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(54) **LIQUID CRYSTAL DISPLAY PANEL AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME**

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(30) **Foreign Application Priority Data**

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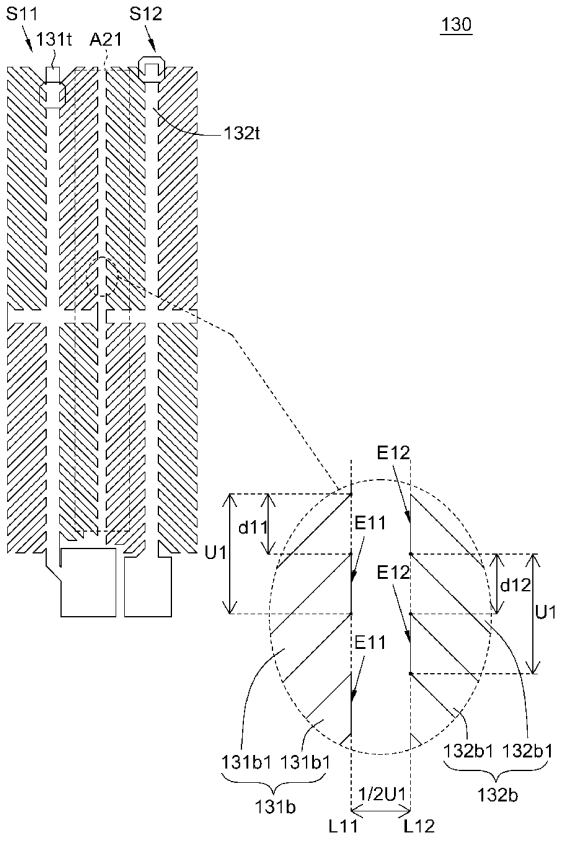
USPC **349/141**

(57) **ABSTRACT**

A liquid crystal display panel includes a first substrate, a second substrate, a liquid crystal layer and an electrode structure. The second substrate is parallel to the first substrate. The liquid crystal layer is located between the first substrate and the second substrate. The electrode structure is disposed on the first substrate. The electrode structure includes a first branch portion and a second branch portion. The first branch portion includes first branch electrodes. The two adjacent first branch electrodes are parallel to each other and separated apart by a first interval. The second branch portion includes second branch electrodes. The two adjacent second branch electrodes are parallel to each other and separated apart by a second interval. Any first branch electrode corresponds to at least part of one of the second intervals. Any second branch electrode corresponds to at least part of one of the first intervals.



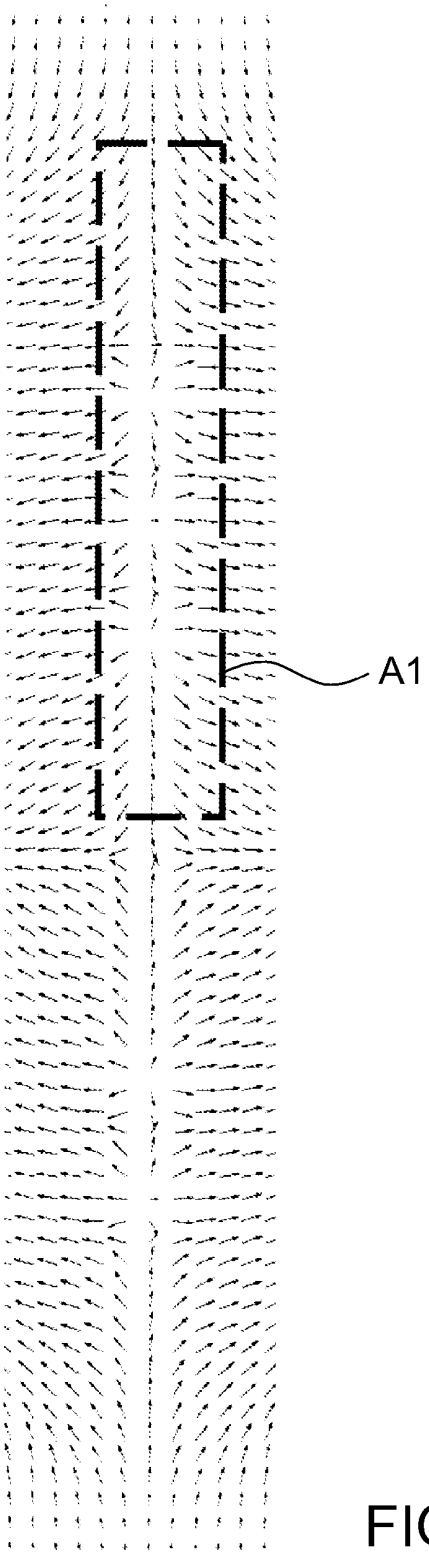


FIG. 1 (Prior Art)

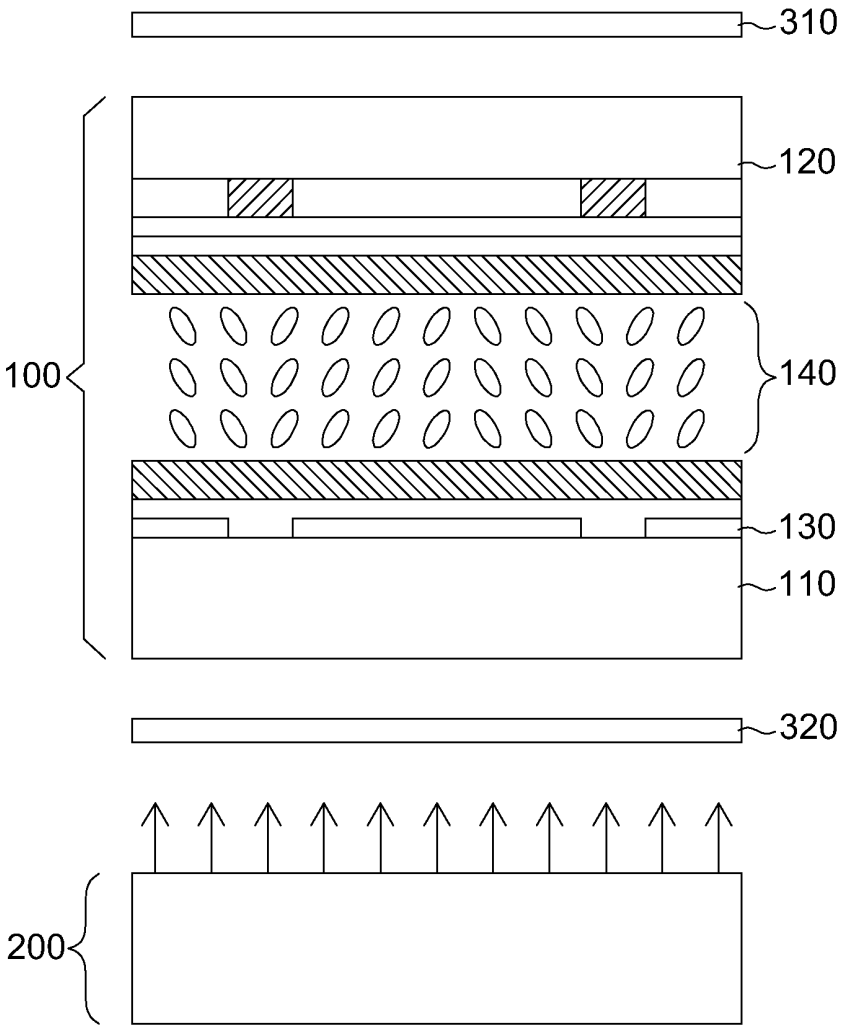


FIG. 2A

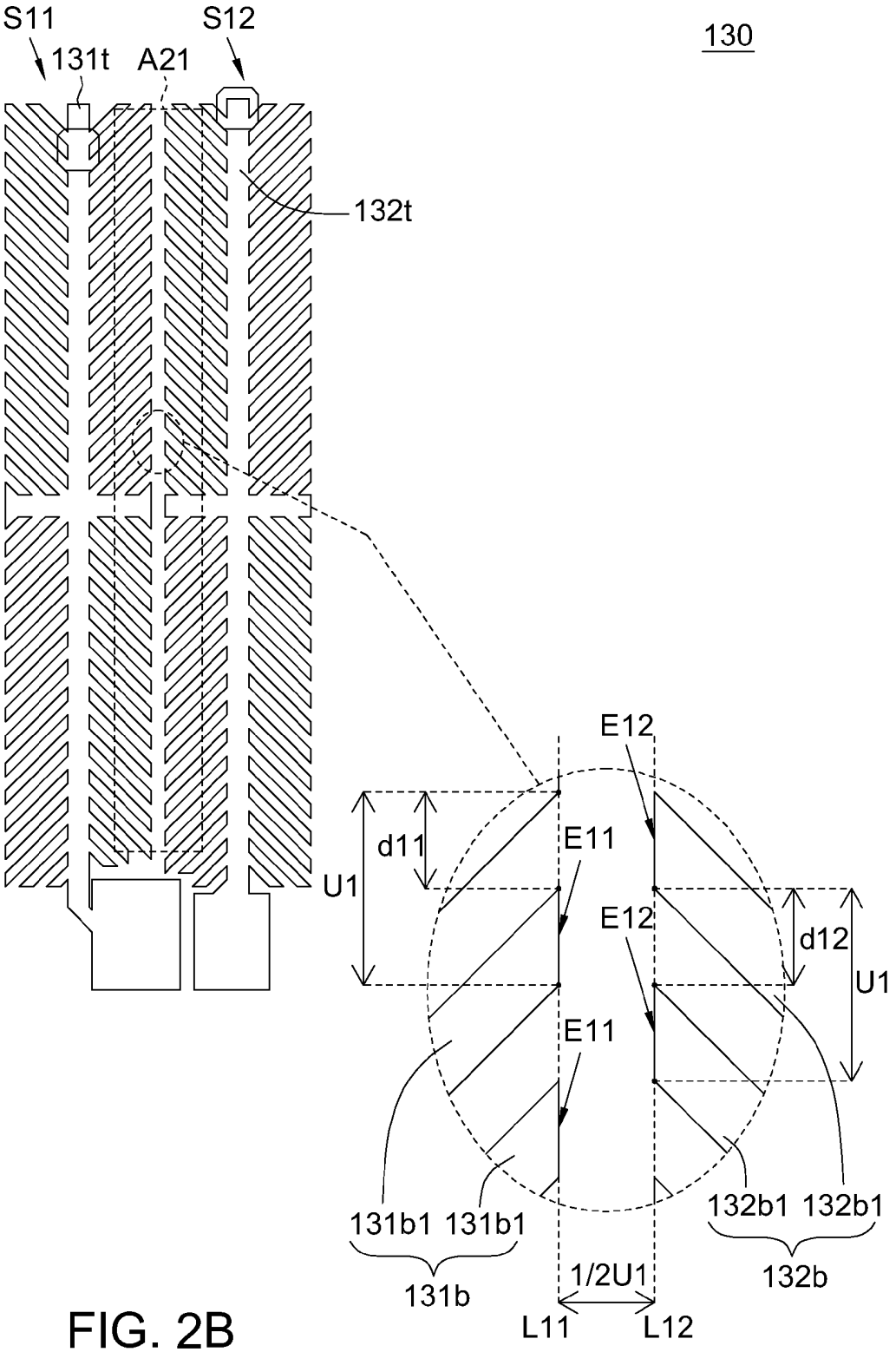

S11
S12
131t
A21
130
132t
E12
d11
E11
U1
E12
d12
U1
E11
131b1
131b1
132b1
132b1
131b
132b
1/2U1
L11
L12

FIG. 2B

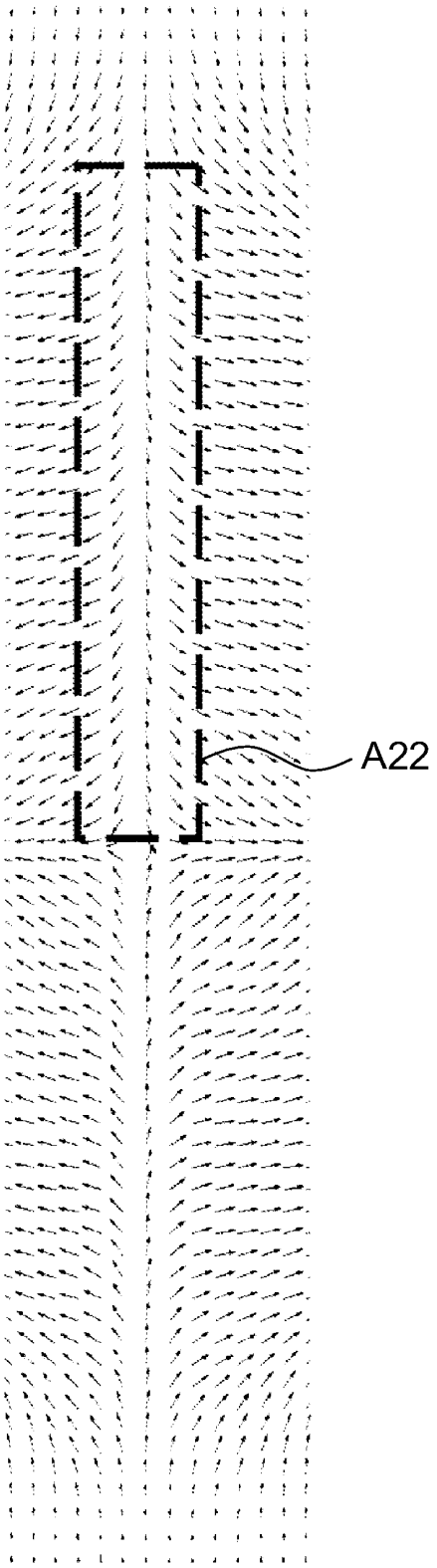


FIG. 2C

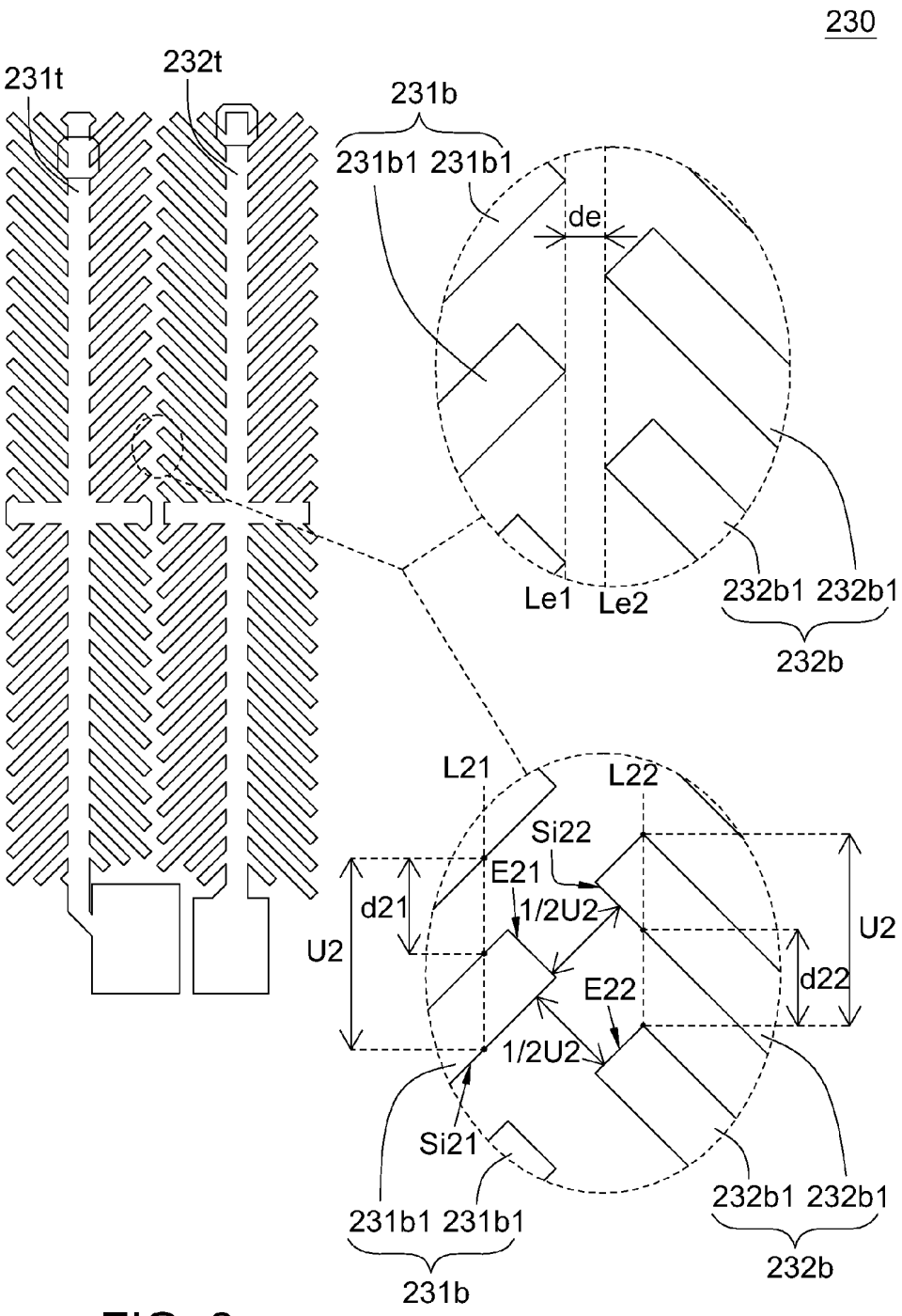

230
231t
232t
231b
231b1 231b1
de
Le1
Le2
232b1 232b1
232b
L21
L22
Si22
E21
1/2U2
d21
U2
U2
d22
E22
1/2U2
Si21
231b1 231b1
231b
232b1 232b1
232b

FIG. 3

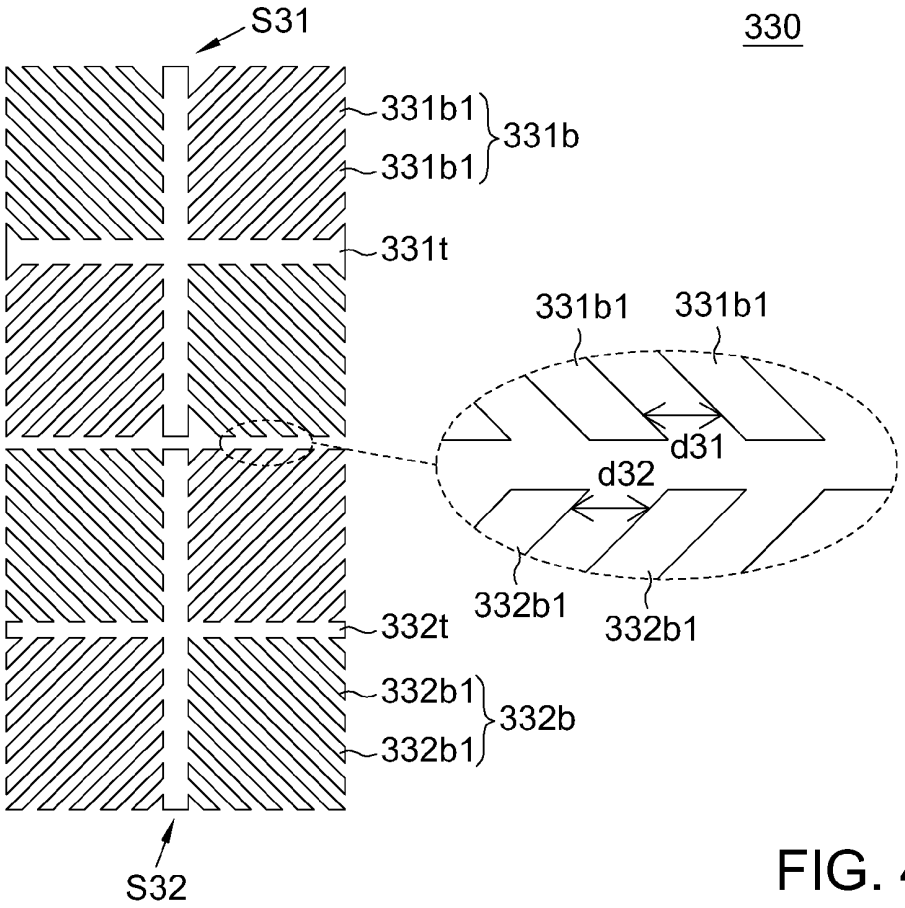

S31
330
331b1
331b1
331b
331t
331b1
331b1
d31
d32
332b1
332b1
332t
332b1
332b1
332b
S32

FIG. 4

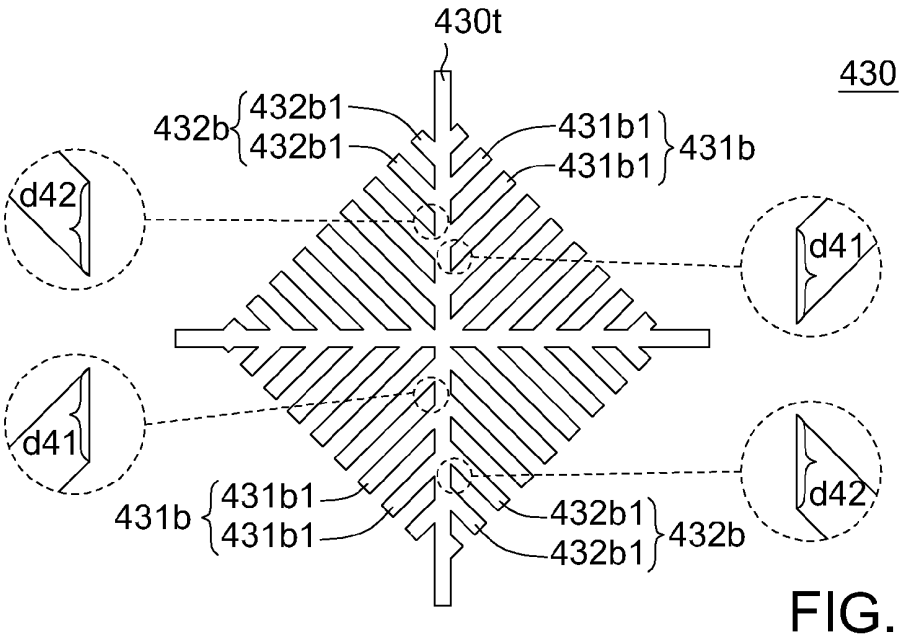

430t
430
432b
432b1
432b1
431b1
431b1
431b
d42
d41
d41
d42
431b
431b1
431b1
432b1
432b1
432b

FIG. 5

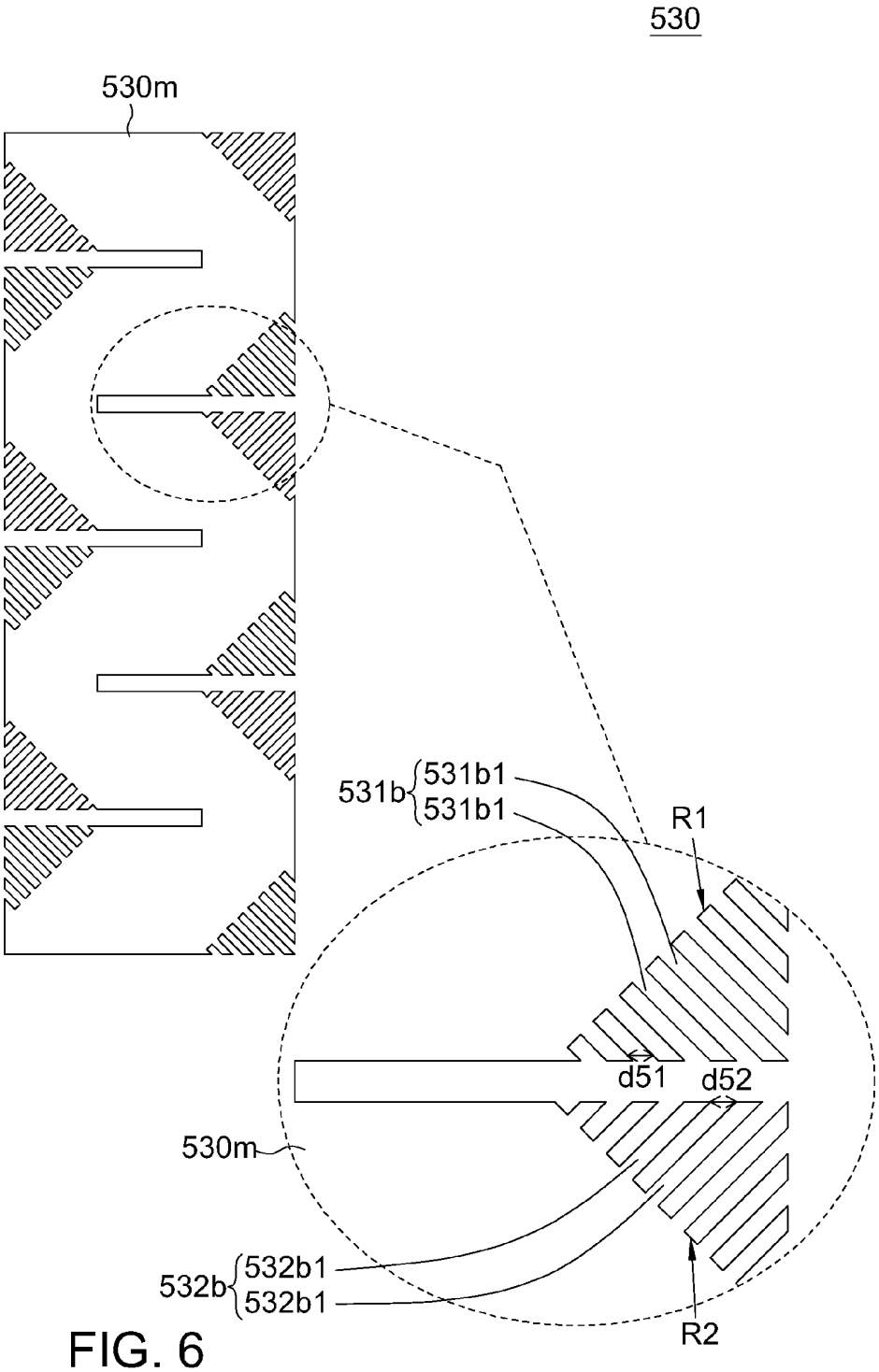


FIG. 6

LIQUID CRYSTAL DISPLAY PANEL AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Divisional application of co-pending U.S. patent application Ser. No. 12/963,860, filed Dec. 9, 2010 and entitled "LIQUID CRYSTAL DISPLAY PANEL AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME". This application claims the benefit of Taiwan application Serial No. 98145117, filed Dec. 25, 2009, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates in general to a liquid crystal display panel and a liquid crystal display device using the same, and more particularly to a multi-domain liquid crystal display panel and a liquid crystal display device using the same.

[0004] 2. Description of the Related Art

[0005] In recent years, display technology has gained significant progress, and the market demand for liquid crystal display is booming. The display quality of a liquid crystal display is essential in the display industry. Currently, wide angle technology has gradually become an important factor in the quality assessment of the liquid crystal display. In the wide angle technology, multi-domain vertical alignment (MVA) technology attracts more and more interest.

[0006] In general, the liquid crystal display includes two polarizers, a liquid crystal display panel and a backlight module. The backlight module is used for providing a light source to the liquid crystal display panel, and the liquid crystal display panel is disposed between the two polarizers. The liquid crystal display panel includes two substrates and a liquid crystal layer which is disposed between the two substrates. Several pixel electrodes are disposed on one of the substrates. To provide multi domains, the pixel electrodes are patterned and divided into regions. Here, the pixel electrode includes two symmetric sub-electrode structures, for example. Each sub-electrode structure includes a stem electrode and several branch electrodes. The branch electrodes are symmetrically connected to the stem electrode.

[0007] Referring to FIG. **1**, a partial diagram of the liquid crystal pointing arrows corresponding to the liquid crystal layer of a pixel electrode is shown. When a voltage is applied to the pixel electrode, the electrical field changes the directions of the liquid crystal pointing arrows, as indicated in the region **A1** at the junction between two sub-electrode structures in FIG. **1**. When the directions of the liquid crystal pointing arrows in the region **A1** are chaotic to form nodes, streaks will occur to the display frame of the liquid crystal display panel. Therefore, the brightness of the liquid crystal display panel will be decreased during display. Or, the brightness of the liquid crystal display panel may become inconsistent during the display of frames so as to deteriorate the display quality. Besides, the generation of streaks normally increases the time for the liquid crystal display panel to resume the stable state. As a result, how to provide a liquid crystal display with excellent display quality has become an imminent task for the industries.

SUMMARY OF THE INVENTION

[0008] The invention is directed to a liquid crystal display panel and a liquid crystal display device using the same, which reduce the occurrence of streaks, increase the brightness and shorten the time for resuming the stable state so as to improve the display quality and product competitiveness.

[0009] According to a first aspect of the present invention, a liquid crystal display panel including a first substrate, a second substrate, a liquid crystal layer and an electrode structure is provided. The second substrate is substantially parallel to the first substrate. The liquid crystal layer is located between the first substrate and the second substrate. The electrode structure is disposed on the first substrate. The electrode structure includes a first branch portion and a second branch portion. The first branch portion includes several first branch electrodes. The two adjacent first branch electrodes are substantially parallel to each other and separated apart by a first interval. The second branch portion includes several second branch electrodes. The two adjacent second branch electrodes are substantially parallel to each other and separated apart by a second interval. Any of the first branch electrodes corresponds to at least part of one of the second intervals. Any of the second branch electrodes corresponds to at least part of one of the first intervals.

[0010] According to a second aspect of the present invention, a liquid crystal display device including a liquid crystal display panel and a backlight module is provided. The backlight module is used for providing light to the liquid crystal display panel to display an image. The liquid crystal display panel includes a first substrate, a second substrate, a liquid crystal layer and an electrode structure. The second substrate is substantially parallel to the first substrate. The liquid crystal layer is located between the first substrate and the second substrate. The electrode structure is disposed on the first substrate. The electrode structure includes a first branch portion and a second branch portion. The first branch portion includes several first branch electrodes. The two adjacent first branch electrodes are substantially parallel to each other and separated apart by a first interval. The second branch portion includes several second branch electrodes. The two adjacent second branch electrodes are substantially parallel to each other and separated apart by a second interval. Any of the first branch electrodes corresponds to at least part of one of the second intervals, and any of the second branch electrodes corresponds to at least part of one of the first intervals.

[0011] The above and other aspects of the invention will become better understood with regard to the following detailed description of the preferred but non-limiting embodiment(s). The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** shows a partial diagram of the liquid crystal pointing arrows corresponding to the liquid crystal layer of a pixel electrode;

[0013] FIG. **2**A shows a liquid crystal display device according to a first embodiment of the invention;

[0014] FIG. **2**B shows an electrode structure in FIG. **2**A;

[0015] FIG. **2**C shows liquid crystal pointing arrows of the liquid crystal layer in FIG. **2**A corresponding to a region in FIG. **2**B;

[0016] FIG. **3** shows an electrode structure according to a second embodiment of the invention;

[0017] FIG. **4** shows an electrode structure according to a third embodiment of the invention;

[0018] FIG. **5** shows an electrode structure according to a fourth embodiment of the invention; and

[0019] FIG. **6** shows an electrode structure according to a fifth embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The liquid crystal display panel and the liquid crystal display device using the same disclosed in the invention are elaboration in a number of embodiments below with accompanying drawings. However, anyone who is skilled in the art of the invention will understand that these drawings and disclosures are for elaboration purpose only, not for limiting the scope of protection of the invention.

First Embodiment

[0021] Referring to FIG. **2**A, a liquid crystal display device according to a first embodiment of the invention is shown. The liquid crystal display device includes a liquid crystal display panel **100**, a backlight module **200** and polarizers **310** and **320**. The absorption axes of the polarizers **310** and **320** are perpendicular to each other. The liquid crystal display panel **100** is disposed between the polarizers **310** and **320**. The backlight module **200** is used for providing light for the liquid crystal display panel **100** to display an image.

[0022] The liquid crystal display panel **100** includes a first substrate **110**, a second substrate **120**, an electrode structure **130** and a liquid crystal layer **140**. The second substrate **120** is substantially parallel to the first substrate **110**. The liquid crystal layer **140** is located between the first substrate **110** and the second substrate **120**. The electrode structure **130** is disposed on the first substrate **110**.

[0023] Referring to FIG. **2**B, an electrode structure **130** in FIG. **2**A is shown. The electrode structure **130** includes a first stem electrode **131***t*, a first branch portion **131***b*, a second stem electrode **132***t* and a second branch portion **132***b*. Let the first stem electrode **131***t* and the first branch portion **131***b* be viewed as a sub-electrode structure S**11**, and the second stem electrode **132***t* and the second branch portion **132***b* be viewed as a sub-electrode structure S**12**, the sub-electrode structures S**11** and S**12** are horizontally adjacent to each other and can respectively be viewed as a first bright region and a second bright region. When an image is displayed, the first bright region and the second bright region can be mixed and displayed in a pixel to produce low color shift effect. Thus, the display quality of the liquid crystal display panel **100** is even more dedicated.

[0024] The first stem electrode **131***t* is, for example, cross-shaped, and the first branch portion **131***b* includes several first branch electrodes **131***b***1**. The first branch electrodes **131***b***1** are connected to the first stem electrode **131***t*. The two adjacent first branch electrodes **131***b***1** are substantially parallel to each other and separated apart by a first interval d**11**. Besides, the second stem electrode **132***t* is, for example, cross-shaped, and the second branch portion **132***b* includes several second branch electrodes **132***b***1**. The second branch electrodes **132***b***1** are connected to the second stem electrode **132***t*. The two adjacent second branch electrodes **132***b***1** are substantially parallel to each other and separated apart by a second interval d**12**. Any of the first branch electrodes **131***b***1** corresponds to at least part of one of the second intervals d**12**, and any of the second branch electrodes **132***b***1** corresponds to at least part of one of the first intervals d**11**.

[0025] In the present embodiment of the invention, the end edge E**11** of each first branch electrode **131***b***1** is located on a first dummy line L**11**, and the end edge E**12** of each second branch electrode **132***b***1** is located on a second dummy line L**12**. The first dummy line L**11** is substantially parallel to the second dummy line L**12**. Let the length of one first interval d**11** and one first branch electrode **131***b***1** being on the first dummy line L**11** be a unit length U**1**, and the length of one second interval d**12** and one second branch electrodes **132***b***1** being on the second dummy line L**12** be the unit length U**1**, the first dummy line L**11** and the second dummy line L**12** are, for example, separated apart by a half of the unit length U**1**. That is, if the unit length U**1** is 10 μm, the first dummy line L**11** and the second dummy line L**12** are separated apart by 5 μm. Thus, the end edge E**11** of any of the first branch electrodes **131***b***1** exactly corresponds to one of the second intervals d**12**, and the end edge E**12** of any of the second branch electrodes **132***b***1** exactly corresponds to one of the first intervals d**11**.

[0026] Referring to FIG. **2**C, liquid crystal pointing arrows of the liquid crystal layer **140** in FIG. **2**A corresponding to a region A**21** in FIG. **2**B are shown. When pixels are switched between the bright state and the dark state, the fringe field at the junction between the first branch portion **131***b* and the second branch portion **132***b* guides the liquid crystal molecules to tilt to a consistent direction, as indicated in the region A**22**. Thus, fewer nodes are generated at the junction between the first branch portion **131***b* and the second branch portion **132***b*, so that the liquid crystal display panel **100** has fewer occurrences of streaks and brightness drop. According to the simulation results, if the liquid crystal molecules are distributed as indicated by the liquid crystal pointing arrows in FIG. **1**, then the liquid crystal molecules spend about 130 ms to resume the stable state. For the liquid crystal display panel **100** of the present embodiment of the invention, the occurrence of streaks is reduced, and the time for resuming the stable state after the occurrence of streaks is effectively reduced to 20 ms.

[0027] In the present embodiment of the invention, the sub-electrode structure S**11** and S**12** is, for example, disposed in a pixel. However, anyone who is skilled in the technology of the invention will understand that the sub-electrode structure S**11** and S**12** can also be disposed in two adjacent pixels so as to reduce the occurrence of streaks, increase brightness and shorten the time for resuming the stable state.

Second Embodiment

[0028] Referring to FIG. **3**, an electrode structure **230** according to a second embodiment of the invention is shown. A first branch portion **231***b* of an electrode structure **230** includes several first branch electrodes **231***b***1**. The two adjacent first branch electrodes **231***b***1** are substantially parallel to each other and separated apart by a first interval d**21**. A second branch portion **232***b* of the electrode structure **230** includes several second branch electrodes **232***b***1**. The two adjacent second branch electrodes **232***b***1** are substantially parallel to each other and separated apart by a second interval d**22**. In the present embodiment of the invention, any of the second branch electrodes **232***b***1** corresponds to at least part of one of the first intervals d**21**, and any of the first branch electrodes **231***b***1** corresponds to at least part of one of the second intervals d**22**, so the advantages of the liquid crystal display panel

equipped with the electrode structure **230** are similar to that of the liquid crystal display panel **100** of the first embodiment.

[0029] In the present embodiment of the invention, one end of each first branch electrode **231***b***1** is connected to the first stem electrode **231***t*, and the other end of each first branch electrode **231***b***1** has two corners formed by an end edge E**21** and two sides Si**21**. The two corners are, for example, 90°. Furthermore, one end of each second branch electrode **232***b***1** is connected to the second stem electrode **232***t*, and the other end of each second branch electrode **232***b***1** has two corners formed by an end edge E**22** and two sides Si**22**. The two corners are, for example, 90°.

[0030] Thus, the end edge E**21** of any of the first branch electrodes **231***b***1** corresponds to the side Si**22** of one of the second branch electrodes **232***b***1**, and the end edge E**22** of any of the second branch electrodes **232***b***1** corresponds to the side Si**21** of one of the first branch electrodes **231***b***1**. Let the length of one first interval d**21** and a part of one first branch electrode **231***b***1** being on a first dummy line L**21** be a unit length U**2**, and the length of one second interval d**22** and a part of one second branch electrode **232***b***1** being on a second dummy line L**22** be the unit length U**2**, the end edge E**21** of the first branch electrode **231***b***1** and the side Si**22** of the adjacent second branch electrode **232***b***1** are separated apart by a half of the unit length U**2**, and the end edge E**22** of the second branch electrode **232***b***1** and the side Si**21** of the adjacent first branch electrode **231***b***1** are separated apart by a half of the unit length U**2**, for example. That is, if the unit length U**2** is 10 μm, then the end edge E**21** of the first branch electrode **231***b***1** and the side Si**22** of the adjacent second branch electrode **232***b***1** are separated apart by 5 μm, and the end edge E**22** of the second branch electrode **232***b***1** and the side Si**21** of the adjacent first branch electrode **231***b***1** are separated apart by 5 μm. Let the unit length U**2** of the present embodiment of the invention be equal to the unit length U**1** of the first embodiment. The interval de between a line Le**1** formed by several corners of the first branch electrodes **231***b***1** and a line Le**2** formed by several corners of the second branch electrodes **232***b***1** is smaller than the interval between the first branch electrode **131***b***1** and the second branch electrode **132***b***1** of the first embodiment. In other words, as the corners of each first branch electrode **231***b***1** and the corners of each second branch electrode **232***b***1** protrude inwardly, the interval de is reduced, so that the width of the corresponding streak is reduced and the display quality is increased.

Third Embodiment

[0031] Referring to FIG. **4**, an electrode structure **330** according to a third embodiment of the invention is shown. The electrode structure **330** includes a sub-electrode structure S**31** including a first stem electrode **331***t* and a first branch portion **331***b*, and a sub-electrode structure S**32** including a second stem electrode **332***t* and a second branch portion **332***b*. The sub-electrode structures S**31** and S**32** are vertically adjacent to each other.

[0032] Since any of second branch electrodes **332***b***1** of the second branch portion **332***b* corresponds to at least part of one first interval d**31**, and any of first branch electrodes **331***b***1** of the first branch portion **331***b* corresponds to at least part of one second interval d**32**, the liquid crystal display panel equipped with the electrode structure **330** has similar advantages like the liquid crystal display panel **100** of the first embodiment.

Fourth Embodiment

[0033] Referring to FIG. **5**, an electrode structure **430** according to a fourth embodiment of the invention is shown. The electrode structure **430** includes a stem electrode **430***t*, a first branch portion **431***b* and a second branch portion **432***b*. The stem electrode **430***t* is, for example, cross-shaped, and the first branch portion **431***b* and the second branch portion **432***b* are respectively connected to two opposite sides of the stem electrode **430***t*.

[0034] Since any of second branch electrodes **432***b***1** of the second branch portion **432***b* corresponds to at least part of one first interval d**41**, and any of first branch electrodes **431***b***1** of the first branch portion **431***b* corresponds to at least part of one second interval d**42**, the liquid crystal display panel equipped with the electrode structure **430** has similar advantages like the liquid crystal display panel **100** of the first embodiment.

Fifth Embodiment

[0035] Referring to FIG. **6**, an electrode structure **530** according to a fifth embodiment of the invention is shown. The electrode structure **530** includes a main electrode **530***m*, a first branch portion **531***b* and a second branch portion **532***b*. The main electrode **530***m* has a first inclined side R**1** and a second inclined side R**2**. The first inclined side R**1** and the second inclined side R**2** form an indent. Each first branch electrode **531***b***1** of the first branch portion **531***b* is connected to the first inclined side R**1** to be located inside the indent. Each second branch electrode **532***b***1** of the second branch portion **532***b* is connected to the second inclined side R**2** to be located inside the indent.

[0036] Since any of the second branch electrodes **532***b***1** corresponds to at least part of one of the first intervals d**51**, and any of the first branch electrodes **531***b***1** corresponds to at least part of one of the second intervals d**52**, the liquid crystal display panel equipped with the electrode structure **530** has similar advantages like the liquid crystal display panel **100** of the first embodiment.

[0037] According to the liquid crystal display panel and the liquid crystal display device using the same disclosed in the above embodiments of the invention, through the disposition of the first branch portion and the second branch portion adjacent to each other, the occurrence of nodes at the junction between the first branch portion and the second branch portion can be reduced so as to increase the overall display brightness. Moreover, since the time for resuming the stable state after the occurrence of streaks is shortened, the display quality can be further improved.

[0038] While the invention has been described by way of example and in terms of the preferred embodiment(s), it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

What is claimed is:

1. A liquid crystal display panel, comprising:

a first substrate;

a second substrate substantially parallel to the first substrate;

a liquid crystal layer located between the first substrate and the second substrate; and

an electrode structure disposed on the first substrate, wherein the electrode structure comprises:

a first branch portion comprising a plurality of first branch electrodes, wherein the two adjacent first branch electrodes are substantially parallel to each other and separated apart by a first interval;

a second branch portion comprising a plurality of second branch electrodes, wherein the two adjacent second branch electrodes are substantially parallel to each other and separated apart by a second interval, any of the first branch electrodes corresponds to at least part of one of the second intervals, and any of the second branch electrodes corresponds to at least part of one of the first intervals; and

a main electrode having a first inclined side and a second inclined side, wherein the first inclined side and the second inclined side form an indent, each first branch electrode is connected to the first inclined side to be located inside the indent, and each second branch electrode is connected to the second inclined side to be located inside the indent.

2. A liquid crystal display device, comprising:

a liquid crystal display panel, comprising:

a first substrate;

a second substrate substantially parallel to the first substrate;

a liquid crystal layer located between the first substrate and the second substrate; and

an electrode structure disposed on the first substrate, the electrode structure comprises:

a first branch portion comprising a plurality of first branch electrodes, wherein the two adjacent first branch electrodes are substantially parallel to each other and separated apart by a first interval;

a second branch portion comprising a plurality of second branch electrodes, wherein the two adjacent second branch electrodes are substantially parallel to each other and separated apart by a second interval, any of the first branch electrodes corresponds to at least part of one of the second intervals, and any of the second branch electrodes corresponds to at least part of one of the first intervals; and

a main electrode having a first inclined side and a second inclined side, wherein the first inclined side and the second inclined side form an indent, each first branch electrode is connected to the first inclined side to be located inside the indent, and each second branch electrode is connected to the second inclined side to be located inside the indent; and

a backlight module used for providing light to the liquid crystal display panel to display an image.

* * * * *

专利名称(译)	液晶显示面板和使用其的液晶显示装置		
公开(公告)号	US20130242248A1	公开(公告)日	2013-09-19
申请号	US13/889724	申请日	2013-05-08
[标]申请(专利权)人(译)	陈建HUNG 杨永晴CHE		
申请(专利权)人(译)	CHEN，CHIEN HUNG 杨，青CHE		
当前申请(专利权)人(译)	群创光电		
[标]发明人	CHEN CHIEN HUNG YANG CHING CHE		
发明人	CHEN, CHIEN HUNG YANG, CHING CHE		
IPC分类号	G02F1/1343		
CPC分类号	G02F1/133707 G02F2001/134345 G02F1/134336 G02F1/134309		
优先权	098145117 2009-12-25 TW		
其他公开文献	US8873012		
外部链接	Espacenet USPTO		

摘要(译)

液晶显示面板包括第一基板，第二基板，液晶层和电极结构。第二基板平行于第一基板。液晶层位于第一基板和第二基板之间。电极结构设置在第一基板上。电极结构包括第一分支部分和第二分支部分。第一分支部分包括第一分支电极。两个相邻的第一分支电极彼此平行并且以第一间隔分开。第二分支部分包括第二分支电极。两个相邻的第二分支电极彼此平行并且以第二间隔分开。任何第一分支电极对应于第二间隔之一的至少一部分。任何第二分支电极对应于第一间隔之一的至少一部分。