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(54) LIQUID CRYSTAL DISPLAY, PANEL THEREFOR, AND MANUFACTURING METHOD THEREOF

(76) Inventors: **Young-Je Cho**, Cheonan-city (KR); **Woo Choi**, Cheonan-city (KR); **Jeong-Ho Lee**, Seoul (KR)

Correspondence Address:
Frank Chau, Esq.
F. CHAU & ASSOCIATES, LLP
1900 Hempstead Turnpike
East Meadow, NY 11554 (US)

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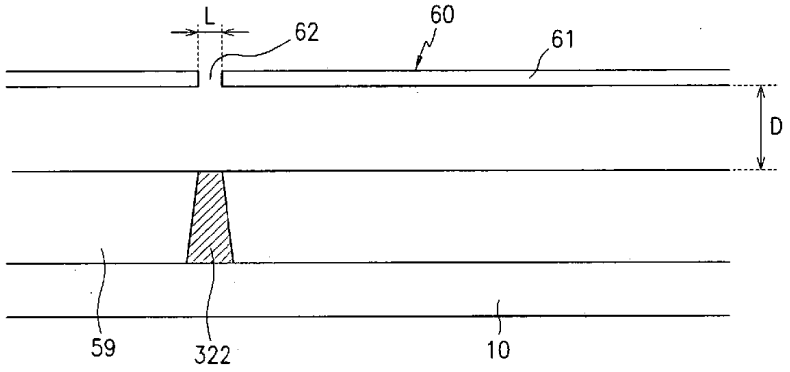
(57) **ABSTRACT**

A panel assembly for a liquid crystal display is provided. The panel assembly includes a panel and a plurality of spacers formed on the panel for supporting the panel. The spacers have at least two different heights or at least two different contact areas with the panel. The spacers include a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers. The height difference between the first spacers and the second spacers is preferably in a range of about 0.3-0.6 microns, and the second spacers have a length larger than the first spacers preferably by 10-20 microns.



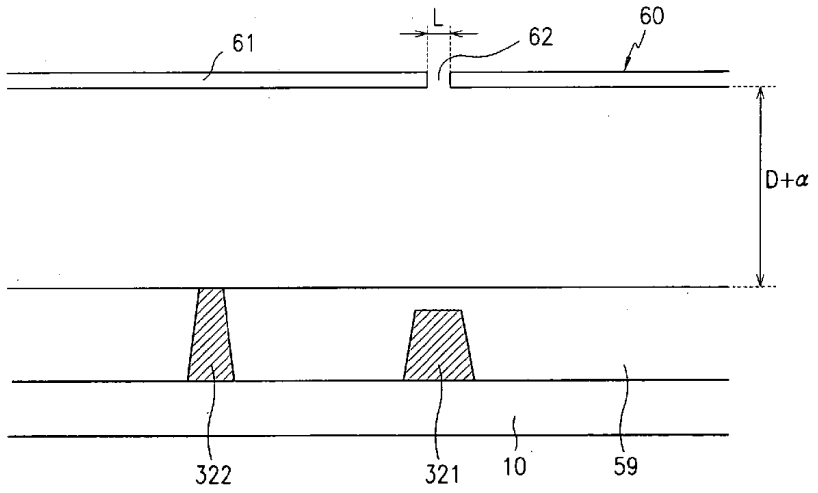


FIG.1

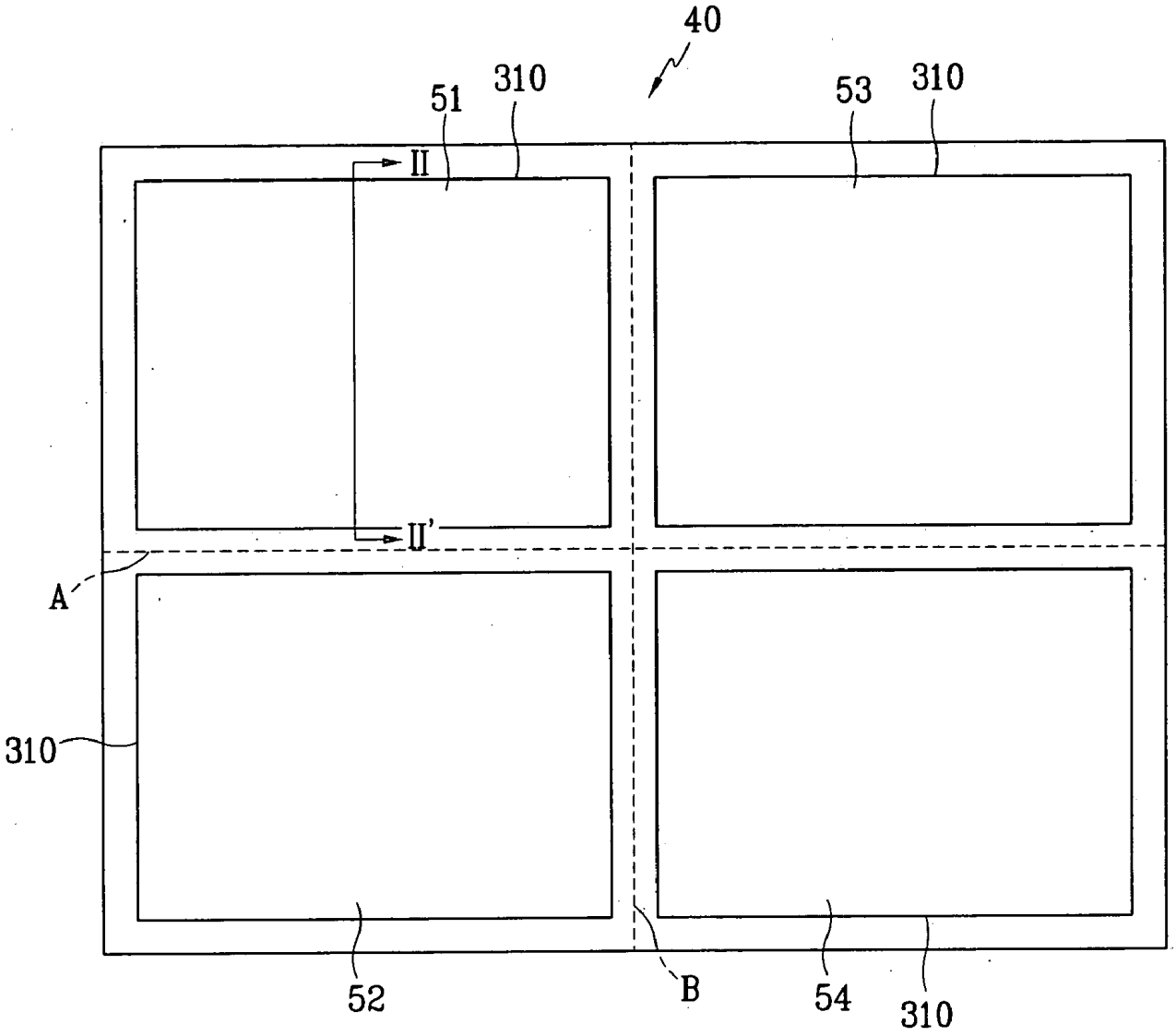


FIG.2

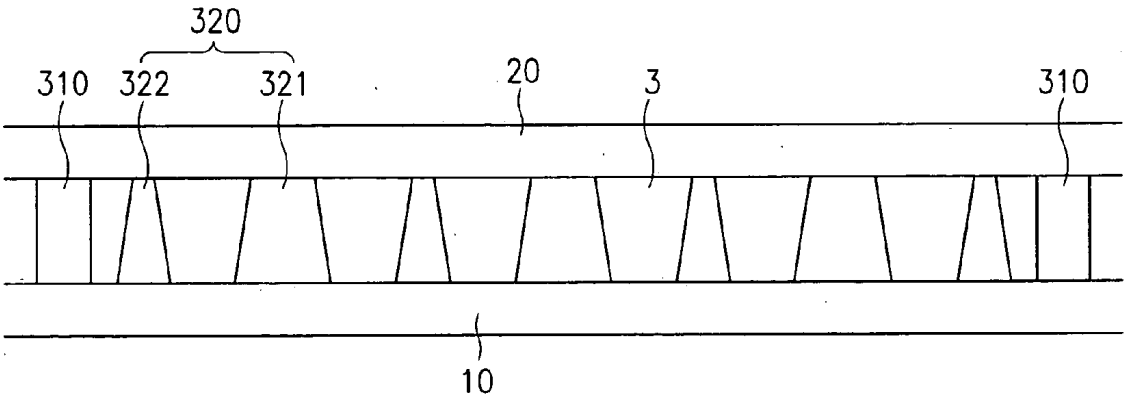


FIG.3

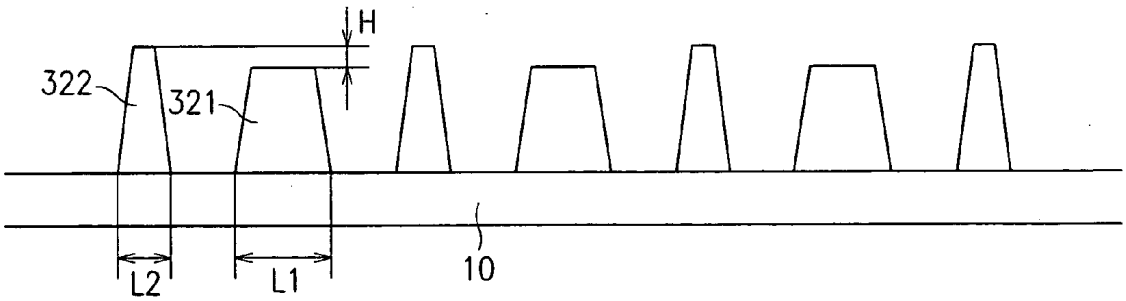


FIG.4A

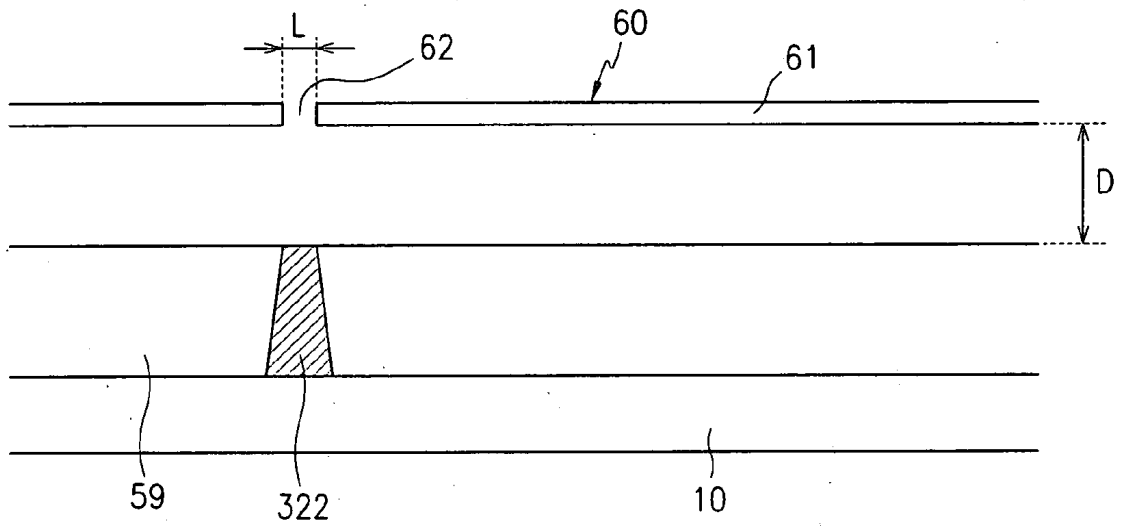


FIG.4B

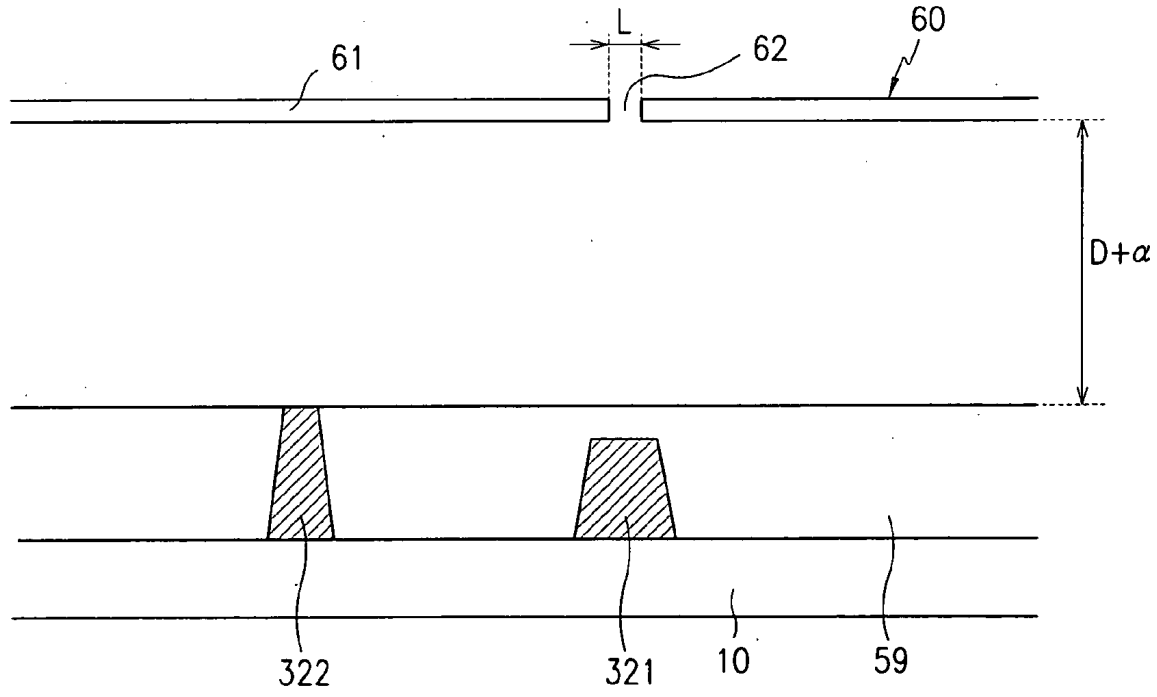


FIG.5A

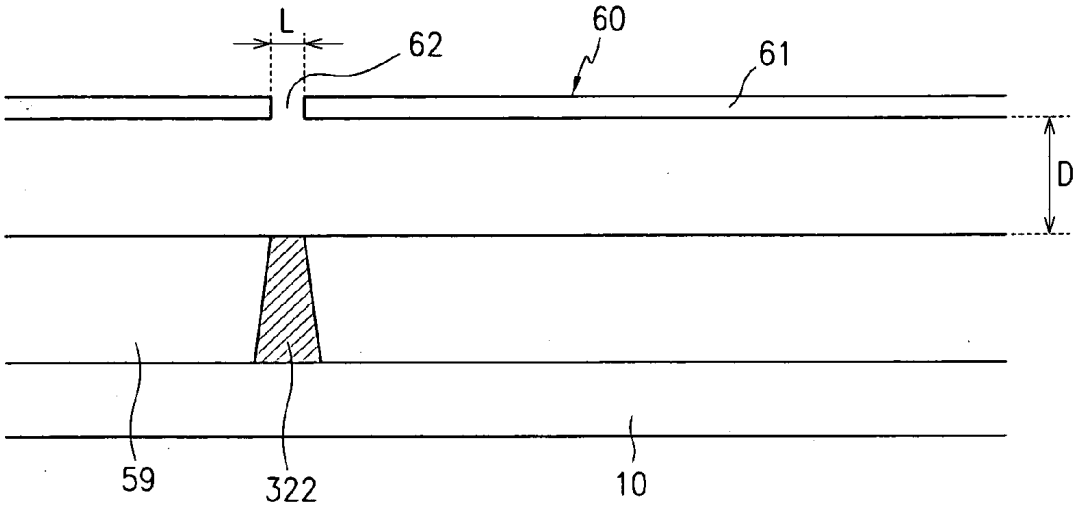


FIG.5B

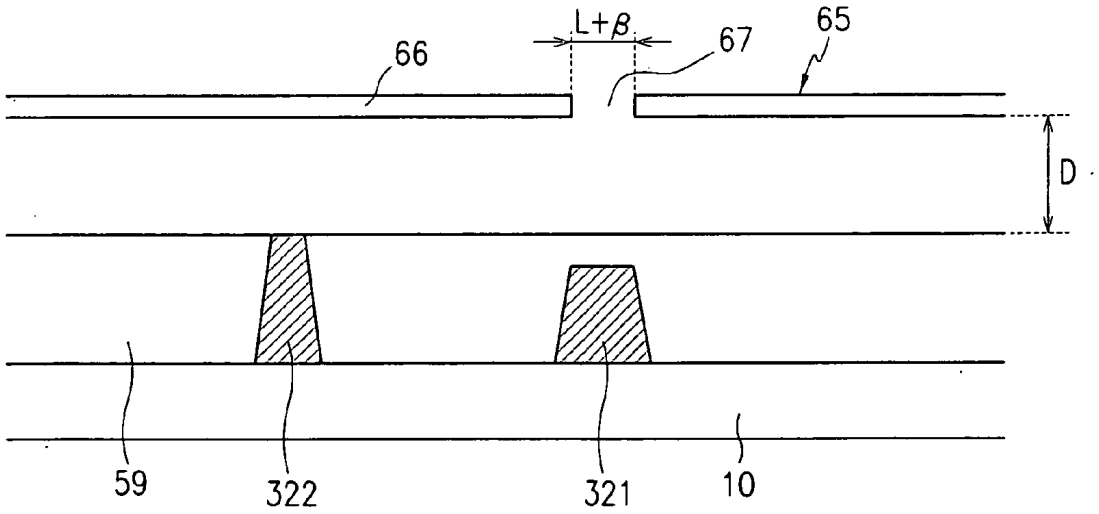


FIG.6

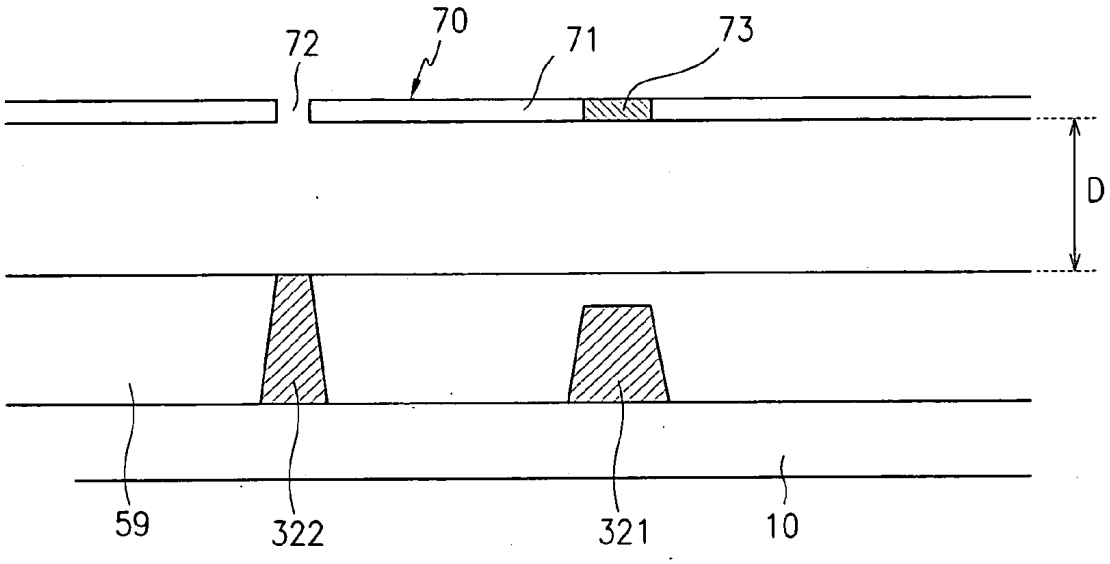


FIG.7

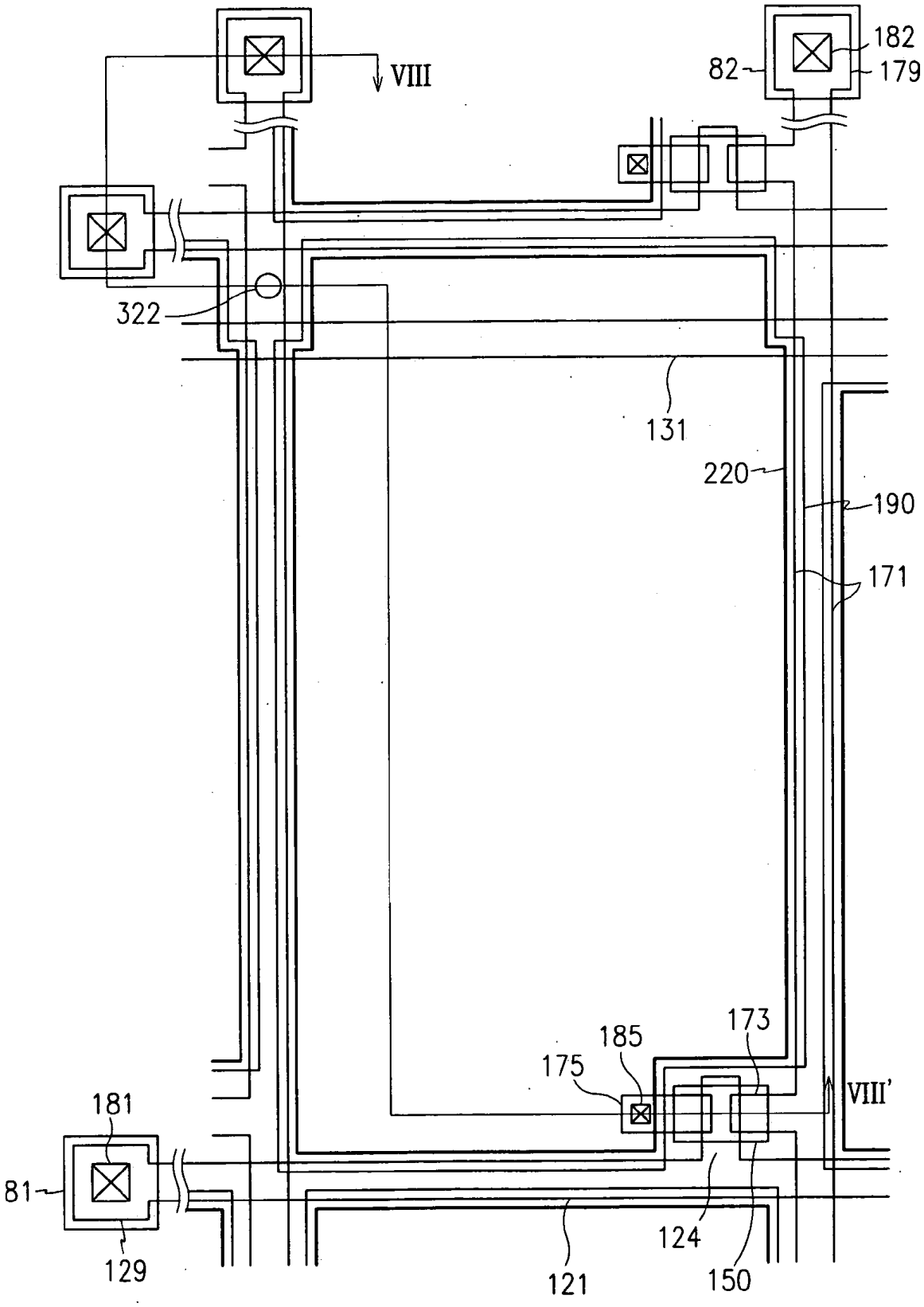

VIII
82
182
179
322
131
220
190
171
173
185
175
VIII'
181
81
129
124
121
150

FIG.8

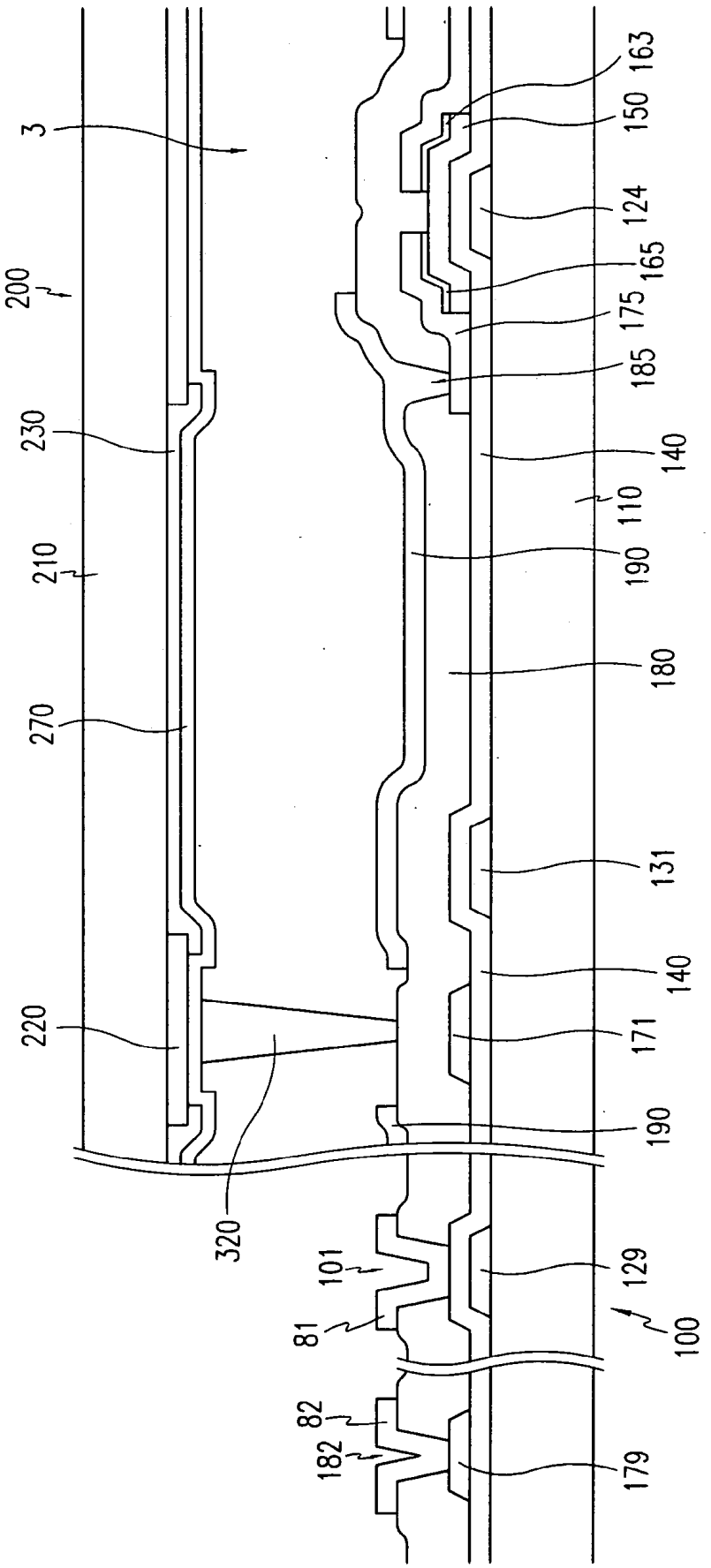
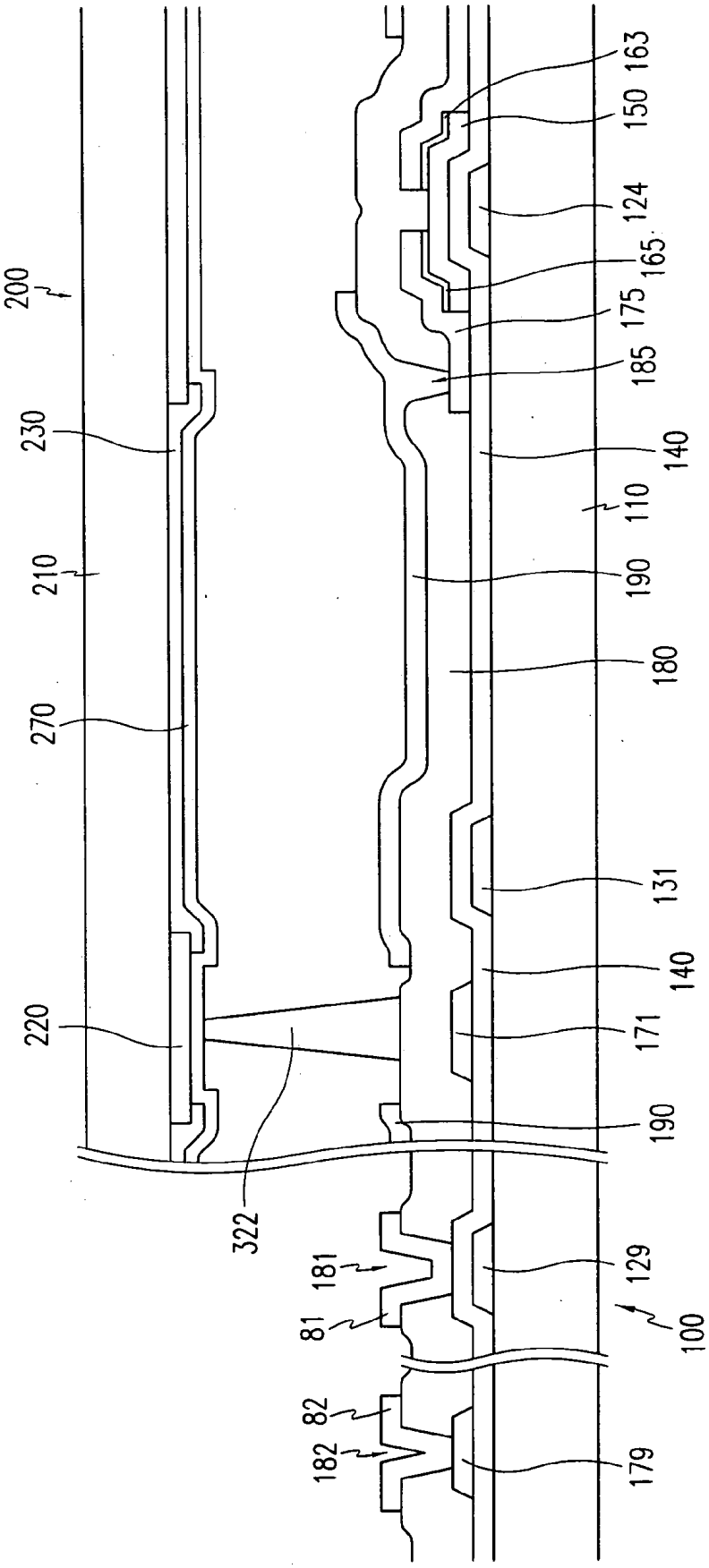

3
200
230
210
270
220
320
101
81
82
182
179
129
100
171
131
140
190
180
110
140
185
175
165
124
150
163

FIG.9


200
230
210
270
220
322
81
181
82
182
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129
100
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171
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140
185
175
165
124
150
163

FIG.10

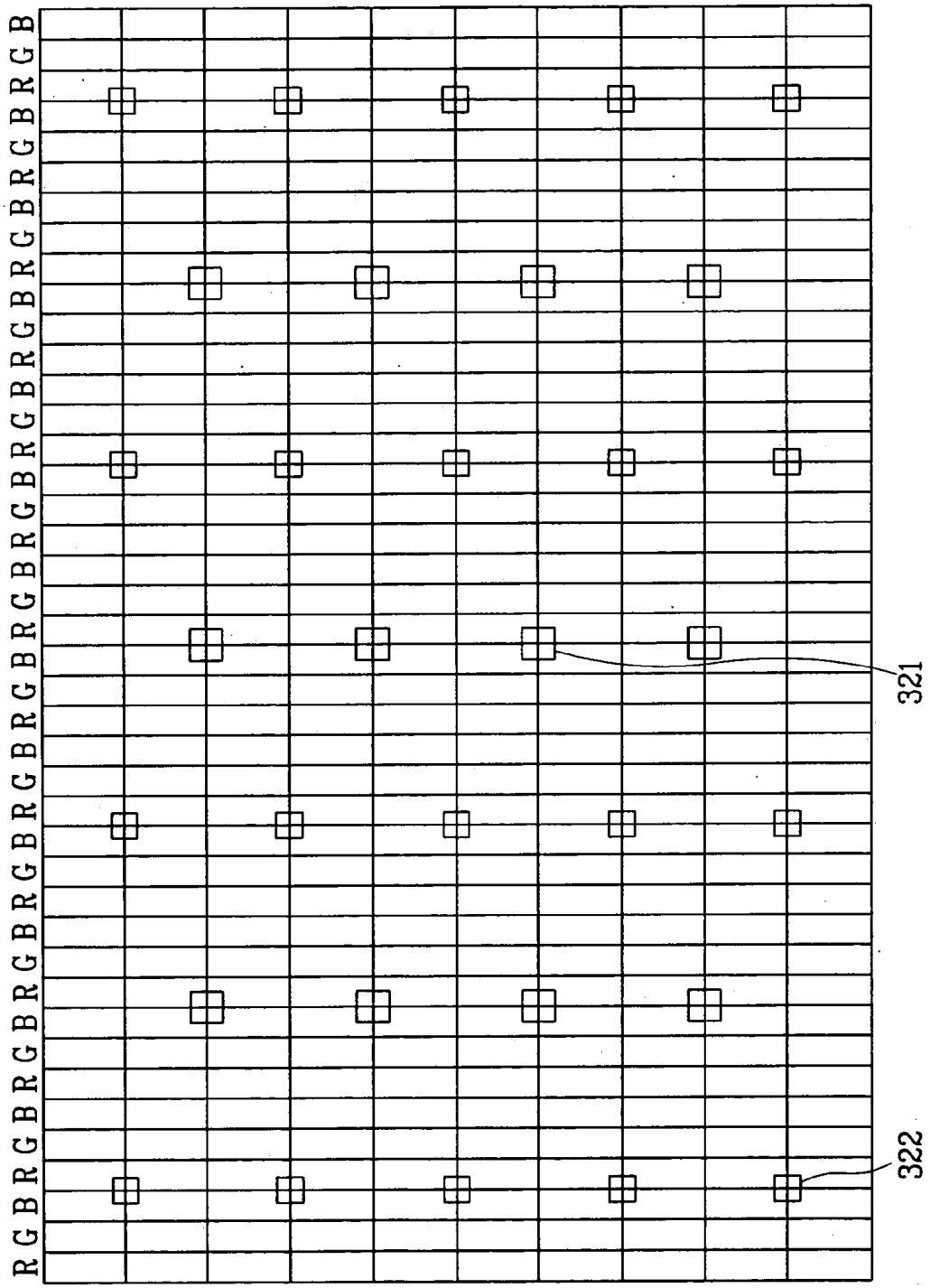


FIG.11

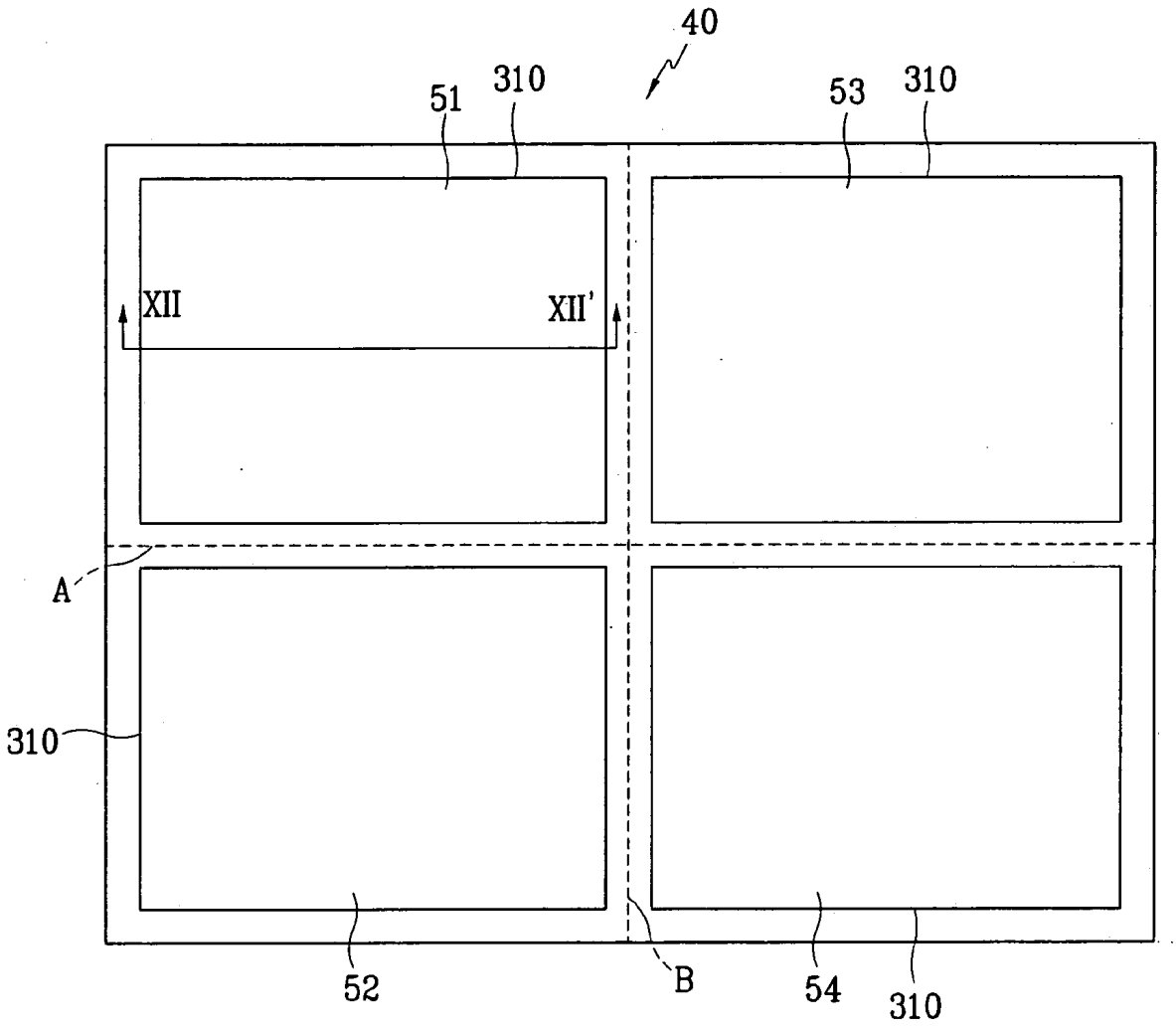


FIG.12

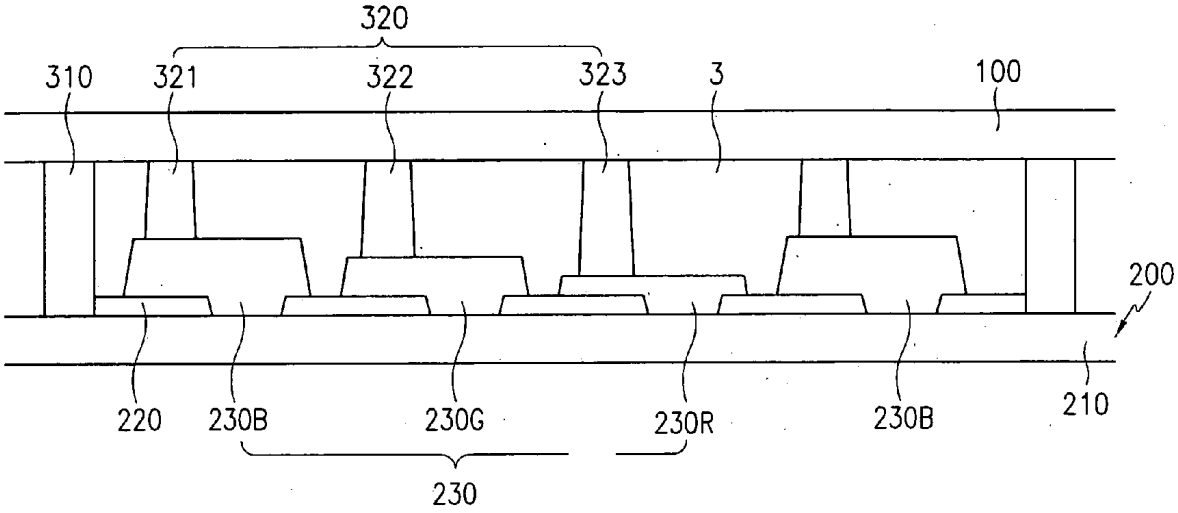

320
310
321
322
323
3
100
200
220
230B
230G
230R
230B
210
230

FIG.13

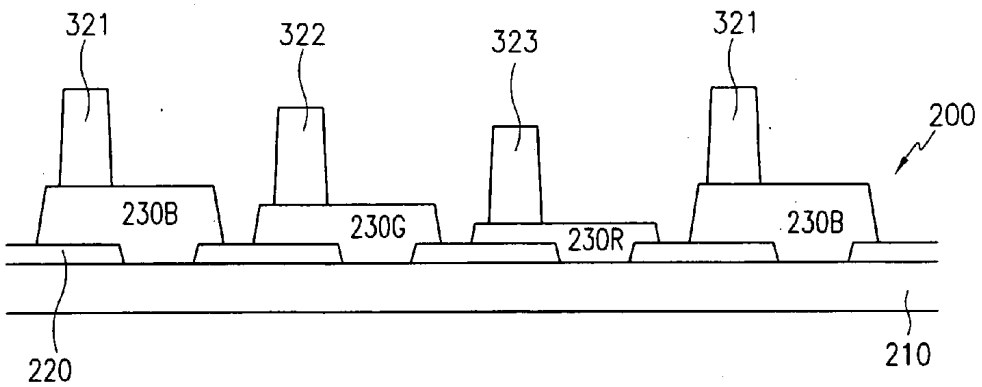

321
322
323
321
200
230B
230G
230R
230B
220
210

FIG.14

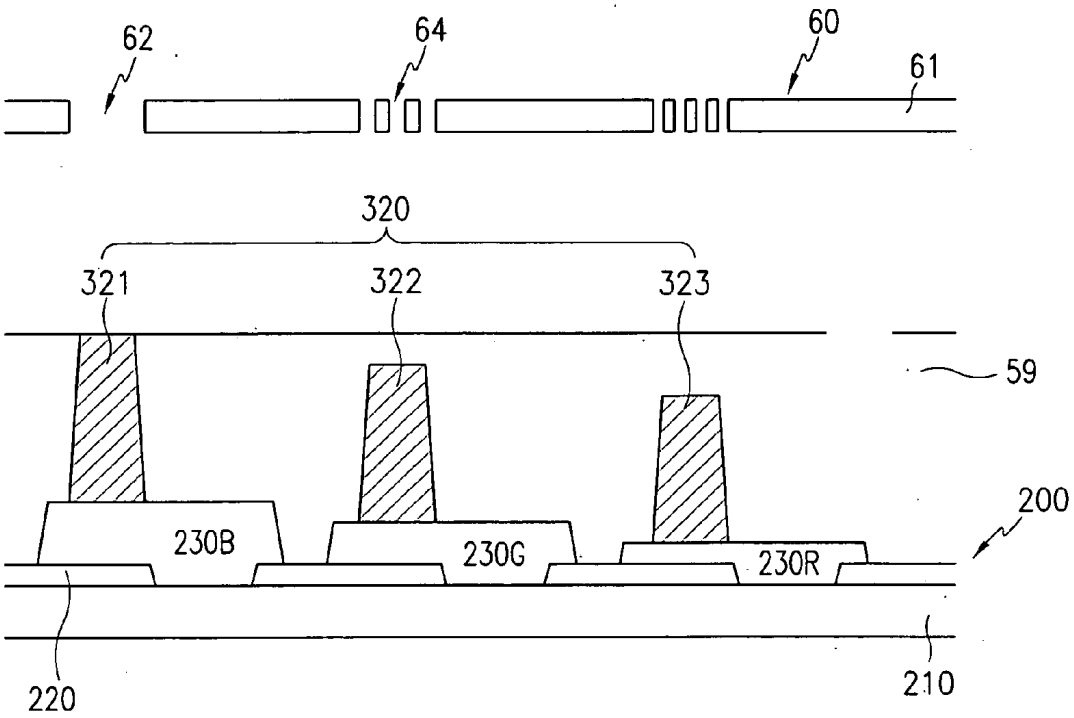

62
64
60
61
320
321
322
323
59
200
230B
230G
230R
220
210

FIG.15

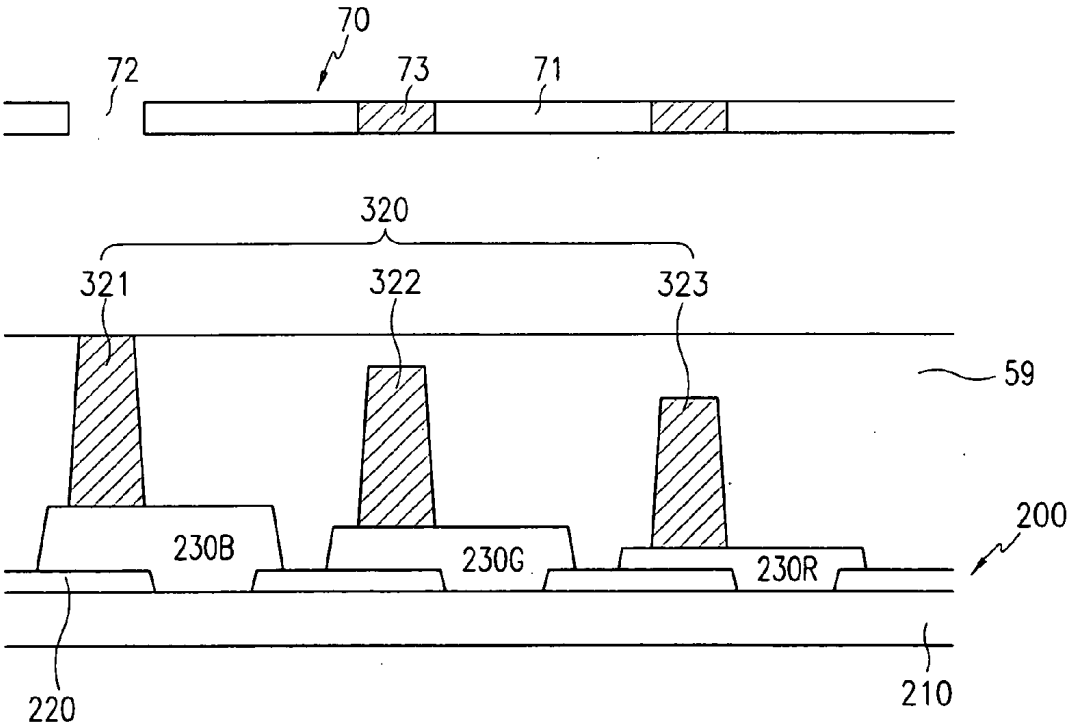
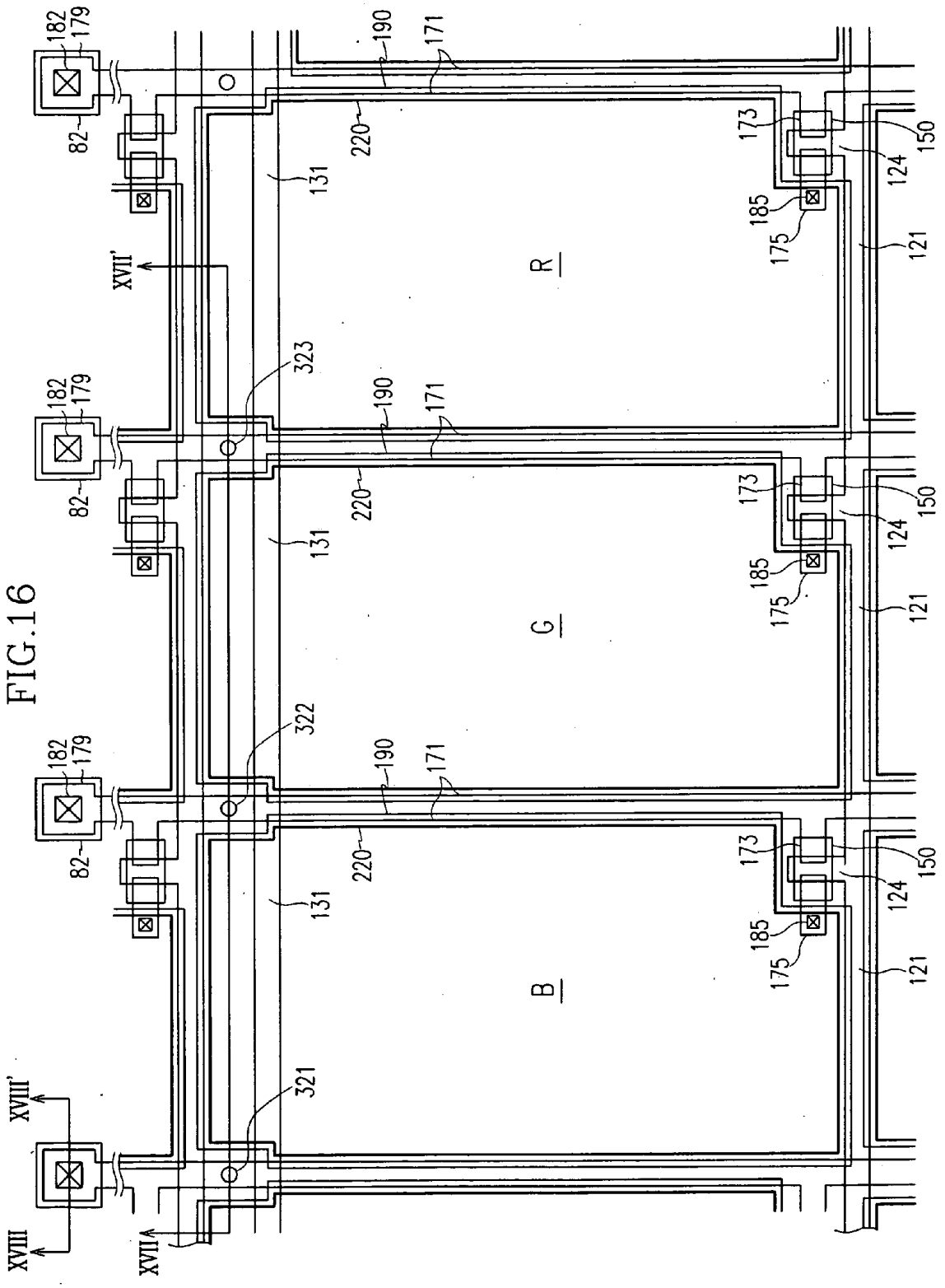

70
72
73
71
320
321
322
323
59
200
230B
230G
230R
220
210

FIG.16


182
179
82
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171
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131
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175
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B
323
322
321
XVII'
XVIII
XVII
XVIII'

FIG.17

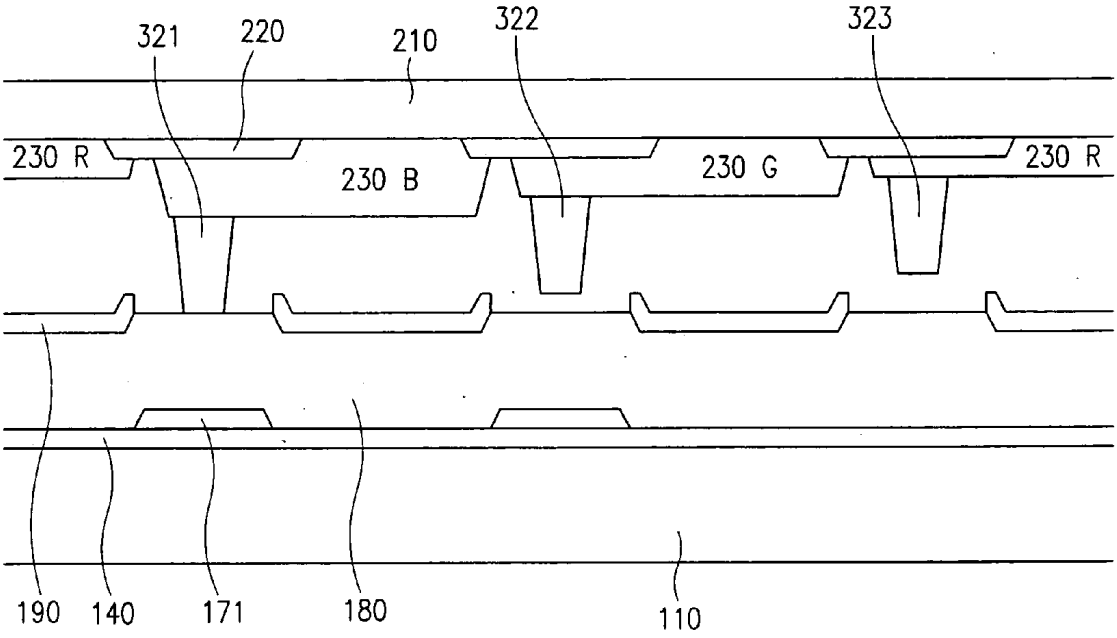

321
220
210
322
323
230 R
230 B
230 G
230 R
190
140
171
180
110

FIG.18

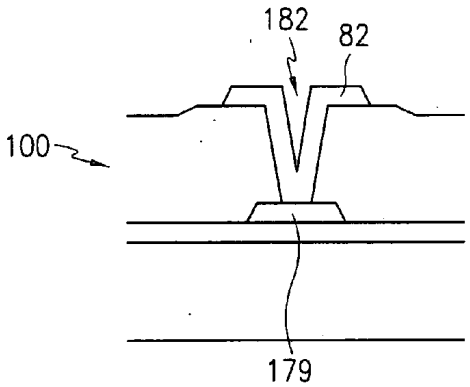
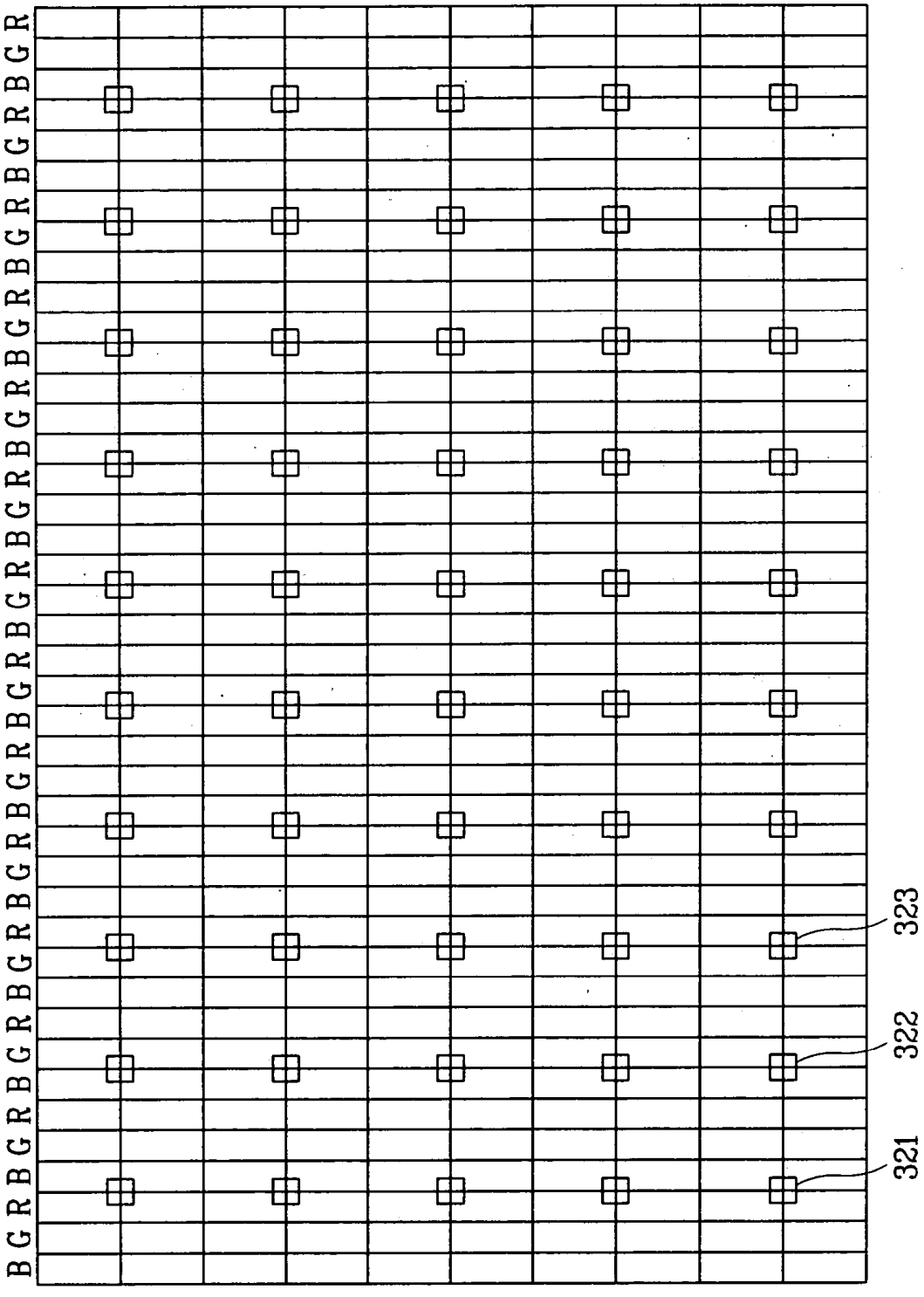

182
82
100
179

FIG.19


B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R B G R
323
322
321

LIQUID CRYSTAL DISPLAY, PANEL THEREFOR, AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

[0001] (a) Field of the Invention

[0002] The present invention relates to a panel for a liquid crystal display, a panel therefor, and a manufacturing method thereof, and in particular, to a liquid crystal display including spacers.

[0003] (b) Description of Related Art

[0004] Generally, a liquid crystal display (LCD) includes two panels including field-generating electrodes and coated with alignment layers and a liquid crystal (LC) layer having dielectric anisotropy and filled in a gap (called a cell gap) between the panels. Electric fields are applied to the LC layer by using field-generating electrodes and the transmittance of light passing through the panels are controlled by adjusting the field strength, thereby displaying desired picture images.

[0005] The two panels are assembled by printing a sealant along a periphery of one of the panels and by hot-pressing the panels.

[0006] The cell gap between the panels are supported by elastic spacers provided between the panels and the sealant also includes spacers for maintaining the cell gap. The LC layer is encapsulated by the sealant. The spacers includes spherical spacers spread on the panels and columnar spacers formed by photolithography.

[0007] The columnar spacers are vertically compressed to support the panels. When the cross sections of the spacers are too small to cause large compression deformation, the spacers are apt to be deformed or to be damaged. On the contrary, if the cross sections of the spacers are too large to cause small compression deformation, it is difficult to adjusting the amount of the LC material to be filled in the gap between the panels. The inappropriate amount of the LC causes bubbles or non-uniform distribution of the LC.

[0008] In particular, it becomes important to keep the cell gap uniform and to facilitate the formation of the LC layer as the LCD becomes large.

SUMMARY OF THE INVENTION

[0009] It is a motivation of the present invention to keep the cell gap uniform and to facilitate the formation of the LC layer.

[0010] A panel assembly for a display device is provided, which includes: a panel; and a plurality of spacers formed on the panel for supporting the panel, wherein the spacers have at least two different heights or at least two different contact areas with the panel.

[0011] The contact areas of the spacers are circular or tetragonal.

[0012] The spacers preferably include a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers. The height difference between the first spacers and the second spacers is preferably in a range of about 0.3-0.6 microns, and the second spacers have a length larger than the first spacers preferably by 10-20 microns. It is preferable that the second spacers have a length in a range of about 30-35 microns and the first spacers have a length in a range of about 15-20 microns.

[0013] Preferably, a concentration of the second spacers is about 200-600/cm^2 and a concentration of the first spacer is about 250-450/cm^2.

[0014] The spacers preferably include a first spacer, a second spacer having a height lower than the first spacer, and a third spacer having a height equal to or lower than the second spacer. The height of the third spacer is preferably equal to the height of the second spacer.

[0015] The panel may include a gate line and a data line transmitting electrical signals, a thin film transistor electrically connected to the gate line and the data line, and a pixel electrode connected to the thin film transistor. Alternatively, the panel includes a plurality of color filters having different thicknesses.

[0016] A liquid crystal display is provided, which includes: a first panel; a second panel opposite each other with a gap therebetween and including a pixel electrode, a switching element connected to the pixel electrode, and a gate line and a data line connected to the switching element for transmitting electrical signals; a plurality of spacers formed between the first panel and the second panel for maintaining the gap; and a liquid crystal layer filled in the gap, wherein the spacers have at least two different contact areas with the panels.

[0017] According to an embodiment of the present invention, a method of manufacturing a liquid crystal panel assembly is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through an exposure mask including an opening and disposed on the panel with a first distance; light-exposing the photoresist through the exposure mask disposed on the panel with a second distance; and developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

[0018] According to another embodiment of the present invention, a method of manufacturing a liquid crystal panel is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through a first exposure mask including a first opening; light-exposing the photoresist through a second exposure mask including a second opening; and developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

[0019] According to another embodiment of the present invention, a method of manufacturing a liquid crystal panel is provided, which includes: coating a photoresist on a panel; light-exposing the photoresist through an exposure mask including a plurality of transmissive areas having different transmittances and a blocking area; and developing the photoresist to form a plurality of spacers having different heights or different contact areas with the panel.

[0020] The plurality of transmissive areas may include a transparent area and a translucent area. Preferably, the transparent area has an opening and the translucent area has a plurality of slits.

[0021] The plurality of transmissive areas may include a transparent area and a plurality of translucent areas having different transmittances.

[0022] The photoresist is preferably a negative type.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above, and other advantages of the present invention will become more apparent by describing preferred embodiments thereof in detail with reference to the accompanying drawings in which:

[0024] **FIG. 1** is a plan view of a panel assembly for an LCD according to an embodiment of the present invention;

[0025] **FIG. 2** is a sectional view of the panel assembly shown in **FIG. 1** taken along the line II-II';

[0026] **FIG. 3** is a sectional view of a panel and a plurality of column spacers formed thereon for the LCD shown in **FIG. 2** before panel combination according to an embodiment of the present invention;

[0027] **FIGS. 4A and 4B** are sectional views of a LC panel assembly shown in **FIG. 3** in intermediate steps of a manufacturing method thereof according to an embodiment of the present invention;

[0028] **FIGS. 5A and 5B** are sectional views of a LC panel assembly shown in **FIG. 3** in intermediate steps of a manufacturing method thereof according to another embodiment of the present invention;

[0029] **FIG. 6** is a sectional view of a LC panel assembly shown in **FIG. 3** in an intermediate step of a manufacturing method thereof according to another embodiment of the present invention;

[0030] **FIG. 7** is a layout view of an LCD according to an embodiment of the present invention;

[0031] **FIG. 8** is an exemplary sectional view of the LCD shown in **FIG. 7** taken along the line VIII-VIII';

[0032] **FIG. 9** is another exemplary sectional view of the LCD shown in **FIG. 7** taken along the line VIII-VIII';

[0033] **FIG. 10** shows exemplary locations of the first and the second spacers **321** and **322** shown in **FIG. 2** according to an embodiment of the present invention;

[0034] FIGS. **11** is a plan view of a panel assembly for an LCD according to an embodiment of the present invention;

[0035] FIGS. **12** is a sectional view of the panel assembly shown in FIGS. **11** taken along the line XII-XII';

[0036] **FIG. 13** is a sectional view of a panel and a plurality of column spacers formed thereon for the LCD shown in **FIG. 12** before panel combination according to another embodiment of the present invention;

[0037] **FIG. 14** is a sectional view of a LC panel assembly in an intermediate step of a manufacturing method thereof according to an embodiment of the present invention;

[0038] **FIG. 15** is a sectional view of a LC panel assembly in an intermediate step of a manufacturing method thereof according to another embodiment of the present invention;

[0039] **FIG. 16** is a layout view of an LCD according to an embodiment of the present invention;

[0040] **FIGS. 17 and 18** are sectional views of the LCD shown in **FIG. 16** taken along the line XVII-XVII' and the line XVIII-XVIII', respectively; and

[0041] **FIG. 19** shows exemplary locations of the spacers shown in FIGS. **12-18** according to an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0042] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. The present invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0043] In the drawings, the thickness of layers, films and regions are exaggerated for clarity. Like numerals refer to like elements throughout. 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.

[0044] Now, liquid crystal displays, panels for a liquid crystal display, and manufacturing methods thereof according to embodiments of the present invention will be described with reference to the accompanying drawings.

[0045] A panel assembly for LCDs according to an embodiment of the present invention will be now described in detail with reference to **FIGS. 1 and 2**.

[0046] **FIG. 1** is a plan view of a panel assembly for LCDs according to an embodiment of the present invention and **FIG. 2** is a sectional view of the panel assembly shown in **FIG. 1** taken along the line II-II'.

[0047] As shown in **FIGS. 1 and 2**, a panel assembly **40** according to an embodiment of the present invention includes two panels **10** and **20** and a plurality of LC layers **3**, a plurality of sealants **310**, and a plurality of columnar spacers **320**, which are disposed between the two panels **10** and **20**.

[0048] The panel assembly **40** includes a plurality of, for example, four device areas divided by dotted lines A and B. The panel assembly **40** is separated into the respective LCDs by scribing the panel assembly **40** along the dotted lines A and B.

[0049] Each of the device areas (or an LCD) includes a display area **51**, **52**, **53** or **54** for displaying images. The display area **51** is substantially enclosed by the sealant **310**, which confines the LC layer **3**. The LC layer **3** may be formed after the panel assembly **40** is separated into the respective devices.

[0050] The spacers **320** are provided for maintaining a gap between the panels **10** and **20** to be uniform and the sealant **310** may contain spacers for supporting the panels **10** and **20** to be parallel to each other.

[0051] As shown in **FIG. 2**, the spacers **320** includes a plurality of first and second spacers **321** and **322** contacting the panels **10** and **20** with different contact areas and sizes.

The different contact areas of the spacers **321** and **322** are obtained by forming spacer columns with different heights and by pressing the spacer columns to have the same height.

[**0052**] **FIG. 3** is a sectional view of a panel and a plurality of column spacers formed thereon for an LCD before panel combination according to an embodiment of the present invention.

[**0053**] A plurality of first and second column spacers **321** and **322** having different top and/or bottom areas and different heights are formed on a panel **10**. The first spacers **321** are shorter and wider than the second spacers **322** as shown in **FIG. 3**.

[**0054**] Top and bottom surfaces of the column spacers **321** and **322** have a shape of a circle with a diameter or a tetragon with edges. The diameter or edge (hereinafter referred to as "length") L1 of the bottom surface of each first spacer **321** is longer than the length L2 of each second spacer **322**. The height difference H is preferably about 0.3 to 0.6 microns. It is preferable that the length L1 of the first spacers **321** ranges from about 30 microns to about 35 microns while the length L2 of the second spacers **322** is in a range between about 15-20 microns such that the length difference (L1-L2) ranges from about 10 microns to about 20 microns. It is also preferable that the bottom areas of the first and the second spacers **321** and **322** are in a range between about 600-1,100 square microns and in a range between about 150-350 square microns, respectively.

[**0055**] Since the first spacers **321** exhibit small compression deformation and are advantageous for dispersing the stress, they are capable of keeping a cell gap between the two panels **10** and **20** uniform. On the contrary, since the second spacers **322** exhibit large compression deformation, they facilitate to adjust an amount of LC for forming the liquid crystal layer **3**.

[**0056**] Now, methods of manufacturing the spacers shown in **FIG. 3** according to embodiments of the present invention are described in detail with reference to FIGS. **4A-6**.

[**0057**] **FIGS. 4A and 4B** are sectional views of a LC panel assembly shown in **FIG. 3** in intermediate steps of a manufacturing method thereof according to an embodiment of the present invention.

[**0058**] Referring to **FIG. 4A, a** negative acrylic photoresist **59** is coated on a LC panel **10**. An exposure mask **60** including an opaque film **61** having a plurality of openings **62** with a length L are disposed on the panel **10** with a distance D. The exposure mask **60** is aligned such that the openings **62** face portions of the photoresist **59** to become the second spacers **322** shown in **FIG. 3**. The photoresist **59** is then exposed to light from a light source through the exposure mask **60** so that the portions of the photoresist **59** exposed to light be hardened.

[**0059**] Referring to **FIG. 4**B, the exposure mask **60** is moved in horizontal and vertical directions such that it is spaced apart from the panel **10** by a distance (D+α), where α is positive, and the openings **62** face portions of the photoresist **59** to become the first spacers **321** shown in **FIG. 3**. The photoresist **59** suffers light exposure through the exposure mask **60**. Since the distance (D+α) is larger than the distance D, the exposed portions of the photoresist **59** in this step have larger areas than those in the previous step due to the diffraction of light, and in addition, the intensity of the light reaching the photoresist **59** in this step is weaker than that in the previous step. Accordingly, the first spacers **321** become wider and shorter than the second spacers **322**.

[**0060**] An experiment was successfully performed under the condition that a light source with luminance of 100-300 mJ/cm^2 was used, the diameter of the openings **62** was 10-15 microns, the distance D between the exposure mask **60** and the panel **10** was 100-200 microns, and the distance (D+α) was 300-400 microns.

[**0061**] **FIGS. 5A and 5B** are sectional views of a LC panel assembly shown in **FIG. 3** in intermediate steps of a manufacturing method thereof according to another embodiment of the present invention.

[**0062**] The step shown in **FIG. 5A** is similar to the step shown in **FIG. 4A**. That is, after a negative acrylic photoresist **59** is coated on a LC panel **10**, an exposure mask **60** including an opaque film **61** having a plurality of openings **62** with a length L is disposed on the panel **10** with a distance D and the photoresist **59** is then exposed to light from a light source through the exposure mask **60** so that portions of the photoresist **59** exposed to light are hardened to be the second spacers **322** shown in **FIG.3**.

[**0063**] Referring to **FIG. 5**B, another exposure mask **65** an opaque film **62** having a plurality of openings **67** with a length L+β, where β is positive, is disposed on the panel **10** such that the openings **67** face portions of the photoresist **59** to become the first spacers **321** shown in **FIG. 3**. The photoresist **59** is exposed to light from another light source with a luminance weaker than that of the light source used in the previous step. Alternatively, the light source used in the previous step is still used with a longer distance from the panel **10**.

[**0064**] **FIG. 6** is a sectional view of a LC panel assembly shown in **FIG. 3** in an intermediate step of a manufacturing method thereof according to another embodiment of the present invention.

[**0065**] Referring to **FIG. 6**, after a negative acrylic photoresist **59** is coated on a LC panel **10**, an exposure mask **70** having a plurality of transparent areas, a plurality of translucent areas, and an opaque area is disposed on the panel **10** with a distance D. The opaque area and the translucent areas include an opaque film **71** and a plurality of translucent films **73**, respectively, while the transparent areas have a plurality of openings **72**. The exposure mask **70** is aligned such that the openings **72** and the translucent films **73** face portions of the photoresist **59** to become the second spacers **322** and the first spacers **321** shown in **FIG. 3**, respectively. The photoresist **59** is then exposed to light from a light source through the exposure mask **70**.

[**0066**] The spacers **321** and **322** may be made from a positive photoresist, and in this case, the opaque areas and the transparent areas shown in FIGS. **4A-6** are reversed.

[**0067**] One of the panels **10** and **20** shown in FIGS. **2-6** is called a thin film transistor (TFT) array panel provided with a plurality of gate lines and a plurality of data lines for transmitting electrical signals such as scanning signals and data signals, a plurality of TFTs electrically connected to the gate lines and the data lines for controlling the data signals,

and a plurality of pixel electrodes receiving the data voltages for driving the LC molecules.

[0068] The other of the panels **10** and **20** shown in FIGS. **2-6** is provided with a common electrode facing the above-described pixel electrodes to generate electric fields for driving the LC molecules, and a plurality of color filters for color display.

[0069] The color filters or the common electrode may be formed on the TFT array panel.

[0070] An exemplary LC panel assembly according to an embodiment of the present invention will be described in more detail with reference to FIGS. **7-9**.

[0071] **FIG. 7** is a layout view of an LCD according to an embodiment of the present invention, **FIG. 8** is an exemplary sectional view of the LCD shown in **FIG. 7** taken along the line VIII-VIII', and **FIG. 9** is another exemplary sectional view of the LCD shown in **FIG. 7** taken along the line VIII-VIII'.

[0072] An LCD according to an embodiment of the present invention includes a TFT array panel **100**, a common electrode panel **200**, and a LC layer **3** and a plurality of column spacers **320** disposed between the panels **100** and **200**.

[0073] The TFT array panel **100** is now described in detail.

[0074] A plurality of gate lines **121** for transmitting gate signals and a plurality of storage electrode lines **131** are formed on an insulating substrate **110**.

[0075] The gate lines **121** and the storage electrode lines **131** extend substantially in a transverse direction and are separated from each other. A plurality of projections of each gate line **121** form a plurality of gate electrodes **124**. The storage electrode lines **131** are supplied with a predetermined voltage such as a common voltage, which is applied to a common electrode **270** on the common electrode panel **200** of the LCD.

[0076] The gate lines **121** and the storage electrode lines **131** may have a multi-layered structure including two films having different physical characteristics, a lower film (not shown) and an upper film (not shown). The upper film is preferably made of low resistivity metal including Al containing metal such as Al and Al alloy for reducing signal delay or voltage drop in the gate lines **121** and the storage electrode lines **131**. On the other hand, the lower film is preferably made of material such as Cr, Mo and Mo alloy, which has good contact characteristics with other materials such as indium tin oxide (ITO) or indium zinc oxide (IZO). A good exemplary combination of the lower film material and the upper film material is Cr and Al—Nd alloy.

[0077] In addition, the lateral sides of the gate lines **121** and the storage electrode lines **131** are tapered, and the inclination angle of the lateral sides with respect to a surface of the substrate **110** ranges about 30-80 degrees.

[0078] A gate insulating layer **140** preferably made of silicon nitride (SiNx) is formed on the gate lines **121** and the storage electrode lines **131**.

[0079] A plurality of semiconductor islands **150** preferably made of hydrogenated amorphous silicon (abbreviated as "a-Si") or polysilicon are formed on the gate insulating layer **140**. The semiconductor islands **150** are located opposite the respective gate electrodes **124**.

[0080] A plurality of ohmic contact islands **163** and **165** preferably made of silicide or n+ hydrogenated a-Si heavily doped with n type impurity are formed on the semiconductor islands **150**.

[0081] The lateral sides of the semiconductor islands **150** and the ohmic contacts **163** and **165** are tapered, and the inclination angles thereof are preferably in a range between about 30-80 degrees.

[0082] A plurality of data lines **171** and a plurality of drain electrodes **175** separated from each other are formed on the ohmic contacts **163** and **165** and the gate insulating layer **140**.

[0083] The data lines **171** for transmitting data voltages extend substantially in the longitudinal direction and intersect the gate lines **121** and the storage electrode lines **131**. A plurality of branches of each data line **171**, which project toward the drain electrodes **175**, form a plurality of source electrodes **173**. A source electrode **173** and a drain electrode **175** in a pair are separated from each other and opposite each other with respect to a gate electrode **124**. A gate electrode **124**, a source electrode **173**, and a drain electrode **175** along with the semiconductor island **150** form a TFT having a channel between the source electrode **173** and the drain electrode **175**.

[0084] The data lines **171** and the drain electrodes **175** may also include a lower film (not shown) preferably made of Mo, Mo alloy or Cr and an upper film (not shown) located thereon and preferably made of Al containing metal.

[0085] Like the gate lines **121** and the storage electrode lines **131**, the data lines **171** and the drain electrodes **175** have tapered lateral sides, and the inclination angles thereof range about 30-80 degrees.

[0086] The ohmic contacts **163** and **165** are interposed only between the underlying semiconductor islands **150** and the overlying data lines **171** and the overlying drain electrodes **175** thereon and reduce the contact resistance therebetween.

[0087] A passivation layer **180** is formed on the data lines **171** and the drain electrodes **175**, and exposed portions of the semiconductor islands **150**, which are not covered with the data lines **171** and the drain electrodes **175**. The passivation layer **180** is preferably made of photosensitive organic material having a good flatness characteristic, low dielectric insulating material such as a-Si:C:O and a-Si:O:F formed by plasma enhanced chemical vapor deposition (PECVD), or inorganic material such as silicon nitride and silicon oxide. The passivation layer **180** may have a double-layered structure including a lower inorganic film and an upper organic film for preventing direct contact between the semiconductor islands **150** and an organic film.

[0088] The passivation layer **180** has a plurality of contact holes **182** and **185** exposing end portions **179** of the data lines **171** and the drain electrodes **175**, respectively. The passivation layer **180** and the gate insulating layer **140** have a plurality of contact holes **181** exposing end portions **129** of the gate lines **121**. The contact holes **181**, **182** and **185** can have various shapes such as polygon or circle. The area of each contact hole **181**, **182** or **185** is preferably equal to or

larger than 0.5 mm×15 μm and not larger than 2 mm×60 μm. The sidewalls of the contact holes **181**, **182** and **185** are inclined with an angle of about 30-85 degrees or have stepwise profiles.

[**0089**] A plurality of pixel electrodes **190** and a plurality of contact assistants **81** and **82**, which are preferably made of ITO, IZO or Cr, are formed on the passivation layer **180**.

[**0090**] The pixel electrodes **190** are physically and electrically connected to the drain electrodes **175** through the contact holes **185** such that the pixel electrodes **190** receive the data voltages from the drain electrodes **175**. The pixel electrodes **190** supplied with the data voltages generate electric fields in cooperation with the common electrode **270**, which reorient liquid crystal molecules disposed therebetween.

[**0091**] A pixel electrode **190** and a common electrode **270** form a capacitor called a "liquid crystal capacitor," which stores applied voltages after turn-off of the TFT. An additional capacitor called a "storage capacitor," which is connected in parallel to the liquid crystal capacitor, is provided for enhancing the voltage storing capacity. The storage capacitors are implemented by overlapping the pixel electrodes **190** with the storage electrode lines **131**. The capacitances of the storage capacitors, i.e., the storage capacitances can be increased by providing a plurality of storage capacitor conductors, which are electrically connected to the pixel electrodes **190**, between the gate insulating layer **140** and the passivation layer **180** opposite the pixel electrodes **190** and the storage electrodes lines **131**.

[**0092**] The pixel electrodes **190** overlap the data lines **171** to increase aperture ratio but it is optional.

[**0093**] The contact assistants **81** and **82** are connected to the exposed end portions **129** of the gate lines **121** and the exposed end portions **179** of the data lines **171** through the contact holes **181** and **182**, respectively. The contact assistants **81** and **82** are not requisites but preferred to protect the exposed portions **129** and **179** and to complement the adhesiveness of the exposed portions **129** and **179** and external devices.

[**0094**] Portions of the passivation layer **180** near the contact assistants **81** and **82** may be completely removed, and such a removal is particularly advantageous for a chip-on-glass type LCD.

[**0095**] The description of the common electrode panel **200** follows.

[**0096**] A black matrix **220** for preventing light leakage is formed on an insulating substrate **210** such as transparent glass and the black matrix **220** includes a plurality of openings facing the pixel electrodes **190** and having substantially the same shape as the pixel electrodes **190**.

[**0097**] A plurality of red, green and blue color filters **230** are formed substantially in the openings of the black matrix **220**. An exemplary arrangement of the color filters **230** is a stripe type that the color filters **230** in a column represent the same color.

[**0098**] A common electrode **270** preferably made of transparent conductive material such as ITO and IZO is formed on the color filters **230** and the black matrix **220**. The common electrode **270** covers entire surface of the panel **200**.

[**0099**] The wider surfaces of the spacers **320** are in contact with the common electrode panel **200** as shown in **FIG. 8** or in contact with the TFT array panel as shown in **FIG. 9**. Although FIGS. **7-9** show the spacers **320** located on the data lines **171**, the spacers **320** can be located on the gate lines **121**, the TFTs, or any places covered by the black matrix **220**.

[**0100**] A pair of polarizers (not shown) are provided on outer surfaces of the panels **100** and **200**.

[**0101**] The LCD may be a twisted nematic (TN) mode LCD where liquid crystal molecules in the liquid crystal layer **300** having positive dielectric anisotropy are aligned parallel to surfaces of the panels **100** and **200** and the molecular orientations are twisted from the surface of one of the panels **100** to the surface of the other of the panels **100** and **200** in absence of electric field. Alternatively, the LCD is a vertically aligned (VA) mode LCD, that is, the liquid crystal molecules in the liquid crystal layer **300** with negative dielectric anisotropy are aligned vertical to surfaces of the panels **100** and **200** in absence of electric field. Alternatively, the LCD is an optically compensated bend (OCB) mode LCD, where the liquid crystal molecules have a bend alignment symmetrical with respect to a mid-plane between the panels **100** and **200** in absence of electric field.

[**0102**] **FIG. 10** shows exemplary locations of the first and the second spacers **321** and **322** shown in **FIG. 2** according to an embodiment of the present invention.

[**0103**] Referring to **FIG. 10, a** plurality of red, green and blue color filters R, G and B are arranged in a stripe type. The spacers **321** and **322** are arranged in a regular or periodic manner along a row direction and a column direction. For example, the spacers **321** and **322** are located between the blue filters B and the red filters R and spaced apart from each other by predetermined transverse and longitudinal distances as shown in **FIG. 10**. The concentration of the first spacers **321** is preferably in a range of about 200-600/cm^2, while that of the second spacers is preferably in a range of about 250-450/cm^2.

[**0104**] A method of manufacturing a panel assembly for an LCD shown in **FIGS. 7 and 9** is now described in detail with reference to **FIGS. 1 and 2** as well as **FIGS. 7 and 9**.

[**0105**] Referring to **FIGS. 7 and 9**, a plurality of gate lines **121**, a plurality of data lines **171**, a plurality of TFTs, a plurality of pixel electrodes **190** and the like are formed on an insulating substrate **110** to form a TFT array panel **100**. An organic insulating material is deposited on the panel **100** and patterned by photolithography to form a plurality of spacers **321** and **322** between the pixel areas. Meanwhile, a black matrix **220**, a plurality of red, green and blue color filters **230**, a common electrode **270**, and so on are formed on another substrate **210** to form a common electrode panel **200**. It is preferable that the size of the spacers **321** and **322** is equal to about 110-130% of the distance between the panels **100** and **200**. The formation of the spacers **321** and **322** using photolithography enables to uniformly arrange the spacers **321** and **322** such that a thin uniform cell gap can be obtained throughout the panels **100** and **200** and the spacers **321** and **322** are prevented from being placed on the pixel electrodes **190**, thereby improving the display characteristics.

[**0106**] Thereafter, a sealant **310** is coated on one of the panels **100** and **200** as shown in **FIGS. 1 and 2**. The sealant

310 has a shape of a closed loop without an injection hole for injecting LC. The sealant **310** may be made of thermo-setting material or ultraviolet-hardening material and may contain a plurality of spacers for keeping the gap between the panels **100** and **200**. Since the sealant **310** has no injection hole, it is important to exactly control the amount of the LC material. In order to solve any problem due to the excessive amount of the LC or the insufficient amount of the LC, a buffer region without LC material even after the termination of the panel combination is preferably provided at the sealant **310**. Meanwhile, it is preferable that the sealant **310** has an anti-reaction film on its surface, which is not reactant with the LC layer **3**.

[**0107**] A LC material is coated or dropped using a LC coater on the one of the panels **100** and **200** coated with the sealant **310**. The LC coater may have a dice shape such that it can drop the LC material at the LC device areas **51-54**. The LC may be sprayed on the entire surface of the LC device areas **51-54**. In this case, the LC coater has a shape of a sprayer.

[**0108**] The panels **100** and **200** are delivered to an assembly device with a vacuum chamber. The room surrounded by the panels **100** and **200** and the sealant **310** is evacuated and the panels **100** and **200** are closely adhered to each other using atmospheric pressure such that the distance between the panels **100** and **200** reaches a desired cell gap. The sealant **310** is completely hardened with the illumination of an ultra-violet (UV) ray using a light exposer. In this way, the two panels **100** and **200** are assembled to form a panel assembly. The two panels **100** and **200** are exactly aligned to a minute order during the step of adhering the panels **100** and **200** and the step of illuminating UV ray on the sealant **310**.

[**0109**] Finally, the panel assembly **40** is separated into the LC device areas **51-54** using a scribing machine.

[**0110**] A panel assembly for LCDs according to another embodiment of the present invention will be now described in detail with reference to **FIGS. 11 and 12**.

[**0111**] **FIG. 11** is a plan view of a panel assembly for LCDs according to another embodiment of the present invention and **FIG. 12** is a sectional view of the panel assembly shown in **FIG. 11** taken along the line XII-XII'.

[**0112**] As shown in **FIGS. 11 and 12**, a panel assembly **40** according to another embodiment of the present invention includes two panels **100** and **200** and a plurality of LC layers **3**, a plurality of sealants **310**, and a plurality of columnar spacers **320**, which are disposed between the two panels **100** and **200**.

[**0113**] The panel assembly **40** includes a plurality of, for example, four device areas divided by dotted lines A and B. The panel assembly **40** is separated into the respective LCDs by scribing the panel assembly **40** along the dotted lines A and B.

[**0114**] Each of the device areas (or an LCD) includes a display area **51**, **52**, **53** or **54** for displaying images. The display area **51** is substantially enclosed by the sealant **310**, which confines the LC layer **3**. The LC layer **3** may be formed after the panel assembly **40** is separated into the respective devices. The sealant **310** may contain spacers for supporting the panels **10** and **20** to be parallel to each other.

[**0115**] The panel **200** includes an insulating substrate **210**, a black matrix **220** formed on the substrate **210**, a plurality of color filters **230** formed on the black matrix **220** and the substrate **210**, and a common electrode (not shown) formed thereon. The color filters **230** include a plurality of red filters **230**R, a plurality of green filters **230**G, and a plurality of blue filters **230**B. The blue filters **230**B, the green filters **230**G, and the red filters **230**R are sequentially arranged in a transverse direction and have decreasing thicknesses as shown in **FIG. 12**.

[**0116**] As shown in **FIG. 12**, the spacers **320** for maintaining a gap between the panels **100** and **200** to be uniform includes a plurality of first, second, and third spacers **321-323** formed on the blue filters **230**B, the green filters **230**G, and the red filters **230**R, respectively, and contacting the panels **100** and **200** with different contact areas. The different contact areas of the spacers **321-323** are obtained by forming spacer columns having the same thickness but having different top heights due to the different thickness of the color filters **230** and by pressing the spacer columns such that the top surfaces of the spacer columns have the same height.

[**0117**] **FIG. 13** is a sectional view of a panel and a plurality of column spacers formed thereon for the LCD shown in **FIG. 12** before panel combination according to another embodiment of the present invention.

[**0118**] A panel **200** includes an insulating substrate **210**, and a black matrix **220**, a plurality of color filters **230**, and a common electrode (not shown), which are sequentially formed on the substrate.**210**. The color filters **230** include a plurality of red filters **230**R, a plurality of green filters **230**G, and a plurality of blue filters **230**B having decreasing thicknesses as shown in **FIG. 13**.

[**0119**] A plurality of first, second, and third column spacers **321-323** having the same height are formed on the blue filters **230**B, the green filters **230**G, and the red filters **230**R, respectively. The heights of top surfaces of the first to the third spacers **321-323** are different due to the different thickness of the color filters **230**B, **230**G, **230**R as shown in **FIG. 13**. The thickness of the green filters **230**G and the red filters **230**R may be equal to equalizing the top heights of the second and the third spacers **322** and **323**.

[**0120**] The first spacers **321**, which are primary spacers, keep a cell gap between the two panels **100** and **200** uniform during a normal operation. The second and the third spacers **322** and **323** prevent the excessive reduction of the cell gap due to an external pressure.

[**0121**] The different contact areas of the spacers **321-323** are also obtained by forming spacer columns having different thicknesses with or without the different thicknesses of the color filters **230** and by pressing the spacer columns such that the top surfaces of the spacer columns have the same height.

[**0122**] Now, methods of manufacturing spacers having different thicknesses according to embodiments of the present invention are described in detail with reference to **FIGS. 14 and 15**.

[**0123**] **FIG. 14** is a sectional view of a LC panel assembly in an intermediate step of a manufacturing method thereof according to an embodiment of the present invention.

[0124] Referring to **FIG. 14, a** negative acrylic photoresist **59** is coated on a LC panel **200**. An exposure mask **60** including an opaque film **61** having a plurality of openings **62** and a plurality of slit areas **64** are disposed on the panel **200**. The slit areas **64** includes a plurality of slits and may have at least two slit areas with different slit widths and different slit distances. The exposure mask **60** is aligned such that the openings **62** face portions of the photoresist **59** to become the tallest spacers **321** and the slit areas **64** face portions of the photoresist **59** to become other spacers **322** and **323**. The photoresist **59** is then exposed to light from a light source through the exposure mask **60** so that the portions of the photoresist **59** exposed to light be hardened. A portion facing a slit area **64** having smaller slit width and smaller slit distance becomes a shorter spacer.

[0125] **FIG. 15** is a sectional view of a LC panel assembly in an intermediate step of a manufacturing method thereof according to another embodiment of the present invention.

[0126] Referring to **FIG. 15**, after a negative acrylic photoresist **59** is coated on a LC panel **200**, an exposure mask **70** having a plurality of transparent areas **72**, a plurality of translucent areas **73**, and an opaque area **71** is disposed on the panel **200**. The opaque area **71** and each translucent area **73** include an opaque film and a translucent film, respectively, while each transparent area **72** has an opening. The translucent areas **73** may include at least two translucent areas having different transmittances. The exposure mask **70** is aligned such that the transparent areas **72** and the translucent areas **73** face portions of the photoresist **59** to become the tallest spacers **321** and the remaining spacers **322** and **323**, respectively. The photoresist **59** is then exposed to light from a light source through the exposure mask **70**. A portion facing a translucent area **73** having smaller transmittance becomes a shorter spacer.

[0127] The spacers **321-323** may be made from a positive photoresist, and in this case, the opaque areas and the transparent areas shown in FIGS. **4A-6** are reversed.

[0128] An exemplary LC panel assembly according to an embodiment of the present invention will be described in more detail with reference to FIGS. **16-18**.

[0129] **FIG. 16** is a layout view of an LCD according to an embodiment of the present invention, and **FIGS. 17 and 18** are sectional views of the LCD shown in **FIG. 16** taken along the line XVII-XVII' and the line XVIII-XVIII', respectively.

[0130] An LCD according to an embodiment of the present invention includes a TFT array panel **100**, a color filter panel **200**, and a LC layer **3** and a plurality of column spacers **321-323** disposed between the panels **100** and **200**.

[0131] The TFT array panel **100** is now described in detail.

[0132] A plurality of gate lines **121** for transmitting gate signals and a plurality of storage electrode lines **131** are formed on an insulating substrate **110**.

[0133] The gate lines **121** and the storage electrode lines **131** extend substantially in a transverse direction and are separated from each other. A plurality of projections of each gate line **121** form a plurality of gate electrodes **124**. The storage electrode lines **131** are supplied with a predetermined voltage such as a common voltage, which is applied to a common electrode on the color filter panel **200** of the LCD.

[0134] The gate lines **121** and the storage electrode lines **131** may have a multi-layered structure including two films having different physical characteristics, a lower film (not shown) and an upper film (not shown). The upper film is preferably made of low resistivity metal including Al containing metal such as Al and Al alloy for reducing signal delay or voltage drop in the gate lines **121** and the storage electrode lines **131**. On the other hand, the lower film is preferably made of material such as Cr, Mo and Mo alloy, which has good contact characteristics with other materials such as indium tin oxide (ITO) or indium zinc oxide (IZO). A good exemplary combination of the lower film material and the upper film material is Cr and Al—Nd alloy.

[0135] In addition, the lateral sides of the gate lines **121** and the storage electrode lines **131** are tapered, and the inclination angle of the lateral sides with respect to a surface of the substrate **110** ranges about 30-80 degrees.

[0136] A gate insulating layer **140** preferably made of silicon nitride (SiNx) is formed on the gate lines **121** and the storage electrode lines **131**.

[0137] A plurality of semiconductor islands **150** preferably made of hydrogenated amorphous silicon (abbreviated as "a-Si") or polysilicon are formed on the gate insulating layer **140**. The semiconductor islands **150** are located opposite the respective gate electrodes **124**.

[0138] A plurality of ohmic contact islands **163** and **165** preferably made of silicide or n+ hydrogenated a-Si heavily doped with n type impurity are formed on the semiconductor islands **150**.

[0139] The lateral sides of the semiconductor islands **150** and the ohmic contacts **163** and **165** are tapered, and the inclination angles thereof are preferably in a range between about 30-80 degrees.

[0140] A plurality of data lines **171** and a plurality of drain electrodes **175** separated from each other are formed on the ohmic contacts **163** and **165** and the gate insulating layer **140**.

[0141] The data lines **171** for transmitting data voltages extend substantially in the longitudinal direction and intersect the gate lines **121** and the storage electrode lines **131**. A plurality of branches of each data line **171**, which project toward the drain electrodes **175**, form a plurality of source electrodes **173**. A source electrode **173** and a drain electrode **175** in a pair are separated from each other and opposite each other with respect to a gate electrode **124**. A gate electrode **124**, a source electrode **173**, and a drain electrode **175** along with the semiconductor island **150** form a TFT having a channel between the source electrode **173** and the drain electrode **175**.

[0142] The data lines **171** and the drain electrodes **175** may also include a lower film (not shown) preferably made of Mo, Mo alloy or Cr and an upper film (not shown) located thereon and preferably made of Al containing metal.

[0143] Like the gate lines **121** and the storage electrode lines **131**, the data lines **171** and the drain electrodes **175** have tapered lateral sides, and the inclination angles thereof range about 30-80 degrees.

[0144] The ohmic contacts **163** and **165** are interposed only between the underlying semiconductor islands **150** and

the overlying data lines **171** and the overlying drain electrodes **175** thereon and reduce the contact resistance therebetween.

[**0145**] A passivation layer **180** is formed on the data lines **171** and the drain electrodes **175**, and exposed portions of the semiconductor islands **150**, which are not covered with the data lines **171** and the drain electrodes **175**. The passivation layer **180** is preferably made of photosensitive organic material having a good flatness characteristic, low dielectric insulating material such as a-Si:C:O and a-Si:O:F formed by plasma enhanced chemical vapor deposition (PECVD), or inorganic material such as silicon nitride and silicon oxide. The passivation layer **180** may have a double-layered structure including a lower inorganic film and an upper organic film for preventing direct contact between the semiconductor islands **150** and an organic film.

[**0146**] The passivation layer **180** has a plurality of contact holes **182** and **185** exposing end portions **179** of the data lines **171** and the drain electrodes **175**, respectively. The contact holes **182** and **185** can have various shapes such as polygon or circle. The area of each contact hole **182** or **185** is preferably equal to or larger than 0.5 mm×15 μm and not larger than 2 mm×60 μm. The sidewalls of the contact holes **182** and **185** are inclined with an angle of about 30-85 degrees or have stepwise profiles.

[**0147**] A plurality of pixel electrodes **190** and a plurality of contact assistants **82**, which are preferably made of ITO, IZO or Cr, are formed on the passivation layer **180**.

[**0148**] The pixel electrodes **190** are physically and electrically connected to the drain electrodes **175** through the contact holes **185** such that the pixel electrodes **190** receive the data voltages from the drain electrodes **175**. The pixel electrodes **190** supplied with the data voltages generate electric fields in cooperation with the common electrode, which reorient liquid crystal molecules disposed therebetween.

[**0149**] The pixel electrodes **190** overlap the data lines **171** to increase aperture ratio but it is optional.

[**0150**] The contact assistants **82** are connected to the exposed end portions **179** of the data lines **171** through the contact holes **182**. The contact assistants **82** are not requisites but preferred to protect the exposed portions **179** of the data lines **171** and to complement the adhesiveness of the exposed portions **179** and external devices.

[**0151**] Portions of the passivation layer **180** near the contact assistants **82** may be completely removed, and such a removal is particularly advantageous for a chip-on-glass type LCD.

[**0152**] The description of the color filter panel **200** follows.

[**0153**] A black matrix **220** for preventing light leakage is formed on an insulating substrate **210** such as transparent glass and the black matrix **220** includes a plurality of openings facing the pixel electrodes **190** and having substantially the same shape as the pixel electrodes **190**.

[**0154**] A plurality of red, green and blue color filters **230**B, **230**G and **230**R are formed substantially in the openings of the black matrix **220**. An exemplary arrangement of the color filters **230**B, **230**G and **230**R is a stripe type that the color filters **230**B, **230**G and **230**R in a column represent the same color.

[**0155**] A common electrode (not shown) preferably made of transparent conductive material such as ITO and IZO is formed on the color filters **230**B, **230**G and **230**R and the black matrix **220**. The common electrode covers entire surface of the panel **200**.

[**0156**] The wider surfaces of the spacers **321-323** are in contact with the color filter panel **200** as shown in **FIG. 17**. Although FIGS. **16-18** show the spacers **321-323** located on the data lines **171**, the spacers **321-323** can be located on the gate lines **121**, the TFTs, or any places covered by the black matrix **220**.

[**0157**] A pair of polarizers (not shown) are provided on outer surfaces of the panels **100** and **200**.

[**0158**] The LCD may be a twisted nematic (TN) mode LCD where liquid crystal molecules in the liquid crystal layer **300** having positive dielectric anisotropy are aligned parallel to surfaces of the panels **100** and **200** and the molecular orientations are twisted from the surface of one of the panels **100** and **200** to the surface of the other of the panels **100** and **200** in absence of electric field. Alternatively, the LCD is a vertically aligned (VA) mode LCD, that is, the liquid crystal molecules in the liquid crystal layer **300** with negative dielectric anisotropy are aligned vertical to surfaces of the panels **100** and **200** in absence of electric field. Alternatively, the LCD is an optically compensated bend (OCB) mode LCD, where the liquid crystal molecules have a bend alignment symmetrical with respect to a mid-plane between the panels **100** and **200** in absence of electric field.

[**0159**] **FIG. 19** shows exemplary locations of the spacers **321-323** shown in FIGS. **12-18** according to an embodiment of the present invention.

[**0160**] Referring to **FIG. 19, a** plurality of red, green and blue color filters R, G and B are arranged in a stripe type. Three kinds of spacers **321-323** are arranged in a regular or periodic manner along a row direction and a column direction. For example, the different kinds of the spacers **321-323** are located between the color filters having different colors and spaced apart from each other by predetermined transverse and longitudinal distances as shown in **FIG. 19**.

[**0161**] A method of manufacturing a panel assembly for an LCD shown in FIGS. **16-18** is now described in detail with reference to **FIGS. 11 and 12** as well as FIGS. **16-17**.

[**0162**] Referring to **FIGS. 16 and 17**, a plurality of gate lines **121**, a plurality of data lines **171**, a plurality of TFTs, a plurality of pixel electrodes **190** and the like are formed on an insulating substrate **110** to form a TFT array panel **100**. Meanwhile, a black matrix **220**, a plurality of red, green and blue color filters **230**R, **230**G and **230**B, a common electrode (not shown), and so on are formed on another substrate **210** to form a color filter panel **200**. An organic insulating material is deposited on the panel **200** and patterned by photolithography to form a plurality of spacers **321-323** located on the respective color filters **230**B, **230**G and **230**R. It is preferable that the size of the spacers **321-323** is equal to about 110-130% of the distance between the panels **100** and **200**. The formation of the spacers **321-323** using photolithography enables to uniformly arrange the spacers **321-**

323 such that a thin uniform cell gap can be obtained throughout the panels **100** and **200** and the spacers **321-323** are prevented from being placed on the pixel electrodes **190**, thereby improving the display characteristics.

[**0163**] Thereafter, a sealant **310** is coated on one of the panels **100** and **200** as shown in **FIGS. 1 and 2**. The sealant **310** has a shape of a closed loop without an injection hole for injecting LC. The sealant **310** may be made of thermo-setting material or ultraviolet-hardening material and may contain a plurality of spacers for keeping the gap between the panels **100** and **200**. Since the sealant **310** has no injection hole, it is important to exactly control the amount of the LC material. In order to solve any problem due to the excessive amount of the LC or the insufficient amount of the LC, a buffer region without LC material even after the termination of the panel combination is preferably provided at the sealant **310**. Meanwhile, it is preferable that the sealant **310** has an anti-reaction film on its surface, which is not reactant with the LC layer **3**.

[**0164**] A LC material is coated or dropped using a LC coater on the one of the panels **100** and **200** coated with the sealant **310**. The LC coater may have a dice shape such that it can drop the LC material at the LC device areas **51-54**. The LC may be sprayed on the entire surface of the LC device areas **51-54**. In this case, the LC coater has a shape of a sprayer.

[**0165**] The panels **100** and **200** are delivered to an assembly device with a vacuum chamber. The room surrounded by the panels **100** and **200** and the sealant **310** is evacuated and the panels **100** and **200** are closely adhered to each other using atmospheric pressure. A member for pressing the panels **100** and **200** may be provided for obtaining a desired cell gap.

[**0166**] The sealant **310** is completely hardened with the illumination of an ultra-violet (UV) ray using a light exposer. In this way, the two panels **100** and **200** are assembled to form a panel assembly. The two panels **100** and **200** are exactly aligned to a minute order during the step of adhering the panels **100** and **200** and the step of illuminating UV ray on the sealant **310**.

[**0167**] Finally, the panel assembly **40** is separated into the LC device areas **51-54** using a scribing machine.

[**0168**] To summarize, the present invention differentiates the areas and the heights of the spacers supporting the panels to keep the cell gap uniform and to facilitate the formation of the LC layer. In addition, the concentration of the spacers can be reduced to prevent the light leakage due to the press.

What is claimed is:

1. A panel assembly for a display device, the panel assembly comprising:

a panel; and

a plurality of spacers formed on the panel for supporting the panel,

wherein the spacers have at least two different heights or at least two different contact areas with the panel.

2. The panel assembly of claim 1, wherein the contact areas of the spacers are circular or tetragonal.

3. The panel assembly of claim 1, wherein the spacers comprise a plurality of first spacers and a plurality of second spacers having a height lower than the first spacers and having a contact area wider than the first spacers.

4. The panel assembly of claim 3, wherein the height difference between the first spacers and the second spacers is in a range of about 0.3-0.6 microns.

5. The panel assembly of claim 3, wherein the second spacers have a length larger than the first spacers by 10-20 microns.

6. The panel assembly of claim 3, wherein the second spacers have a length in a range of about 30-35 microns and the first spacers have a length in a range of about 15-20 microns.

7. The panel assembly of claim 3, wherein a concentration of the second spacers is about 200-600/cm^2 and a concentration of the first spacer is about 250-450/cm^2.

8. The panel assembly of claim 1, wherein the spacers comprise a first spacer, a second spacer having a height lower than the first spacer, and a third spacer having a height equal to or lower than the second spacer.

9. The panel assembly of claim 8, wherein the height of the third spacer is equal to the height of the second spacer.

10. The panel assembly of claim 1, wherein the panel comprises a gate line and a data line transmitting electrical signals, a thin film transistor electrically connected to the gate line and the data line, and a pixel electrode connected to the thin film transistor.

11. The panel assembly of claim 1, wherein the panel comprises a plurality of color filters having different thicknesses.

12. A liquid crystal display, comprising:

a first panel;

a second panel opposite each other with a gap therebetween and including a pixel electrode, a switching element connected to the pixel electrode, and a gate line and a data line connected to the switching element for transmitting electrical signals;

a plurality of spacers formed between the first panel and the second panel for maintaining the gap; and

a liquid crystal layer filled in the gap,

wherein the spacers have at least two different contact areas with the panels.

13. A method of manufacturing a liquid crystal panel assembly, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through an exposure mask including an opening and disposed on the panel with a first distance;

light-exposing the photoresist through the exposure mask disposed on the panel with a second distance; and

developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

14. The method of claim 13, wherein the photoresist is a negative type.

15. A method of manufacturing a liquid crystal panel, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through a first exposure mask including a first opening;

light-exposing the photoresist through a second exposure mask including a second opening; and

developing the photoresist to form first and second spacers having different heights or different contact areas with the panel.

16. The method of claim 15, wherein the photoresist is a negative type.

17. A method of manufacturing a liquid crystal panel, the method comprising:

coating a photoresist on a panel;

light-exposing the photoresist through an exposure mask including a plurality of transmissive areas having different transmittances and a blocking area; and

developing the photoresist to form a plurality of spacers having different heights or different contact areas with the panel.

18. The method of claim 17, wherein the plurality of transmissive areas comprise a transparent area and a translucent area.

19. The method of claim 18, wherein the transparent area has an opening and the translucent area has a plurality of slits.

20. The method of claim 17, wherein the plurality of transmissive areas comprise a transparent area and a plurality of translucent areas having different transmittances.

21. The method of claim 17, wherein the photoresist is a negative type.

* * * * *

专利名称(译)	液晶显示器，其面板及其制造方法		
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[标]申请(专利权)人(译)	赵龙JE CHOI WOO 李廷HO		
申请(专利权)人(译)	CHO YOUNG-JE CHOI WOO 李廷HO		
当前申请(专利权)人(译)	CHO YOUNG-JE CHOI WOO 李廷HO		
[标]发明人	CHO YOUNG JE CHOI WOO LEE JEONG HO		
发明人	CHO, YOUNG-JE CHOI, WOO LEE, JEONG-HO		
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摘要(译)

提供了一种用于液晶显示器的面板组件。面板组件包括面板和形成在面板上的多个间隔件，用于支撑面板。间隔件与面板具有至少两个不同的高度或至少两个不同的接触区域。间隔物包括多个第一间隔物和多个第二间隔物，所述第二间隔物的高度低于第一间隔物并且具有比第一间隔物宽的接触面积。第一间隔物和第二间隔物之间的高度差优选地在约0.3-0.6微米的范围内，并且第二间隔物的长度优选地比第一间隔物大10-20微米。