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Lee et al.

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(54) **LIQUID CRYSTAL DISPLAY DEVICE**

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G02F 1/1337 (2006.01)

(52) **U.S. Cl.**
CPC ***G02F 1/133707*** (2013.01); *G02F 2001/134345* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A display device may include a liquid crystal layer and a pixel electrode that overlaps the liquid crystal layer. The pixel electrode may include a first bar, a second bar, a third bar, and a plurality of first-type branches. The second bar may be directly connected to a first end of the first bar. The third bar may be directly connected to a first end of the second bar or directly connected to a second end of the first bar. The first-type branches may be slanted with respected to the first bar and may be positioned between the third bar and at least one of the first bar and the second bar.

19 Claims, 12 Drawing Sheets

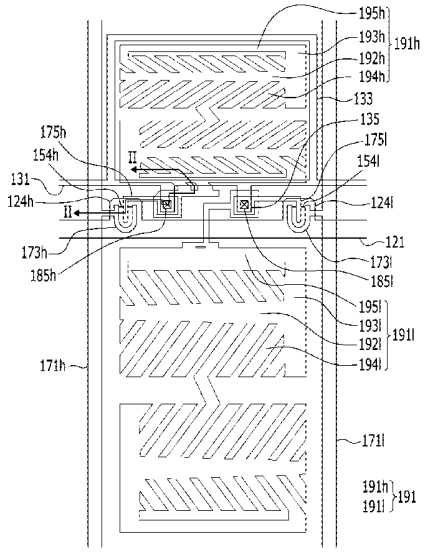


FIG. 1

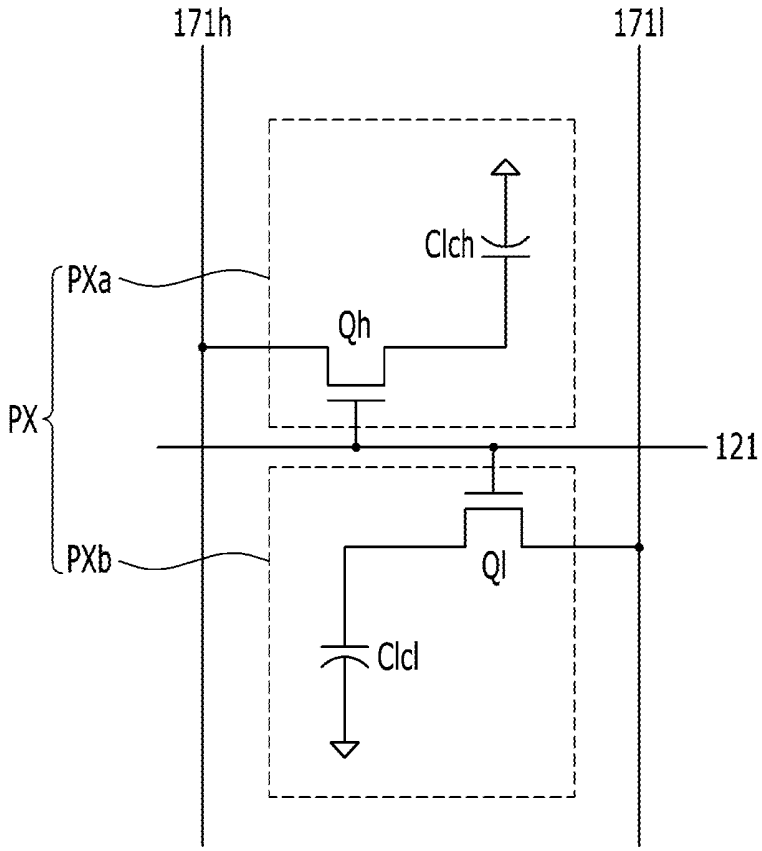
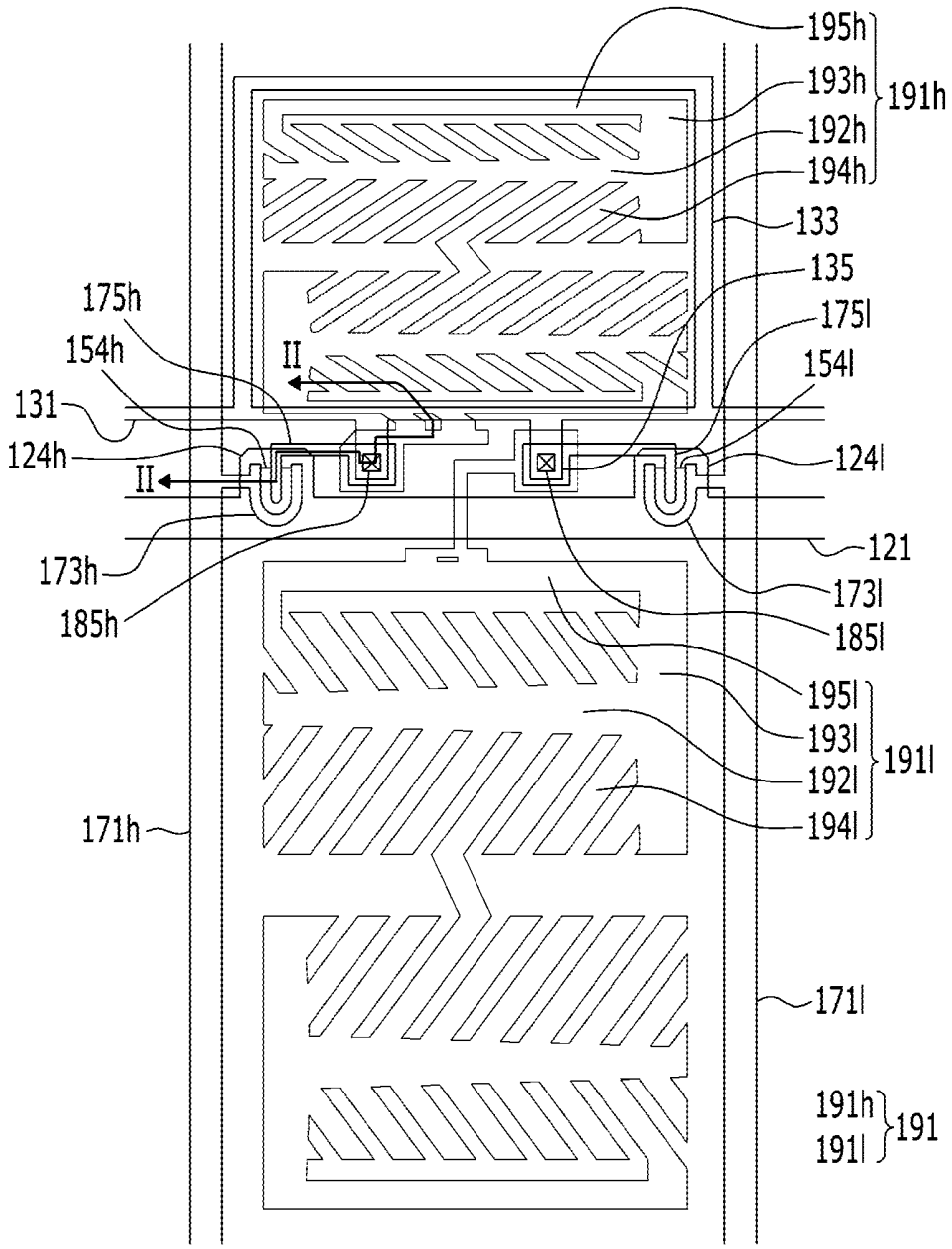


FIG. 2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173l
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195l
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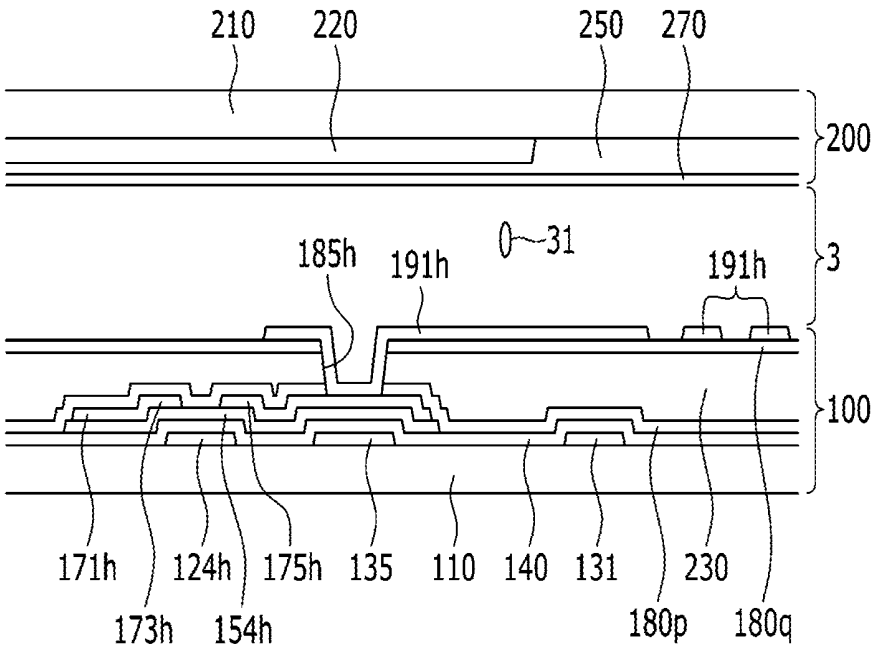
194l
191l
171h
171l
191h
191l
191

FIG. 3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200
31
185h
191h
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171h
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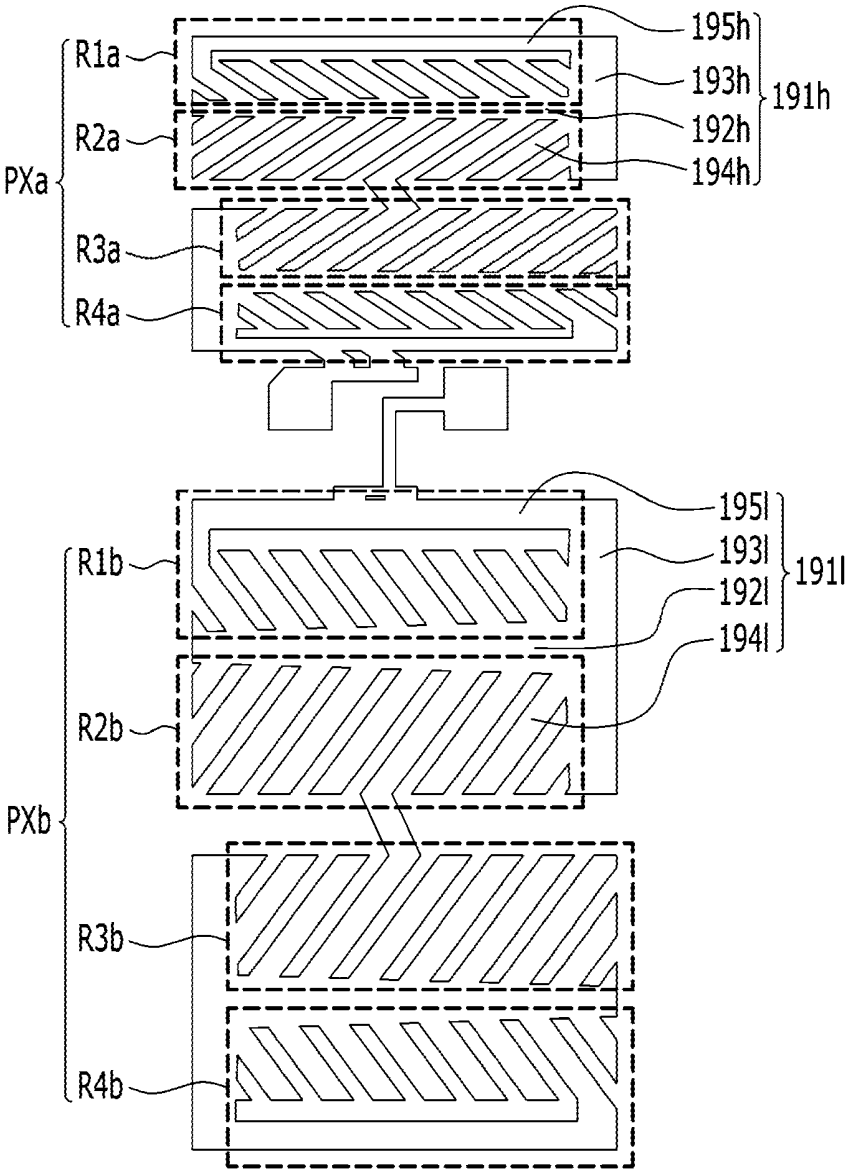
175h
135
110
140
131
230
173h
154h
180p
180q

FIG. 4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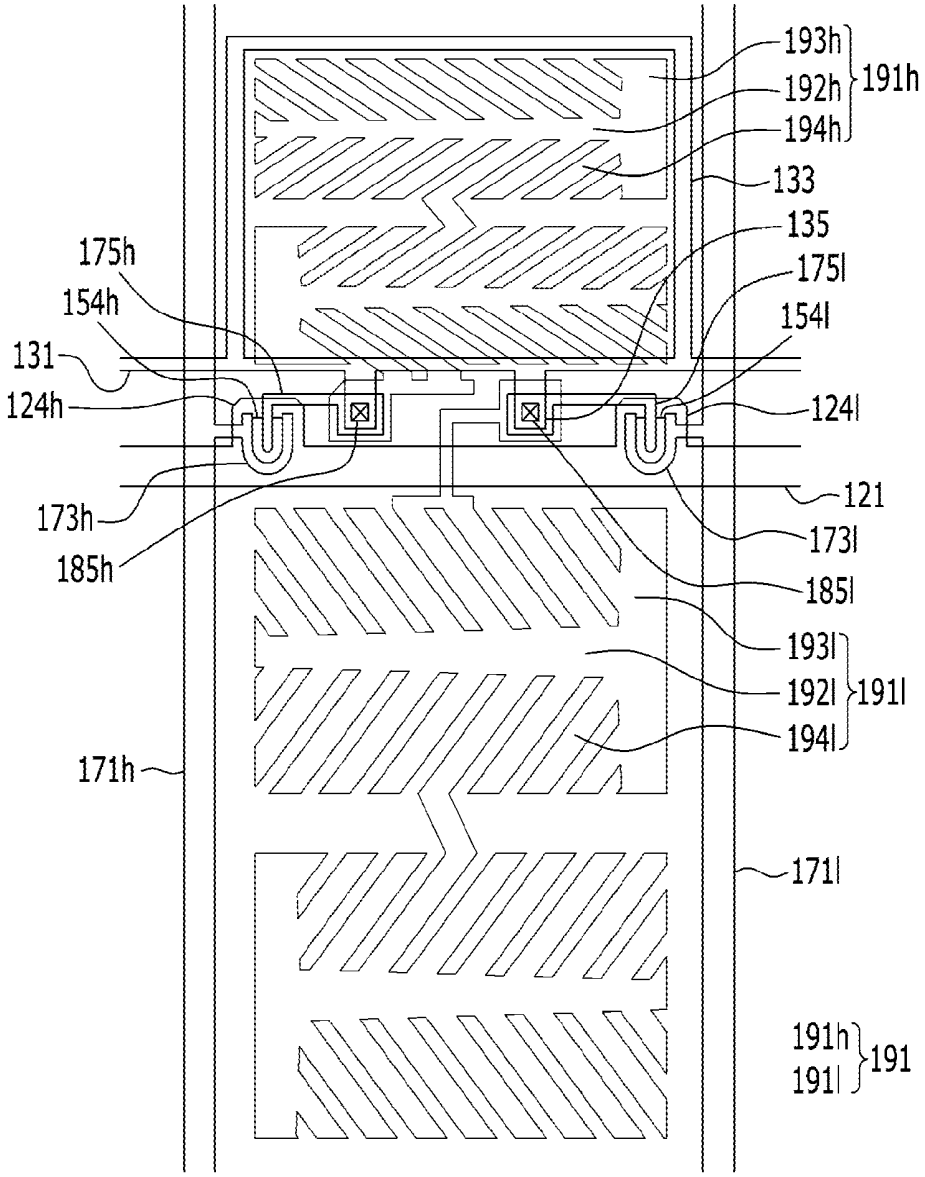
R4b

FIG. 5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191

FIG. 6

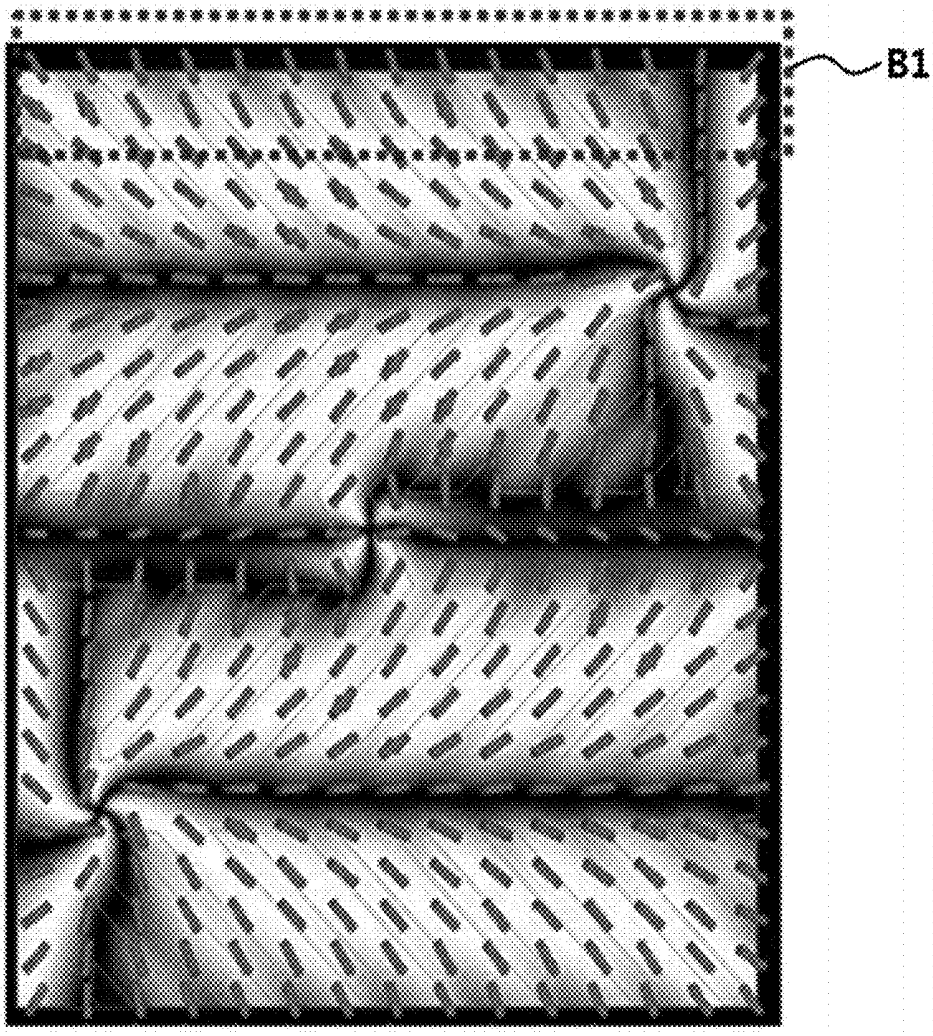


FIG. 7

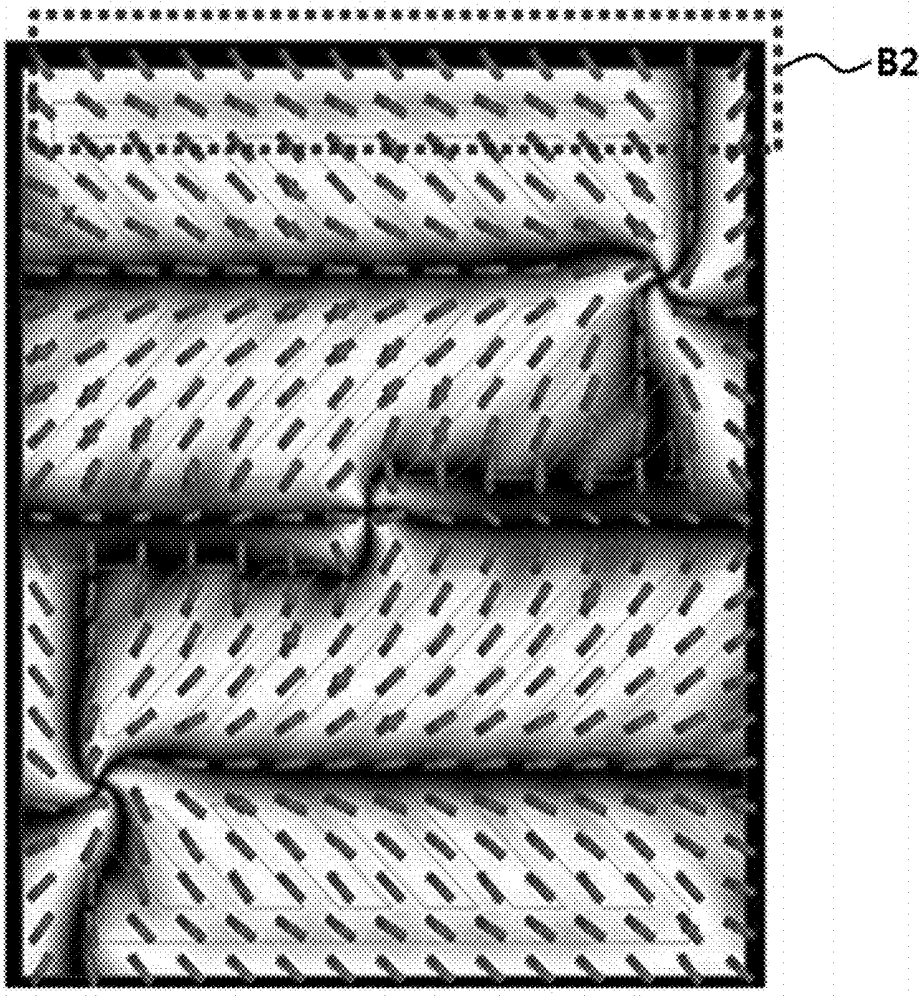


FIG. 8

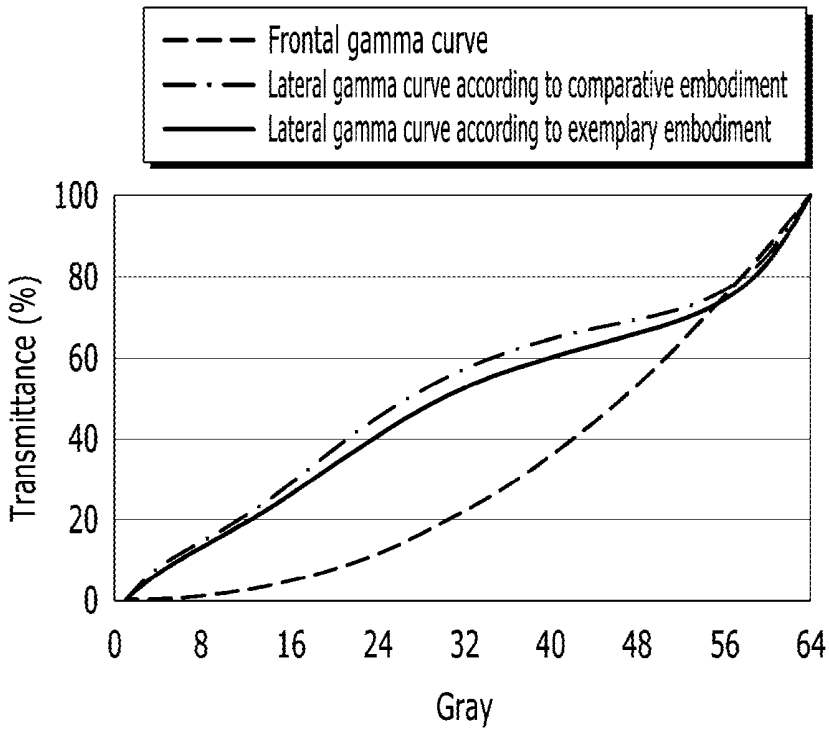
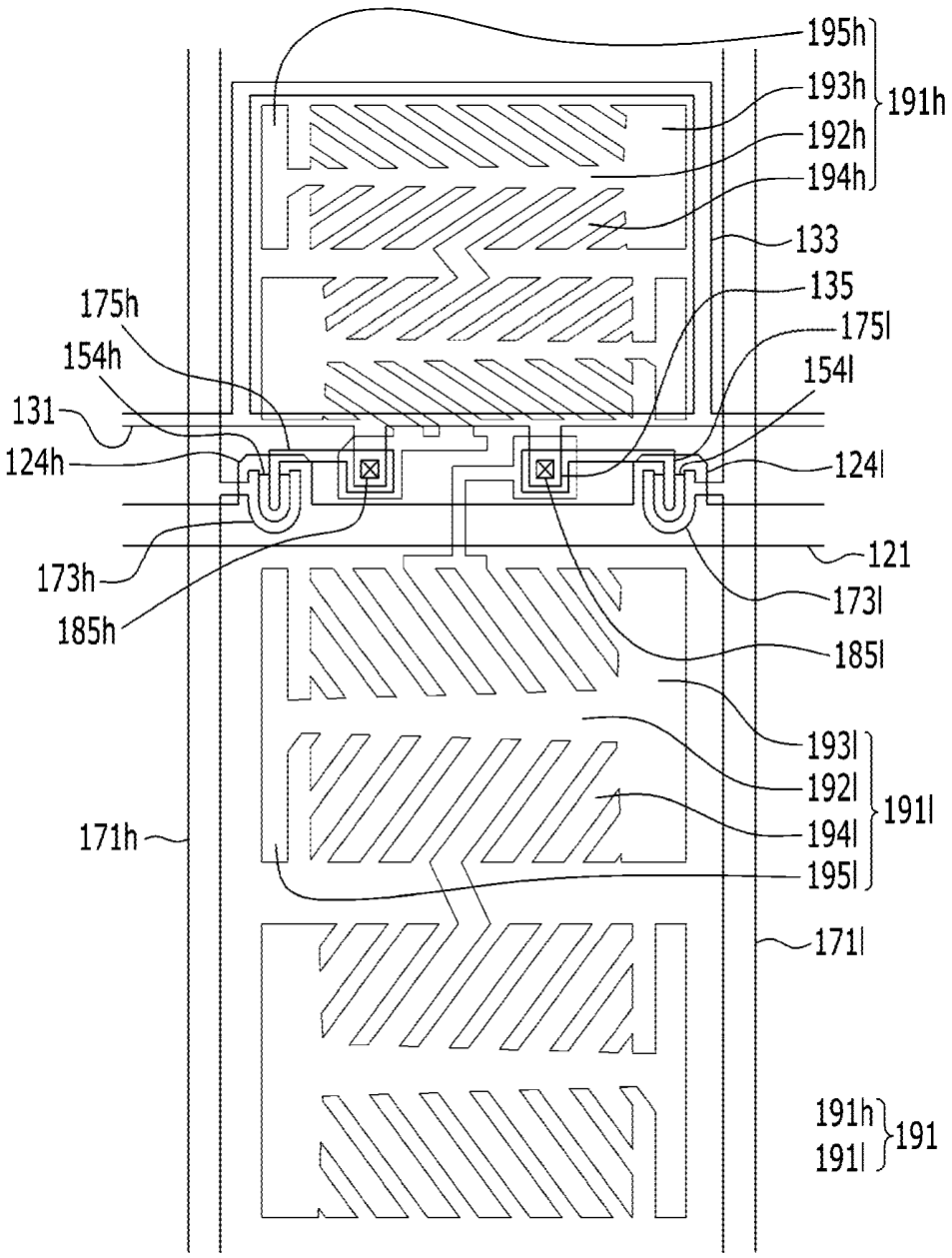

Frontal gamma curve
Lateral gamma curve according to comparative embodiment
Lateral gamma curve according to exemplary embodiment
Transmittance (%)
100
80
60
40
20
0
0
8
16
24
32
40
48
56
64
Gray

FIG. 9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171h
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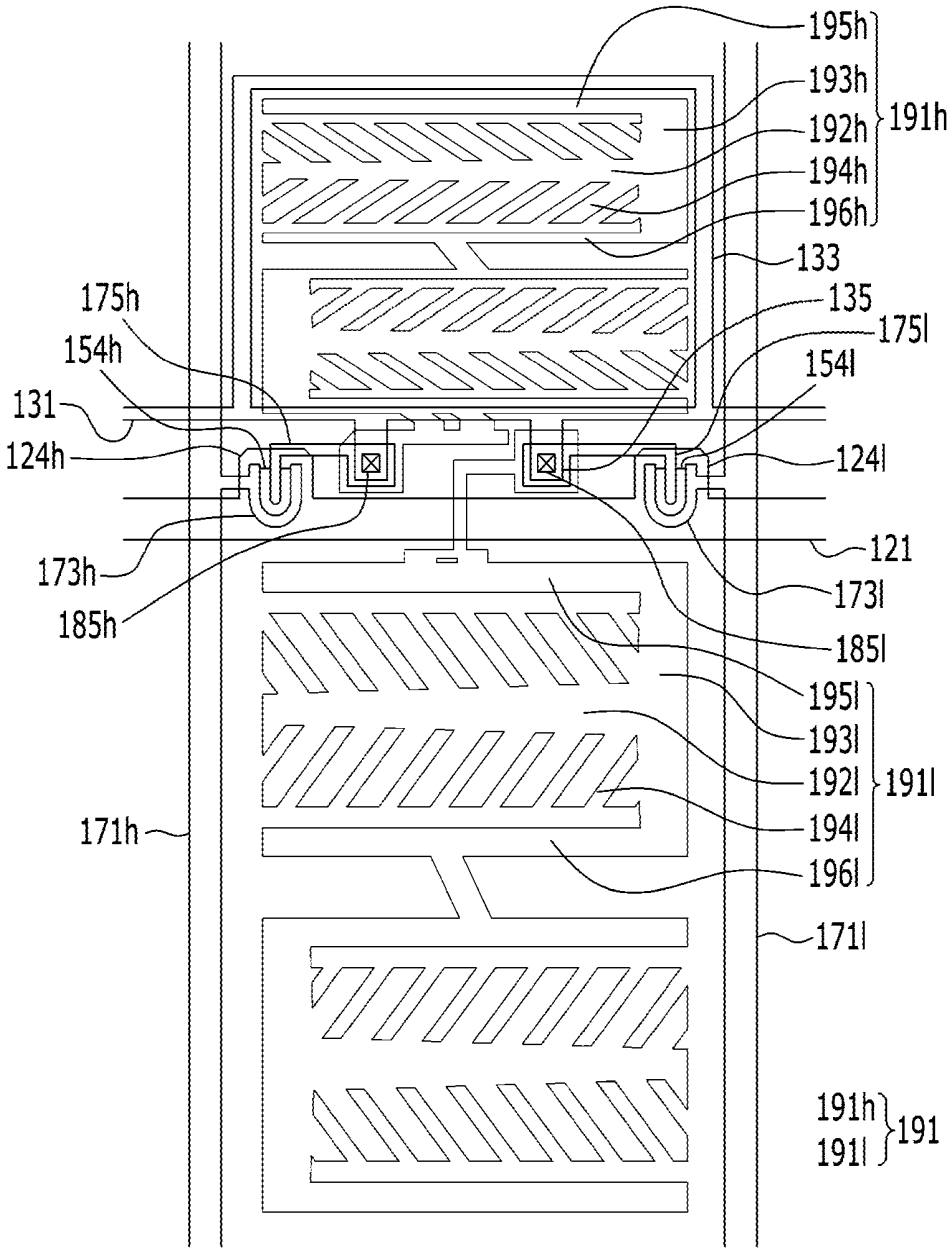
191h
191l
191

FIG. 10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192l
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196l
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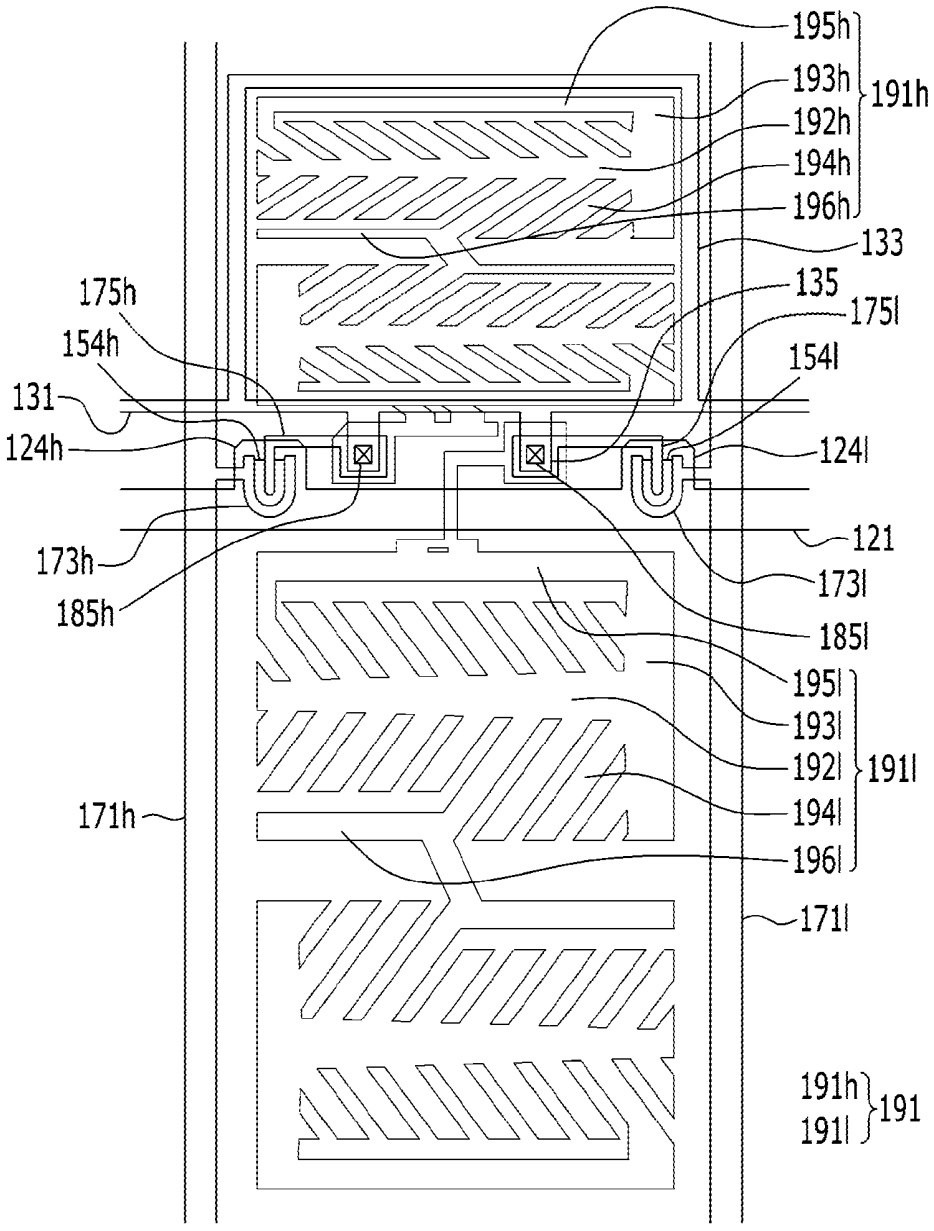
171h
171l
191h
191l
191

FIG. 11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191l
171h
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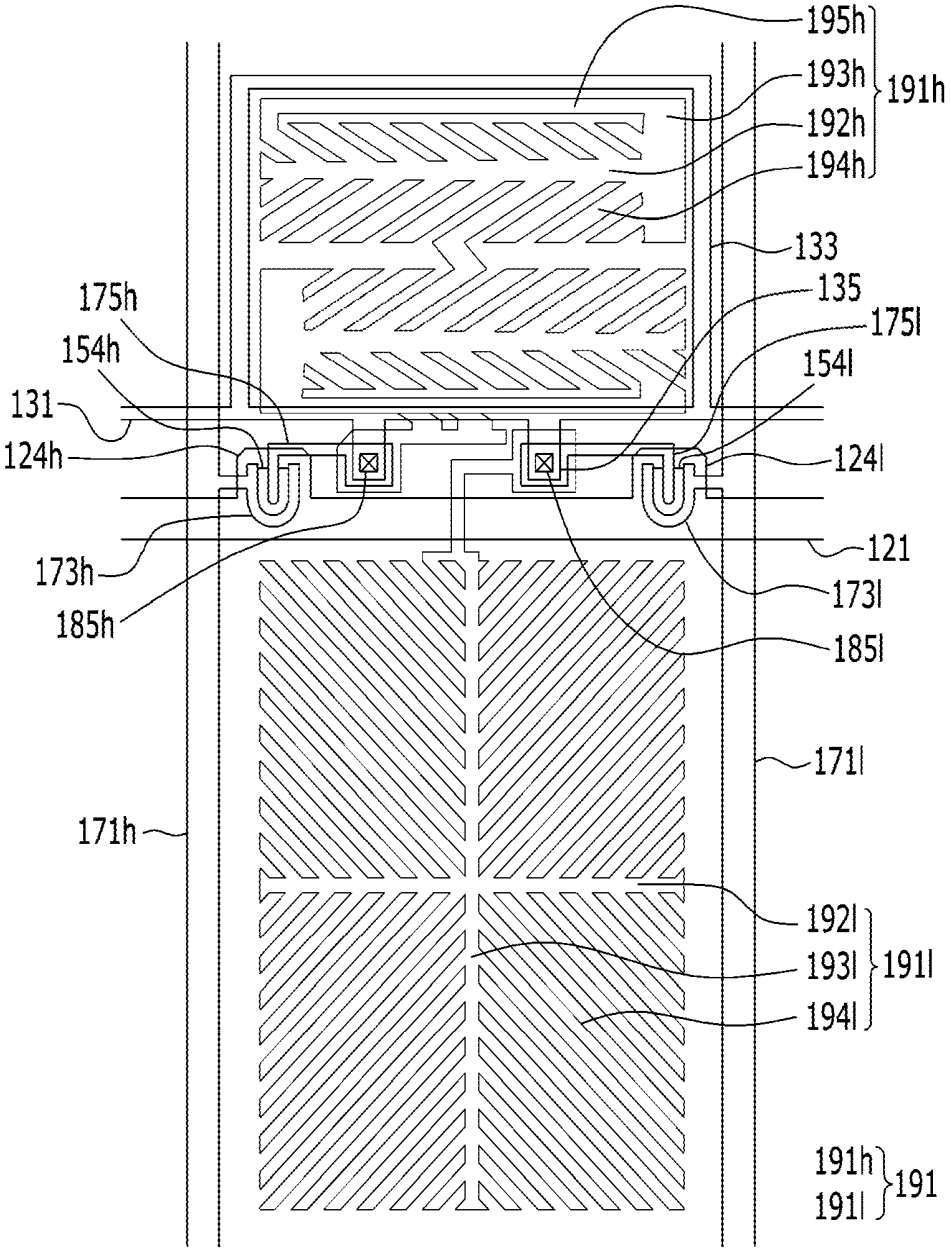
191h
191l
191

FIG. 12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194l
191l
191h
191l
191
175h
154h
131
124h
173h
185h
171h

LIQUID CRYSTAL DISPLAY DEVICE

RELATED APPLICATION(S)

This application claims priority to and the benefit of Korean Patent Application No. 10-2015-0070664 filed in the Korean Intellectual Property Office on May 20, 2015; the entire contents of the Korean Patent Application are incorporated herein by reference.

BACKGROUND

(a) Technical Field

The technical field relates to a liquid crystal display device.

(b) Description of the Related Art

A liquid crystal display device may include a pixel electrode, a common electrode, and a liquid crystal layer. The liquid crystal display may generate an electric field in a liquid crystal layer by applying a voltage to the electrodes, to determine orientations of liquid crystal molecules of the liquid crystal layer, for controlling transmission of incident light, thereby displaying an image. Visibility of the displayed image at different positions (or different viewing angles) with respect to the display device may be substantially different. As a result, visibility of the displayed image may be unsatisfactory. The above information disclosed in this Background section is provided to enhance understanding of the background of this application. The Background section may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

Embodiments may be related to a liquid crystal display device with satisfactory side visibility.

An embodiment may be related to a display device. The display device may include a liquid crystal layer and a pixel electrode. The pixel electrode may overlap the liquid crystal layer. The pixel electrode may include a first bar, a second bar, a third bar, and a plurality of first-type branches. The second bar may be directly connected to a first end of the first bar. The third bar may be directly connected to a first end of the second bar or directly connected to a second end of the first bar. The first-type branches may be slanted with respected to the first bar and may be positioned between the third bar and at least one of the first bar and the second bar.

The third bar may be directly connected to the first end of the second bar and may extend parallel to the first bar.

The third bar may be directly connected to the second end of the first bar and may extend parallel to the second bar.

The pixel electrode may include a fourth bar. A first end of the third bar may be directly connected to the first end of the second bar. A second end of the third bar may be directly connected to a first end of the fourth bar. A second end of the fourth bar may be directly connected to a first-type branch among the first-type branches.

The pixel electrode may include a fourth bar. The third bar may be directly connected to the first end of the second bar. The fourth bar may be directly connected to a second end of the second bar. The first bar may be positioned between the third bar and the fourth bar and may extend parallel to the fourth bar.

The pixel electrode may include a fourth bar and a second-type branch. The first bar may be positioned between the plurality of first-type branches and the second-type branch. The second-type branch may be slanted with respect to the first bar and may be directly connected to each of the first bar and the fourth bar.

The fourth bar may be shorter than the third bar.

A first end of the second-type branch may be directly connected to the first bar. A second end of the second-type branch may be directly connected to the fourth bar.

The pixel electrode may include a third-type branch. The third-type branch may extend parallel to the second-type branch and may be electrically connected through the second-type branch to the fourth bar.

The third-type branch may be shorter than the second-type branch and may be positioned between the first bar and the fourth bar.

The second-type branch may be longer than the third-type branch and may be positioned between the third-type branch and the second bar.

The third-type branch may be shorter than the second-type branch and may be positioned between the second-type branch and the second bar.

The third-type branch may be shorter than the second-type branch and may be directly connected to the second bar.

Distances from the first-type branches to the third bar may be equal to one another.

The display device may include a transistor that is electrically connected to the pixel electrode. The third bar may be positioned between the transistor and the plurality of first-type branches in a plan view of the display device.

The pixel electrode may include a fourth bar, a fifth bar, a sixth bar, and a plurality of second-type branches. The fifth bar may be directly connected to a first end of the fourth bar. The sixth bar may be directly connected to a first end of the fifth bar or directly connected to a second end of the fourth bar. The sixth bar may be electrically connected to the third bar. The second-type branches may be slanted with respected to the fourth bar and may be positioned between the sixth bar and at least one of the fourth bar and the fifth bar.

The third bar may be positioned at a first edge of the pixel electrode. The sixth bar may be poisoned at a second edge of the pixel electrode. The second edge of the pixel electrode may be opposite the first edge of the pixel electrode.

At least one of the plurality of first-type branches and the plurality of second-type branches and at least one of the first bar and the fourth bar may be positioned between the third bar and the sixth bar.

The pixel electrode may include a fourth bar, a fifth bar, a sixth bar, and a plurality of second-type branches. The fifth bar may be directly connected to a first end of the fourth bar. The sixth bar may be directly connected to a first end of the fifth bar or directly connected to a second end of the fourth bar. The sixth bar may be electrically insulated from the third bar. The second-type branches may be slanted with respected to the fourth bar and may be positioned between the sixth bar and at least one of the fourth bar and the fifth bar.

The third bar may be positioned at a first edge of the pixel electrode. The sixth bar may be poisoned at a second edge of the pixel electrode. The second edge of the pixel electrode may be opposite the first edge of the pixel electrode.

The display device may include a gate line, a first transistor, and a second transistor. The first transistor may be electrically connected to each of the third bar and the gate line. The second transistor may be electrically connected to each of the sixth bar and the gate line. The first transistor and the second transistor may be positioned between the third bar and the sixth bar in a plan view of the display device.

An may be related to a display that includes the following elements: a first substrate and a second substrate that face each other; a pixel electrode disposed on the first substrate; a common electrode disposed on the second substrate; a liquid crystal layer disposed between the first substrate and the second substrate. The pixel electrode includes the following elements: a T-shaped stem having a horizontal stem and a vertical stem; a plurality of minute branches extending from the T-shaped stem; and an outer stem directly connected to one end portion of the T-shaped stem, and disposed at an edge of a pixel area.

The outer stem may have a rod-like shape.

The outer stem may be directly connected to a minute branch near a first end portion of the horizontal stem and may be directly connected to the vertical stem, which is directly connected to a second end portion of the horizontal stem.

Some minute branches positioned between the minute branch and the vertical stem may be separated from the outer stem at a predetermined distance.

The pixel electrode may include two T-shaped stems, and two pluralities of minute branches may extend from each of the T-shaped stems.

One outer stem may be connected to a first end portion of each of the T-shaped stems.

Two outer stems may be respectively disposed at upper and lower edges of the pixel area and may extend parallel to the horizontal stem.

The pixel electrode may include a first subpixel electrode and a second subpixel electrode, to which different voltages are applied, and each of the first subpixel electrode and the second subpixel electrode may include a T-shaped stem, a plurality of minute branches, and an outer stem.

An outer stem may extend from a first end portion of a horizontal stem.

The outer stem may be separated from some minute branches by at a predetermined distance.

The outer stem may extend parallel to the vertical stem.

Two outer stem may be respectively disposed at left and right edges of the pixel area.

The pixel electrode may further include an auxiliary stem positioned at a central portion of the pixel area.

The outer stem and the auxiliary stem may each have a rod-like shape.

The pixel electrode may include two T-shaped stems, and the auxiliary stem may be positioned between the two T-shaped stems.

One auxiliary stem may extend from each of the T-shaped stems.

The auxiliary stem may be directly connected to a minute branch.

The outer stem and the auxiliary stem may extend parallel to the horizontal stem.

The pixel electrode may include a first subpixel electrode and a second subpixel electrode, to which different voltages are applied. The first subpixel electrode may include a T-shaped stem and may include first-type minute branches extending from the T-shaped stem. The second subpixel electrode may include a cross-shaped stem and may include second-type minute branches extending from the cross-shaped stem.

A data voltage applied to the first subpixel electrode may be higher than a data voltage applied to the second subpixel electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic equivalent circuit diagram of a pixel of a liquid crystal display device, or "liquid crystal display" for conciseness, according to an embodiment.

FIG. **2** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment.

FIG. **3** is a schematic cross-sectional view cut along a line III-III indicated in FIG. **2** according to an embodiment.

FIG. **4** is a schematic plan view illustrating some constituent elements illustrated in FIG. **2**.

FIG. **5** is a schematic plan view illustrating one pixel of a liquid crystal display according to a comparative embodiment.

FIG. **6** illustrates directions in which liquid crystal molecules are inclined (or oriented) in a liquid crystal display according to a comparative embodiment.

FIG. **7** illustrates directions in which liquid crystal molecules are inclined (or oriented) in a liquid crystal display according to an exemplary embodiment.

FIG. **8** is a graph illustrating gamma curves associated with a front (or center) and a side of a liquid crystal display according to an exemplary embodiment, as well as a gamma curve associated with a side of a liquid crystal display according to a comparative embodiment.

FIG. **9** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment.

FIG. **10** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment.

FIG. **11** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment.

FIG. **12** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment.

DETAILED DESCRIPTION

Some embodiments are described with reference to the accompanying drawings. As those skilled in the art would realize, the described embodiments may be modified in various ways.

Although the terms "first", "second", etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms may be used to distinguish one element from another element. Thus, a first element discussed below may be termed a second element without departing from teachings of one or more embodiments. The description of an element as a "first" element may not require or imply the presence of a second element or other elements. The terms "first", "second", etc. may also be used to differentiate different categories or sets of elements. For conciseness, the terms "first", "second", etc. may represent, for example, "first-category (or first-set)", "second-category (or second-set)", etc., respectively.

In the drawings, thicknesses of layers, films, panels, regions, etc., may be exaggerated for clarity. Like reference numerals may designate like elements in this application. When a first element (such as a layer, film, region, or substrate) is referred to as being "on" a second element, the first element can be directly on the second element, or one or more intervening elements may also be present. In contrast, when a first element is referred to as being "directly on" a second element, there are no intervening elements intentionally provided between the first element and the second element.

A drawing and related description may use a particular position and/or orientation of a device as an example. The device may have various positions and/or orientations.

In this application, a "stem" or "bar" may mean a straight piece that is longer than it is wide.

FIG. **1** is a schematic equivalent circuit diagram of a pixel of a liquid crystal display device, or "liquid crystal display" for conciseness according to an embodiment.

Referring to FIG. **1**, the liquid crystal display includes a plurality of signal lines **121**, **171***h*, and **171***l*. A pixel area PX may be defined by these signal lines **121**, **171***h* and **171***l*. The pixel area PX may include a first subpixel area PXa and a second subpixel area PXb.

The signal lines **121**, **171***h*, and **171***l* include a gate line **121** for transferring gate signals, a first data line **171***h* for transferring a first data voltage, and a second data line **171***l* for transferring a second data voltage different from the first voltage.

A first switching element Qh is in electrical connection with the gate line **121** and the first data line **171***h*, and a second switching element Ql is in electrical connection with the gate line **121** and the second data line **171***l*.

A first liquid crystal capacitor Clch connected to the first switching element Qh is located in the first subpixel area PXa, and a second liquid crystal capacitor Clcl connected to the second switching element Ql is located in the second subpixel area PXb.

A first terminal of the first switching element Qh is connected to the gate line **121**, a second terminal thereof is connected to the first data line **171***h*, and a third terminal thereof is connected to the first liquid crystal capacitor Clch.

A first terminal of the second switching element Ql is connected to the gate line **121**, a second terminal thereof is connected to the second data line **171***l*, and a third terminal thereof is connected to the second liquid crystal capacitor Clcl.

An operation of the liquid crystal display according to the exemplary embodiment is described as follows: When a gate-on voltage is applied to the gate line **121**, the first switching element Qh and the second switching element Ql are turned on, and the liquid crystal capacitors Clch and Clcl are charged by different data voltages transferred through the data lines **171***h* and **171***l*. The data voltage transferred by the second data line **171***l* may be lower than the data voltage transferred by the first data line **171***h*. Accordingly, the second liquid crystal capacitor Clcl can be charged by a lower voltage than that of the first liquid crystal capacitor Clch. Advantageously, satisfactory side visibility of an image displayed by the liquid crystal display may be attained.

Referring to FIG. **2** to FIG. **4**, one pixel area of a liquid crystal display according to an embodiment is described.

FIG. **2** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment, FIG. **3** is a schematic cross-sectional view provided along a line III-III indicated in FIG. **2** according to an embodiment, and FIG. **4** is a schematic plan view illustrating some constituent elements illustrated in FIG. **2**. FIG. **4** illustrates pixel electrodes of the liquid crystal display according to an embodiment.

Referring to FIG. **2** to FIG. **4**, the liquid crystal display includes a lower display panel **100** and an upper display panel **200** configured to face each other, and a liquid crystal layer 3 interposed between these two display panels **100** and **200**.

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

A gate line **121**, and a first gate electrode **124***h* and a second gate electrode **124***l*, which protrude from the gate line **121**, are formed on a first substrate **110** made of transparent glass, plastic, or the like.

The gate line **121** mainly extends in a horizontal direction to transmit a gate signal.

A sustain electrode line **131** and sustain electrodes **133** and **135** protruding from the sustain electrode line **131** may be further formed on the first substrate **110**.

The sustain electrode line **131** extends in a direction parallel to the gate line **121**, and is formed to be separated from the gate line **121**. A predetermined voltage may be applied to the sustain electrode line **131**. The sustain electrode **133** protruding above the sustain electrode line **131** is formed to surround the boundary of a first subpixel electrode **191***h*, which will be described later. The sustain electrode **135** protruding below the sustain electrode line **131** overlaps a first drain electrode **175***h* and a second drain electrode **175***l*, which will be described later.

A gate insulating layer **140** is formed on the gate line **121**, the first gate electrode **124***h*, the second gate electrode **124***l*, the sustain electrode line **131**, and the sustain electrodes **133** and **135**. The gate insulating layer **140** may be formed of an inorganic insulating material such as at least one of a silicon nitride (SiNx), a silicon oxide (SiOx), and the like. The gate insulating layer **140** may be formed as a single layer or multiple layers.

A first semiconductor **154***h* and a second semiconductor **154***l* are formed on the gate insulating layer **140**. The first semiconductor **154***h* may be disposed on the first gate electrode **124***h*, and the second semiconductor **154***l* may be disposed on the second gate electrode **124***l*. The first semiconductor **154***h* may also be disposed below the first data line **171***h*, and the second semiconductor **154***l* may also be disposed below the second data line **171***l*. The first semiconductor **154***h* and the second semiconductor **154***l* may be made of amorphous silicon, polycrystalline silicon, a metal oxide, and the like.

Ohmic contact members (not illustrated) may be further formed on each of the first semiconductor **154***h* and the second semiconductor **154***l*. The ohmic contact members may be formed of a material such as a silicide or n+ hydrogenated amorphous silicon doped with an n-type impurity in high concentration.

On the first semiconductor **154***h*, the second semiconductor **154***l*, and the gate insulating layer **140**, the first data line **171***h*, the second data line **171***l*, a first source electrode **173***h*, the first drain electrode **175***h*, a second source electrode **173***l*, and the second drain electrode **175***l* are formed.

The first data line **171***h* and the second data line **171***l* may transfer data signals, may mainly extend in a vertical direction, and may cross the gate line **121** and the storage electrode line **131**.

The first data line **171***h* and the second data line **171***l* transfer different data voltages. For example, the data voltage transferred by the second data line **171***l* is lower than the data voltage transferred by the first data line **171***h*.

The first source electrode **173***h* is formed to protrude from the first data line **171***h* above the first gate electrode **124***h*, and the second source electrode **173***l* is formed to protrude from the second data line **171***l* above the second gate electrode **124***l*. The first drain electrode **175***h* and the second drain electrode **175***l* each include one wide end portion with the other end portion having a rod shape. The wide end portions of the first drain electrode **175***h* and the second drain electrode **175***l* overlap the sustain electrode **135** protruding under the sustain electrode line **131**. Each of the other rod shape end portions of the first drain electrode **175***h* and the second drain electrode **175***l* is partially surrounded by the first source electrode **173***h* and the second source electrode **173***l*.

The first and second gate electrodes **124***h* and **124***l*, the first and second source electrodes **173***h* and **173***l*, and the first and second drain electrodes **175***h* and **175***l* constitute the respective first and second thin film transistors (TFT) Qh and Ql together with the first and second semiconductors

154*h* and 154*l*. In this case, a channel of the thin film transistor is formed in the respective semiconductors 154*h* and 154*l* between the source electrodes 173*h* and 173*l* and the drain electrodes 175*h* and 175*l*, respectively.

A first passivation layer 180*p* is formed on the first data line 171*h*, the second data line 171*l*, the first source electrode 173*h*, the first drain electrode 175*h*, the first semiconductor 154*h* exposed between the first source electrode 173*h* and the first drain electrode 175*h*, the second source electrode 173*l*, the second drain electrode 175*l*, and the second semiconductor 154*l* exposed between the second source electrode 173*l* and the second drain electrode 175*l*. The first passivation layer 180*p* may be formed of an inorganic insulating material such as a silicon nitride (SiNx), a silicon oxide (SiOx), and the like.

A color filter 230 is formed on the first passivation layer 180*p*. The color filter 230 may be formed in a column direction.

Each color filter 230 may display one of three primary colors, such as red, green, and blue. The color filter 230 is not limited to the three primary colors of red, green, and blue, but may also display cyan, magenta, yellow, and white-based colors.

A second passivation layer 180*q* is formed on the color filter 230. The second passivation layer 180*q* may be formed of an inorganic insulating material such as at least one of a silicon nitride (SiNx), a silicon oxide (SiOx), and the like.

The color filter 230 may not be formed on the lower display panel 100, but may be formed on the upper display panel. In addition, the second passivation layer 180*q* may be omitted.

In the first passivation layer 180*p*, the color filter 230, and the second passivation layer 180*q*, a first contact hole 185*h* is formed to expose the wide end portion of the first drain electrode 175*h*, and a second contact hole 185*l* is formed to exposed the wide end portion of the second drain electrode 175*l*.

A pixel electrode 191 is formed on the second passivation layer 180*q*. The pixel electrode 191 may be made of a transparent metal oxide such as at least one of indium tin oxide (ITO), indium zinc oxide (IZO), and the like.

The pixel electrode 191 includes a first subpixel electrode 191*h* and a second subpixel electrode 191*l*. The first subpixel electrode 191*h* is disposed on the first subpixel area PXa, and the second subpixel electrode 191*l* is disposed on the second subpixel area PXb.

The first subpixel electrode 191*h* is connected to the first drain electrode 175*h* through the first contact hole 185*h*, and the second subpixel electrode 191*l* is connected to the second drain electrode 175*l* through the second contact hole 185*l*. Accordingly, when the first thin film transistor Qh and the second thin film transistor Ql are turned on, different data voltages are applied to the first subpixel electrode 191*h* and the second subpixel electrode 191*l* from the first drain electrode 175*h* and the second drain electrode 175*l*, respectively.

The overall shape of each of the first subpixel electrode 191*h* and the second subpixel electrode 191*l* is quadrangular. The first subpixel electrode 191*h* and the second subpixel electrode 191*l* respectively include T-shaped stems respectively including horizontal stems (or bars) 192*h* and 192*l* and vertical stems (or bars) 193*h* and 193*l*. In addition, the first sub-pixel electrode 191*h* and the second sub-pixel electrode 191*l* further include a plurality of minute branches 194*h* and a plurality of minute branches 194*l*, which extend from the horizontal stems 192*h* and 192*l* and the vertical stems 193*h* and 193*l*. The first subpixel electrode 191*h* and the second subpixel electrode 191*l* each may include two T-shaped stems, and the minute branches 194*h* and 194*l* extend from the T-shaped stems. The first subpixel electrode 191*h* and the second subpixel electrode 191 further include outer stems (or bars) 195*h* and 195*l*, which are respectively connected to end portions of the T-shaped stems.

The horizontal stems 192*h* and 192*l* mainly extend in a horizontal direction, which is a direction parallel to the gate line 121.

The first subpixel area PXa and the second subpixel area PXb respectively include first areas R1*a* and R1*b*, second areas R2*a* and R2*b*, third areas R3*a* and R3*b*, and fourth areas R4*a* and R4*b*. When viewed from a plan view, two T-shaped stems are vertically disposed in each of the first subpixel area PXa and the second subpixel area PXb. The first areas R1*a* and R1*b* are respectively separated from the second areas R2*a* and R2*b* by the horizontal stems 192*h* and 192*l* of the T-shaped stem positioned at upper sides. Similarly, the third areas R3*a* and R3*b* are respectively separated from the fourth areas R4*a* and R4*b* by the horizontal stems 192*h* and 192*l* of the T-shaped stem positioned at a lower side.

The vertical stems 193*h* and 193*l* mainly extend in a vertical direction, which is a direction parallel to the data lines 171*h* and 171*l*, respectively. The vertical stems 193*h* and 193*l* are each positioned at one edge of the first subpixel area PXa and the second subpixel area PXb. For example, the vertical stems 193*h* and 193*l* may be positioned at left and right edges of the first subpixel area PXa and the second subpixel area PXb. Specifically, the vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the upper side may be positioned at the right edges of the first subpixel area PXa and the second subpixel area PXb. The vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the lower side may be positioned at the left edges of the first subpixel area PXa and the second subpixel area PXb. However, the present embodiment is not limited thereto, and the positions of the vertical stems 193*h* and 193*l* may be oppositely determined Specifically, the vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the upper side may be positioned at the left edges of the first subpixel area PXa and the second subpixel area PXb, and the vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the lower side may be positioned at the right edges of the first subpixel area PXa and the second subpixel area PXb.

The vertical stems 193*h* and 193*l* are each connected to one end portion of the horizontal stems 192*h* and 192*l*. For example, the vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the upper side may be connected to right end portions of the horizontal stems 192*h* and 192*l*. The vertical stems 193*h* and 193*l* of the T-shaped stem positioned at the lower side may be connected to left end portions of the horizontal stems 192*h* and 192*l*.

The minute branches 194*h* and 194*l* extend in an oblique direction with respect to the horizontal stems 192*h* and 192*l* and the vertical stems 193*h* and 193*l*

For example, the minute branches 194*h* and 194*l* may form an angle of about 40 to 50 degrees with respect to the horizontal stems 192*h* and 192*l*.

The minute branches 194*h* and 194*l* extend in four directions from each of the T-shaped stems. The minute branches 194*h* and 194*l* extend in different directions in the first areas R1*a* and R1*b*, the second areas R2*a* and R2*b*, the third areas R3*a* and R3*b*, and the fourth areas R4*a* and R4*b*. Specifically, in the first areas R1*a* and R1*b*, the minute branches 194*h* and 194*l* may extend in an upper left direction from the horizontal stems 192*h* and 192*l* and the vertical

stems **193***h* and **193***l*. In the second areas R2*a* and R2*b*, the minute branches **194***h* and **194***l* may extend in a lower left direction from the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*. In the third areas R3*a* and R3*b*, the minute branches **194***h* and **194***l* may extend in an upper right direction from the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*. In the fourth areas R4*a* and R4*b*, the minute branches **194***h* and **194***l* may extend in a lower right direction from the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*.

Each of the outer stems **195***h* and **195***l* may be directly connected to one end portion of one of the T-shaped stems. The outer stems **195***h* and **195***l* are positioned at edges of the first subpixel area PXa and the second subpixel area PXb. Specifically, the outer stems **195***h* and **195***l* may be positioned at upper and lower edges of the first subpixel area PXa and the second subpixel area PXb. The outer stems **195***h* and **195***l* have rod-like shapes or bar structures. The outer stems **195***h* and **195***l* extend straight parallel to the horizontal stems **192***h* and **192***l*. The outer stems **195***h* and **195***l* may connect the vertical stems **193***h* and **193***l* to minute branches **194***h* and **194***l*. Outer stems **195***h* and **195***l* may be directly connected to minute branches **194***h* and **194***l*, "directly-connected minute branches **194***h* and **194***l*", near first end portions of horizontal stems **192***h* and **192***l* and may be directly connected to vertical stems **193***h* and **193***l* near second end portions of the horizontal stems **192***h* and **192***l*. Minute branches **194***h* and **194***l* not directly connected to outer stems **195***h* and **195***l* may be positioned between the directly-connected minute branches **194***h* and **194***l* and vertical stems **193***h* and **193***l* and may be separated from the outer stems **195***h* and **195***l* by a constant predetermined distance.

In an embodiment, the pixel electrode **191** includes the first subpixel electrode **191***h* and the second subpixel electrode **191***l*, and the first subpixel electrode **191***h* and second subpixel electrode **191***l* include the T-shaped stems, the minute branches **194***h* and **194***l*, and the outer stems **195***h* and **195***l*. In an embodiment, the pixel electrode **191** may include two or more subpixel electrodes, or may be a single pixel electrode. In an embodiment, some of the two or more subpixel electrodes may include T-shaped stems, minute branches, and outer stems, and the other subpixel electrodes may have different shapes.

Next, the second display panel **200** is described.

A light blocking member **220** is formed on a second substrate **210** made of transparent glass, plastic, or the like. The light blocking member **220** is also called a black matrix and serves to prevent light leakage. The light blocking member **220** may overlap the gate line **121**, the data lines **171***h* and **171***l*, and the thin film transistors Qh and Ql.

An overcoat **250** may be formed on the light blocking member **220**. The overcoat **250** serves to planarize a top surface of the second substrate **210**.

A common electrode **270** is formed on the overcoat **250**. The common electrode **270** may be made of a transparent metal oxide such as indium tin oxide (ITO), indium zinc oxide (IZO), and the like. The common electrode **270** may be formed on the entire surface of the second substrate **210**.

The liquid crystal layer 3 may include a plurality of liquid crystal molecules **31** having negative dielectric anisotropy.

When a predetermined voltage is applied to the pixel electrode **191** and the common electrode **270**, an electric field is generated between the lower display panel **100** and the upper display panel **200**. The electric field includes a vertical component of an approximately vertical direction with respect to the surfaces of the lower display panel **100** and the upper display panel **200**, and the liquid crystal molecules **31** incline in an approximately horizontal direction with respect to the surfaces of the lower display panel **100** and the upper display panel **200**.

A fringe field may be generated between edges of the horizontal stems **192***h* and **192***l*, the vertical stems **193***h* and **193***l*, the micro branches **194***h* and **194***l*, and the common electrode **270** to allow the liquid crystal molecules **31** to incline with respect to the connection portions of the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*, and in an approximate horizontal direction with respect to the micro branches **194***h* and **194***l*.

In the first areas R1*a* and R1*b*, the liquid crystal molecules **31** are inclined in a lower right direction. In the second areas R2*a* and R2*b*, the liquid crystal molecules **31** are inclined in an upper right direction. In the third areas R3*a* and R3*b* the liquid crystal molecules **31** are inclined in a lower left direction. In the fourth areas R4*a* and R4*b*, the liquid crystal molecules **31** are inclined in an upper left direction.

In an embodiment, since outer stems **195***h* and **195***l* are formed at edges of the first subpixel area PXa and the second subpixel area PXb, liquid crystal molecules **31** are also inclined at the edges in a direction substantially parallel to the minute branches **194***h* and **194***l*. Accordingly, liquid crystal molecules **31** positioned near the horizontal stems **192***h* and **192***l* in the first subpixel area PXa and the second subpixel area PXb may be oriented at angles of about 45 degrees with respect to the horizontal stems **192***h* and **192***l* (in a plan view), and liquid crystal molecules **31** positioned at edges of the first subpixel area PXa and the second subpixel area PXb also may be oriented at angles of about 45 degrees with respect to the horizontal stems **192***h* and **192***l* (in the plan view). Since most of the liquid crystal molecules **31** are inclined at angles of about 45 degrees (in the plan view), characteristics of an image viewed in front of the center of the liquid crystal display may be similar to those of the image viewed from a side (or lateral) position with respect to the liquid crystal display. Thus, satisfactory side visibility may be attained.

Enhancement of side visibility according to an embodiment is described with reference to FIG. **5** to FIG. **8**.

FIG. **5** is a schematic plan view illustrating one pixel of a liquid crystal display according to a comparative embodiment, and FIG. **6** illustrates directions in which liquid crystal molecules are inclined in the liquid crystal display according to the comparative embodiment. FIG. **7** illustrates directions in which liquid crystal molecules are inclined in a liquid crystal display according to an exemplary embodiment, e.g., the liquid crystal display described with reference to FIG. **1**, FIG. **2**, FIG. **3**, and FIG. **4**). FIG. **8** is a graph illustrating gamma curves associated with a front (or center) and a side of a liquid crystal display according to the exemplary embodiment, as well as a gamma curve associated with a side of a liquid crystal display according to the comparative embodiment.

As shown in FIG. **5**, in the liquid crystal display according to the comparative embodiment, the first subpixel electrode **191***h* and second subpixel electrode **191***l* respectively include T-shaped stems including the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*. In addition, the first sub-pixel electrode **191***h* and the second sub-pixel electrode **191***l* further include a plurality of minute branches **194***h* and **194***l* which extend from the horizontal stems **192***h* and **192***l* and the vertical stems **193***h* and **193***l*, respectively. The liquid crystal display according to the comparative embodiment is different from the liquid crystal display

according to an embodiment in that the first subpixel electrode **191***h* and second subpixel electrode **191***l* include no outer stems.

Referring to FIG. **6**, in the liquid crystal display according to the comparative embodiment, liquid crystal molecules positioned at an edge B1 of a pixel are inclined at angles that are significantly greater than 45 degrees with respect to the horizontal stems **192***h* and **192***l*, as a result of action in a vertical fringe field. In contrast, liquid crystal molecules **31** positioned near the horizontal stems **192***h* and **192***l* are inclined at angles of about 45 degrees with respect to the horizontal stems **192***h* and **192***l*. Given the significant angle differences, characteristics of an image viewed from a center-front position with respect to the liquid crystal display may be significantly different from those of the image viewed from a side (or lateral) position with respect to the liquid crystal display.

Referring to FIG. **7**, in the liquid crystal display according to the exemplary embodiment, since the outer stems are adjacent to an edge B2 of a pixel, liquid crystal molecules positioned at the edges B2 may be oriented substantially parallel to minute branches **194***h* or **194***l*. Accordingly, liquid crystal molecules **31** positioned at the edges of the pixel as well as liquid crystal molecules **31** positioned near the horizontal stems **192***h* and **192***l* may be oriented at angles of about 45 degrees with respect to the horizontal stems **192***h* and **192***l*. Given the substantially consistent orientations of liquid crystal molecules, side visibility associated with the exemplary embodiment may be enhanced over side visibility associated with the comparative embodiment.

As shown in FIG. **8**, a frontal gamma curve (associated with a center-front position with respect to a liquid crystal display) is different from lateral gamma curves (associated with a side position with respect to the liquid crystal display). If a lateral gamma curve is substantially close to the frontal gamma curve, characters of an image viewed at the side position may be similar to characters of the image viewed at the center-front position, such that the side visibility may be substantially satisfactory.

The lateral gamma curve of the liquid crystal display according to the exemplary embodiment is closer to the frontal gamma curve than the lateral gamma curve of the liquid crystal display according to the comparative embodiment. Therefore, the side visibility associated with the exemplary embodiment is enhanced over the side visibility associated with the comparative embodiment.

FIG. **9** is a schematic plan view illustrating one pixel of a liquid crystal display according to an embodiment. Some features of the liquid crystal display associated with FIG. **9** may be identical or analogous to some features described with reference to one of more of FIG. **1**, FIG. **2**, FIG. **3**, and FIG. **4**.

Referring to FIG. **9**, the pixel electrode **191** of the liquid crystal display includes T-shaped stems, minute branches **194***h* and **194***l* extending from the T-shaped stems, and outer stems (or bars) **195***h* and **195***l* directly connected to end portions of the T-shaped stems.

The outer stems **195***h* and **195***l* are directly connected to end portions of the T-shaped stem and are positioned at edges of the first subpixel area PXa and the second subpixel area PXb. Specifically, the outer stems **195***h* and **195***l* are positioned at left and right edges of first subpixel area PXa and the second subpixel area PXb. The outer stems **195***h* and **195***l* are formed to have rod-like shapes (or bar structures). The outer stems **195***h* and **195***l* extend parallel to the vertical stems **193***h* and **193***l*. The outer stems **195***h* and **195***l* are directly connected to end portions of the horizontal stems **192***h* and **192***l*. For vertical stems **193***h* and **193***l* that are positioned at the left edges of the first subpixel area PXa and the second subpixel area PXb, the corresponding outer stems **195***h* and **194***l* are positioned at the right edges of the first subpixel area PXa and the second subpixel area PXb. For vertical stems **193***h* and **193***l* that are positioned at the right edges of the first subpixel area PXa and the second subpixel area PXb, the corresponding outer stems **195***h* and **194***l* are positioned at the left edges of the first subpixel area PXa and the second subpixel area PXb. The outer stems **195***h* and **195***l* are separated from minute branches **194***h* and **194***l* that are adjacent to the outer stems **195***h* and **195***l* by a predetermined distance.

FIG. **10** is a top plan view illustrating one pixel of a liquid crystal display according to an embodiment. Some features of the liquid crystal display associated with FIG. **10** may be identical or analogous to some features described with reference to one of more of FIG. **1**, FIG. **2**, FIG. **3**, and FIG. **4**.

Referring to FIG. **10**, the pixel electrode **191** of the liquid crystal display includes T-shaped stems, minute branches **194***h* and **194***l* extending from the T-shaped stems, and outer stems (or bars) **195***h* and **195***l* connected to end portions of the T-shaped stems. The pixel electrode **191** further includes auxiliary stems (or bars) **196***h* and **196***l* positioned at central portions of the first subpixel area PXa and the second subpixel area PXb.

The outer stems **195***h* and **195***l* and the auxiliary stems **196***h* and **196***l* are formed to have rod-like shapes (or bar structures). The outer stems **195***h* and **195***l* and the auxiliary stems **196***h* and **196***l* may extend parallel to one another and to the horizontal stems **192***h* and **192***l*. A length of the auxiliary stems **196***h* and **196***l* may be substantially equal to that of the outer stems **195***h* and **195***l*.

Each of the first subpixel electrode **191***h* and the second subpixel electrode **191***l* includes two T-shaped stems, and minute branches **194***h* and **194***l* extend from the T-shaped stems in at least four different directions. The T-shaped stems may be vertically disposed. Each of auxiliary stems **196***h* and **196***l* may be positioned between two immediately neighboring T-shaped stems. Auxiliary stems **196***h* and **196***l* extend from T-shaped stems. Particularly, auxiliary stems **196***h* and **196***l* may extend from vertical stems **193***h* and **193***l*. Auxiliary stems **196***h* and **196***l* are separated from minute branches **194***h* and **194***l* that are adjacent to the auxiliary stems **196***h* and **196***l* by a predetermined distance.

FIG. **11** is a top plan view illustrating one pixel of a liquid crystal display according to an embodiment. Some features of the liquid crystal display associated with FIG. **11** may be identical or analogous to some features described with reference to one of more of FIG. **1**, FIG. **2**, FIG. **3**, and FIG. **4**.

Referring to FIG. **11**, the pixel electrode **191** of the liquid crystal display includes T-shaped stems, minute branches **194***h* and **194***l* extending from the T-shaped stems, outer stems (or bars) **195***h* and **195***l* connected to end portions of the T-shaped stems, and auxiliary stems (or bars) **196***h* and **196***l* positioned at central portions of the first subpixel area PXa and the second subpixel area PXb.

The outer stems **195***h* and **195***l* and the auxiliary stems **196***h* and **196***l* have rod-like shapes. The outer stems **195***h* and **195***l* and the auxiliary stems **196***h* and **196***l* may extend parallel to the horizontal stems **192***h* and **192***l*. A length of the auxiliary stems **196***h* and **196***l* may be approximately half of that of the outer stems **195***h* and **195***l*.

Each of the first subpixel electrode **191***h* and the second subpixel electrode **191***l* includes two T-shaped stems, and

minute branches **194***h* and **194***l* extend from the T-shaped stems in at least four different directions. The T-shaped stems may be vertically disposed. Each of auxiliary stems **196***h* and **196***l* may be positioned between two immediately neighboring T-shaped stems. The auxiliary stems **196***h* and **196***l* extend from T-shaped stems. The auxiliary stems **196***h* and **196***l* are separated from minute branches **194***h* and **194***l* that are adjacent to the auxiliary stems **196***h* and **196***l* by a predetermined distance.

FIG. **12** is a top plan view illustrating one pixel of a liquid crystal display according to an embodiment. Some features of the liquid crystal display associated with FIG. **12** may be identical or analogous to some features described with reference to one of more of FIG. **1**, FIG. **2**, FIG. **3**, and FIG. **4**.

Referring to FIG. **12**, the first subpixel electrode **191***h* of the liquid crystal display includes a T-shaped stem (having a first horizontal stem **192***h* and a first vertical stem **193***h*), first minute branches **194***h* extending from the T-shaped stem, and an outer stem **195***h* connected to one end portion of the T-shaped stem.

The second subpixel electrode **191***l* includes a cross-shaped stem (having a second horizontal stem **192***l* and a second vertical stem **193***l*) and second minute branches **194***l* extending from the cross-shaped stem.

Since the first subpixel electrode has the outer stem **195***h*, satisfactory side visibility associated with the display device may be attained. Further, since the second subpixel electrode has the cross-shaped stem, satisfactory transmittance associated with the display device can be obtained.

In summary, referring to FIG. **2**, FIG. **3**, FIG. **4**, FIG. **9**, FIG. **10**, FIG. **11**, and FIG. **12**, a display device may include a liquid crystal layer 3 and a pixel electrode **191**. The pixel electrode **191** may overlap the liquid crystal layer 3. The pixel electrode **191** may include a bar **192***h*, a bar **193***h*, a bar **195***h*, and a plurality of first-type branches. The bar **193***h* may be directly connected to a first end of the bar **192***h* (e.g., right end of the top bar **192***h* in FIG. **2**). The bar **195***h* may be directly connected to a first end of the bar **193***h* (e.g., upper end of the top bar **193***h* in FIG. **2**) or directly connected to a second end of the bar **192***h* (e.g., left end of the top bar **192***h* in FIG. **9**). The first-type branches (e.g., the top slanted branches in FIG. **2**) may be slanted with respected to the bar **192***h* (e.g., the top bar **192***h* in FIG. **2**) and may be positioned between the bar **195***h* (e.g., the top bar **195***h* in FIG. **2** or FIG. **9**) and at least one of the bar **192***h* (e.g., the top bar **192***h* in FIG. **2**) and the bar **193***h* (e.g., the top bar **193***h* in FIG. **9**).

Referring to, e.g., FIG. **2**, the bar **195***h* may be directly connected to the first end of the bar **193***h* (e.g., upper end of the top bar **193***h*) and may extend parallel to the bar **192***h*.

Referring to, e.g., FIG. **9**, the bar **195***h* may be directly connected to the second end of the bar **192***h* (e.g., left end of the top bar **192***h*) and may extend parallel to the bar **193***h*.

Referring to, e.g., FIG. **2**, the pixel electrode **191** may include a fourth bar (e.g., the top-left vertical bar). A first end of the bar **195***h* (e.g., right end of the top bar **195***h*) may be directly connected to the first end of the bar **193***h* (e.g., upper end of the top bar **193***h*). A second end of the bar **195***h* (e.g., left end of the top bar **195***h*) may be directly connected to a first end of the fourth bar (e.g., upper end of the top-left vertical bar). A second end of the fourth bar (e.g., lower end of the top-left vertical bar) may be directly connected to a first-type branch (e.g., the top-left branch) among the first-type branches.

Referring to, e.g., FIG. **10**, the pixel electrode **191** may include a bar **196***h*. The bar **195***h* may be directly connected to the first end (e.g., upper end) of the bar **193***h*. The bar **196***h* may be directly connected to a second end (e.g., lower end) of the bar **193***h*. The bar **192***h* may be positioned between the bar **195***h* and the bar **196***h* and may extend parallel to the bar **196***h*.

Referring to, e.g., FIG. **11**, the pixel electrode **191** may include a bar **196***h* and a second-type branch. The bar **192***h* may be positioned between the plurality of first-type branches and the second-type branch. The second-type branch may be slanted with respect to the bar **192***h* and may be directly connected to each of the bar **192***h* and the bar **196***h*. The bar **196***h* may be shorter than the bar **195***h*. A first end (e.g., upper end) of the second-type branch may be directly connected to the bar **192***h*. A second end (e.g., lower end) of the second-type branch may be directly connected to the bar **196***h*. The pixel electrode **191** may include a third-type branch. The third-type branch may extend parallel to the second-type branch and may be electrically connected through the second-type branch to the bar **196***h*.

Referring to, e.g., FIG. **11**, the third-type branch may be shorter than the second-type branch and may be positioned between the bar **192***h* and the bar **196***h*.

Referring to, e.g., FIG. **11**, the second-type branch may be longer than the third-type branch and may be positioned between the third-type branch and the bar **193***h*.

Referring to, e.g., FIG. **11**, the third-type branch may be shorter than the second-type branch and may be positioned between the second-type branch and the bar **193***h*.

Referring to, e.g., FIG. **11**, the third-type branch may be shorter than the second-type branch and may be directly connected to the bar **193***h*.

Referring to e.g., FIG. **2**, distances from the first-type branches to the bar **195***h* may be equal to one another.

Referring to e.g., FIG. **2**, the display device may include a transistor (e.g., the transistor that includes the electrodes **124***h*, **173***h*, and **175***h*) that is electrically connected to the pixel electrode **191**. The bar **195***h* (e.g., the lower bar **195***h*) may be positioned between the transistor and the plurality of first-type branches (e.g., the bottom branches of the electrode **191***h*) in a plan view of the display device.

Referring to FIG. **2**, FIG. **3**, FIG. **4**, FIG. **9**, FIG. **10**, FIG. **11**, and FIG. **12**, the pixel electrode **191** may include a lower bar **192***h*, a lower bar **193***h*, a lower bar **195***h*, and a plurality of second-type branches (e.g., bottom branches of the electrode **191***h*). The lower bar **193***h* may be directly connected to a first end (e.g., left end) of the lower bar **192***h*. The lower bar **195***h* may be directly connected to a first end of the lower bar **193***h* (e.g., lower end of the lower bar **193***h* in FIG. **2**) or directly connected to a second end of the lower bar **192***h* (e.g., right end of the lower bar **192***h* in FIG. **9**). The lower bar **195***h* may be electrically connected to the upper bar **195***h* (through the bars **193***h*, **192***h*, and some branches). The second-type branches may be slanted with respected to the lower bar **192***h* and may be positioned between the lower bar **195***h* and at least one of the lower bar **192***h* and the lower bar **193***h*.

Referring to e.g., FIG. **9**, the upper bar **195***h* may be positioned at a first edge (e.g., left edge) of the pixel electrode **191**. The lower bar **195***h* may be poisoned at a second edge (e.g., right edge) of the pixel electrode **191**. The second edge of the pixel electrode **191** may be opposite the first edge of the pixel electrode **191**.

Referring to, e.g., FIG. **2** or FIG. **9**, at least one of the plurality of first-type branches (e.g., top branches of the electrode **191***h*) and the plurality of second-type branches (e.g., bottom branches of the electrode **191***h*) and at least one

of the upper bar **192***h* and the lower bar **192***h* may be positioned between the upper bar **195***h* and the lower bar **195***h*.

Referring to FIG. **2**, FIG. **3**, FIG. **4**, FIG. **9**, FIG. **10**, FIG. **11**, and FIG. **12**, the pixel electrode **191** may include a bar **192***l*, a bar **193***l*, a bar **195***l*, and a plurality of second-type branches (e.g., bottom branches of the electrode **191***l*). The bar **193***l* (e.g., the lower bar **193***l*) may be directly connected to a first end of the bar **192***l* (e.g., the left end of the lower bar **192***l*). The bar **195***l* (e.g., the lower bar **195***l*) may be directly connected to a first end of the bar **193***l* (e.g., the lower end of the lower bar **193***l* in FIG. **2**) or directly connected to a second end of the bar **192***l* (e.g., the right end of the lower bar **193***l* in FIG. **9**). The bar **195***l* may be electrically insulated from the bar **195***h*. The second-type branches may be slanted with respected to the bar **192***l* and may be positioned between the bar **195***l* and at least one of the bar **192***l* and the bar **193***l*.

Referring to e.g., FIG. **2** or FIG. **9**, the bar **195***h* may be positioned at a first edge (e.g., top edge or left edge) of the pixel electrode **191**. The bar **195***l* may be poisoned at a second edge (e.g., bottom edge or right edge) of the pixel electrode **191**. The second edge of the pixel electrode **191** may be opposite the first edge of the pixel electrode **191**.

Referring to, e.g., FIG. **2** or FIG. **9**, the display device may include a gate line **121**, a transistor Qh (which includes the electrodes **124***h*, **173***h*, and **175***h*), and a transistor Ql (which includes the electrodes **124***l*, **173***l*, and **175***l*). The transistor Qh may be electrically connected to each of the bar **195***h* and the gate line **121**. The transistor Ql may be electrically connected to each of the bar **195***l* and the gate line **121**. The transistor Qh and the transistor Ql may be positioned between the bar **195***h* and the bar **195***l* in a plan view of the display device. The gate line **121** may be electrically connected to each of the gate electrode **124***h* of the transistor Qh and the gate electrode **124***l* of the transistor Ql and may extend substantially parallel to each of the bars **195***h* and **195***l*.

While some embodiments have been described as examples, possible embodiments are not limited to the described embodiments. Embodiments are intended to cover various modifications and equivalent arrangements applicable within the spirit and scope defined by the appended claims.

What is claimed is:

1. A liquid crystal display comprising:

a first substrate and a second substrate configured to face each other;

a pixel electrode disposed on the first substrate;

a common electrode disposed on the second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate,

wherein the pixel electrode includes

a T-shaped stem configured to have a horizontal stem and a vertical stem;

a plurality of minute branches configured to extend from the T-shaped stem; and

an outer stem connected to one end portion of the T-shaped stem, and disposed at an edge of a pixel area,

wherein the outer stem connects the minute branches, which are connected to a first end portion of the horizontal stem, to the vertical stem, which is connected to a second end portion of the horizontal stem, and

wherein a plurality of minute branches positioned between the minute branches connected to the first end portion of the horizontal stem and the vertical stem connected to the second end portion of the horizontal stem are separated from the outer stem at a predetermined distance.

2. The liquid crystal display of claim **1**, wherein the outer stem is formed to have a rod-like shape.

3. The liquid crystal display of claim **1**, wherein the pixel electrode includes two T-shaped stems, and the minute branches are extended in four different directions from each of the T-shaped stems.

4. The liquid crystal display of claim **3**, wherein the outer stem is connected to a first end portion of each of the T-shaped stems.

5. The liquid crystal display of claim **4**, wherein the outer stem is disposed at upper and lower edges of the pixel area, and is extended in a direction parallel to the horizontal stem.

6. The liquid crystal display of claim **1**, wherein the pixel electrode includes a first subpixel electrode and a second subpixel electrode, to which different voltages are applied, and

each of the first subpixel electrode and the second subpixel electrode includes the T-shaped stem, the plurality of minute branches, and the outer stem.

7. The liquid crystal display of claim **1**, wherein the outer stem is extended from a first end portion of the horizontal stem.

8. The liquid crystal display of claim **7**, wherein the outer stem is extended in a direction parallel to the vertical stem.

9. The liquid crystal display of claim **8**, wherein the outer stem is disposed at left and right edges of the pixel area.

10. The liquid crystal display of claim **1**, wherein the pixel electrode further includes an auxiliary stem positioned at a central portion of the pixel area.

11. The liquid crystal display of claim **10**, wherein the outer stem and the auxiliary stem are formed to have a rod-like shape.

12. The liquid crystal display of claim **11**, wherein the pixel electrode includes two T-shaped stems, and the minute branches are extended in four different directions from each of the T-shaped stems, and

the auxiliary stem is positioned between the two T-shaped stems.

13. The liquid crystal display of claim **12**, wherein the auxiliary stem is extended from each of the T-shaped stems.

14. The liquid crystal display of claim **12**, wherein the auxiliary stem is extended from the minute branches.

15. The liquid crystal display of claim **10**, wherein the outer stem and the auxiliary stem are extended in a direction parallel to the horizontal stem.

16. The liquid crystal display of claim **1**, wherein:

the pixel electrode includes a first subpixel electrode and a second subpixel electrode, to which different voltages are applied,

the first subpixel electrode includes the T-shaped stem having a first horizontal stem and a first vertical stem, with first minute branches extended from the T-shaped stem, and

the second subpixel electrode includes a cross-shaped stem having a second horizontal stem and a second vertical stem, with second minute branches extended from the cross-shaped stem.

17. The liquid crystal display of claim **16**, wherein a data voltage applied to the first subpixel electrode is higher than a data voltage applied to the second subpixel electrode.

18. The liquid crystal display of claim **1**, wherein the outer stem is longer than the vertical stem.

19. The liquid crystal display of claim **18**, wherein the pixel electrode includes a connected section, wherein the

outer stem is connected through the connected section to a minute branch among the minute branches, and wherein the connected section extends parallel to the vertical stem, is shorter than the vertical stem, and is directly connected to each of the outer stem and the minute branch.

* * * * *

专利名称(译)	液晶显示装置		
公开(公告)号	US9817272	公开(公告)日	2017-11-14
申请号	US14/932829	申请日	2015-11-04
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	LEE SE HYUN CHANG HAK SUN SHIN CHEOL		
发明人	LEE, SE HYUN CHANG, HAK SUN SHIN, CHEOL		
IPC分类号	G02F1/1343 G02F1/1337		
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外部链接	Espacenet USPTO		

摘要(译)

显示装置可以包括液晶层和与液晶层重叠的像素电极。像素电极可包括第一条，第二条，第三条和多个第一类型分支。第二杆可以直接连接到第一杆的第一端。第三杆可以直接连接到第二杆的第一端或直接连接到第一杆的第二端。第一类型分支可以倾斜于第一杆并且可以定位在第三杆与第一杆和第二杆中的至少一个之间。