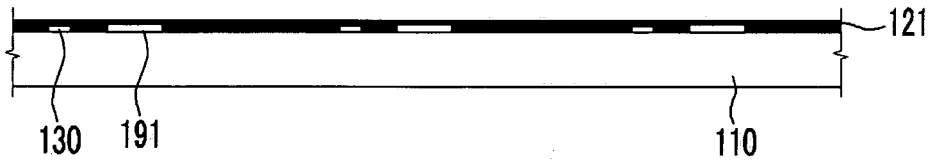
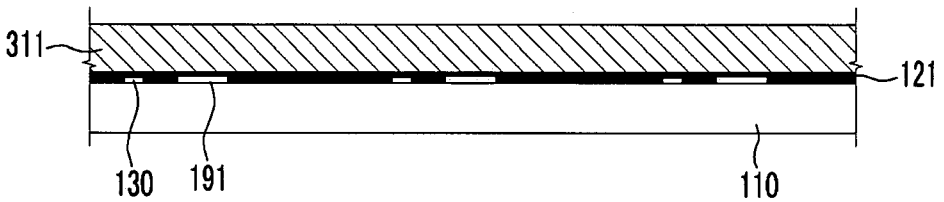
【FIG. 6】



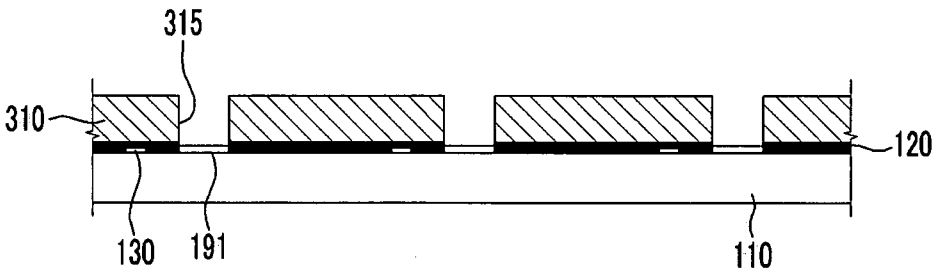
【FIG. 7】



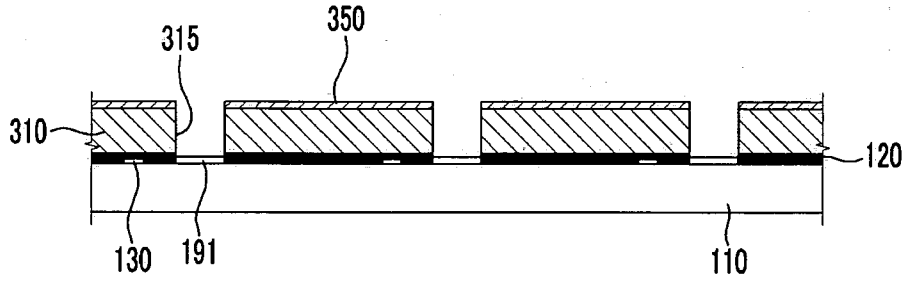
【FIG. 8】



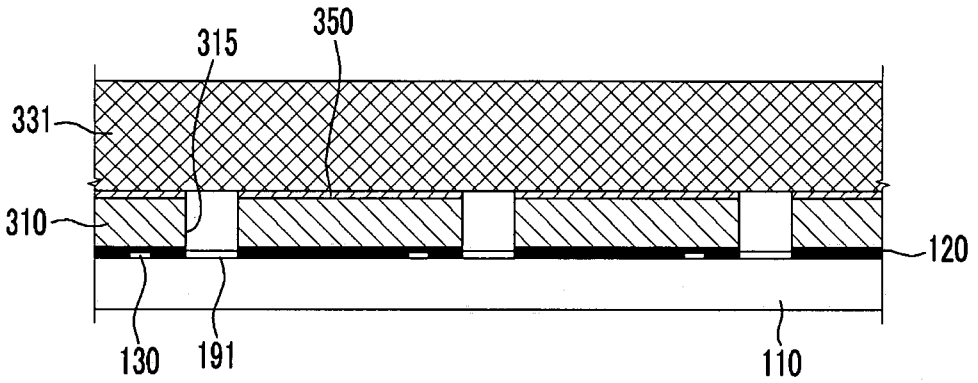
【FIG. 9】



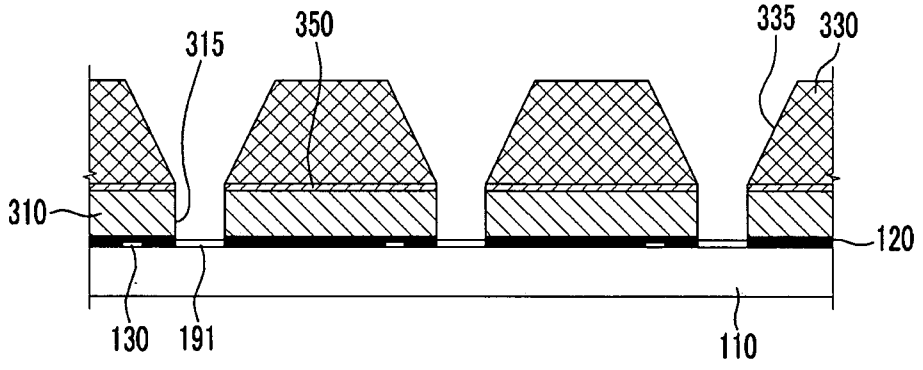
【FIG. 10】



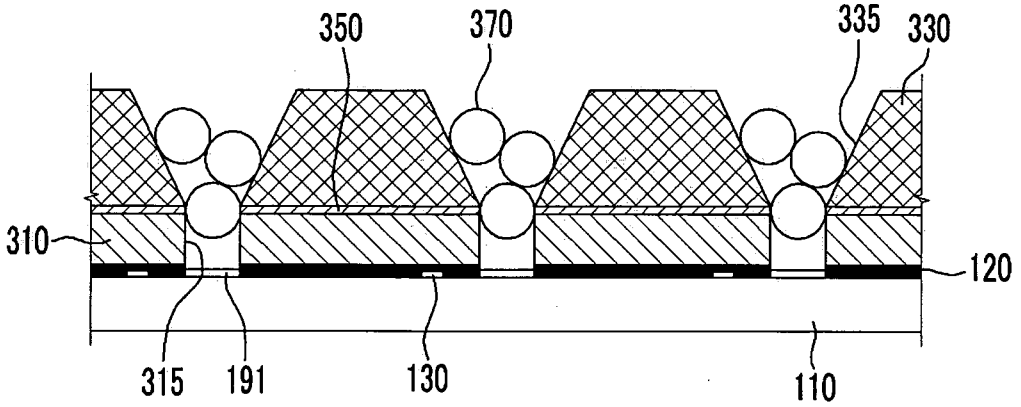
【FIG. 11】



【FIG. 12】



【FIG. 13】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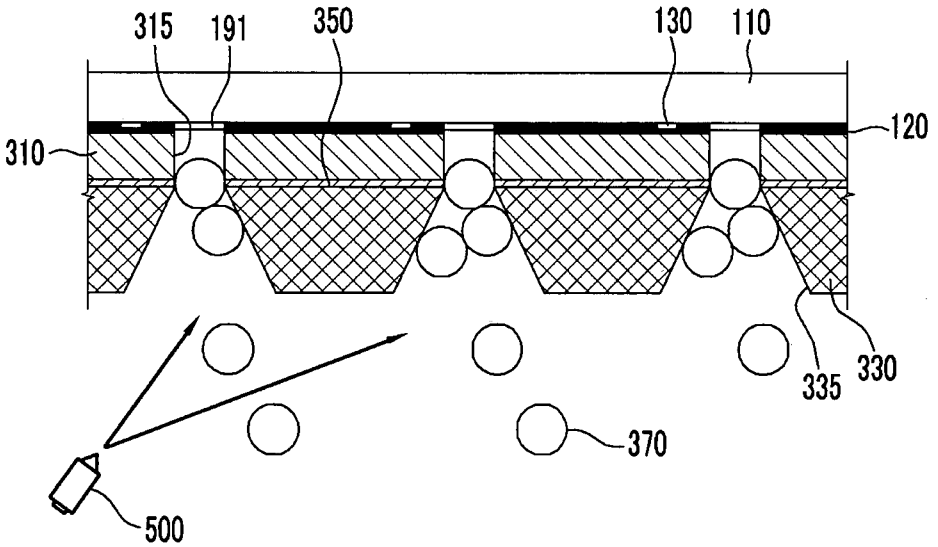
【FIG. 14】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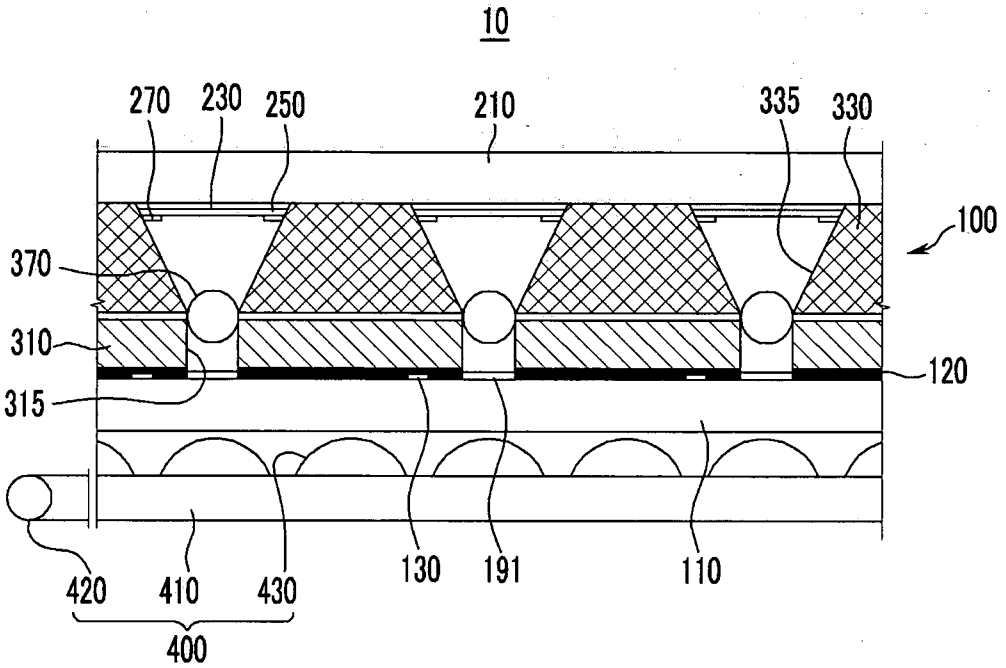
【FIG. 15】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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/003489

A. CLASSIFICATION OF SUBJECT MATTER

G02F 1/1335(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 : G02F, H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal) & keywords : " electric", "field", "driving", "display","barrier", "rib", "groove", "electrode", "substrate", "light", "blocking" , "unit", "voltage"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2006-0098314 A (DONGJIN SEMICHEM CO., LTD.) 18 September 2006 (2006-09-18) See the abstract; claims 1-33; figures 1-10	1-34
A	KR 10-0631291 B1 (DONGJIN SEMICHEM CO., LTD.) 4 October 2006 (2006-10-04) See the abstract; claims 1-24; figures 1-6	1-34
A	JP 2006-058548 A (BRIDGESTONE CORP) 2 March 2006 (2006-03-02) See the abstract	1-34
A	KR 10-2003-0038042 A (BOE HYDIS TECHNOLOGY CO., LTD.) 16 May 2003 (2003-05-16) See the abstract; claim 1;figures 3-5	1-34

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 SEPTEMBER 2008 (30.09.2008)	**30 SEPTEMBER 2008 (30.09.2008)**

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Facsimile No. 82-42-472-7140

Authorized officer

Ban Sung Won

Telephone No. 82-42-481-8359

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/003489

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