



US 20050134540A1

(19) **United States**(12) **Patent Application Publication**
Kim(10) **Pub. No.: US 2005/0134540 A1**(43) **Pub. Date: Jun. 23, 2005**(54) **LIQUID CRYSTAL DISPLAY AND PANEL THEREFOR**(22) Filed: **Dec. 16, 2004**(75) Inventor: **Dong-Gyu Kim, Yongin-si (KR)**(30) **Foreign Application Priority Data**

Dec. 19, 2003 (KR)..... 10-2003-0094066

Correspondence Address:

David W. Heid**MacPHERSON KWOK CHEN & HEID LLP****Suite 226****1762 Technology Drive****San Jose, CA 95110 (US)****Publication Classification**(51) **Int. Cl.⁷ H04N 7/01**(52) **U.S. Cl. 345/92**(57) **ABSTRACT**

A liquid crystal display is provided, which includes: a substrate; a field-generating electrode formed on the substrate; and a slope member formed on the substrate and having an inclination angle smaller than about 45 degrees.

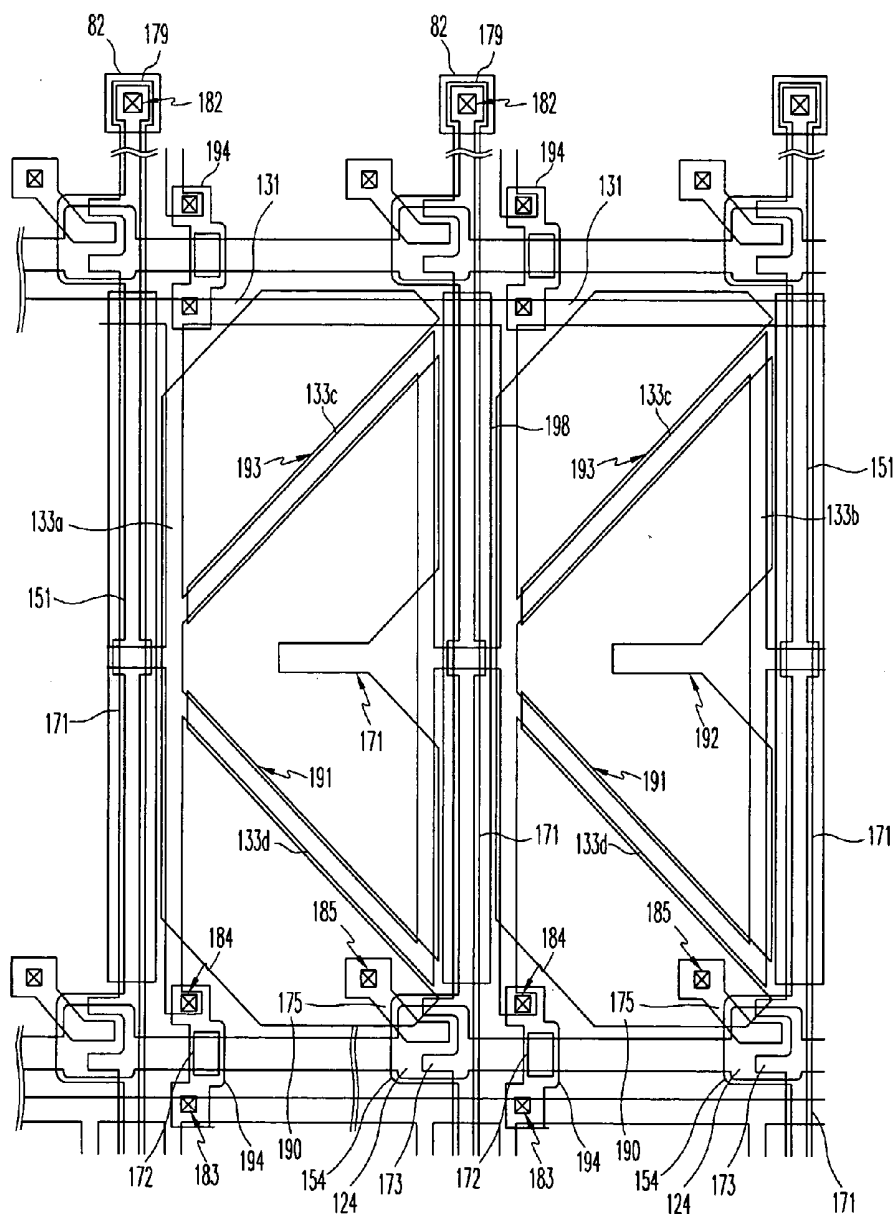
(73) Assignee: **Samsung Electronics Co., Ltd., Suwon-si (KR)**(21) Appl. No.: **11/016,475**

FIG. 1

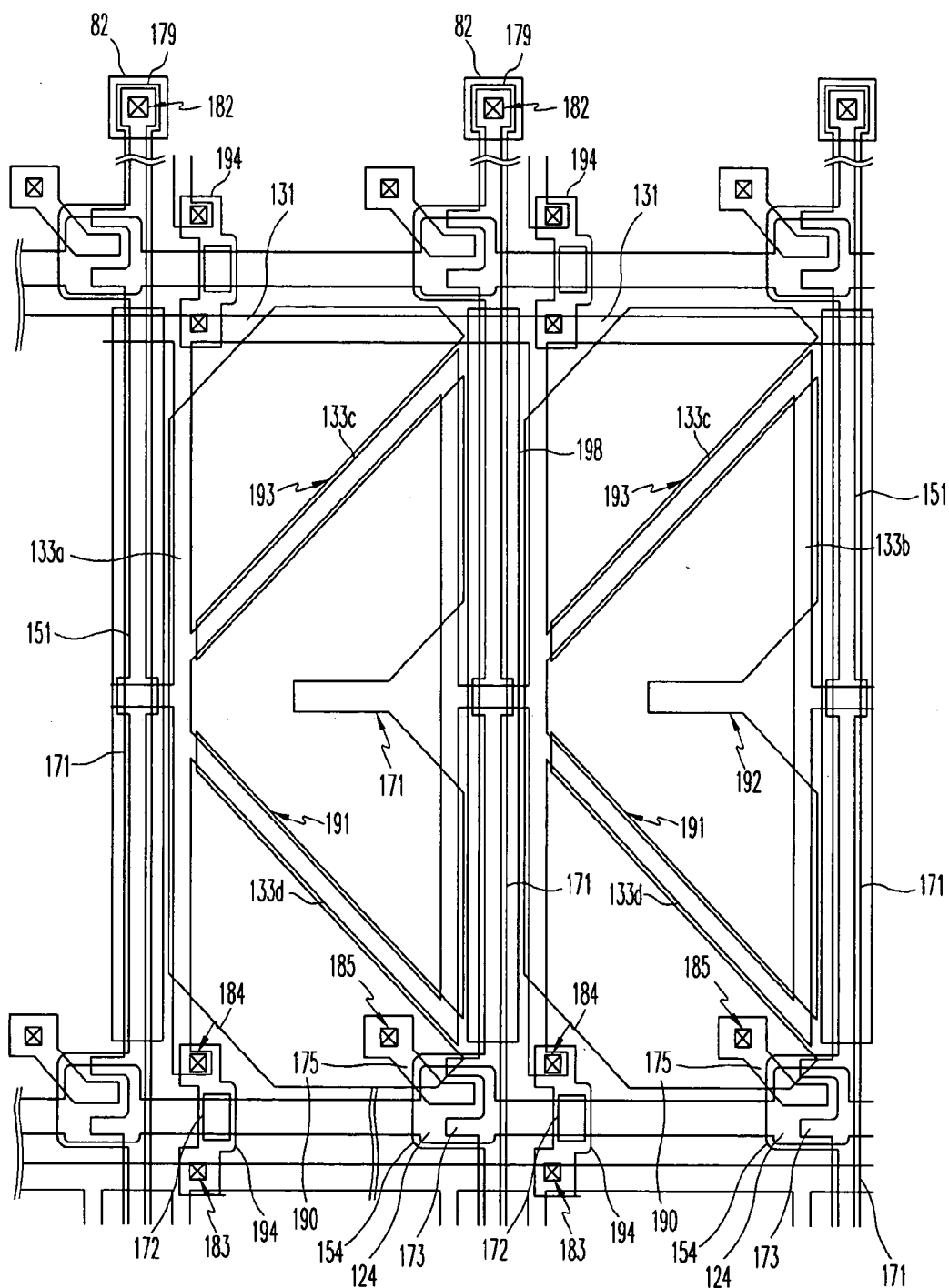


FIG.2

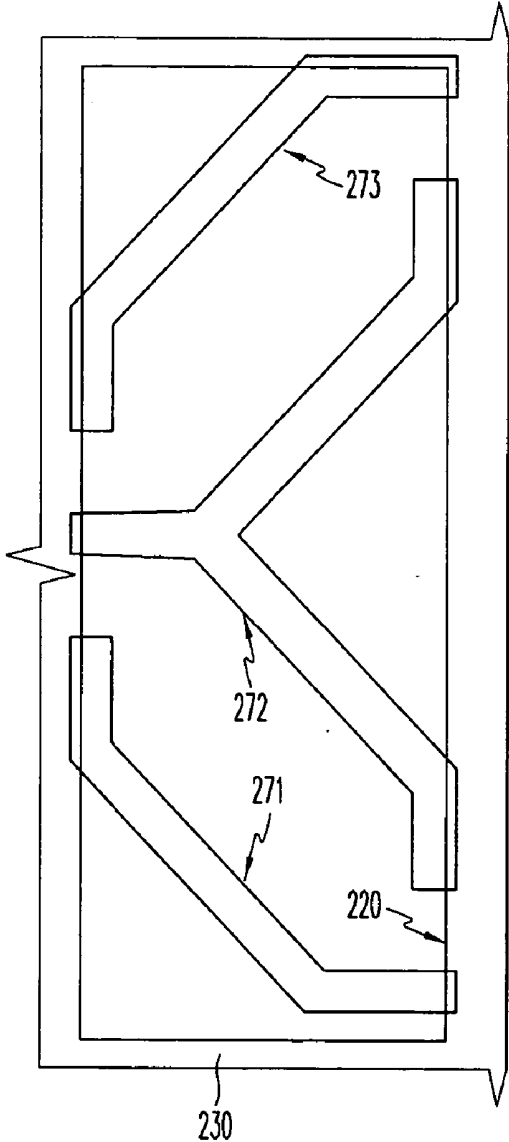


FIG.3

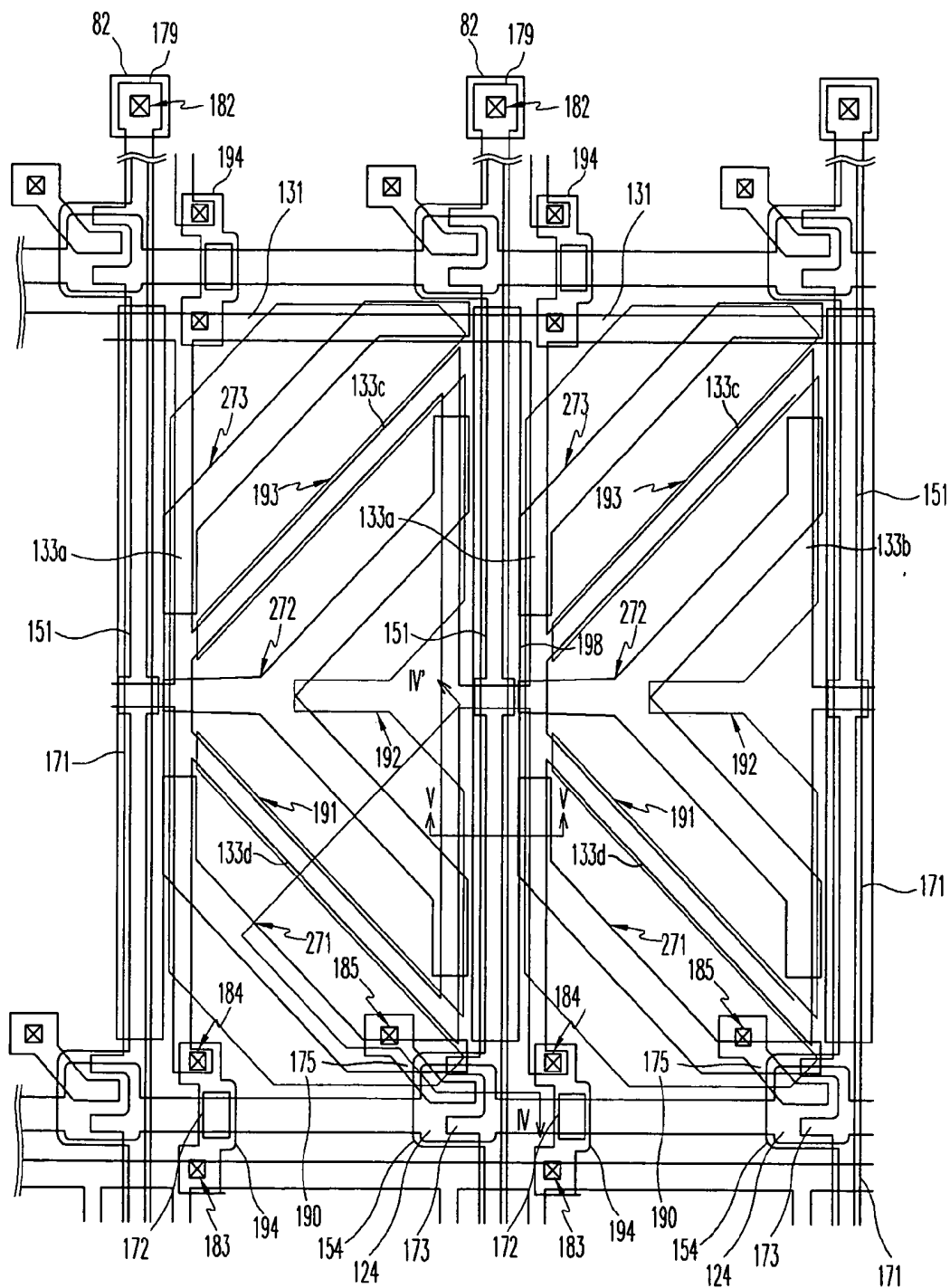


FIG. 4

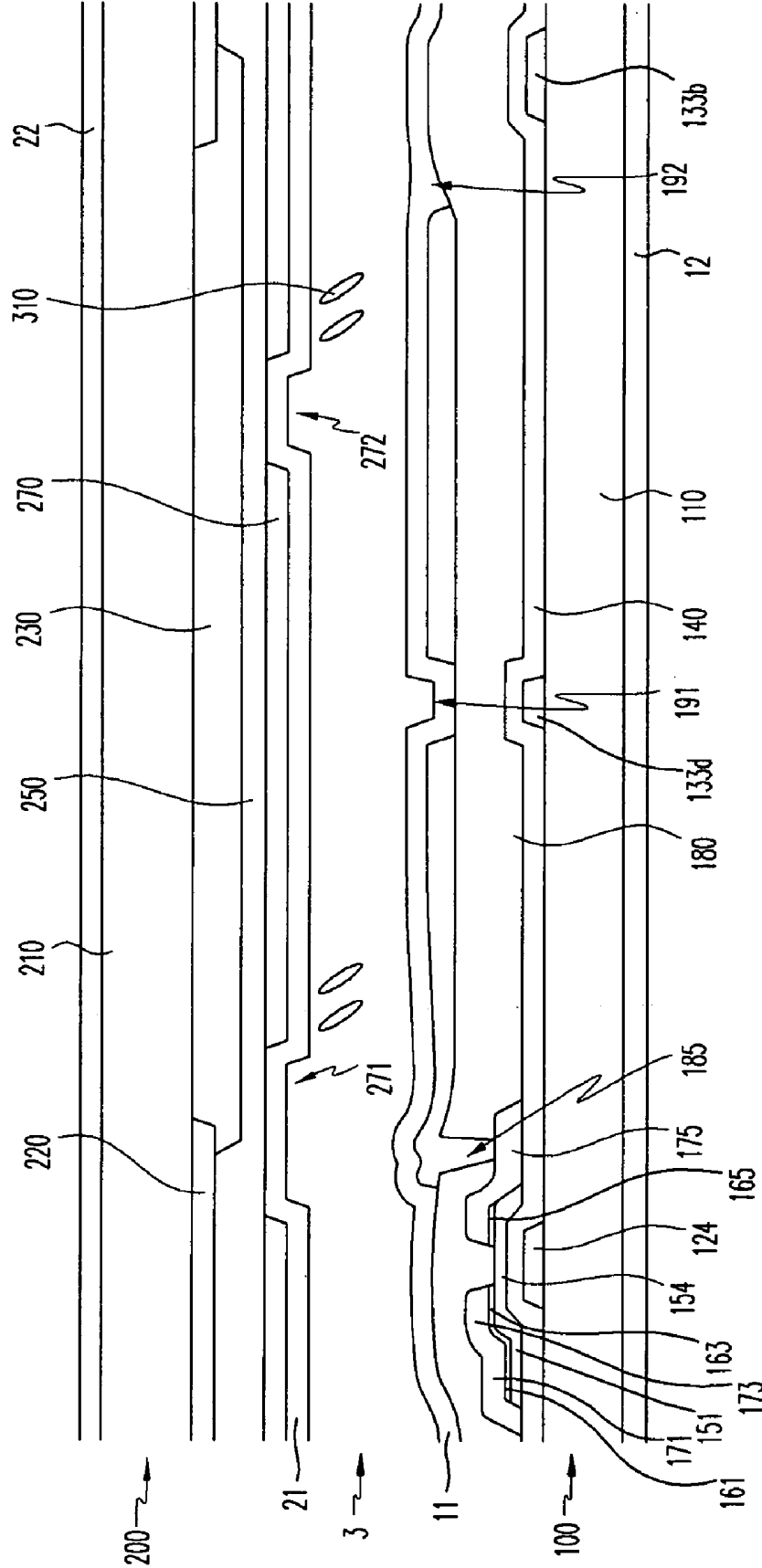


FIG. 5

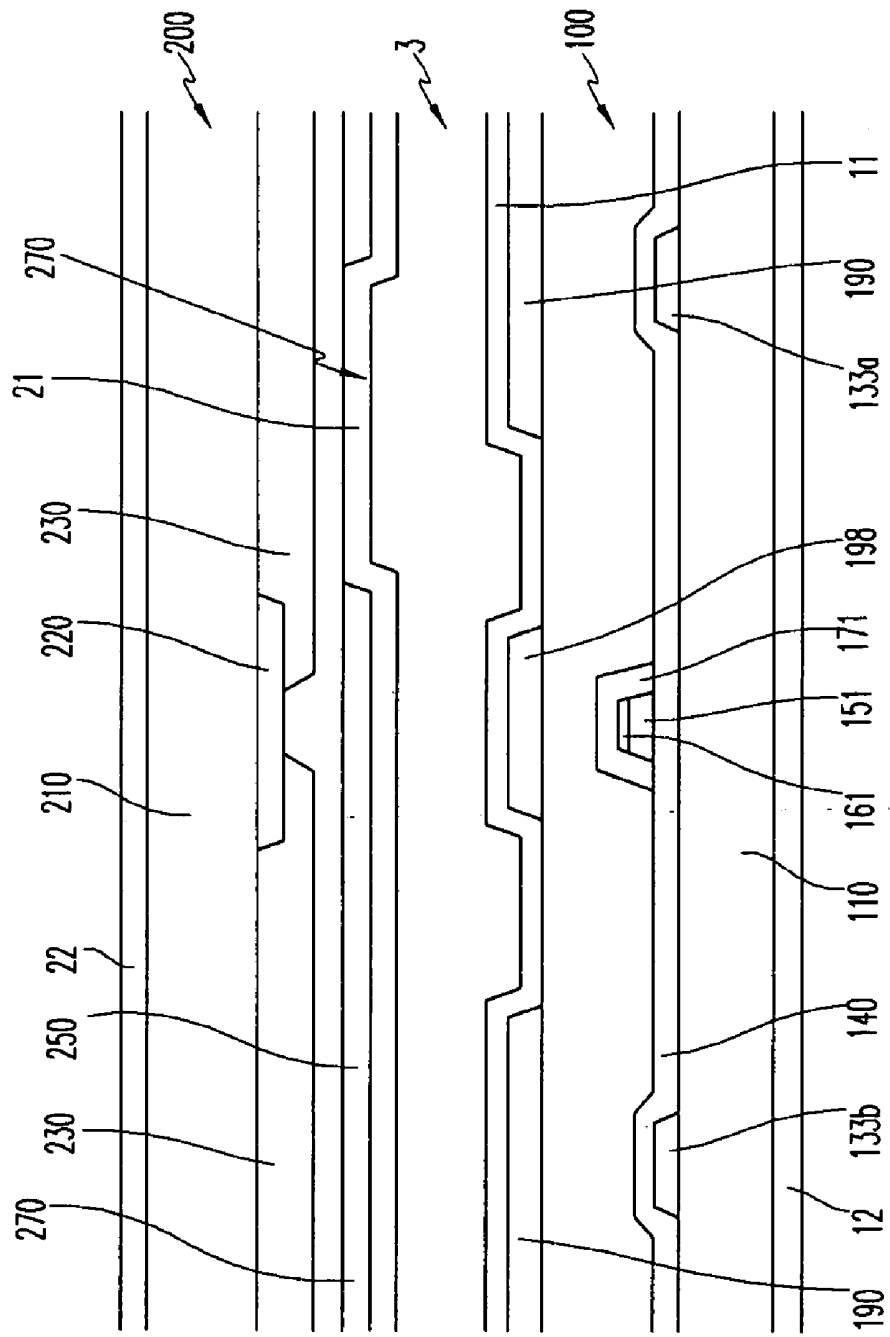


FIG. 7

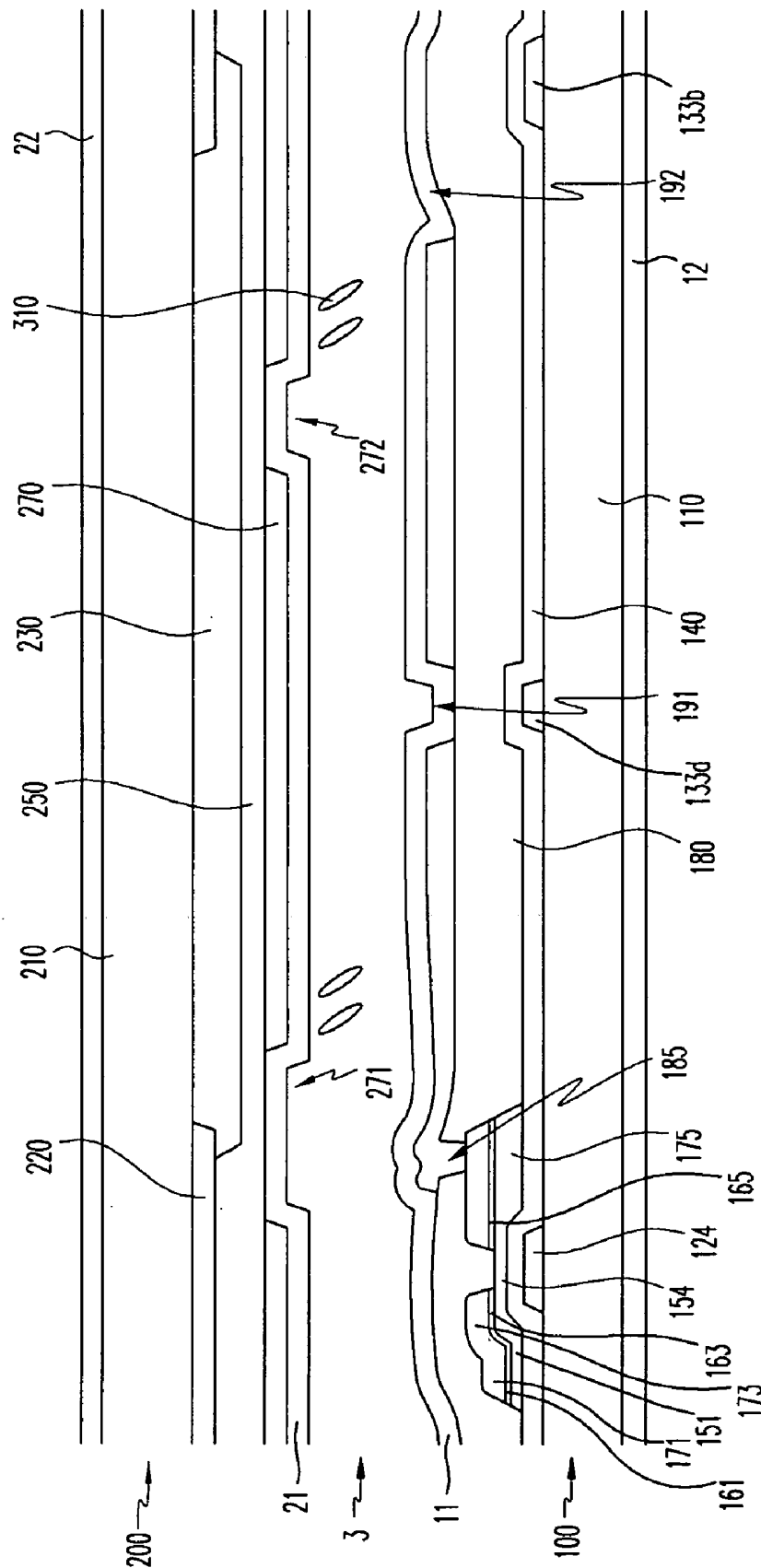


FIG.8

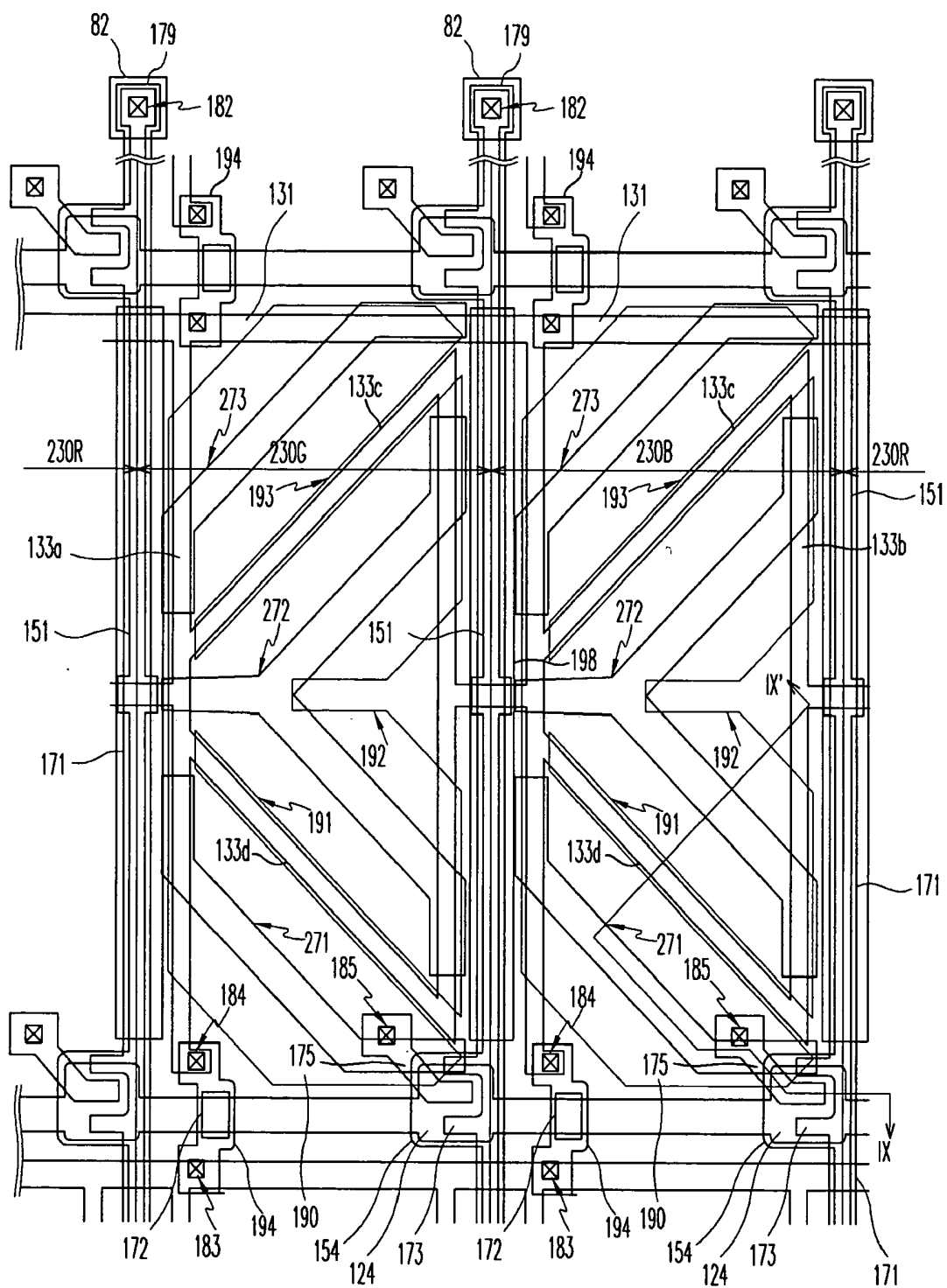


FIG.9

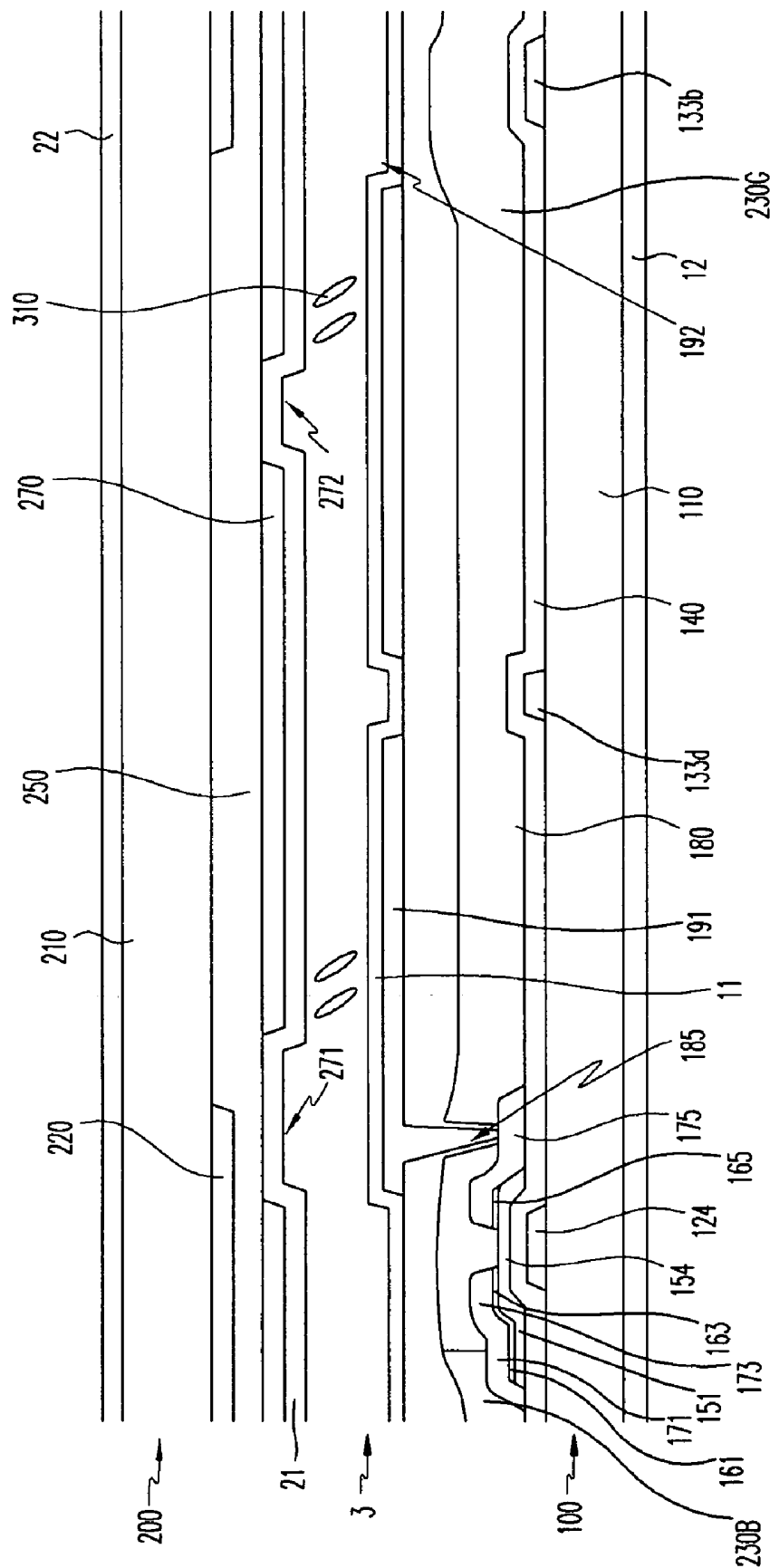


FIG.10

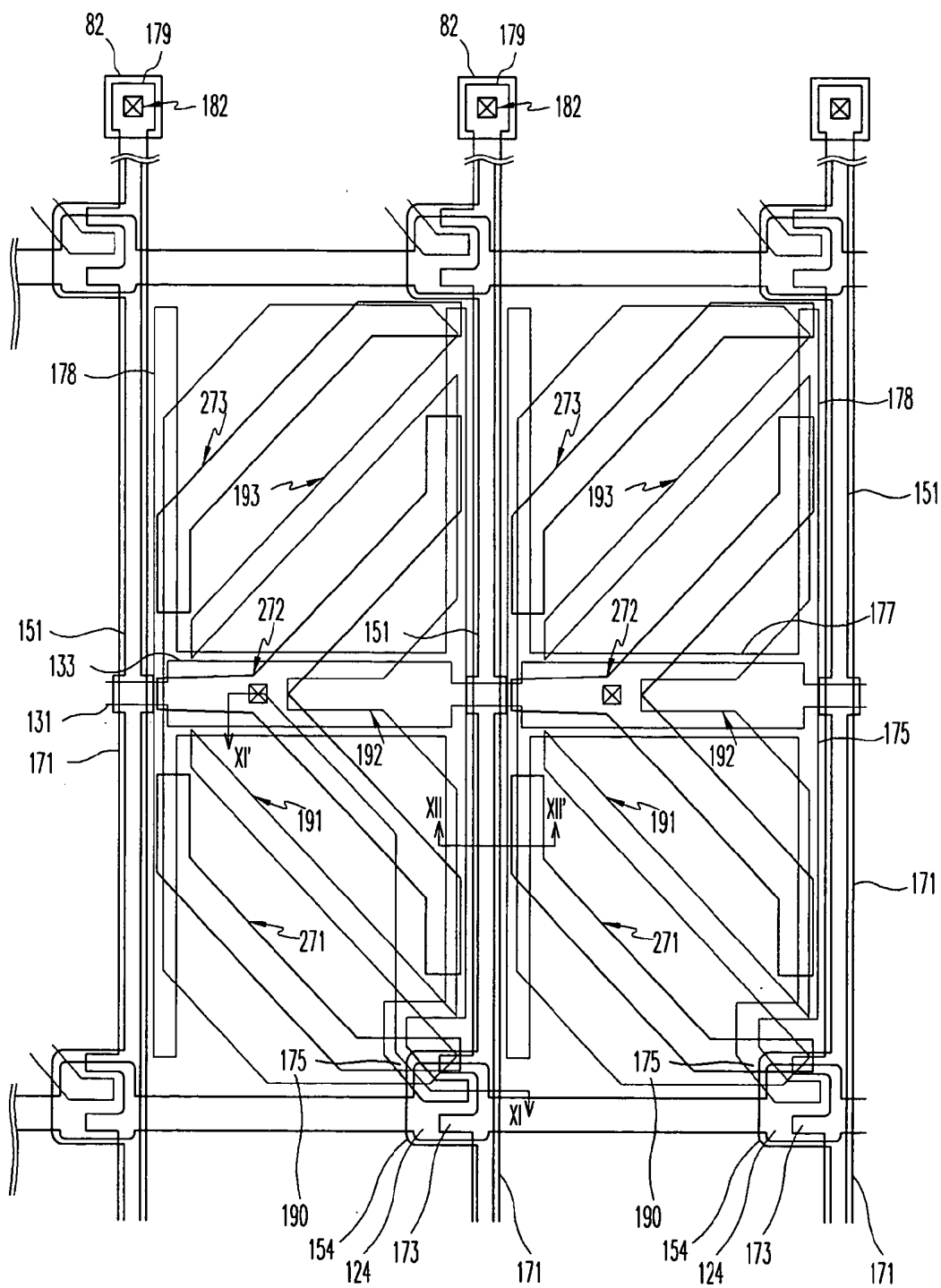


FIG.11

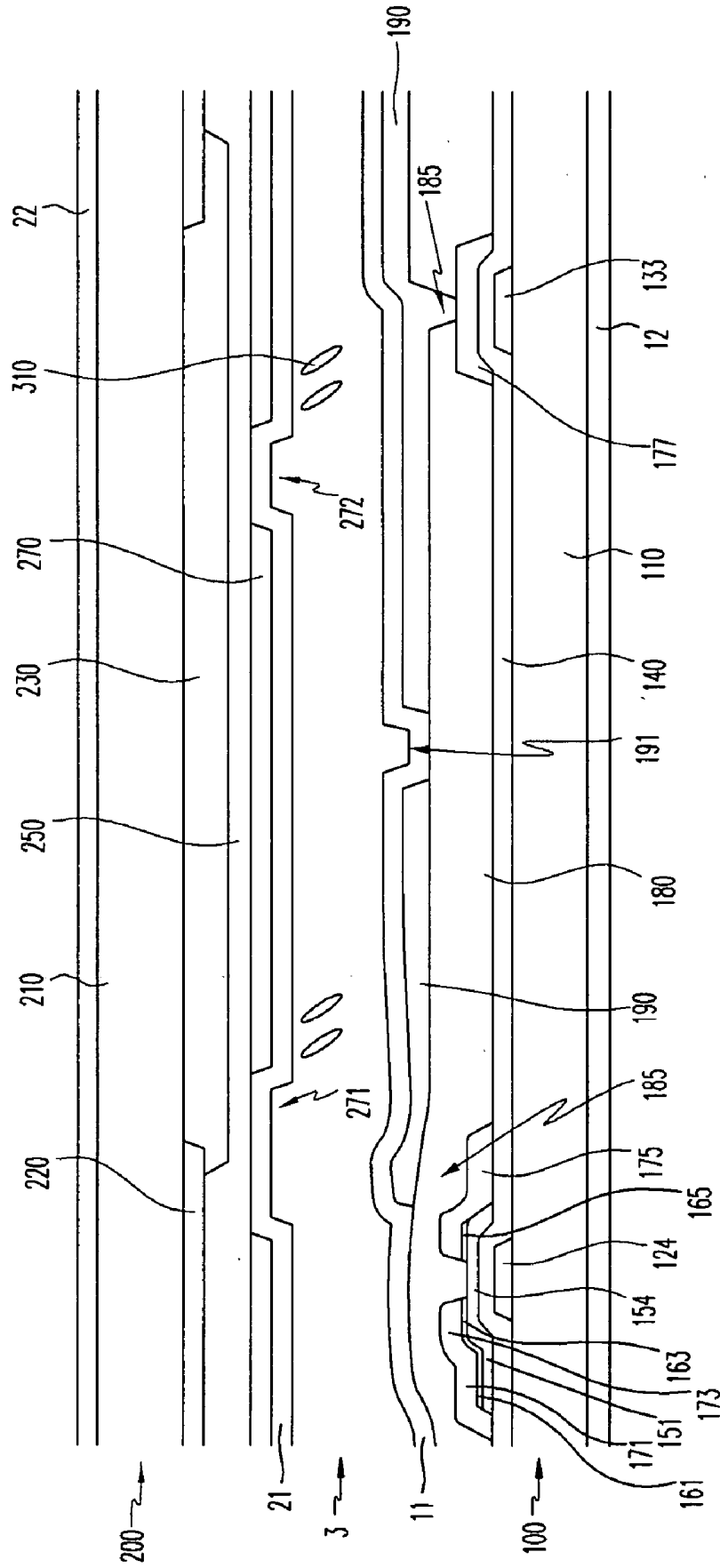


FIG.12

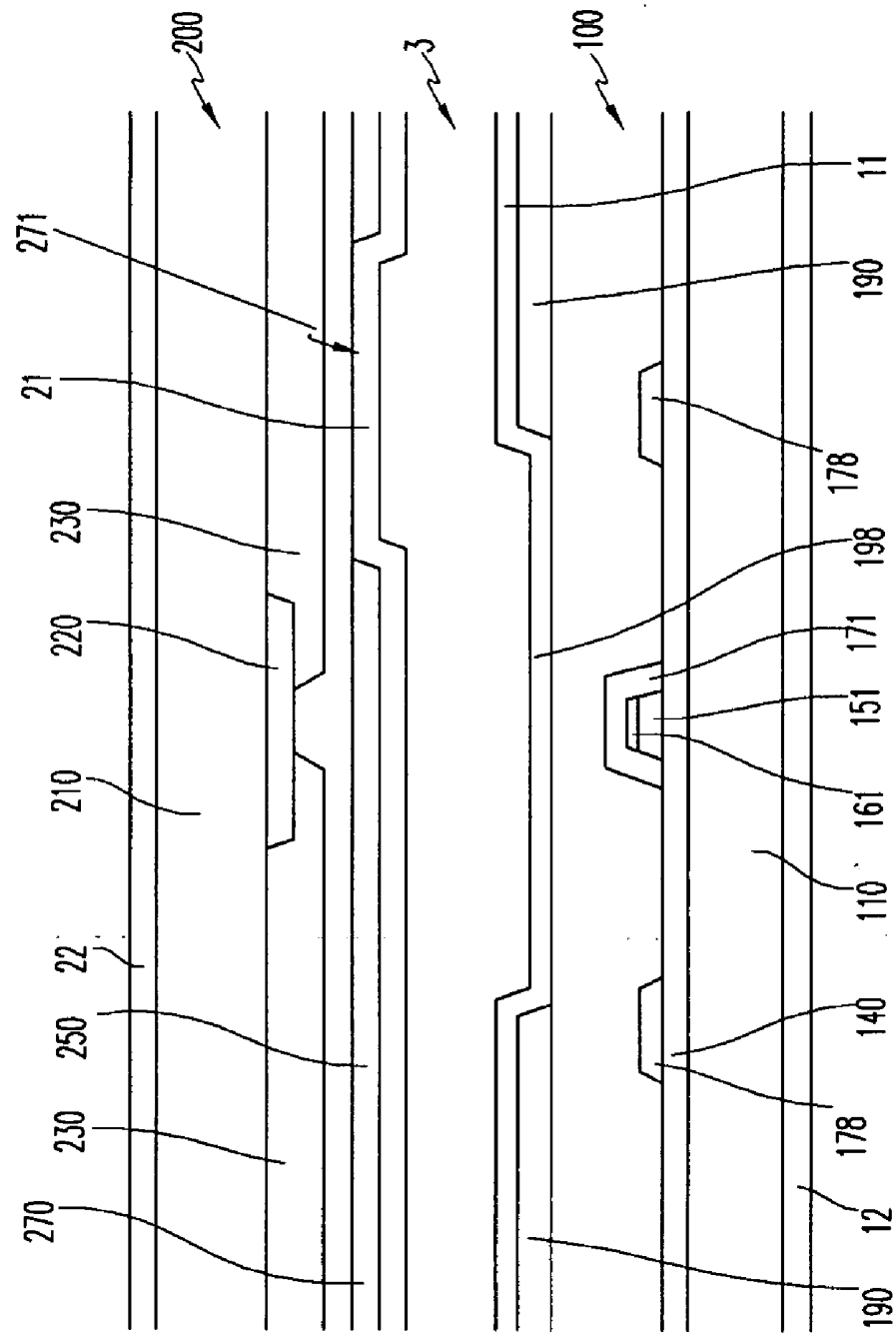


FIG.13

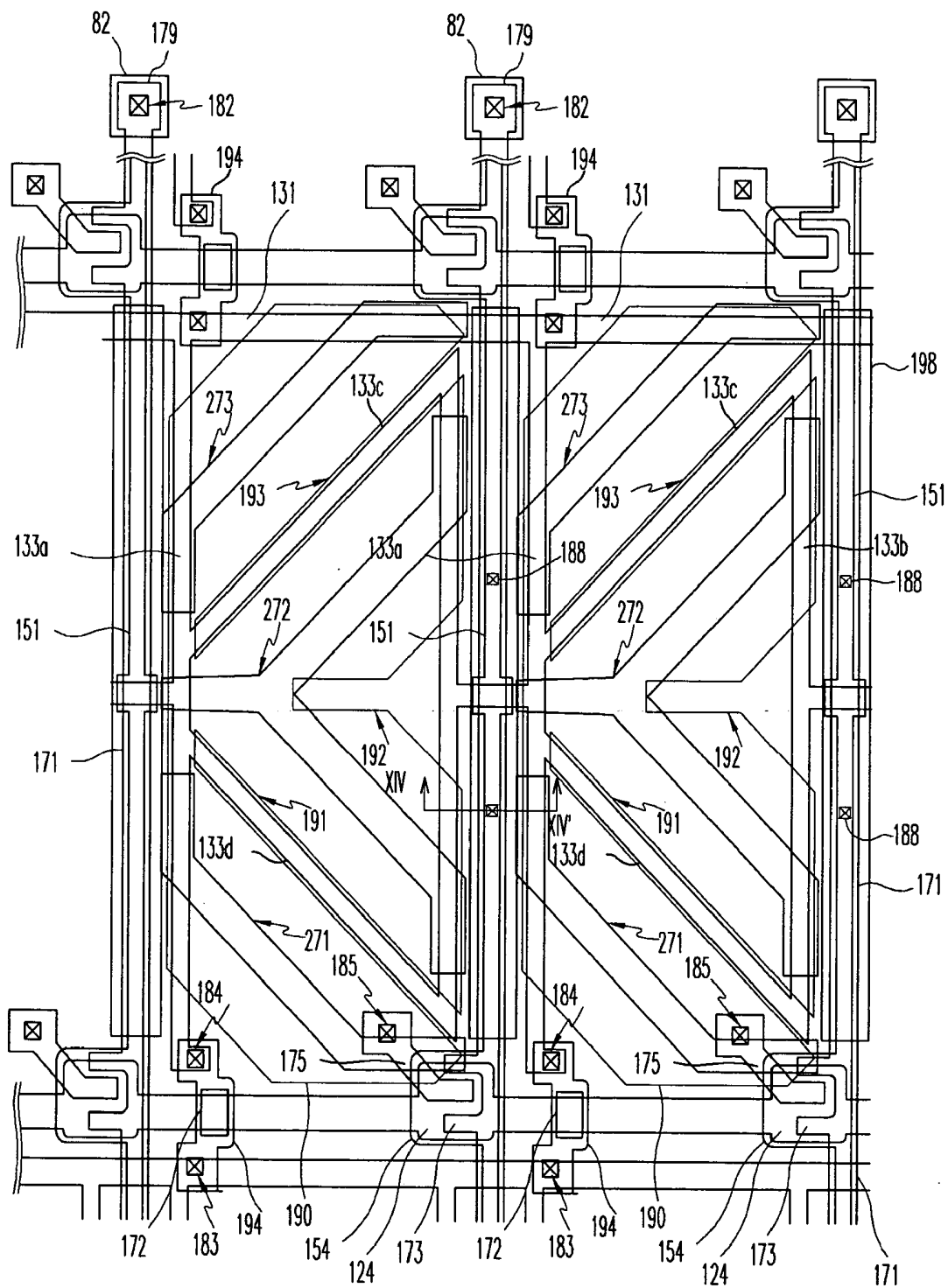
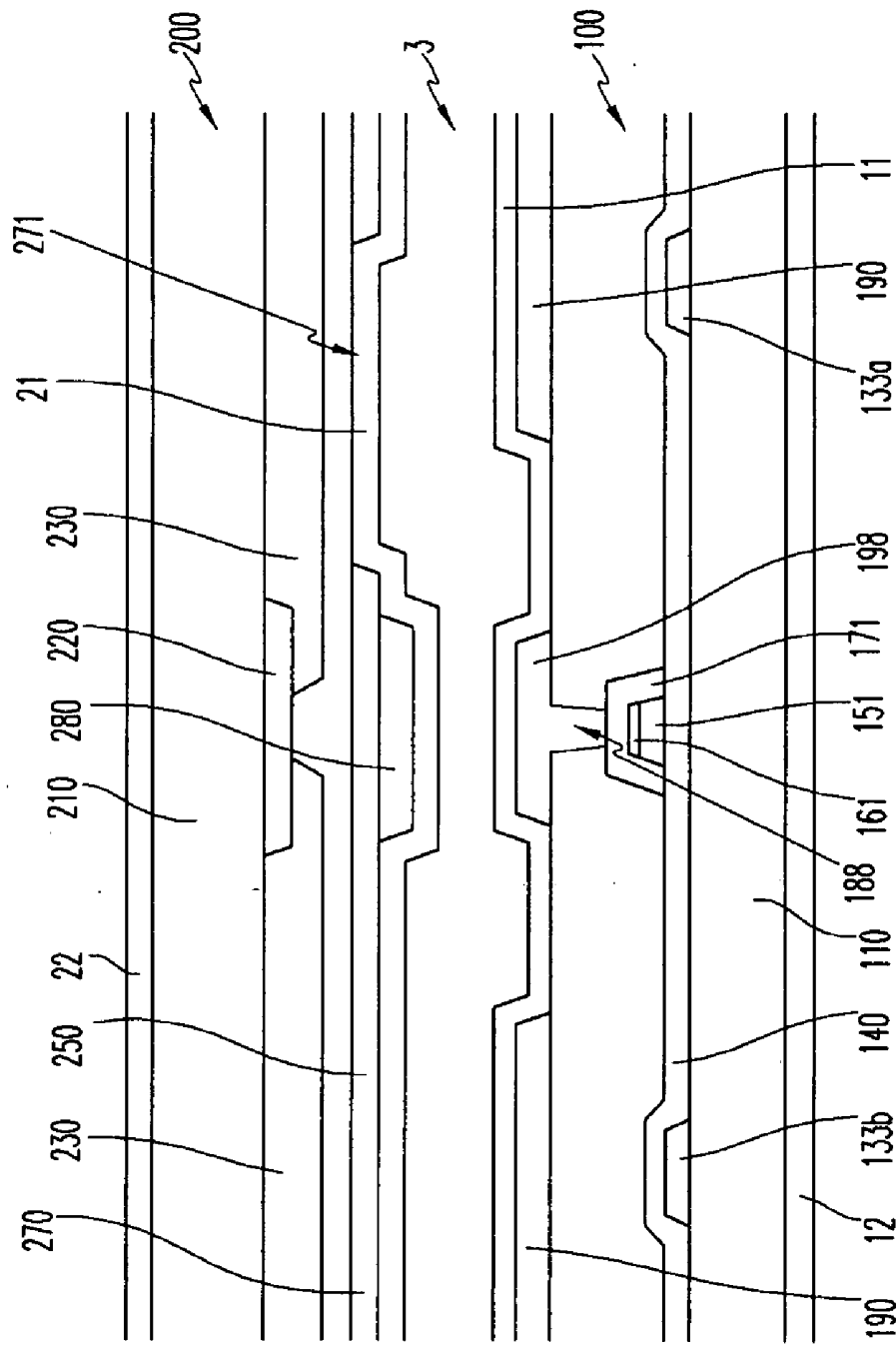


FIG. 14



LIQUID CRYSTAL DISPLAY AND PANEL THEREFOR

BACKGROUND OF THE INVENTION

[0001] (a) Field of the Invention

[0002] The present invention relates to a liquid crystal display and a panel therefor.

[0003] (b) Description of the Related Art

[0004] A liquid crystal display (LCD) is one of the most widely used flat panel displays. An LCD includes two panels provided with field-generating electrodes such as pixel electrodes and a common electrode and a liquid crystal (LC) layer interposed therebetween. The LCD displays images by applying voltages to the field-generating electrodes to generate an electric field in the LC layer, which determines orientations of LC molecules in the LC layer to adjust polarization of incident light.

[0005] When an active area on a backplane for LCDs is too large to use an exposure mask, the entire exposure is accomplished by repeating a divisional exposure called step-and-repeat process. One divisional exposure unit or area is called a shot. Since transition, rotation, distortion, and etc. are generated during light exposure, the shots are not aligned accurately. Accordingly, parasitic capacitances generated between signal lines and pixel electrodes differ depending on the shots, and this causes the luminance difference between the shots, which is recognized at the pixels located at a boundary between the shots. Therefore, the stitch defect is generated on the screen of the LCD due to luminance discontinuity between the shots.

[0006] In the meantime, a vertical alignment (VA) mode LCD, which aligns LC molecules such that the long axes of the LC molecules are perpendicular to the panels in absence of electric field, is spotlighted because of its high contrast ratio and wide reference viewing angle that is defined as a viewing angle making the contrast ratio equal to 1:10 or as a limit angle for the inversion in luminance between the grays.

[0007] The wide viewing angle of the VA mode LCD can be realized by cutouts in the field-generating electrodes and protrusions on the field-generating electrodes. Since the cutouts and the protrusions can determine the tilt directions of the LC molecules, the tilt directions can be distributed into several directions by using the cutouts and the protrusions such that the reference viewing angle is widened.

[0008] The VA mode LCD usually employs a normally black mode for obtaining high contrast ratio. However, this may decrease the lateral visibility such that the displayed image looks brighter and whiter as it goes to the sides.

SUMMARY OF THE INVENTION

[0009] A motivation of the present invention is to solve the problems of the conventional art.

[0010] A thin film transistor array panel is provided, which includes: a first signal line; a second signal line intersecting the first signal line; a thin film transistor connected to the first signal line and the second signal line; a pixel electrode connected to the thin film transistor; and an aligning member extending substantially parallel to the second signal line,

overlapping the second signal line, and having an edge closer to the pixel electrode than the second signal line.

[0011] The aligning member and the pixel electrode may be disposed on the same layer.

[0012] The alignment member may be connected to the second signal line.

[0013] A thin film transistor array panel is provided, which includes: a first signal line; a second signal line intersecting the first signal line; a thin film transistor connected to the first signal line and the second signal line; a pixel electrode connected to the thin film transistor; and an aligning member connected to the pixel electrode and having an edge closer to the pixel electrode than the second signal line.

[0014] The aligning member and the second signal line may be disposed on the same layer.

[0015] The thin film transistor may include a drain electrode connected to the pixel electrode and the aligning member.

[0016] A liquid crystal display is provided, which includes: a first panel including a first signal line, a second signal line intersecting the first signal line, a thin film transistor connected to the first signal line and the second signal line, a pixel electrode connected to the thin film transistor, and an aligning member extending substantially parallel to the second signal line and having an edge closer to the pixel electrode than the second signal line; a second panel facing the first panel and including a common electrode formed thereon; and a liquid crystal layer disposed between the first panel and the second panel.

[0017] A liquid crystal display is provided, which includes: a first panel including a first signal line, a second signal line intersecting the first signal line, a thin film transistor connected to the first signal line and the second signal line, a pixel electrode connected to the thin film transistor, and an aligning member connected to the pixel electrode and having an edge closer to the pixel electrode than the second signal line; a second panel facing the first panel and including a common electrode formed thereon; and a liquid crystal layer disposed between the first panel and the second panel.

[0018] The liquid crystal display may further include a tilt direction determining member disposed at least one of the first and the second panels and determining tilt directions of liquid crystal molecules of the liquid crystal layer.

[0019] The liquid crystal layer may have negative dielectric anisotropy and is subjected to vertical alignment.

[0020] The tilt direction determining member may include a cutout formed at the pixel electrode or the common electrode.

[0021] The tilt direction determining member may have a width ranging about 9-12 microns.

[0022] The tilt direction determining member may make an angle of about 45 degrees with the first signal line.

[0023] The tilt direction determining member may include a protrusion formed on the pixel electrode or the common electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present invention will become more apparent by describing embodiments thereof in detail with reference to the accompanying drawings in which:

[0025] **FIG. 1** is a layout view of a TFT array panel of an LCD according to an embodiment of the present invention;

[0026] **FIG. 2** is a layout view of a common electrode panel of an LCD according to an embodiment of the present invention;

[0027] **FIG. 3** is a layout view of an LCD including the TFT array panel shown in **FIG. 1** and the common electrode panel shown in **FIG. 2**;

[0028] **FIGS. 4 and 5** are sectional views of the LCD shown in **FIG. 3** taken along the lines IV-IV' and V-V';

[0029] **FIG. 6** is a layout view of an LCD according to another embodiment of the present invention;

[0030] **FIG. 7** is a sectional view of the LCD shown in **FIG. 6** taken along the line VII-VII';

[0031] **FIG. 8** is a layout view of an LCD according to another embodiment of the present invention;

[0032] **FIG. 9** is a sectional view of the LCD shown in **FIG. 8** taken along the line IX-IX';

[0033] **FIG. 10** is a layout view of an LCD according to another embodiment of the present invention;

[0034] **FIGS. 11 and 12** are sectional views of the LCD shown in **FIG. 10** taken along the lines XI-XI' and XII-XII';

[0035] **FIG. 13** is a layout view of an LCD according to another embodiment of the present invention; and

[0036] **FIG. 14** is a sectional view of the LCD shown in **FIG. 13** taken along the line XIII-XIII'.

DETAILED DESCRIPTION OF EMBODIMENTS

[0037] 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.

[0038] 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.

[0039] Now, liquid crystal displays and thin film transistor (TFT) array panels for LCDs according to embodiments of the present invention will be described with reference to the accompanying drawings.

[0040] An LCD according to an embodiment of the present invention will be described in detail with reference to **FIGS. 1-5**.

[0041] **FIG. 1** is a layout view of a TFT array panel of an LCD according to an embodiment of the present invention, **FIG. 2** is a layout view of a common electrode panel of an LCD according to an embodiment of the present invention, **FIG. 3** is a layout view of an LCD including the TFT array panel shown in **FIG. 1** and the common electrode panel shown in **FIG. 2**, and **FIGS. 4 and 5** are sectional views of the LCD shown in **FIG. 3** taken along the lines IV-IV' and V-V'.

[0042] 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** interposed between the panels **100** and **200**.

[0043] The TFT array panel **100** is now described in detail with reference **FIGS. 1 and 3-5**.

[0044] A plurality of gate lines **121** and a plurality of storage electrode lines **131** are formed on an insulating substrate **110** such as transparent glass.

[0045] The gate lines **121** extend substantially in a transverse direction and are separated from each other and transmit gate signals. Each gate line **121** includes a plurality of projections forming a plurality of gate electrodes **124** and may extend to be connected a driving circuit that may be integrated on the TFT array panel **100**. Each gate line **121** may include an end portion having a large area for contact with another layer or an external driving circuit.

[0046] Each storage electrode line **131** extends substantially in the transverse direction and is disposed between adjacent two of the gate lines **121** and close to upper one of the two gate lines **121**. Each storage electrode line **131** includes a plurality of sets of branches **133a-133d** and a plurality of connections **133e** connecting the branches **133a-133d**.

[0047] A set of branches **133a-133d** includes two longitudinal branches forming first and second storage electrodes **133a** and **133b** and spaced apart from each other and two oblique branches forming third and fourth storage electrodes **133c** and **133d** and connected between the first and the second storage electrodes **133a** and **133b**. In detail, the first storage electrode **133a** has a free end portion and a fixed end portion that is connected to the storage electrode line **131** and has a projection. The third and the fourth storage electrodes **133c** and **133d** extend approximately from a center of the first storage **133a** and upper and lower ends of the second storage electrode **133b**, respectively.

[0048] Each of the connections **133e** is connected between a first storage electrode **133a** of a set of storage electrodes **133a-133d** and a second storage electrode **133b** of another set of storage electrodes **133a-133d** adjacent thereto.

[0049] 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. Each storage electrode line **131** may include a pair of stems extending in the transverse direction.

[0050] The gate lines **121** and the storage electrode lines **131** are preferably made of Al containing metal such as Al and Al alloy, Ag containing metal such as Ag and Ag alloy, Cu containing metal such as Cu and Cu alloy, Mo containing metal such as Mo and Mo alloy, Cr, Ti or Ta. The gate lines

121 and the storage electrode lines **131** may have a multilayered structure including two films having different physical characteristics. One of the two films is preferably made of low resistivity metal including Al containing metal, Ag containing metal, and Cu containing metal for reducing signal delay or voltage drop in the gate lines **121** and the storage electrode lines **131**. The other film is preferably made of material such as Mo containing metal, Cr, Ta or Ti, which has good physical, chemical, and electrical contact characteristics with other materials such as indium tin oxide (ITO) or indium zinc oxide (IZO). Good examples of the combination of the two films are a lower Cr film and an upper Al—Nd alloy film and a lower Al film and an upper Mo film.

[0051] In addition, the lateral sides of the gate lines **121** and the storage electrode lines **131** are inclined relative to a surface of the substrate, and the inclination angle thereof ranges about 20-80 degrees.

[0052] A gate insulating layer **140** preferably made of silicon nitride (SiNx) is formed on the gate lines **121** and the storage electrode lines **131**.

[0053] A plurality of semiconductor stripes **151** preferably made of hydrogenated amorphous silicon (abbreviated to "a-Si") or polysilicon are formed on the gate insulating layer **140**. Each semiconductor stripe **151** extends substantially in the longitudinal direction and has a plurality of projections **154** branched out toward the gate electrodes **124**. The semiconductor stripes **151** become wide near the gate lines **121** and the storage electrode lines **131** such that the semiconductor stripes **151** cover large areas of the gate lines **121** and the storage electrode lines **131**.

[0054] A plurality of ohmic contact stripes and islands **161** and **165** preferably made of silicide or n+hydrogenated a-Si heavily doped with n type impurity such as phosphorous are formed on the semiconductor stripes **151**. Each ohmic contact stripe **161** has a plurality of projections **163**, and the projections **163** and the ohmic contact islands **165** are located in pairs on the projections **154** of the semiconductor stripes **151**.

[0055] The lateral sides of the semiconductor stripes **151** and the ohmic contacts **161** and **165** are inclined relative to a surface of the substrate, and the inclination angles thereof are preferably in a range between about 30-80 degrees.

[0056] A plurality of data lines **171**, a plurality of drain electrodes **175** separated from the data lines **171**, and a plurality of isolated metal pieces **172** are formed on the ohmic contacts **161** and **165** and the gate insulating layer **140**.

[0057] The data lines **171** for transmitting data voltages extend substantially in the longitudinal direction and intersecting the gate lines **121**, the storage electrode lines **131**, and the connections **133e** such that each data line **171** is disposed between the first and the second storage electrodes **133a** and **133b** in adjacent sets of the branches **133a-133d** of the storage electrode lines **131**. Each data line **171** includes an end portion **179** having a large area for contact with another layer or an external device and a plurality of source electrodes projecting toward the drain electrodes **175**.

[0058] Each drain electrode **175** includes an end portion having a large area for contact with another layer and

another end portion disposed on a gate electrode **124** and partly enclosed by a source electrode **173**. A gate electrode **124**, a source electrode **173**, and a drain electrode **175** along with a projection **154** of a semiconductor stripe **151** form a TFT having a channel formed in the projection **154** disposed between the source electrode **173** and the drain electrode **175**.

[0059] The metal pieces **172** are disposed on the gate lines **121** near the end portions of the storage electrodes **133a**.

[0060] The data lines **171**, the drain electrodes **175**, and the metal pieces **172** are preferably made of refractory metal such as Cr, Mo, Ti, Ta or alloys thereof. However, they may also have a multilayered structure including a low-resistivity film (not shown) and a good-contact film (not shown). A good example of the combination is a lower Mo film, an intermediate Al film, and an upper Mo film as well as the above-described combinations of a lower Cr film and an upper Al—Nd alloy film and a lower Al film and an upper Mo film.

[0061] 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.

[0062] The ohmic contacts **161** and **165** are interposed only between the underlying semiconductor stripes **151** and the overlying data lines **171** and the overlying drain electrodes **175** thereon and reduce the contact resistance therebetween. The semiconductor stripes **151** include a plurality of exposed portions, which are not covered with the data lines **171** and the drain electrodes **175**, such as portions located between the source electrodes **173** and the drain electrodes **175**. Although the semiconductor stripes **151** are narrower than the data lines **171** at most places, the width of the semiconductor stripes **151** becomes large near the gate lines **121** and the storage electrode lines **131** as described above, to smooth the profile of the surface, thereby preventing the disconnection of the data lines **171**.

[0063] A passivation layer **180** is formed on the data lines **171**, the drain electrodes **175**, the metal pieces **172**, and the exposed portions of the semiconductor stripes **151**. The passivation layer **180** is preferably made of inorganic insulator such as silicon nitride or silicon oxide, photosensitive organic material having a good flatness characteristic, or low dielectric insulating material having dielectric constant lower than 4.0 such as a-Si:C:O and a-Si:O:F formed by plasma enhanced chemical vapor deposition (PECVD). The passivation layer **180** may have a double-layered structure including a lower inorganic film and an upper organic film.

[0064] The passivation layer **180** has a plurality of contact holes **182** and **185** exposing the end portions **179** of the data lines **171** and the end portions of the drain electrodes **175**, respectively. The passivation layer **180** and the gate insulating layer **140** have a plurality of contact holes **183** exposing portions of the storage electrode lines **131** near the fixed end portions of the first storage electrodes **133a** and a plurality of contact holes **184** exposing the projections of the free end portions of the first storage electrodes **133a**.

[0065] A plurality of pixel electrodes **190**, a plurality of aligning members **198**, a plurality of contact assistants **82**, and a plurality of overpasses **194**, which are preferably made

of transparent conductor such as ITO or IZO or reflective conductor such as Ag or Al, are formed on the passivation layer 180.

[0066] 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.

[0067] The pixel electrodes 190 supplied with the data voltages generate electric fields in cooperation with the common electrode 270, which determine the orientations of liquid crystal molecules 310 in the liquid crystal layer 3.

[0068] A pixel electrode 190 and the common electrode 270 form 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 including the storage electrodes 133a-133d.

[0069] Each pixel electrode 190 is chamfered at its left corners and the chamfered edges of the pixel electrode 190 make an angle of about 45 degrees with the gate lines 121.

[0070] Each pixel electrode 190 has a lower cutout 191, a center cutout 192, and an upper cutout 193, which partition the pixel electrode 190 into a plurality of partitions. The cutouts 191-193 substantially have an inversion symmetry with respect to an imaginary transverse line bisecting the pixel electrode 190.

[0071] The lower and the upper cutouts 191 and 193 obliquely extend from a right edge of the pixel electrode 190 near an upper right corner approximately to a center of a left edge of the pixel electrode 190 and overlap the third and the fourth storage electrodes 133c and 133d. The lower and the upper cutouts 191 and 193 they are disposed at lower and upper halves of the pixel electrode 190, respectively, which can be divided by the imaginary transverse line. The lower and the upper cutouts 191 and 193 make an angle of about 45 degrees to the gate lines 121, and they extend substantially perpendicular to each other.

[0072] The center cutout 192 extends along the imaginary transverse line and has an inlet from the right edge of the pixel electrode 190, which has a pair of inclined edges substantially parallel to the lower cutout 191 and the upper cutout 193, respectively.

[0073] Accordingly, the lower half of the pixel electrode 190 is partitioned into two lower partitions by the lower cutout 191 and the upper half of the pixel electrode 190 is also partitioned into two upper partitions by the upper cutout 193. The number of partitions or the number of the cutouts is varied depending on the design factors such as the size of pixels, the ratio of the transverse edges and the longitudinal edges of the pixel electrodes, the type and characteristics of the liquid crystal layer 3, and so on.

[0074] The aligning members 198 extend along the data lines 171 and fully cover the data lines 171 such that edges of the aligning members 198 are closer to the pixel electrodes 190 than the data lines 171. The aligning members 198 are floating, but they may be connected to the data lines 171 through contact holes (not shown) penetrating the gate

insulating layer 140 and the passivation layer 180. Total parasitic capacitance between the data lines 171 and the pixel electrodes 190 and between the aligning members 198 and the pixel electrodes 190 is almost determined by the latter. In addition, the distance between the pixel electrodes 190 and the aligning members 198 can be uniformly maintained since they are made of the same layer. Accordingly, the parasitic capacitance of the pixel electrodes can be made uniform and thus the stitch defect due to a divisional exposure can be reduced.

[0075] The aligning members 198 can serve as detour of disconnected data lines 171 and the length of an alignment member 198 may be longer than that of two or more pixel electrodes 190.

[0076] The contact assistants 82 are connected to the end portions 179 of the data lines 171 through the contact holes 182. The contact assistants 82 protect the end portions 179 and complement the adhesion of the end portions 179 and external devices.

[0077] The overpasses 194 cross over the gate lines 121 and they are connected to the exposed projection of the fixed end portions of the first storage electrodes 133a and the exposed portions of the storage electrode lines 131 through the contact holes 184 and 183, respectively, which are disposed opposite each other with respect to the gate lines 121. The overpasses 194 overlaps the metal pieces 172 and they may be electrically connected to the metal pieces 172. The storage electrode lines 131 including the storage electrodes 133a-133d along with the overpasses 194 and the metal pieces 172 are used for repairing defects in the gate lines 121, the data lines 171, or the TFTs. The electrical connection between the gate lines 121 and the storage electrode lines 131 for repairing the gate lines 121 is obtained by illuminating the cross points of the gate lines 121 and the overpasses 194 by a laser beam to electrically connect the gate lines 121 to the overpasses 194. In this case, the metal pieces 172 enhance the electrical connection between the gate lines 121 and the overpasses 194.

[0078] The description of the common electrode panel 200 follows with reference to FIGS. 2-5.

[0079] A light blocking member 220 called a black matrix for preventing light leakage is formed on an insulating substrate 210 such as transparent glass. The light blocking member 220 may include a plurality of openings that face the pixel electrodes 190 and may have substantially the same planar shape as the pixel electrodes 190. Otherwise, the light blocking member 220 may include linear portions corresponding to the data lines 171 and other portions corresponding to the TFTs.

[0080] A plurality of color filters 230 are formed on the substrate 210 and they are disposed substantially in the areas enclosed by the light blocking member 220. The color filters 230 may extend substantially along the longitudinal direction along the pixel electrodes 190. The color filters 230 may represent one of the primary colors such as red, green and blue colors.

[0081] An overcoat 250 for preventing the color filters 230 from being exposed and for providing a flat surface is formed on the color filters 230 and the light blocking member 220.

[0082] A common electrode **270** preferably made of transparent conductive material such as ITO and IZO is formed on the overcoat **250**.

[0083] The common electrode **270** has a plurality of sets of cutouts **271-273**.

[0084] A set of cutouts **271-273** face a pixel electrode **190** and include a lower cutout **271**, a center cutout **272**, and an upper cutout **273**. Each of the cutouts **271-273** is disposed between adjacent cutouts **191-193** of the pixel electrode **190** or between a cutout **191** or **193** and a chamfered edge of the pixel electrode **190**. In addition, each of the cutouts **271-273** has at least an oblique portion extending parallel to the lower cutout **191** or the upper cutout **193** of the pixel electrode **190**. The cutouts **271-273** have substantially an inversion symmetry with respect to the above-described transverse line bisecting the pixel electrode **190**.

[0085] Each of the lower and upper cutouts **271** and **273** includes an oblique portion extending approximately from a left edge of the pixel electrode **190** approximately to lower or upper edge of the pixel electrode **190**, and transverse and longitudinal portions extending from respective ends of the oblique portion along edges of the pixel electrode **190**, overlapping the edges of the pixel electrode **190**, and making obtuse angles with the oblique portion.

[0086] The center cutout **272** includes a central transverse portion extending approximately from the left edge of the pixel electrode **190** along the third storage electrode **133c**, a pair of oblique portions extending from an end of the central transverse portion approximately to a right edge of the pixel electrode and making obtuse angles with the central transverse portion, and a pair of terminal longitudinal portions extending from the ends of the respective oblique portions along the right edge of the pixel electrode **190**, overlapping the right edge of the pixel electrode **190**, and making obtuse angles with the respective oblique portions.

[0087] The number of the cutouts **271-273** may be varied depending on the design factors, and the light blocking member **220** may also overlap the cutouts **271-273** to block the light leakage through the cutouts **271-273**.

[0088] Alignment layers **11** and **21** that may be homeotropic are coated on inner surfaces of the panels **100** and **200**, and polarizers **12** and **22** are provided on outer surfaces of the panels **100** and **200** such that their polarization axes may be crossed and one of the transmissive axes may be parallel to the gate lines **121**. One of the polarizers may be omitted when the LCD is a reflective LCD.

[0089] The LCD may further include at least one retardation film (not shown) for compensating the retardation of the LC layer **3**. The retardation film has birefringence and gives a retardation opposite to that given by the LC layer **3**. The retardation film may include uniaxial or biaxial optical compensation film, in particular, negative uniaxial compensation film.

[0090] The LCD may further include a backlight unit (not shown) supplying light to the LC layer **3** through the polarizers **12** and **22**, the retardation film, and the panels **100** and **200**.

[0091] It is preferable that the LC layer **3** has negative dielectric anisotropy and it is subjected to a vertical alignment that the LC molecules **310** in the LC layer **3** are aligned

such that their long axes are substantially vertical to the surfaces of the panels **100** and **200** in absence of electric field. Accordingly, incident light cannot pass the crossed polarization system **12** and **22**.

[0092] As shown in FIG. 3, a set of the cutouts **191-193** and **271-273** divides a pixel electrode **190** into a plurality of sub-areas and each sub-area has two major edges.

[0093] The cutouts **191-193** and **271-273** control the tilt directions of the LC molecules in the LC layer **3**. This will be described in detail.

[0094] Upon application of the common voltage to the common electrode **270** and a data voltage to the pixel electrodes **190**, an electric field substantially perpendicular to the surfaces of the panels **100** and **200** is generated. The LC molecules **310** tend to change their orientations in response to the electric field such that their long axes are perpendicular to the field direction.

[0095] The cutouts **191-193** and **271-273** of the electrodes **190** and **270** and the edges of the pixel electrodes **190** distort the electric field to have a horizontal component that is substantially perpendicular to the edges of the cutouts **191-193** and **271-273** and the edges of the pixel electrodes **190**. Accordingly, the LC molecules on each sub-area are tilt in a direction by the horizontal component and the azimuthal distribution of the tilt directions are localized to four directions, thereby increasing the viewing angle of the LCD.

[0096] The width of the cutouts **191-193** and **271-273** is preferably in a range between about nine microns to about twelve microns.

[0097] At least one of the cutouts **191-193** and **271-273** can be substituted with protrusions (not shown) or depressions (not shown). The protrusions are preferably made of organic or inorganic material and disposed on or under the field-generating electrodes **190** or **270** and have a width of about five microns to about ten microns.

[0098] The shapes and the arrangements of the cutouts **191-193** and **271-273** may be modified.

[0099] Since the tilt directions of all domains make an angle of about 45 degrees with the gate lines **121**, which are parallel to or perpendicular to the edges of the panels **100** and **200**, and the 45-degree intersection of the tilt directions and the transmissive axes of the polarizers **12** and **22** gives maximum transmittance, the polarizers **12** and **22** can be attached such that the transmissive axes of the polarizers **12** and **22** are parallel to or perpendicular to the edges of the panels **100** and **200** and it reduces the production cost.

[0100] An LCD according to another embodiment of the present invention will be described in detail with reference to FIGS. 6 and 7.

[0101] FIG. 6 is a layout view of an LCD according to another embodiment of the present invention, and FIG. 7 is a sectional view of the LCD shown in FIG. 6 taken along the line VII-VII'.

[0102] Referring to FIGS. 6 and 7, an LCD according to this embodiment also includes a TFT array panel **100**, a common electrode panel **200**, a LC layer **3** interposed between the panels **100** and **200**, and a pair of polarizers **12** and **22** attached on outer surfaces of the panels **100** and **200**.

[0103] Layered structures of the panels **100** and **200** according to this embodiment are almost the same as those shown in **FIGS. 1-5**.

[0104] Regarding the TFT array panel **100**, a plurality of gate lines **121** including gate electrodes **124** and a plurality of storage electrode lines **131** are formed on a substrate **110**, and a gate insulating layer **140**, a plurality of semiconductor stripes **151** including projections **154**, and a plurality of ohmic contact stripes **161** including projections **163** and a plurality of ohmic contact islands **165** are sequentially formed thereon. A plurality of data lines **171** including source electrodes **173** and end portions **179**, a plurality of drain electrodes **175**, and a plurality of isolated metal pieces **172** are formed on the ohmic contacts **161** and **165**, and a passivation layer **180** is formed thereon. A plurality of contact holes **182-185** are provided at the passivation layer **180** and the gate insulating layer **140**. A plurality of pixel electrodes **190** having a plurality of cutouts **191-193**, a plurality of aligning members **198**, a plurality of contact assistants **82**, and a plurality of overpasses **194** are formed on the passivation layer **180**, and an alignment layer **11** is coated thereon.

[0105] Regarding the common electrode panel **200**, a light blocking member **220**, a plurality of color filters **230**, an overcoat **250**, a common electrode **270** having a plurality of cutouts **271-273**, and an alignment layer **21** are formed on an insulating substrate **210**.

[0106] Different from the LCD shown in **FIGS. 1-5**, the semiconductor stripes **151** of the TFT array panel **100** according to this embodiment have almost the same planar shapes as the data lines **171** and the drain electrodes **175** as well as the underlying ohmic contacts **161** and **165**. However, the projections **154** of the semiconductor stripes **151** include some exposed portions, which are not covered with the data lines **171** and the drain electrodes **175**, such as portions located between the source electrodes **173** and the drain electrodes **175**.

[0107] Furthermore, the TFT array panel **100** further includes a plurality of semiconductor islands (not shown) and a plurality of ohmic contact islands (not shown) disposed thereon, which are disposed on the metal pieces **172**.

[0108] Moreover, the storage electrodes **133b** have triangular protrusions having edges substantially parallel to oblique edges of the cutouts **192**.

[0109] In addition, the gate lines **121** have expanded end portion **129**, respectively. Accordingly, a plurality of contact holes **181** exposing the end portions **129** of the gate lines **121** are provided at the gate insulating layer **140** and the passivation layer **180**, and a plurality of contact assistants **81** connected to the end portions **129** through the contact holes **181** are additionally provided.

[0110] A manufacturing method of the TFT array panel according to an embodiment simultaneously forms the data lines **171**, the drain electrodes **175**, the metal pieces **172**, the semiconductors **151**, and the ohmic contacts **161** and **165** using one photolithography process.

[0111] A photoresist pattern for the photolithography process has position-dependent thickness, and in particular, it has first and second portions with decreased thickness. The first portions are located on wire areas that will be occupied by the data lines **171**, the drain electrodes **175**, and the metal pieces **172** and the second portions are located on channel areas of TFTs.

[0112] The position-dependent thickness of the photoresist is obtained by several techniques, for example, by providing translucent areas on the exposure mask as well as transparent areas and light blocking opaque areas. The translucent areas may have a slit pattern, a lattice pattern, a thin film(s) with intermediate transmittance or intermediate thickness. When using a slit pattern, it is preferable that the width of the slits or the distance between the slits is smaller than the resolution of a light exposer used for the photolithography. Another example is to use reflowable photoresist. In detail, once a photoresist pattern made of a reflowable material is formed by using a normal exposure mask only with transparent areas and opaque areas, it is subject to reflow process to flow onto areas without the photoresist, thereby forming thin portions.

[0113] As a result, the manufacturing process is simplified by omitting a photolithography step.

[0114] Many of the above-described features of the LCD shown in **FIGS. 1-5** may be appropriate to the TFT array panel shown in **FIGS. 6 and 7**.

[0115] An LCD according to another embodiment of the present invention will be described in detail with reference to **FIGS. 8 and 9**.

[0116] **FIG. 8** is a layout view of an LCD according to another embodiment of the present invention, and **FIG. 9** is a sectional view of the LCD shown in **FIG. 8** taken along the line IX-IX'.

[0117] Referring to **FIGS. 8 and 9**, an LCD according to this embodiment also includes a TFT array panel **100**, a common electrode panel **200**, a LC layer **3** interposed between the panels **100** and **200**, and a pair of polarizers **12** and **22** attached on outer surfaces of the panels **100** and **200**.

[0118] Layered structures of the panels **100** and **200** according to this embodiment are almost the same as those shown in **FIGS. 1-4**.

[0119] Regarding the TFT array panel **100**, a plurality of gate lines **121** including gate electrodes **124** and a plurality of storage electrode lines **131** are formed on a substrate **110**, and a gate insulating layer **140**, a plurality of semiconductor stripes **151** including projections **154**, and a plurality of ohmic contact stripes **161** including projections **163** and a plurality of ohmic contact islands **165** are sequentially formed thereon. A plurality of data lines **171** including source electrodes **173** and end portions **179**, a plurality of drain electrodes **175**, and a plurality of isolated metal pieces **172** are formed on the ohmic contacts **161** and **165**, and a passivation layer **180** is formed thereon. A plurality of contact holes **182-185** are provided at the passivation layer **180** and the gate insulating layer **140**, and a plurality of pixel electrodes **190** having a plurality of cutouts **191-193**, a plurality of aligning members **198**, a plurality of contact assistants **82**, and a plurality of overpasses **194** are formed on the passivation layer **180**.

[0120] Regarding the common electrode panel **200**, a light blocking member **220**, an overcoat **250**, a common electrode **270** including a plurality of cutouts **271-273**, and an alignment layer **21** are formed on an insulating substrate **210**.

[0121] Different from the LCD shown in **FIGS. 1-5**, the TFT array panel **100** includes a plurality of color filter stripes **230** disposed under the passivation layer **180**, while the TFT array panel **100** has no color filter. The color filter stripes **230** extend along a longitudinal direction and edges of adjacent two of the color filter stripes **230** exactly match

with each other on the data lines 171, but the color filters 230 may overlap each other to block the light leakage between the pixel electrodes 190, or may be spaced apart from each other. When the color filters 230 overlap each other, a light blocking member 220 disposed on a common electrode panel 200 may be omitted.

[0122] The light blocking member 220 may be also disposed on the TFT array panel 100 rather than the common electrode panel 200.

[0123] Many of the above-described features of the LCD shown in FIGS. 1-5 may be appropriate to the TFT array panel shown in FIGS. 8 and 9.

[0124] An LCD according to another embodiment of the present invention will be described in detail with reference to FIGS. 10-11.

[0125] FIG. 10 is a layout view of an LCD according to another embodiment of the present invention, and FIGS. 11 and 12 are sectional views of the LCD shown in FIG. 10 taken along the lines XI-XI' and XII-XII'.

[0126] Referring to FIGS. 10-12, an LCD according to this embodiment also includes a TFT array panel 100, a common electrode panel 200, a LC layer 3 interposed between the panels 100 and 200, and a pair of polarizers 12 and 22 attached on outer surfaces of the panels 100 and 200.

[0127] Layered structures of the panels 100 and 200 according to this embodiment are almost the same as those shown in FIGS. 1-5.

[0128] Regarding the TFT array panel 100, a plurality of gate lines 121 including gate electrodes 124 and a plurality of storage electrode lines 131 are formed on a substrate 110, and a gate insulating layer 140, a plurality of semiconductor stripes 151 including projections 154, and a plurality of ohmic contact stripes 161 including projections 163 and a plurality of ohmic contact islands 165 are sequentially formed thereon. A plurality of data lines 171 including source electrodes 173 and end portions 179 and a plurality of drain electrodes 175 are formed on the ohmic contacts 161 and 165 and the gate insulating layer 140, and a passivation layer 180 is formed thereon. A plurality of contact holes 182 and 185 are provided at the passivation layer 180 and the gate insulating layer 140. A plurality of pixel electrodes 190 having a plurality of cutouts 191-193 and a plurality of contact assistants 82 are formed on the passivation layer 180 and an alignment layer 11 is coated thereon.

[0129] Regarding the common electrode panel 200, a light blocking member 220, a plurality of color filters 230, an overcoat 250, a common electrode 270 including a plurality of cutouts 271-273, and an alignment layer 21 are formed on an insulating substrate 210.

[0130] Different from the LCD shown in FIGS. 1-5, the storage electrode lines 131 are substantially linear and substantially equidistant from adjacent gate lines 121. The storage electrodes lines 131 have a plurality of expansions protruding upward and downward. Furthermore, there is no overpass, no contact hole related thereto, and no isolated metal piece.

[0131] In addition, each of the drain electrodes 175 extends to form an aligning member 178 that includes a pair of longitudinal portions extending substantially parallel to the data lines 171 and disposed adjacent to respective data lines 171 and a pixel electrode 190 and a transverse portion

177 connecting the two longitudinal portions and overlapping the expansion of a storage electrode line 131. The longitudinal portions have edges closer to the pixel electrodes 190 than the data lines 171. In other words, the longitudinal portions have edges disposed between the pixel electrodes 190 and the data lines 171. Accordingly, the parasitic capacitance between the pixel electrodes 190 and the data lines 171 is substantially equal to the parasitic capacitance between the aligning members 178 and the data lines 171, which is uniform.

[0132] Many of the above-described features of the LCD shown in FIGS. 1-5 may be appropriate to the TFT array panel shown in FIGS. 10-12.

[0133] An LCD according to another embodiment of the present invention will be described in detail with reference to FIGS. 13 and 14.

[0134] FIG. 13 is a layout view of an LCD according to another embodiment of the present invention, and FIG. 14 is a sectional view of the LCD shown in FIG. 13 taken along the line XIII-XIII'.

[0135] Referring to FIGS. 11 and 12, an LCD according to this embodiment also includes a TFT array panel 100, a common electrode panel 200, a LC layer 3 interposed between the panels 100 and 200, and a pair of polarizers 12 and 22 attached on outer surfaces of the panels 100 and 200.

[0136] Layered structures of the panels 100 and 200 according to this embodiment are almost the same as those shown in FIGS. 13 and 14.

[0137] Regarding the TFT array panel 100, a plurality of gate lines 121 including gate electrodes 124 and a plurality of storage electrode lines 131 are formed on a substrate 110, and a gate insulating layer 140, a plurality of semiconductor stripes 151 including projections 154, and a plurality of ohmic contact stripes 161 including projections 163 and a plurality of ohmic contact islands 165 are sequentially formed thereon. A plurality of data lines 171 including source electrodes 173 and end portions 179, a plurality of drain electrodes 175, and a plurality of isolated metal pieces 172 are formed on the ohmic contacts 161 and 165, and a passivation layer 180 is formed thereon. A plurality of contact holes 182-185 are provided at the passivation layer 180 and the gate insulating layer 140. A plurality of pixel electrodes 190 having a plurality of cutouts 191-193, a plurality of aligning members 198, a plurality of contact assistants 82, and a plurality of overpasses 194 are formed on the passivation layer 180.

[0138] Regarding the common electrode panel 200, a light blocking member 220, an overcoat 250, a common electrode 270 including a plurality of cutouts 271-273, and an alignment layer 21 are formed on an insulating substrate 210.

[0139] Different from the LCD shown in FIGS. 1-5, the passivation layer 180 has a plurality of contact holes 188 exposing the data lines 171 and the aligning members 198 are connected to the data lines 171 through the contact holes 188.

[0140] In addition, the common electrode panel 200 includes a plurality of short-circuit prevention members 280 disposed on the common electrode 270 and facing the aligning members 198. The short-circuit prevention members 280 prevents the direct contact between the common electrode 270 and the aligning members 198. The short-circuit prevention members 280 may be formed along with

columnar spacers for maintaining a gap between the panels **100** and **200** by using a mask having position-dependent light transmittance.

[0141] Many of the above-described features of the LCD shown in **FIGS. 1-5** may be appropriate to the TFT array panel shown in **FIGS. 13 and 14**.

[0142] While the present invention has been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the appended claims.

What is claimed is:

1. A thin film transistor array panel comprising:
 - a first signal line;
 - a second signal line intersecting the first signal line;
 - a thin film transistor connected to the first signal line and the second signal line;
 - a pixel electrode connected to the thin film transistor; and
 - an aligning member extending substantially parallel to the second signal line, overlapping the second signal line, and having an edge closer to the pixel electrode than the second signal line.
2. The thin film transistor array panel of claim 1, wherein the aligning member and the pixel electrode are disposed on the same layer.
3. The thin film transistor array panel of claim 1, wherein the aligning member is connected to the second signal line.
4. A liquid crystal display comprising:
 - a first panel including a first signal line, a second signal line intersecting the first signal line, a thin film transistor connected to the first signal line and the second signal line, a pixel electrode connected to the thin film transistor, and an aligning member extending substantially parallel to the second signal line and having an edge closer to the pixel electrode than the second signal line;
 - a second panel facing the first panel and including a common electrode formed thereon; and
 - a liquid crystal layer disposed between the first panel and the second panel.
5. The liquid crystal display of claim 4, further comprising a tilt direction determining member disposed at least one of the first and the second panels and determining tilt directions of liquid crystal molecules of the liquid crystal layer.
6. The liquid crystal display of claim 5, wherein the liquid crystal layer has negative dielectric anisotropy and is subjected to vertical alignment.
7. The liquid crystal display of claim 5, wherein the tilt direction determining member comprises a cutout formed at the pixel electrode or the common electrode.
8. The liquid crystal display of claim 7, wherein the tilt direction determining member has a width ranging about 9-12 microns.

9. The liquid crystal display of claim 5, wherein the tilt direction determining member makes an angle of about 45 degrees with the first signal line.

10. The liquid crystal display of claim 5, wherein the tilt direction determining member comprises a protrusion formed on the pixel electrode or the common electrode.

11. A thin film transistor array panel comprising:

- a first signal line;
- a second signal line intersecting the first signal line;
- a thin film transistor connected to the first signal line and the second signal line;
- a pixel electrode connected to the thin film transistor; and
- an aligning member connected to the pixel electrode and having an edge closer to the second signal line than the pixel electrode.

12. The thin film transistor array panel of claim 11, wherein the aligning member and the second signal line are disposed on the same layer.

13. The thin film transistor array panel of claim 11, wherein the thin film transistor comprises a drain electrode connected to the pixel electrode and the aligning member.

14. A liquid crystal display comprising:

- a first panel including a first signal line, a second signal line intersecting the first signal line, a thin film transistor connected to the first signal line and the second signal line, a pixel electrode connected to the thin film transistor, and an aligning member connected to the pixel electrode and having an edge closer to the second signal line than the pixel electrode;

- a second panel facing the first panel and including a common electrode formed thereon; and

- a liquid crystal layer disposed between the first panel and the second panel.

15. The liquid crystal display of claim 14, further comprising a tilt direction determining member disposed at least one of the first and the second panels and determining tilt directions of liquid crystal molecules of the liquid crystal layer.

16. The liquid crystal display of claim 15, wherein the liquid crystal layer has negative dielectric anisotropy and is subjected to vertical alignment.

17. The liquid crystal display of claim 15, wherein the tilt direction determining member comprises a cutout formed at the pixel electrode or the common electrode.

18. The liquid crystal display of claim 17, wherein the tilt direction determining member has a width ranging about 9-12 microns.

19. The liquid crystal display of claim 15, wherein the tilt direction determining member makes an angle of about 45 degrees with the first signal line.

20. The liquid crystal display of claim 15, wherein the tilt direction determining member comprises a protrusion formed on the pixel electrode or the common electrode.

* * * * *

专利名称(译)	液晶显示器及其面板		
公开(公告)号	US20050134540A1	公开(公告)日	2005-06-23
申请号	US11/016475	申请日	2004-12-16
[标]申请(专利权)人(译)	三星电子株式会社		
申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KIM DONG GYU		
发明人	KIM, DONG-GYU		
IPC分类号	G02F1/1368 G02F1/133 G02F1/1333 G02F1/1343 G02F1/136 G02F1/139 G09F9/30 H01L29/786 H04N7/01		
CPC分类号	G02F1/133707 G02F1/1393 G02F1/134336		
优先权	1020030094066 2003-12-19 KR		
其他公开文献	US7538842		
外部链接	Espacenet USPTO		

摘要(译)

提供一种液晶显示器，包括：基板；形成在基板上的场产生电极；斜面构件形成在基板上并具有小于约45度的倾斜角。

