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(54) **LIQUID CRYSTAL DISPLAY**

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G02F 1/1343 (2006.01)

(52) **U.S. Cl.** **349/156; 349/130; 349/141**

(58) **Field of Classification Search** **349/129-130, 349/139, 141, 155-156**

See application file for complete search history.

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(57) **ABSTRACT**

A liquid crystal display includes; first and second substrates facing each other, a liquid crystal layer interposed between the first and second substrates and including liquid crystal molecules, a first subpixel electrode disposed on the first substrate, the first subpixel electrode receiving a first data voltage, a second subpixel electrode disposed on the first substrate, the second subpixel electrode receiving a second data voltage; and a short protrusion disposed on the second substrate and simultaneously facing the first and second subpixel electrodes, wherein the liquid crystal layer is vertically aligned and has positive dielectric anisotropy.

13 Claims, 13 Drawing Sheets

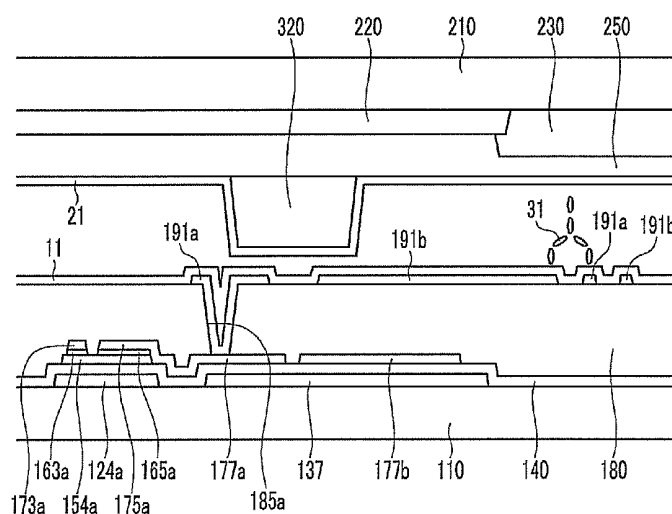


FIG. 1

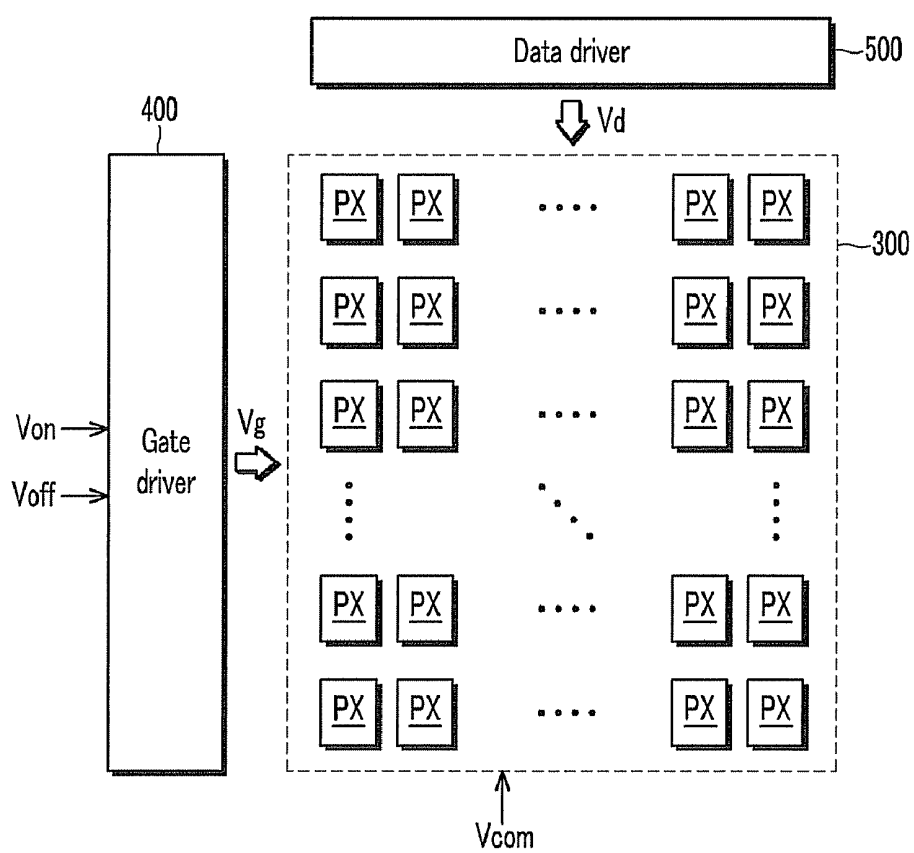


FIG. 2

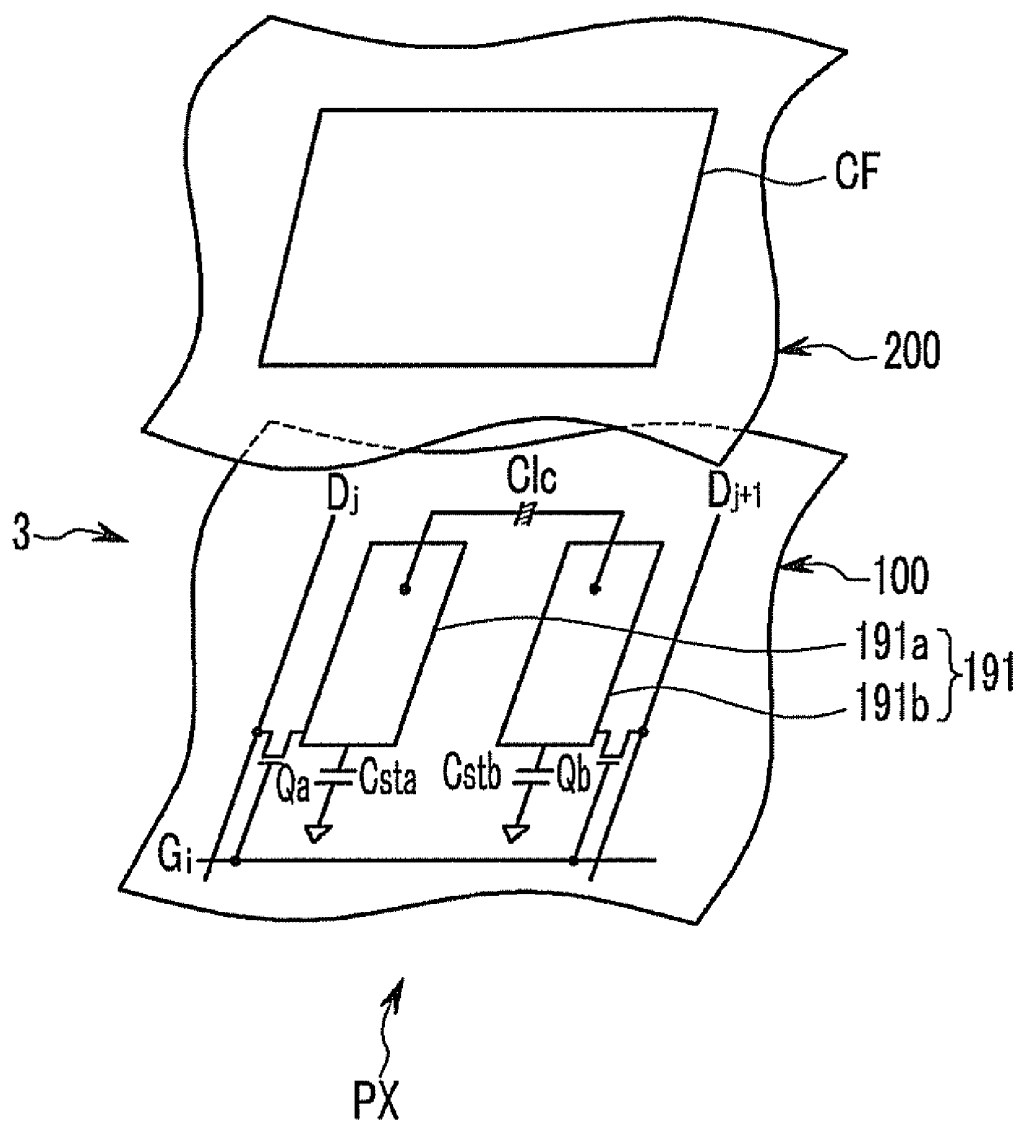


FIG. 3

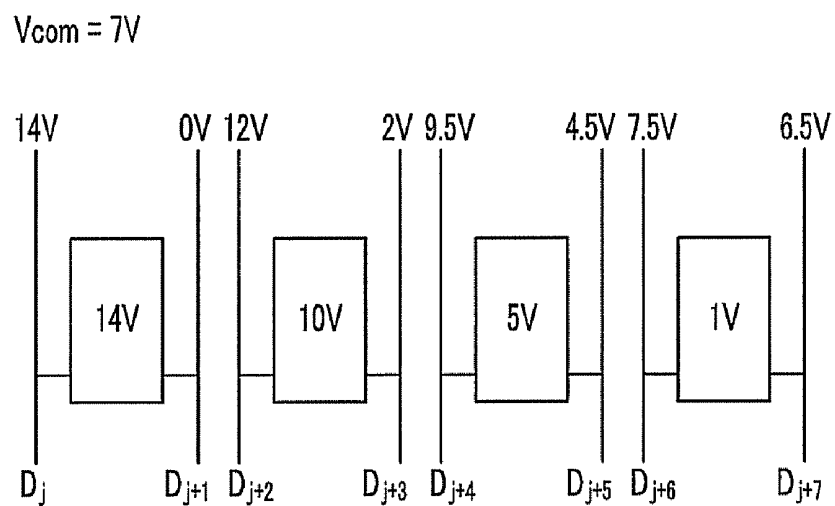


FIG. 4

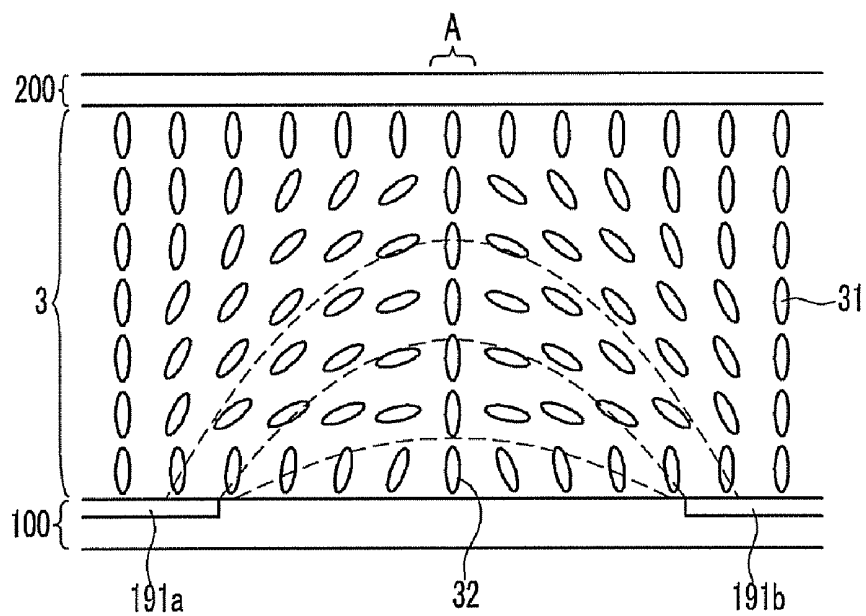


FIG. 5

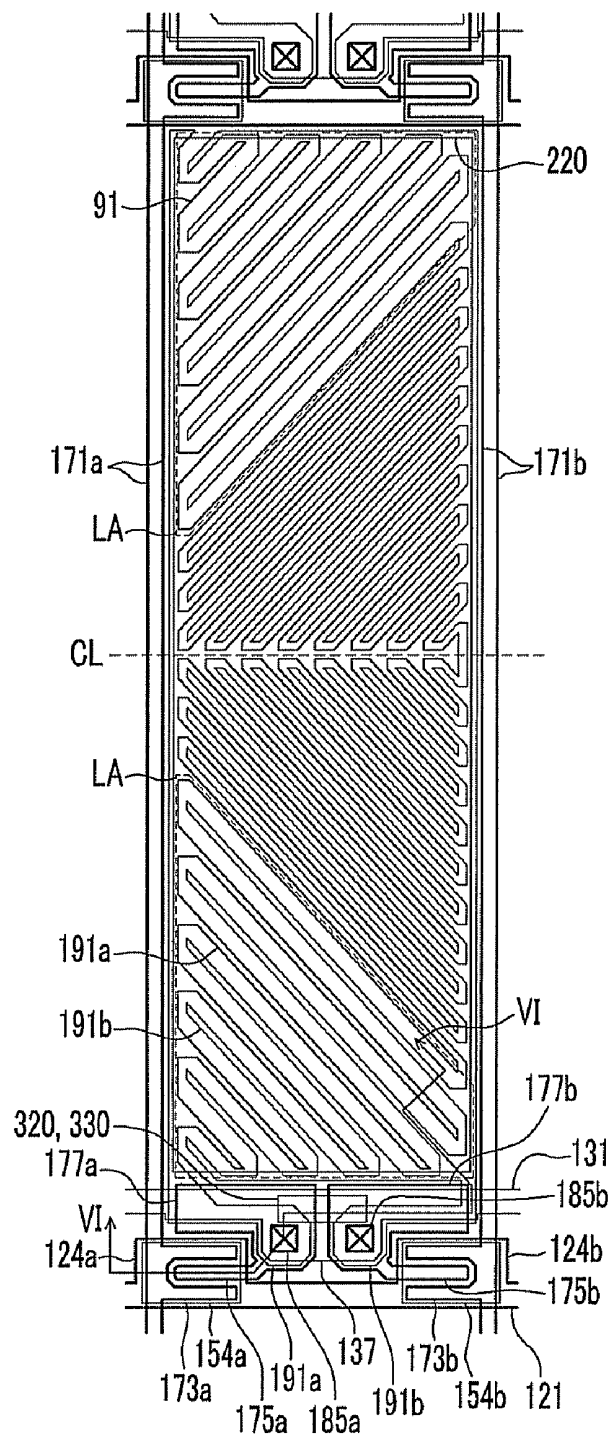


FIG. 6

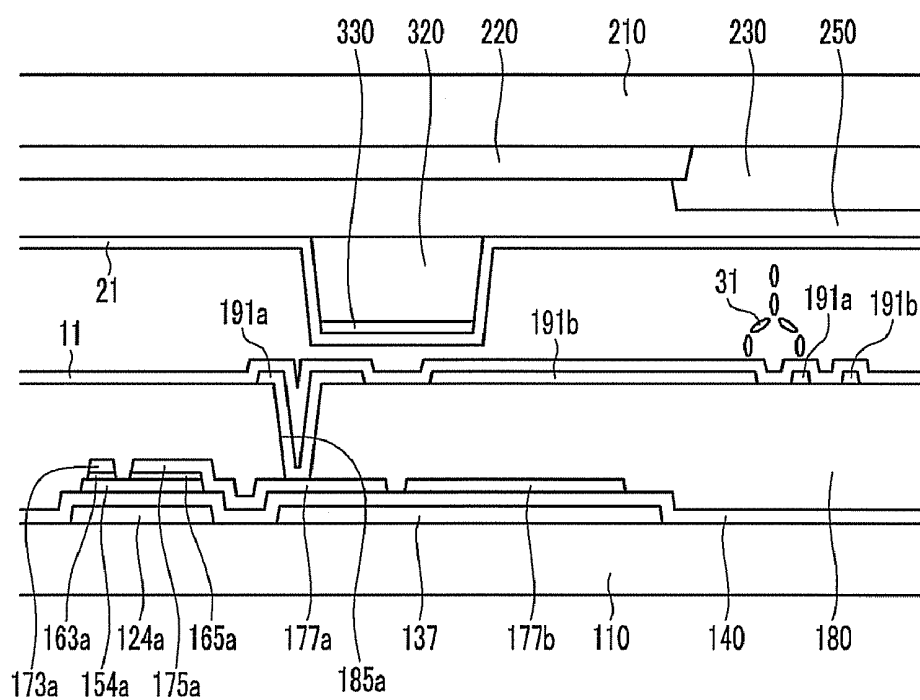


FIG. 7

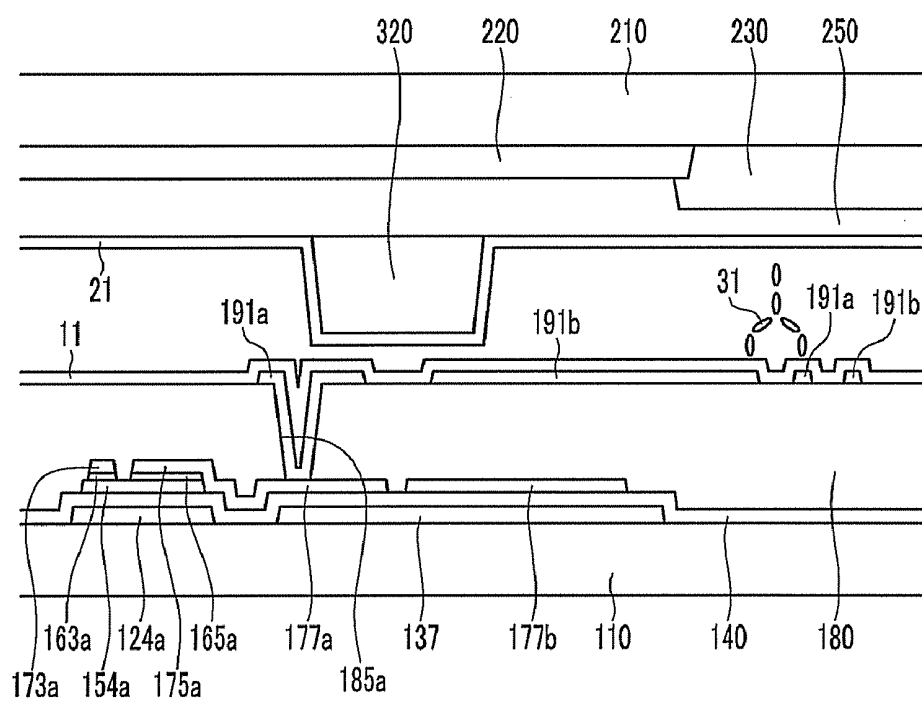


FIG. 8

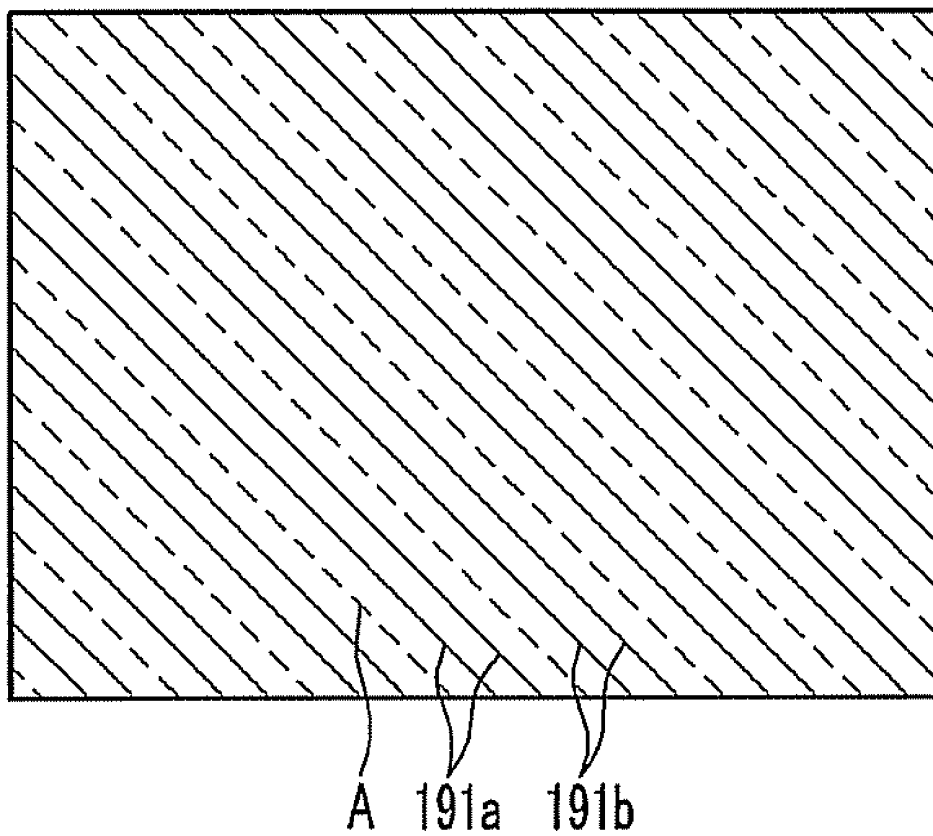


FIG. 9

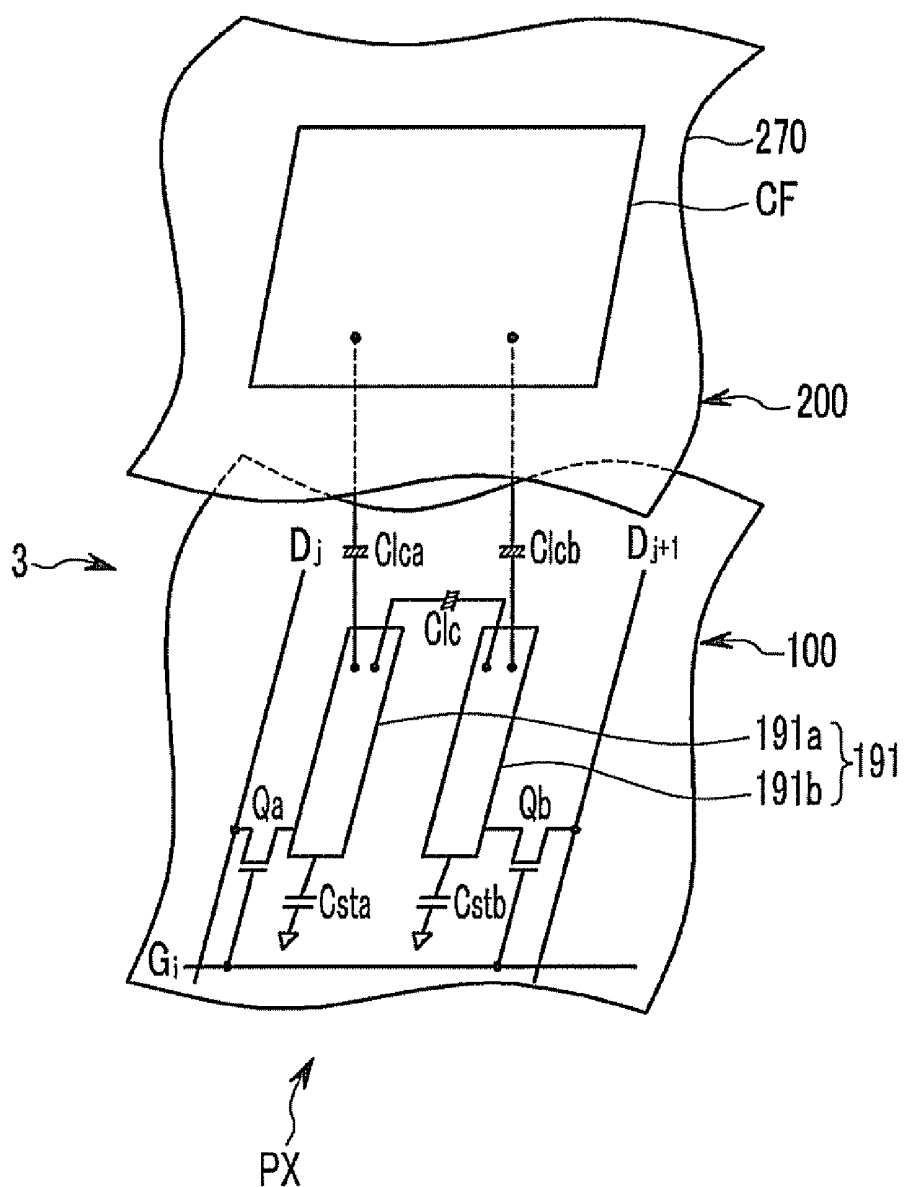


FIG. 10

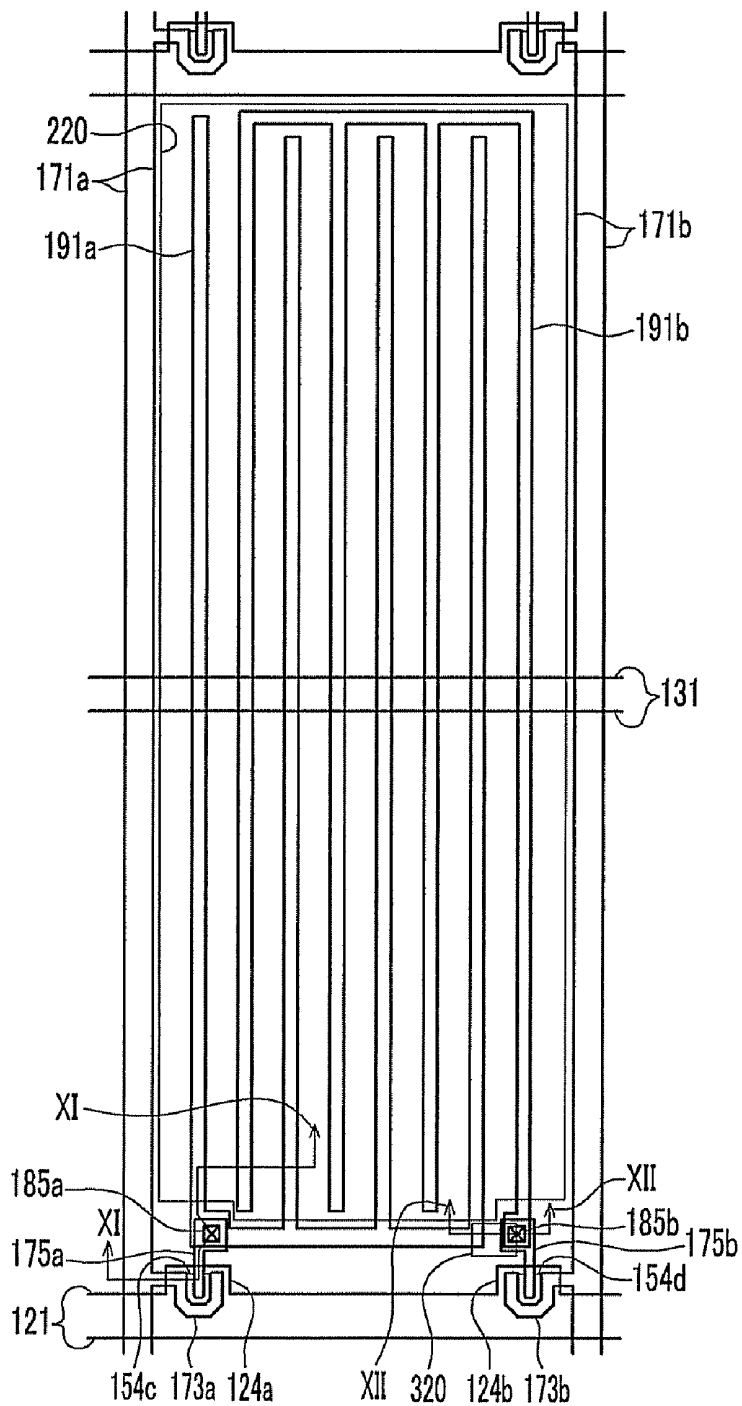


FIG. 11

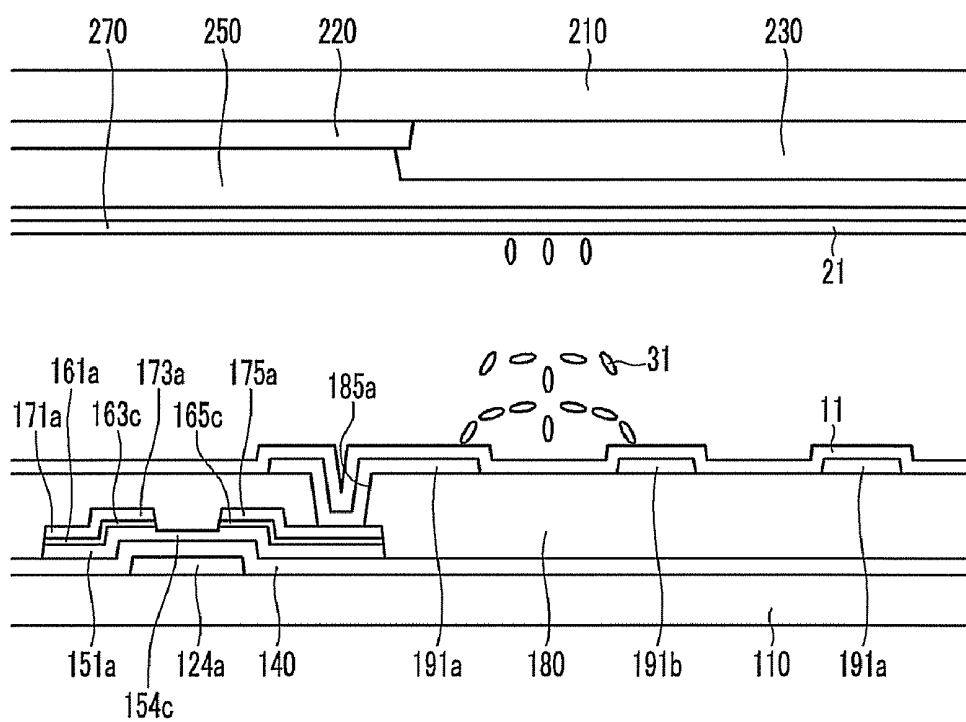


FIG. 12

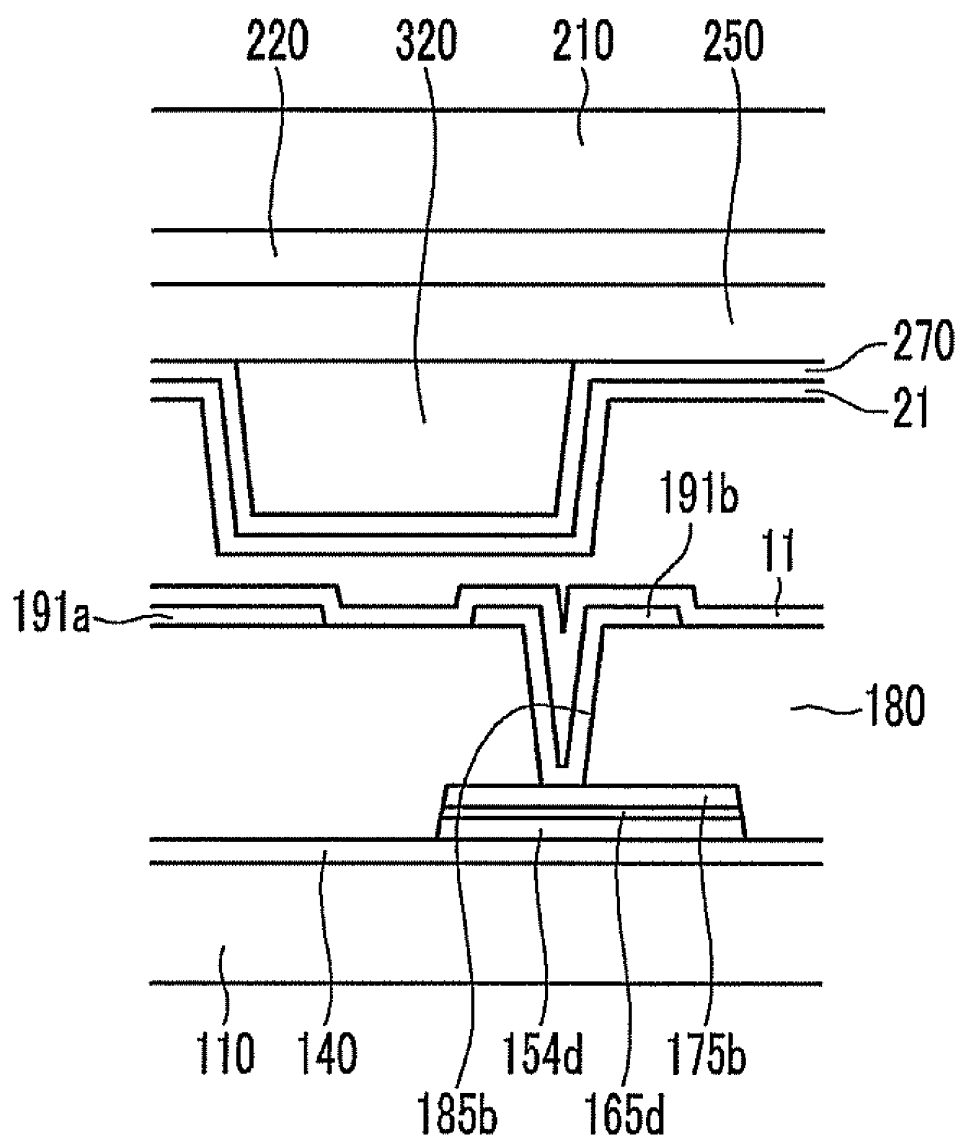


FIG. 13

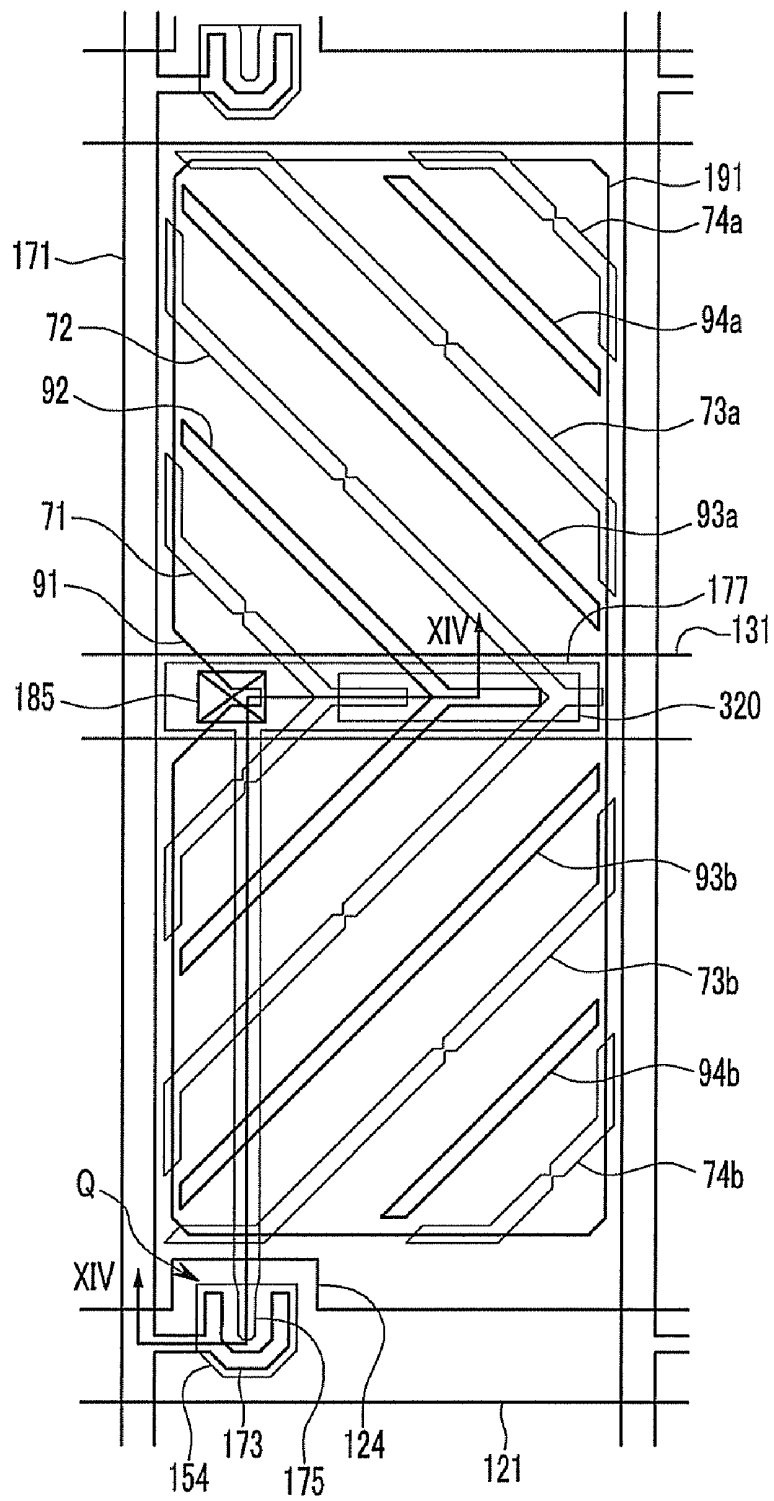
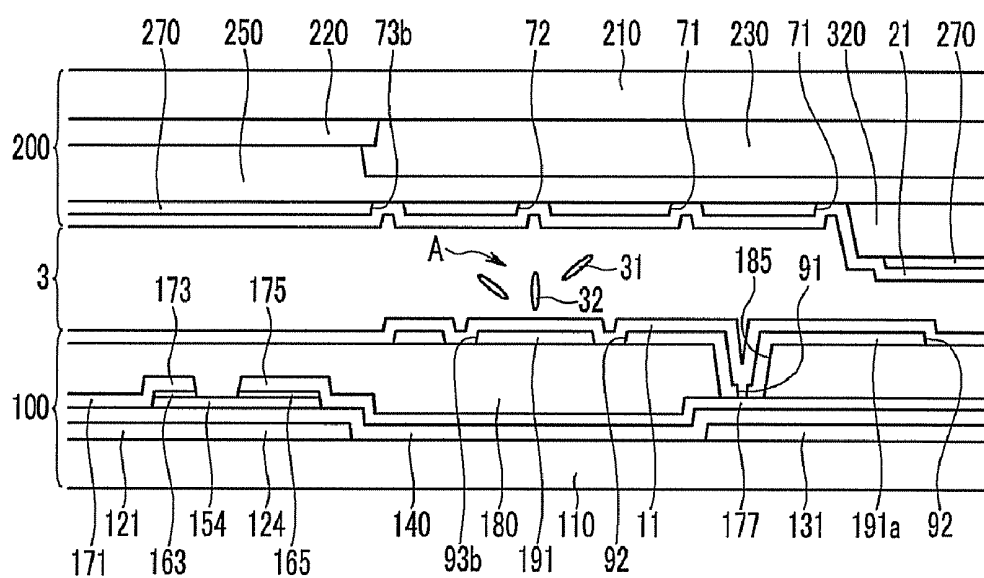


FIG. 14



LIQUID CRYSTAL DISPLAY

This application claims priority to Korean Patent Application No. 10-2008-0120017, filed on Nov. 28, 2008, and all the benefits accruing therefrom under 35 U.S.C. §119, the contents of which in its entirety are herein incorporated by reference.

BACKGROUND OF THE INVENTION**(a) Field of the Invention**

The present invention relates to a liquid crystal display ("LCD").

(b) Description of the Related Art

A liquid crystal display (hereinafter referred to as an "LCD") is one of the most widely used flat panel displays. A typical LCD includes two display panels provided with electric field generating electrodes, such as pixel electrodes and a common electrode, and a liquid crystal layer interposed between the two display panels. In the typical LCD, voltages are applied to the electric field generating electrodes to generate an electric field in the liquid crystal layer. Due to the generated electric field, alignment of the liquid crystal molecules may be controlled to effect polarization of incident light passing therethrough, thereby displaying images.

The typical LCD also includes switching elements connected to the respective pixel electrodes, and a plurality of signal lines such as gate lines and data lines for controlling the switching elements and applying voltages to the pixel electrodes.

The typical LCD receives an input image signal from an external graphics controller, the input image signal contains luminance information for each pixel PX, and the luminance has a particular number of possible grays (e.g., a preset grayscale). Each pixel is applied with a data voltage corresponding to the desired luminance information. The data voltage applied to the pixel appears as a pixel voltage according to a difference with reference to the common voltage, and each pixel displays the luminance representing a gray of the image signal according to the pixel voltage. Here, the range of the pixel voltages that are applicable to the LCD is determined according to a driver.

On the other hand, the driver of the LCD is typically mounted on the display panel in a form of a plurality of IC chips, or is installed on a flexible circuit film and attached to the display panel. However, the IC chip makes up a high proportion of the manufacturing cost of an LCD.

Also, the aperture ratio of a display device is remarkably reduced as the number of wires formed in the liquid crystal panel assembly, such as the gate lines or data lines, increases.

BRIEF SUMMARY OF THE INVENTION

An exemplary embodiment of a liquid crystal display ("LCD") according to an exemplary embodiment of the present invention includes; first and second substrates facing each other; a liquid crystal layer interposed between the first and second substrates and including liquid crystal molecules, a first subpixel electrode disposed on the first substrate, the first subpixel electrode receiving a first data voltage, a second subpixel electrode disposed on the first substrate, the second subpixel electrode receiving a second data voltage, and a short protrusion disposed on the second substrate and simultaneously facing the first and second subpixel electrodes, wherein the liquid crystal layer is vertically aligned and has positive dielectric anisotropy.

In one exemplary embodiment, the short protrusion may include a conductive polymer.

In one exemplary embodiment, the liquid crystal display may further include a short electrode disposed on the short protrusion.

In one exemplary embodiment, the short electrode may include a conductive material, exemplary embodiments of which include indium tin oxide ("ITO") and indium zinc oxide ("IZO").

In one exemplary embodiment, a height of the short protrusion may be smaller than a cell gap of the liquid crystal layer.

In one exemplary embodiment, the short protrusion may be disposed in a region where light is not transmitted.

In one exemplary embodiment, the liquid crystal display may further include a light blocking member disposed on at least one of the first substrate and the second substrate, wherein the short protrusion may overlap the light blocking member.

In one exemplary embodiment, the liquid crystal display may further include; a gate line disposed on the first substrate and which transmits a gate signal, a first data line disposed on the first substrate, the first data line transmitting the first data voltage, a second data line disposed on the first substrate, the second data line transmitting the second data voltage, a first switching element connected to the gate line and the first data line and including a first drain electrode connected to the first subpixel electrode, and a second switching element connected to the gate line and the second data line and including a second drain electrode connected to the second subpixel electrode.

In one exemplary embodiment, the short protrusion may overlap at least one of the first and second drain electrodes.

In one exemplary embodiment, the liquid crystal display may further include a storage electrode line disposed on the first substrate and comprising a portion overlapping at least one of the first and second drain electrodes, wherein the short protrusion may overlap the storage electrode line.

In one exemplary embodiment, each of the first and second subpixel electrodes may include a plurality of branch electrodes, wherein the branch electrodes of the first subpixel electrode and the branch electrodes of the second subpixel electrode may be alternately disposed.

In one exemplary embodiment, the first and second data voltages may have different polarities and a same magnitude with respect to a common voltage.

In one exemplary embodiment, a common electrode which is disposed on the short protrusion and applied with a common voltage.

Another exemplary embodiment of an LCD according to the present invention includes; first and second substrates facing each other, a liquid crystal layer interposed between the first and second substrates and including liquid crystal molecules, a pixel electrode disposed on the first substrate and including a first inclination direction determining member, a short protrusion disposed on the second substrate and facing the pixel electrode, and a common electrode disposed on the short protrusion, the common electrode including a second inclination direction determining member, the common electrode receiving a common voltage, wherein the liquid crystal layer is vertically aligned and has negative dielectric anisotropy.

In one exemplary embodiment, at least one of the first and second inclination direction determining members may include a cutout.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, advantages, and features of the invention will become more apparent by describing in

further detail exemplary embodiments thereof with reference to the attached drawings, in which:

FIG. 1 is a block diagram of an exemplary embodiment of a liquid crystal display ("LCD") according to the present invention.

FIG. 2 is an equivalent circuit diagram of one pixel of an exemplary embodiment of an LCD having an exemplary embodiment of a structure according to the present invention.

FIG. 3 is a schematic diagram illustrating a pixel and a voltage applied to a data line of an exemplary embodiment of an LCD according to the present invention.

FIG. 4 is a cross-sectional view of an exemplary embodiment of an LCD of the present invention.

FIG. 5 is a top plan layout view of an exemplary embodiment of an LCD according to the present invention.

FIG. 6 and FIG. 7 are cross-sectional views illustrating first and second exemplary embodiments of the LCD shown in FIG. 5 taken along line VI-VI, respectively.

FIG. 8 is a view illustrating arrangement of pixel electrodes in an exemplary embodiment of an LCD according to the present invention.

FIG. 9 is an equivalent circuit diagram of one pixel of an exemplary embodiment of an LCD having an exemplary embodiment of a structure according to the present invention.

FIG. 10 is a top plan layout view of an exemplary embodiment of an LCD according to the present invention.

FIG. 11 and FIG. 12 are cross-sectional views of the exemplary embodiment of an LCD illustrated in FIG. 10 taken along lines XI-XI and XII-XII, respectively.

FIG. 13 is a top plan layout view of an exemplary embodiment of an LCD according to the present invention.

FIG. 14 is a cross-sectional view of an exemplary embodiment of an LCD illustrated in FIG. 13 taken along line XIV-XIV.

DETAILED DESCRIPTION OF THE INVENTION

The invention now will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like reference numerals refer to like elements.

It will be understood that when an element is referred to as being "on" another element, it can be directly on the other element or intervening elements may be present therebetween. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will be understood that, although the terms first, second, third etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," or "includes" and/or "including" when used in this specification, specify the presence of stated features, regions, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, regions, integers, steps, operations, elements, components, and/or groups thereof.

Furthermore, relative terms, such as "lower" or "bottom" and "upper" or "top," may be used herein to describe one element's relationship to another elements as illustrated in the Figures. It will be understood that relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the Figures. For example, if the device in one of the figures is turned over, elements described as being on the "lower" side of other elements would then be oriented on "upper" sides of the other elements. The exemplary term "lower", can therefore, encompass both an orientation of "lower" and "upper," depending on the particular orientation of the figure. Similarly, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The exemplary terms "below" or "beneath" can, therefore, encompass both an orientation of above and below.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

Exemplary embodiments of the present invention are described herein with reference to cross section illustrations that are schematic illustrations of idealized embodiments of the present invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the present invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. For example, a region illustrated or described as flat may, typically, have rough and/or nonlinear features. Moreover, sharp angles that are illustrated may be rounded. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the precise shape of a region and are not intended to limit the scope of the present invention.

Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

Now, a liquid crystal display ("LCD") according to an exemplary embodiment of the present invention will be described with reference to FIG. 1 to FIG. 3.

FIG. 1 is a block diagram of an exemplary embodiment of an LCD according to the present invention, FIG. 2 is an equivalent circuit diagram of one pixel of an exemplary embodiment of an LCD having an exemplary embodiment of a structure according to the present invention, and FIG. 3 is a

schematic diagram illustrating a pixel and a voltage applied to a data line of an exemplary embodiment of an LCD according to the present invention.

As shown in FIG. 1, an exemplary embodiment of an LCD according to the present invention includes a liquid crystal panel assembly **300**, a gate driver **400**, and a data driver **500**.

Referring to FIG. 1 and FIG. 2, in an equivalent circuit, the liquid crystal panel assembly **300** includes a plurality of signal lines G_i , D_j , and D_{j+1} , and a plurality of pixels PX that are connected to the plurality of signal lines and are arranged in an approximately matrix shape. Meanwhile, the liquid crystal panel assembly **300** includes lower and upper panels **100** and **200** that face each other, and a liquid crystal layer 3 interposed therebetween.

The signal lines G_i , D_j , and D_{j+1} include a plurality of gate lines $G1$ - G_n that transmit gate signals (also referred to as "scanning signals"), and a plurality of data lines $D1$ - D_m that transmit data signals. The gate lines G_i extend substantially in a transverse direction and are disposed substantially parallel to each other, and the data lines D_j and D_{j+1} extend substantially in a longitudinal direction and are disposed substantially parallel to each other.

Referring to FIG. 2, each pixel PX includes first and second switching elements Qa and Qb, respectively, connected to signal lines G_i , D_j , and D_{j+1} , a liquid crystal capacitor Clc, and first and second storage capacitors Csta and Cstb connected thereto. Alternative exemplary embodiments include configurations wherein the first and second storage capacitors Csta and Cstb are omitted.

In the present exemplary embodiment, the first/second switching element Qa/Qb is a three-terminal element such as a thin film transistor ("TFT") provided on the lower panel **100**, having a control terminal connected to the gate line G_i , an input terminal connected to the data line D_j/D_{j+1} , and an output terminal connected to the liquid crystal capacitor Clc and the first/second storage capacitor Csta/Cstb.

The liquid crystal capacitor Clc uses a first subpixel electrode **191a** and a second subpixel electrode **191b** of the lower panel **100** as two terminals thereof. The first and second subpixel electrodes **191a** and **191b** form a pixel electrode **191**. The liquid crystal layer 3 between the first and second subpixel electrodes **191a** and **191b** functions as a dielectric material of the liquid crystal capacitor Clc.

Exemplary embodiments include configurations wherein the pixel electrode **191**, including the first and second subpixel electrodes **191a** and **191b**, formed on the lower panel **100**, and the common electrode, may be disposed in a different layer from each other or in the same layer, e.g., they may be formed together on the upper or lower panels **200** or **100**, respectively. When the pixel electrode **191** and the common electrode CE are disposed on the same panel **100** or **200**, the display device is said to exhibit in-plane switching. The first and second subpixel electrodes **191a** and **191b** are respectively connected to the first and second switching elements Qa and Qb, respectively. In an alternative exemplary embodiment, the second subpixel electrode **191b** may be provided in the upper panel **200**, wherein the second subpixel electrode **191b** may not be connected to a switching element but applied with a common voltage Vcom.

In the present exemplary embodiment, the liquid crystal layer 3 has dielectric anisotropy, and liquid crystal molecules of the liquid crystal layer 3 may be aligned such that their major axes are substantially perpendicular to the surfaces of the two display panels when no electric field is applied. That is, the liquid crystal layer 3 may be vertically aligned.

In one exemplary embodiment, the first/second storage capacitor Csta/Cstb, which serve as assistants to the liquid

crystal capacitor Clc, may be formed where an additional electrode line (not shown) provided on the lower display panel **100** overlaps the first/second subpixel electrode **191a/191b** with an insulator interposed therebetween.

For color display, each pixel PX uniquely represents one of primary colors (i.e., spatial division) or each pixel PX sequentially represents the primary colors in turn (i.e., temporal division), such that a spatial or temporal sum of the primary colors is recognized by a user as a desired color. An exemplary embodiment of a set of the primary colors includes red, green, and blue colors. FIG. 2 shows an example of the spatial division in which each pixel PX includes a color filter CF representing one of the primary colors in an area of the upper panel **200** facing the first and second subpixel electrodes **191a** and **191b**. Alternative exemplary embodiments include configurations wherein the color filter CF may be provided on or under the first and second subpixel electrodes **191a** and **191b** on the lower panel **100**.

At least one polarizer (not shown) for providing light polarization is provided in the liquid crystal panel assembly **300**.

Referring again to FIG. 1, the gate driver **400** is connected to the gate lines G_i of the liquid crystal panel assembly **300**, and applies gate signals Vg, each of which is a combination of a gate-on voltage Von and a gate-off voltage Voff, to the gate lines G_i .

The data driver **500** is connected to the data lines D_j and D_{j+1} of the liquid crystal panel assembly **300** to apply data voltages Vd to the data lines D_j and D_{j+1} .

Next, an exemplary embodiment of a driving method of an LCD according to the present invention will be described with reference to FIG. 3 and FIG. 4 as well as FIG. 1 and FIG. 2.

FIG. 3 is a schematic diagram illustrating a pixel and a voltage applied to a data line of an exemplary embodiment of an LCD according to the present invention, and FIG. 4 is a cross-sectional view of an exemplary embodiment LCD according to the present invention.

First, referring to FIG. 1 and FIG. 2, the data driver **500** applies data voltages Vd for a row of pixels to the corresponding data lines D_j and D_{j+1} . The gate driver **400** applies the gate-on voltage Von to the gate lines G_i , so as to turn on the first and second switching elements Qa and Qb connected thereto. Accordingly, the data voltages applied to the data lines D_j and D_{j+1} are supplied to the pixels PX through the turned-on first and second switching elements Qa and Qb. That is, the first subpixel electrode **191a** is applied with the data voltage Vd of the first data line D_j through the first switching element Qa, and the second subpixel electrode **191b** is applied with the data voltage Vd of the second data line D_{j+1} through the second switching element Qb. The data voltages applied to the first and second subpixel electrodes **191a** and **191b** are voltages corresponding to the luminance to be displayed by the pixel PX, and, in the present exemplary embodiment, have opposite polarities to each other with respect to the common voltage Vcom.

The difference between two data voltages Vd applied to the first and second subpixel electrodes **191a** and **191b** and having the opposite polarity appears as a charged voltage of the liquid crystal capacitor Clc, that is, a pixel voltage. This will be described in more detail with reference to FIG. 3.

FIG. 3 illustrates a data voltage Vd applied to the data lines D_j , D_{j+1} , D_{j+2} , D_{j+3} , D_{j+4} , D_{j+5} , D_{j+6} , and D_{j+7} in the exemplary embodiment wherein the charged voltages of the liquid crystal capacitors Clc of the four neighboring pixels PX, that is, the pixel voltages, are 14V, 10V, 5V, and 1V, respectively, and the maximum and minimum voltages that are available in

the liquid crystal display are respectively 0V and 14V according to an exemplary embodiment of the present invention.

Referring to FIG. 3, each pixel PX is connected to two data lines, e.g., D_j and D_{j+1}/D_{j+2} and D_{j+3}/D_{j+4} and D_{j+5}/D_{j+6} and D_{j+7} . In the present exemplary embodiment, the two data lines D_j and D_{j+1}/D_{j+2} and D_{j+3}/D_{j+4} and D_{j+5}/D_{j+6} and D_{j+7} connected to one pixel PX are applied with different data voltages Vd having different polarities with respect to the common voltage Vcom. The difference between the two data voltages Vd is the pixel voltage of each pixel PX. For example, in the exemplary embodiment wherein the common voltage Vcom is 7V, the target pixel voltage of the first pixel PX is 14V such that the first and second data lines D_j and D_{j+1} may be applied with 14V and 0V, and the target pixel voltage of the second pixel PX is 10V such that the third and fourth data lines D_{j+2} and D_{j+3} may be applied with 12V and 2V. Also, the target pixel voltage of the third pixel PX is 5V such that the fifth and sixth data lines D_{j+4} and D_{j+5} may be applied with 9.5V and 4.5V, and the target pixel voltage of the fourth pixel PX is 1V such that the seventh and eighth data lines D_{j+6} and D_{j+7} may be applied with 7.5V and 6.5V. These target pixel voltages and data voltages are included herein to better illustrate the invention and are not limiting thereof.

In this way, if a potential difference is generated between both terminals of the liquid crystal capacitors Clc, an electric field that is substantially parallel to the surface of the display panels **100** and **200** is generated in the liquid crystal layer 3 between the first and second subpixel electrodes **191a** and **191b**. When liquid crystal molecules **31** have positive dielectric anisotropy, the liquid crystal molecules **31** of the liquid crystal layer 3 are arranged in response to the electric field such their long axes may be inclined substantially parallel to the direction of the electric field, and the inclination degree depends on a magnitude of the pixel voltage. Such a liquid crystal layer 3 is called an EOC (electrically-induced optical compensation) mode layer. Also, the change degree of the polarization of light that passes through the liquid crystal layer 3 is changed according to the declination degree of the liquid crystal molecules **31**. Such change of the polarization appears as a change of transmittance by the polarizer, and thereby the pixels PX display images having the desired luminance, e.g., grayscale.

By repeating this procedure by a unit of a horizontal period (also referred to as "1H"), the gate-on voltage Von is sequentially applied to all gate lines G_i and the data voltage Vd is applied to all pixels PX, thereby displaying images for a frame.

In one exemplary embodiment, when the next frame starts after one frame finishes, the inversion control signal RVS applied to the data driver **500** is controlled such that the polarity of the data signals is reversed (which is referred to as "frame inversion"). In such an exemplary embodiment, the polarity of the data voltages Vd flowing in the data lines D_j and D_{j+1} is periodically reversed during one frame according to the characteristic of the inversion signal (for example row inversion and dot inversion), or the polarity of the data voltages Vd applied to the row of one pixels may be reversed (for example column inversion and dot inversion).

In this way, two data voltages Vd having different polarities with respect to the common voltage Vcom are applied to one pixel PX such that a driving voltage of an LCD may be increased, a response speed of liquid crystal molecules **31** may be improved, and transmittance of an LCD may be improved. Also, since polarities of two data voltages Vd applied to one pixel PX are substantially opposite to each other with respect to a common voltage, even in a case that the inversion type at the data driver **500** is column inversion or

row inversion, degradation of display quality due to flicker may be prevented, similar to dot inversion driving.

Moreover, since when the first and second switching elements Qa and Qb in one pixel PX are turned off, the voltages applied to the first and second subpixel electrodes **191a** and **191b** all drop by the respective kickback voltages such that the charged voltage of the pixel PX is hardly changed. Accordingly, display characteristics of an LCD may be improved.

Also, when liquid crystal molecules **31** that are arranged substantially perpendicular to the display panels **100** and **200** in the initial state are used, the contrast ratio of an LCD may be increased and a wide viewing angle may be realized. Particularly, liquid crystal molecules **31** having positive dielectric anisotropy have larger dielectric anisotropy and lower rotational viscosity compared to liquid crystal molecules having negative dielectric anisotropy, so a fast response speed may be obtained. Additionally, since inclination directions of liquid crystal molecules **31** having positive dielectric anisotropy are definitely determined in response to an electric field so that the liquid crystal molecules **31** are rearranged substantially instantaneously even when the arrangement of the liquid crystal molecule **31** is disordered, good display characteristics may be obtained.

Next, a detailed structure of an exemplary embodiment of an LCD according to the present invention will be described in detail with reference to FIG. 5 to FIG. 8 as well as FIG. 1 to FIG. 4.

FIG. 5 is a top plan layout view of an exemplary embodiment of an LCD according to the present invention, FIG. 6 and FIG. 7 are cross-sectional views of first and second exemplary embodiments of the exemplary embodiment of an LCD shown in FIG. 5 taken along line VI-VI, respectively, and FIG. 8 is a view illustrating arrangement of pixel electrodes in an exemplary embodiment of an LCD according to the present invention.

Referring to FIG. 5 to FIG. 7, an exemplary embodiment of an LCD according to the present invention includes a lower panel **100** and an upper panel **200** facing each other, and a liquid crystal layer 3 interposed between the display panels **100** and **200**.

First, the lower panel **100** will be described.

A plurality of gate conductors including a plurality of gate lines **121** and a plurality of storage electrode lines **131** are formed on an insulating substrate **110**.

Each gate line **121** transmits gate signals, and includes a plurality of pairs of first and second gate electrodes **124a** and **124b** protruding upward therefrom.

The storage electrode lines **131** extend substantially in a transverse direction, and are supplied with a predetermined voltage such as a common voltage Vcom. Each storage electrode line **131** is disposed between two neighboring gate lines **121**, and, in the present exemplary embodiment, is closer to the lower gate line **121**. Each storage electrode line **131** includes a plurality of storage electrodes **137** protruding downward. However, alternative exemplary embodiments include configurations wherein the shape and arrangement of the storage electrode lines **131** may be variously changed.

A gate insulating layer **140**, exemplary embodiments of which may be made of silicon nitride ("SiNx") or silicon oxide ("SiOx"), is formed on the gate conductors **121** and **131**.

A plurality of pairs of first and second semiconductor islands **154a** and **154b**, exemplary embodiments of which may be made of hydrogenated amorphous silicon (a-Si) or polysilicon, are formed on the gate insulating layer **140**. The

first and second semiconductor islands **154a** and **154b** are respectively disposed on the first and second gate electrodes **124a** and **124b**.

A pair of ohmic contact islands **163a** and **165a** is formed on each first semiconductor island **154a**, and a pair of ohmic contact islands (not shown) is formed on each second semiconductor island **154b**. Exemplary embodiments of the ohmic contact islands **163a** and **165a** may be made of a material such as n+ hydrogenated amorphous silicon in which an n-type impurity such as phosphorus is doped with a high concentration, or of silicide.

A plurality of pairs of first and second data lines **171a** and **171b** and a plurality of first and second drain electrodes **175a** and **175b** are formed on the ohmic contacts **163a** and **165a**, and the gate insulating layer **140**. The first and second data lines **171a** and **171b** transmit data signals, and extend substantially in the longitudinal direction thereby being disposed substantially perpendicular to the gate lines **121** and the storage electrode lines **131**. The first and second data lines **171a** and **171b** include a plurality of pairs of first and second source electrodes **173a** and **173b**, exemplary embodiments of which may be bent in a C shape or in a transversely turned C shape toward the first and second gate electrodes **124a** and **124b**.

In the present exemplary embodiment, the first/second drain electrode **175a/175b** includes a bar-shaped end portion and a first/second extension **177a/177b** having a wide area. The bar-shaped end portion of the first/second drain electrode **175a/175b** is disposed opposite to the first/second source electrode **173a/173b** with respect to the first/second gate electrode **124a/124b**, and is enclosed by the curved first/second source electrode **173a/173b**. The first extension **177a** is overlapped with a left half of the storage extension part **137**, and the second extension **177b** is overlapped with a right half of the storage extension part **137**. However, alternative exemplary embodiments include different configurations for the first/second source electrodes **173a/173b** and the first/second drain electrode **175a/175b**, e.g., in one exemplary embodiment the source and drain electrodes may include interdigitated comb-shaped electrodes.

The first/second gate electrode **124a/124b**, the first/second source electrode **173a/173b**, and the first/second drain electrode **175a/175b** respectively constitute the first/second thin film transistor Qa/Qb together with the first/second semiconductor **154a/154b**. The channels of the first/second thin film transistor Qa/Qb is formed in the first/second semiconductor **154a/154b** between the first/second source electrode **173a/173b** and the first/second drain electrode **175a/175b**.

In the present exemplary embodiment, the ohmic contacts **163a** and **165a** (and those not shown) are formed only between the underlying semiconductors **154a** (and **154b**) and the overlying data conductors **171a** and **175a** (and **171b** and **175b**), and reduce the contact resistance therebetween. The first and second semiconductors **154a** and **154b** have a portion that is exposed without being covered by the data conductors **171a**, **171b**, **175a**, and **175b**, and a portion between the first and second source electrodes **173a** and **173b** and the first and second drain electrodes **175a** and **175b** as shown in FIGS. 6 and 7.

A passivation layer **180** is formed on the data conductors **171a**, **171b**, **175a**, and **175b**, and the exposed semiconductors **154a** and **154b**. The passivation layer **180** includes a plurality of contact holes **185a** and **185b** exposing the first and second extensions **177a** and **177b**.

A plurality of pixel electrodes **191** including a plurality of pairs of first and second subpixel electrodes **191a** and **191b**, exemplary embodiments of which may be made of a transparent conductive material exemplary embodiments of which

include indium tin oxide ("ITO") and indium zinc oxide ("IZO"), or a reflective material, exemplary embodiments of which include metals such as aluminum, silver, chromium, and alloys thereof, are formed on the passivation layer **180**.

In the present exemplary embodiment, the overall planar outline of one pixel electrode **191** is a rectangle, and the first and second subpixel electrodes **191a** and **191b** are separated from each other with a gap disposed therebetween. In one exemplary embodiment, the first and second subpixel electrodes **191a** and **191b** may be engaged, or interlaced, with one another as described in more detail below. The first and second subpixel electrodes **191a** and **191b** have a substantially symmetrical form with reference to a virtual horizontal center line CL.

In the present exemplary embodiment, the first subpixel electrode **191a** includes a lower projection portion, a left longitudinal stem portion, a horizontal stem portion extending to the right from a center of the longitudinal stem portion, and a plurality of branch portions. A branch portion positioned above the horizontal center line CL extends obliquely in an upper right direction from the longitudinal stem portion or the horizontal stem portion. The other branch portion positioned below the horizontal center line CL extends obliquely in a lower right direction from the longitudinal stem portion or the horizontal stem portion. In one exemplary embodiment, an angle formed by the branch portions with the gate line **121** or the horizontal center line CL may be approximately 45 degrees.

In the present exemplary embodiment, the second pixel electrode **191b** includes the lower projection portion, a right longitudinal stem portion, upper and lower horizontal stem portions, and a plurality of branch portions. The upper and lower horizontal stem portions extend horizontally to the left from a lower end and an upper end of the longitudinal stem portion, respectively. A branch portion positioned above the horizontal center line CL extends obliquely in a lower left direction from the longitudinal stem portion or the upper horizontal stem portion. The other branch portion positioned below the horizontal center line CL extends obliquely in an upper left direction from the longitudinal stem portion or the lower horizontal stem portion. An angle formed by the branch portions of the second pixel electrode **191b** with the gate line **121** or the horizontal center line CL may also be approximately 45 degrees, similar to the first subpixel electrode **191a**. The upper and lower branch portions may be disposed at substantially right angles to each other around the horizontal center line CL.

The branch portions of the first and second subpixel electrodes **191a** and **191b** are engaged with each other and are alternately disposed, thereby forming a pectinated pattern. In one exemplary embodiment, a low gray region LA where the interval between neighboring branch portions is narrow and a high gray region (the remaining region except for the low gray region LA) where the interval between neighboring branch portions is relatively far exist, and the low gray region LA is divided on the upper and lower sides with respect to the high gray region. The interval between branch portions of the first and second subpixel electrodes **191a** and **191b** and the width of the branch portions may be variously changed in the low gray region LA and the high gray region. Alternative exemplary embodiments include configurations wherein only a high or low gray region is formed.

Accordingly, it is possible to make the inclination angle of the liquid crystal molecules various and to display different luminances from one image information by varying the intervals between the first and second subpixel electrodes **191a** and **191b** of one pixel. Further, it is possible to make an image

viewed from a side similar to an image viewed from a front by properly adjusting the intervals between the branch portions of the first and second subpixel electrodes **191a** and **191b**. Therefore, it is possible to improve lateral visibility and to enhance transmittance.

The first and second subpixel electrodes **191a** and **191b** are physically and electrically connected to the first and second drain electrodes **175a** and **175b** through the contact holes **185a** and **185b**. The first and second subpixel electrodes **191a** and **191b** receive the data voltage from the first and second drain electrodes **175a** and **175b**. The first and second subpixel electrodes **191a** and **191b** constitute the liquid crystal capacitor Clc together with the liquid crystal layer 3. The first and second subpixel electrodes **191a** and **191b** maintain the applied voltage even after the first and second thin film transistors Qa and Qb are turned off due to the voltage stored in the liquid crystal capacitor Clc and the voltage stored in the first and second storage capacitors Csta and Cstb, when present.

The first and second extension parts **177a** and **177b** of the first and second drain electrode **175a** and **175b** connected to the first and second subpixel electrodes **191a** and **191b** are overlapped with the storage extension part **137** with the gate insulating layer **140** interposed therebetween, thereby constituting the first and second storage capacitors Csta and Cstb. The first and second storage capacitors Csta and Cstb enhance the voltage storage capacity of the liquid crystal capacitor Clc as has been previously described.

Next, the upper panel **200** will be described.

A light blocking member **220** is formed on an insulation substrate **210**. The light blocking member **220** prevents light leakage between the pixel electrodes **191** and includes an opening region therein facing the pixel electrodes **191**.

A plurality of color filter **230** is formed on the insulation substrate **210** and the light blocking member **220**. A majority of an individual color filter **230** exists within a region surrounded by the light blocking member **220**. In one exemplary embodiment, the color filters **230** may be elongated along a row of the pixel electrodes **191**, e.g., each pixel of a particular row may share a common color filter. Each of the color filters **230** may display one of primary colors including three primary colors such as red, green, and blue as discussed above.

An overcoat **250** is formed on the color filters **230** and the light blocking member **220**. In one exemplary embodiment, the overcoat **250** may be made of an organic, or inorganic, insulator. The overcoat **250** prevents the color filters **230** from being exposed and provides a flat surface, e.g., it planarizes the underlying layers. Exemplary embodiments include configurations wherein the overcoat **250** may be omitted.

A plurality of short protrusions **320** is formed on the overcoat **250**. In one exemplary embodiment, each short protrusion **320** simultaneously faces the first and second subpixel electrodes **191a** and **191b**, and is disposed in a region where light is not transmitted, such as the region where the first and second drain electrodes **175a** and **175b** or the storage electrodes **137** are disposed, as shown in FIG. 5, and thereby reduction of the aperture ratio and the transmittance of the display may be prevented. Exemplary embodiments include configurations wherein the short protrusion **320** may be made of an organic material, exemplary embodiments of which include resin, and the height of the short protrusion **320** is smaller than the cell gap of the liquid crystal layer 3.

Referring to FIG. 6, a short electrode **330** is further formed on the short protrusion **320**. The short electrode **330** may be formed by depositing a conductive material, exemplary embodiments of which include ITO or IZO, and patterning it by photolithography. Exemplary embodiments include con-

figurations wherein the short electrode **330** may cover the overcoat **250** as well as the short protrusion **320** (not shown). Alternative exemplary embodiments include configurations wherein the short electrode **330** is omitted, e.g., as in the exemplary embodiment illustrated in FIG. 7. In one such alternative exemplary embodiment the short protrusion **320** may be made of a conductive polymer.

Alignment layers **11** and **21** are formed on inner surfaces of the lower and upper panels **100** and **200**, and they may be vertical alignment layers.

A polarizer (not shown) may be provided on outer surfaces of the panels **100** and **200**.

In the present exemplary embodiment, the liquid crystal layer 3 interposed between the lower panel **100** and the upper panel **200** has positive dielectric anisotropy. The liquid crystal molecules **31** may have their long axes aligned to be substantially vertical to the surfaces of two panels **100** and **200** in the absence of an electric field.

When data voltages having different polarities are applied to the first and second subpixel electrodes **191a** and **191b**, a potential difference is generated between both terminals of the liquid crystal capacitor Clc, e.g., the first and second pixel electrodes, such that the liquid crystal molecules **31** are inclined substantially parallel to the direction of the electric field, as illustrated in FIG. 4. However, the liquid crystal molecules **32** spaced at the same distance from the first and second subpixel electrodes **191a** and **191b** may not be tilted to either side and maintain their initial vertical orientation.

Here, if a pressure from the outside is applied to the display panels **100** and **200**, the cell gap of the liquid crystal layer 3 of the pressed portion is decreased, and the short electrode **330** (in FIG. 6), or the short protrusion **320** (in FIG. 7) of the upper panel **200**, contacts the first and second subpixel electrodes **191a** and **191b** of the lower panel **100** with the alignment layers **11** and **21** interposed therebetween. Thus, leakage current flows between the first and second subpixel electrodes **191a** and **191b** such that the voltage difference between the first and second subpixel electrodes **191a** and **191b** almost vanishes and the pressed pixel PX displays substantially black. Accordingly, although liquid crystal molecules **32** at the region A spaced at the same distance from the first and second subpixel electrodes **191a** and **191b** are tilted horizontal to the display panels **100** and **200** by the externally supplied pressure, the electric field that was applied to the liquid crystal layer 3 almost vanishes. Thus, the original vertical alignment state may be recovered again when the pressure from the outside is removed. That is, display deterioration such as yellowish bruising is not generated, wherein the yellowish bruising is generated when the liquid crystal molecules **32** arranged substantially horizontal to the display panels **100** and **200** by pressure are influenced by the strong electric field in the liquid crystal layer 3 so that the liquid crystal molecules **32** maintain the horizontal state even after the removal of the pressure.

Also, the pixels PX around the pressed region are also pressed such that the short electrode **330** (in FIG. 6) or the short protrusion **320** (in FIG. 7) of the upper panel **200** gets closer to the first and second subpixel electrodes **191a** and **191b** of the lower panel **100** via the alignment layers **11** and **21**. Thus, the capacitance of the capacitor formed by the short electrode **330** or the short protrusion **320** with the first and second subpixel electrodes **191a** and **191b** is increased, and the voltage difference between the first and second subpixel electrodes **191a** and **191b** is decreased. Accordingly, the corresponding pixels PX display an image of a low gray. Therefore, even though the liquid crystal molecules **32** around the region A spaced at the same distance from the first and second

subpixel electrodes **191a** and **191b** were pressed by an exterior pressure, the liquid crystal molecules **32** may restore their initial vertical alignment state substantially instantaneously when the pressure is removed.

After the pixels that were pressed by an exterior pressure displayed a black or low gray image, the pixels again receive data voltages corresponding to an image to be displayed through the first and the second data lines **171a** and **171b**.

In this way, by forming short protrusions **320** in the upper panel **200**, deterioration such as a stain generated by a pressure may be removed without the need of changing the driving method or decrease of luminance. When no pressure is applied, the short protrusion **320** or the short electrode **330** forms a capacitor along with the first and second subpixel electrodes **191a** and **191b** of the lower panel **100**. The capacitor may have a function to assist the first and second storage capacitors **Csta** and **Cstb**. Thereby, the short protrusions **320** may allow for quickly and easily removing image deterioration from the resultant display.

Next, an exemplary embodiment of an LCD according to the present invention will be described with reference to FIG. 9 to FIG. 12.

FIG. 9 is an equivalent circuit diagram of one pixel of an exemplary embodiment of an LCD having an exemplary embodiment of a structure according to the present invention, FIG. 10 is a top plan layout view of an exemplary embodiment of an LCD according to the present invention, and FIG. 11 and FIG. 12 are cross-sectional views of the exemplary embodiment of an LCD illustrated in FIG. 10 taken along lines XI-XI and XII-XII, respectively.

Referring to FIG. 9, the present exemplary embodiment of an LCD also includes signal lines including a plurality of gate lines G_j and plurality of pairs of data lines D_j and D_{j+1} , and a plurality of pixels PX connected thereto, similar to the exemplary embodiment of FIG. 2.

Each pixel PX includes first and second switching elements **Qa** and **Qb** that are connected to the signal lines G_j , D_j , and D_{j+1} , a liquid crystal capacitor **Clc**, and the first and second storage capacitors **Csta** and **Cstb**.

However, unlike the previous exemplary embodiment shown in FIG. 2, in the present exemplary embodiment, a common electrode **270** is formed on substantially the whole surface of an upper panel **200**. The first and second liquid crystal capacitors **Clca** and **Clcb** include the first and second subpixel electrodes **191a** and **191b** of a lower panel **100** and the common electrode **270** of the upper panel **200** as two terminals, respectively, and the liquid crystal capacitor **Clc** includes the first and second subpixel electrodes **191a** and **191b** of the lower panel **100** as the two terminals.

In the present exemplary embodiment, an electric field parallel to the panels **100** and **200** is generated in a liquid crystal layer 3 between the first and second subpixel electrodes **191a** and **191b** that are applied with data voltages having different polarities. At the same time, an electric field is generated in the liquid crystal layer 3 between the first and second subpixel electrodes **191a** and **191b** of the lower panel and the common electrode **270** of the upper panel **200**. Edges of the first and second subpixel electrodes **191a** and **191b** distort the electric field together with the common electrode **270**, thereby generating a horizontal component that is substantially perpendicular to the edges of the subpixel electrodes **191a** and **191b**. Therefore, liquid crystal molecules of the liquid crystal layer 3 having positive dielectric anisotropy are aligned to be substantially parallel to the electric field, and a variation degree of polarization of light incident in the liquid crystal layer 3 is varied depending on an inclination degree of the liquid crystal molecules.

Next, one exemplary embodiment of the liquid crystal display shown in FIG. 9 will be described with reference to FIG. 10 to FIG. 12.

A layered structure of the current exemplary embodiment of a liquid crystal panel assembly is substantially the same as that of the previous exemplary embodiments of a liquid crystal panel assembly shown in FIG. 5 to FIG. 7.

First, referring to the lower panel **100**, a plurality of gate lines **121** including a plurality of pairs of first and second gate electrodes **124a** and **124b**, a plurality of storage electrode lines **131**, a gate insulating layer **140**, a plurality of pairs of first and second semiconductor stripes **151a** and **151b**, a plurality of pairs of first and second ohmic contact stripes **161a**, a plurality of pairs of first and second ohmic contact islands **165c**, a plurality of pairs of first and second data lines **171a** and **171b**, a plurality of pairs of first and second drain electrodes **175a** and **175b**, a passivation layer **180**, first and second subpixel electrodes **191a** and **191b**, and an alignment layer **11** are sequentially formed on an insulating substrate **110**.

Next, referring to the upper panel **200**, a light blocking member **220**, a color filter **230**, an overcoat **250**, a short protrusion **320**, a common electrode **270**, and an alignment layer **21** are sequentially formed on an insulation substrate **210**.

Unlike the exemplary embodiment of a liquid crystal panel assembly shown in FIG. 5 to FIG. 7, in the present exemplary embodiment, the first and second semiconductors **151a** and **151b** are linear and include first and second protrusions **154c** and **154d** protruding along source electrodes **173a** and **173b** and drain electrodes **175a** and **175b**. Further, the ohmic contacts **161a** also linearly extend along the data lines **171a** and **171b** and include protrusions **163a** protruding along the source electrodes **173a** and **173b**.

The storage electrode lines **131** are positioned between two adjacent gate lines **121** and are spaced from the two gate lines **121** by substantially the same distance. The first and second subpixel electrodes **191a** and **191b** overlap with the storage electrode lines **131** with the gate line insulating layer **140** and the passivation layer **180** interposed therebetween, thereby forming first and second storage capacitors **Csta** and **Cstb**.

In the present exemplary embodiment, each of the first and second subpixel electrodes **191a** and **191b** has a longitudinal portion and a plurality of transverse portions. The transverse portion of the first subpixel electrode **191a** is positioned at a lower end of the pixel and the longitudinal portions of the first subpixel electrode **191a** extend upward from the transverse portion. The transverse portion of the second pixel electrode **191b** is positioned at an upper end of the pixel and the plurality of longitudinal portions of the second pixel electrode **191b** extend downward from the transverse portion. The transverse portions and the longitudinal portions of the first and second subpixel electrodes **191a** and **191b** are substantially perpendicular to each other. The longitudinal portions of the first and second subpixel electrodes **191a** and **191b** are alternately arranged. Alternative exemplary embodiments include configurations wherein the transverse and longitudinal arrangement of the subpixel electrodes **191a** and **191b** may be variously modified.

Each short protrusion **320** faces both the first and second subpixel electrodes **191a** and **191b** and is disposed in a region where the light blocking member **220** is disposed, thereby preventing a decrease of the aperture ratio and the transmittance as well as covering, and thereby preventing the viewing of, textures where the arrangement of the liquid crystal molecules **31** is not controlled around the short protrusion **320**.

In the present exemplary embodiment, if a pressure from the outside is applied to the display panels **100** and **200**, the common electrode **270** on the short protrusion **320** of the upper panel **200** contacts the first and second subpixel electrodes **191a** and **191b** of the lower panel **100** with the alignment layers **11** and **21** therebetween. Then, leakage current flows between the common electrode **270** and the first and second subpixel electrodes **191a** and **191b** such that the voltage difference between the common electrode **270** and the first and second subpixel electrodes **191a** and **191b** is eliminated, and the pushed pixel PX displays a nearly black display. Accordingly, although the liquid crystal molecules **32** that were initially vertically aligned happen to be pressed horizontal to the display panels **100** and **200** by an exterior pressure, the electric field applied to the liquid crystal layer **3** is almost eliminated such that the initial vertical alignment state may again be restored shortly after the external pressure is removed. This may allow a display deterioration to be quickly and easily removed as discussed in detail above.

Various characteristics of the liquid crystal display shown in FIG. **5** to FIG. **7** may also be applied to the present exemplary embodiment.

Next, referring to FIG. **13** and FIG. **14**, another exemplary embodiment of an LCD according to the present invention will be described.

FIG. **13** is a top plan layout view of an exemplary embodiment of an LCD according to the present invention, and FIG. **14** is a cross-sectional view of the exemplary embodiment of an LCD shown in FIG. **13** taken along line XIV-XIV.

A layered structure of the present exemplary embodiment of a liquid crystal panel assembly is also substantially the same as that of the previous exemplary embodiment of a liquid crystal panel assembly shown in FIG. **5** to FIG. **7**.

First, referring to the lower panel **100**, a gate line **121** including a plurality of gate electrodes **124** and a plurality of storage electrode lines **131**, a gate insulating layer **140**, a plurality of semiconductor islands **154**, a plurality of pairs of ohmic contact islands **163** and **165**, a plurality of data lines **171**, a plurality of drain electrodes **175**, a passivation layer **180** having a plurality of contact holes **185**, a plurality of pixel electrodes **191**, and an alignment layer **11** are sequentially formed on an insulation substrate **110**.

Referring to the upper panel **200**, a light blocking member **220**, a color filter **230**, an overcoat **250**, a short protrusion **320**, a common electrode **270**, and an alignment layer **21** are formed on an insulation substrate **210**.

In the present exemplary embodiment, each pixel electrode **191** has an approximately quadrangle shape having four main edges disposed nearly parallel to the gate lines **121** or the data lines **171**, as well as four chamfered corners. Each pixel electrode **191** includes a first central cutout **91**, a second central cutout **92**, a first upper cutout **93a**, a first lower cutout **93b**, a second upper cutout **94a**, and a second lower cutout **94b**, and is divided into a plurality of partitions by the cutouts **91-94b**.

In the present exemplary embodiment, the common electrode **270** has a plurality of sets of cutouts **71**, **72**, **73a**, **73b**, **74a**, and **74b**. The cutouts **71-74b** include first and second central cutouts **71** and **72**, first and second upper cutouts **73a** and **74a**, and first and second lower cutouts **73b** and **74b**. Also in the present exemplary embodiment, each of the cutouts **71-74b** has at least one oblique portion substantially extending obliquely to the gate lines **Gi**, and each oblique portion has a plurality of notches that are concave or convex.

Alternative exemplary embodiments include configurations wherein at least one of the cutouts **91-94b** and **71-74b** of the pixel electrodes **191** and the common electrode **270** may

be replaced with protrusions or depressions, and the shape and arrangement thereof may be changed.

The liquid crystal layer **3** between the lower panel **100** and the upper panel **200** may have negative dielectric anisotropy, and may be initially oriented such that the major axes of the liquid crystal molecules of the liquid crystal layer **3** are substantially perpendicular to the surfaces of the two display panels **100** and **200** when no electric field is applied.

The pixel electrode **191** and the common electrode **270** form a liquid crystal capacitor **C_{lc}** along with the liquid crystal layer **3** therebetween to maintain the applied voltages after the thin film transistor **Q**, which includes the gate electrode **124**, the semiconductor **154**, the source electrode **173**, and the drain electrode **175**, is turned off.

A wide end portion **177** of the drain electrode **175** connected to the pixel electrode **191** overlaps the storage electrode line **131** via the gate insulating layer **140** to form the storage capacitor **C_{st}** to enhance the voltage storing capacity of the liquid crystal capacitor **C_{lc}**.

The pixel electrodes **191** applied with the data voltage generate an electric field together with the common electrode **270** applied with the common voltage **V_{com}**, thereby determining an orientation of liquid crystal molecules of the liquid crystal layer **3** between the two electrodes **191** and **270**. This electric field includes a vertical component substantially perpendicular to the surface of the display panels **100** and **200**, and a horizontal component substantially parallel to the surface of the display panels **100** and **200** and substantially perpendicular to the cutouts **91-94b** and **71-74b**. The inclined direction of the liquid crystal molecules is primarily determined depending on the horizontal component, and the tilt directions of the liquid crystal molecules are basically classified into four directions. When the tilt directions of the liquid crystal molecules are diversified in this way, the reference viewing angle of the liquid crystal display may be increased.

However, there exist liquid crystal molecules **32** that are disposed between liquid crystal molecules **31** that are inclined in the different directions, and are not inclined in any direction, thereby maintaining the initial vertical alignment state. If a pressure from the outside is applied to the display panels **100** and **200**, the common electrode **270** on the short protrusion **320** of the upper panel **200** contacts the pixel electrode **191** of the lower panel **100** via the alignment layers **11** and **21**. Thus, leakage current flows between the common electrode **270** and the pixel electrode **191** such that the voltage difference between the common electrode **270** and the pixel electrode **191** is eliminated, and thereby the pushed pixel PX displays nearly black. Accordingly, although liquid crystal molecules **32** that were initially vertically aligned are pressed horizontal to the display panels **100** and **200** by the exterior pressure, the electric field applied to the liquid crystal layer **3** is almost eliminated such that the initial vertical alignment state may be restored shortly after the external pressure is removed, thereby preventing stains.

In the present exemplary embodiment, the short protrusion **320** overlaps the storage electrode line **131** such that decrease of the aperture ratio and the transmittance may be prevented, and textures that are generated by the liquid crystal molecules **31** that are not controlled near the short protrusion **320** may be covered.

According to an exemplary embodiment of the present invention, a response speed of liquid crystal molecules may be improved, and a contrast ratio and a viewing angle may be increased. Also, good display characteristics may be obtained regardless of any influence such as a pressure from the outside of an LCD.

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

What is claimed is:

1. A liquid crystal display comprising:
first and second substrates facing each other;
a liquid crystal layer interposed between the first and second substrates and including liquid crystal molecules;
a first subpixel electrode disposed on the first substrate, the first subpixel electrode receiving a first data voltage;
a second subpixel electrode disposed on the first substrate, the second subpixel electrode receiving a second data voltage; and
a short protrusion disposed on the second substrate and simultaneously facing the first and second subpixel electrodes,
wherein the liquid crystal layer is vertically aligned and has positive dielectric anisotropy, and
the short protrusion is disposed in a region where light is not transmitted.
2. The liquid crystal display of claim 1, wherein the short protrusion comprises a conductive polymer.
3. The liquid crystal display of claim 1, further comprising: a short electrode disposed on the short protrusion.
4. The liquid crystal display of claim 3, wherein the short electrode comprises a conductive material.
5. The liquid crystal display of claim 4, wherein the conductive material includes at least one of indium tin oxide and indium zinc oxide.
6. The liquid crystal display of claim 1, wherein a height of the short protrusion is smaller than a cell gap of the liquid crystal layer.
7. The liquid crystal display of claim 1, further comprising: a light blocking member disposed on at least one of the first substrate and the second substrate,
wherein the short protrusion overlaps the light blocking member.

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8. The liquid crystal display of claim 1, further comprising:
a gate line disposed on the first substrate and which transmits a gate signal;
a first data line disposed on the first substrate, the first data line transmitting the first data voltage;
a second data line disposed on the first substrate, the second data line transmitting the second data voltage;
a first switching element connected to the gate line and the first data line, the first switching element comprising a first drain electrode connected to the first subpixel electrode; and
a second switching element connected to the gate line and the second data line, the second switching element comprising a second drain electrode connected to the second subpixel electrode.
9. The liquid crystal display of claim 8, wherein the short protrusion overlaps at least one of the first and second drain electrodes.
10. The liquid crystal display of claim 8, further comprising:
a storage electrode line disposed on the first substrate and comprising a portion overlapping at least one of the first and second drain electrodes,
wherein the short protrusion overlaps the storage electrode line.
11. The liquid crystal display of claim 1, wherein each of the first and second subpixel electrodes comprises a plurality of branch electrodes, and
wherein the branch electrodes of the first subpixel electrode and the branch electrodes of the second subpixel electrode are alternately disposed.
12. The liquid crystal display of claim 1, wherein the first and second data voltages have different polarities and substantially a same magnitude with respect to a common voltage.
13. The liquid crystal display of claim 1, further comprising:
a common electrode which is disposed on the short protrusion and applied with a common voltage.

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专利名称(译)	液晶显示器		
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摘要(译)

液晶显示器包括：第一基板和第二基板彼此面对，液晶层介于第一基板和第二基板之间并包括液晶分子，第一子像素电极设置在第一基板上，第一子像素电极接收第一数据电压，第二子像素电极设置在第一基板上，第二子像素电极接收第二数据电压;和短突起设置在第二基板上并同时面对第一和第二子像素电极，其中液晶层垂直排列并具有正介电各向异性。

