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(54) **PIXEL STRUCTURE, DRIVING METHOD THEREOF, PIXEL ARRAY STRUCTURE, AND LIQUID CRYSTAL DISPLAY PANEL**

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(58) **Field of Classification Search** 349/39, 349/144, 41, 38, 43
See application file for complete search history.

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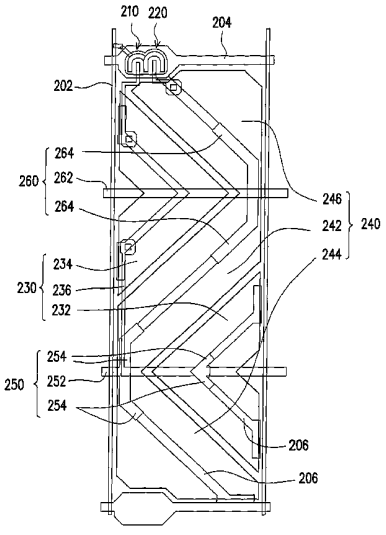
(57) **ABSTRACT**

A pixel structure electrically connected to a data line and a scan line, and including a first and a second active device, a first and a second pixel electrode, and a first and a second capacitance electrode is provided. The first pixel electrode electrically connected to the first active device includes a first and a second electrode block electrically connected to each other. The second pixel electrode electrically connected to the second active device is electrically insulated from the first pixel electrode and separates the first and the second electrode block. The first pixel electrode respectively forms a first and a second capacitor with the first and the second capacitance electrode. The second pixel electrode respectively forms a third and a fourth capacitor with the first and the second capacitance electrode. The first and the second capacitor have different capacitances. The third and the fourth capacitor have different capacitances.

16 Claims, 11 Drawing Sheets



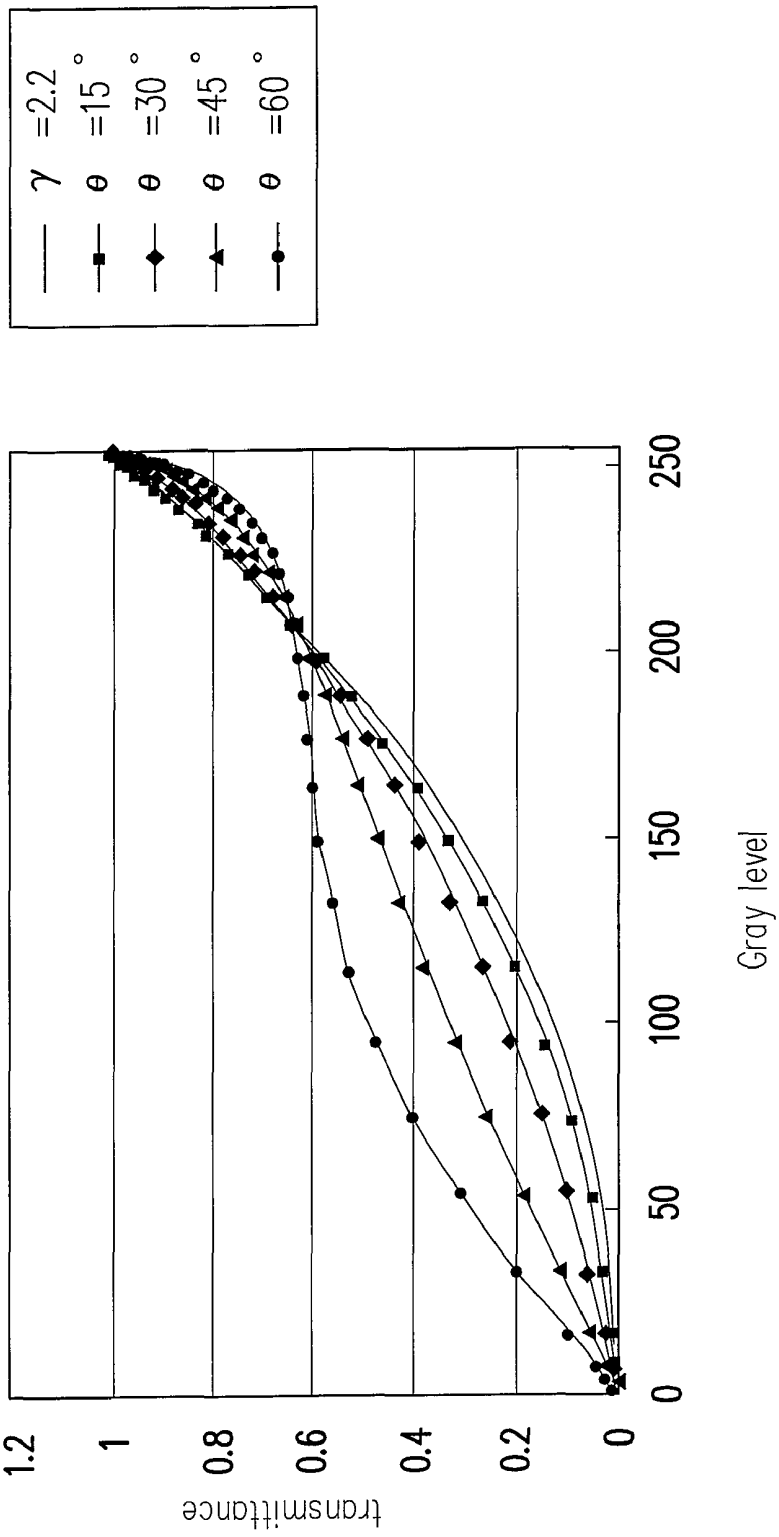


FIG. 1 (PRIOR ART)

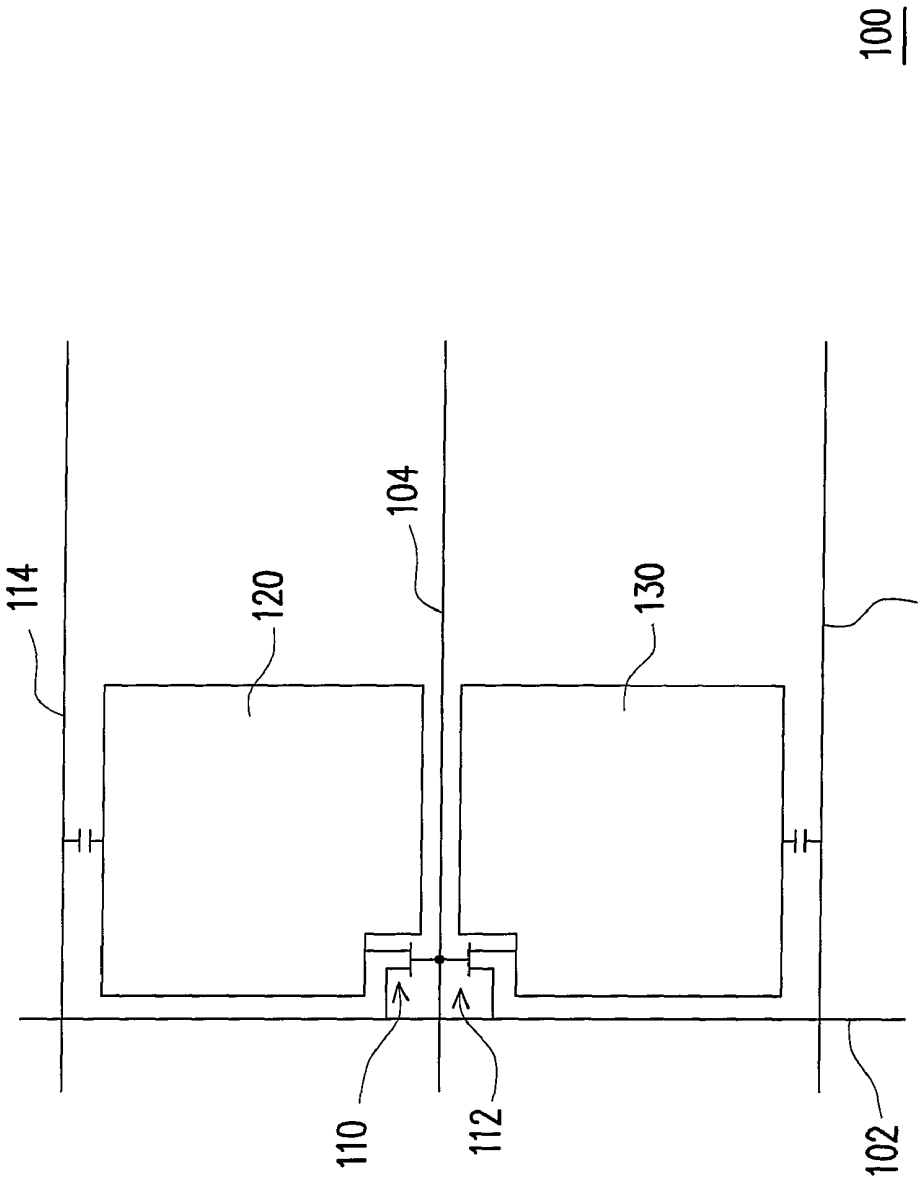


FIG. 2 (PRIOR ART)

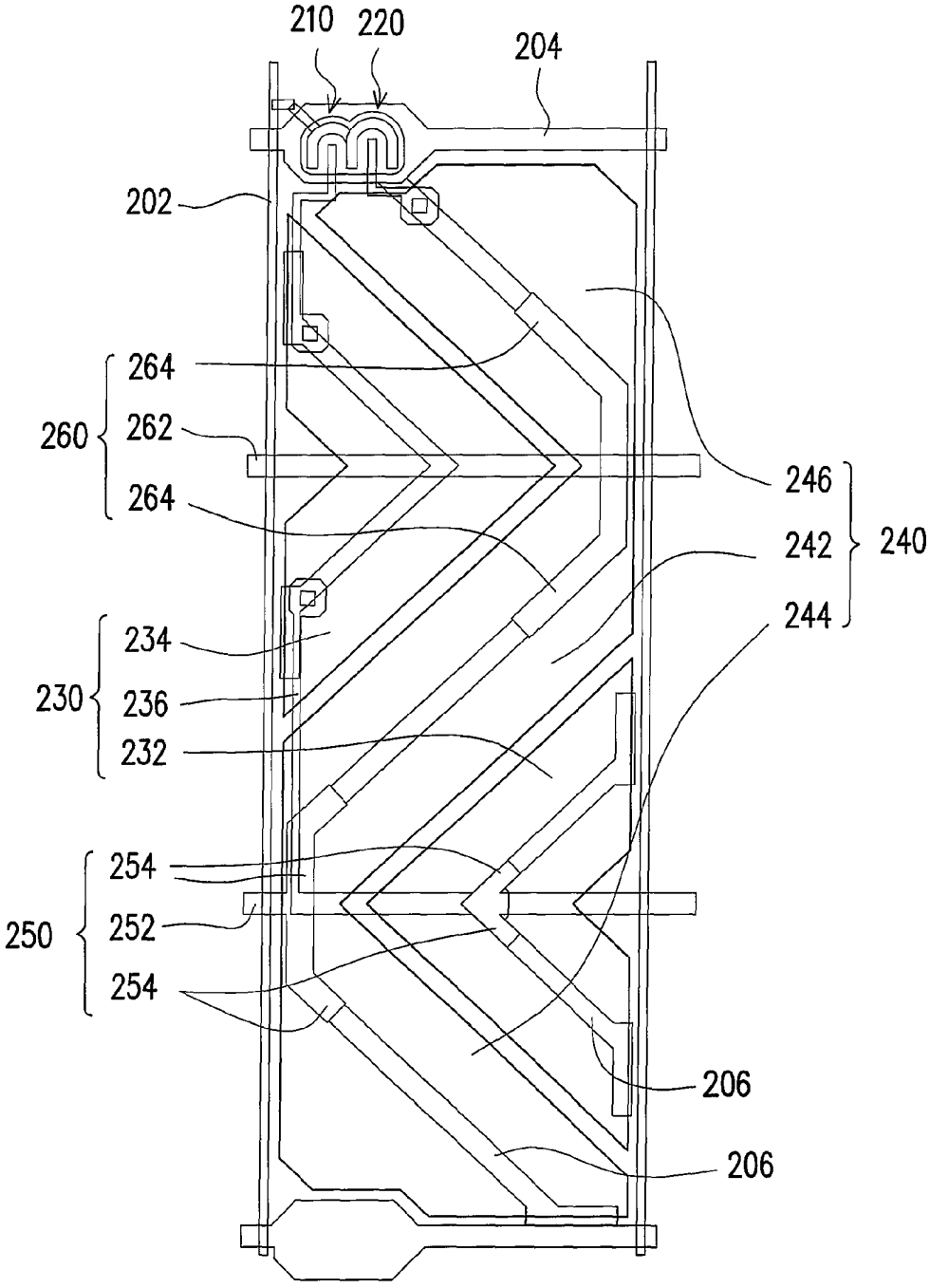

210
220
204
202
264
260
262
264
246
242
240
244
234
230
236
232
254
250
252
254
206
206

FIG. 3A

200

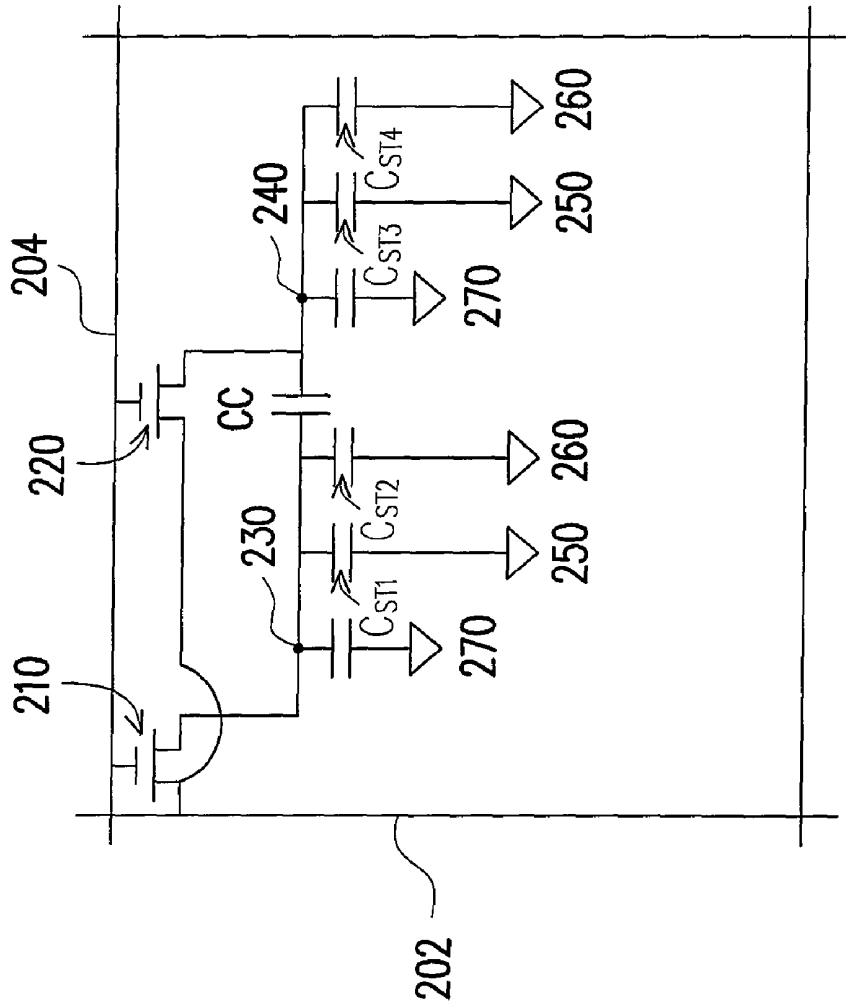

200
204
220
210
240
230
CC
C_{ST4}
C_{ST3}
C_{ST2}
C_{ST1}
260
250
270
260
250
270
202

FIG. 3B

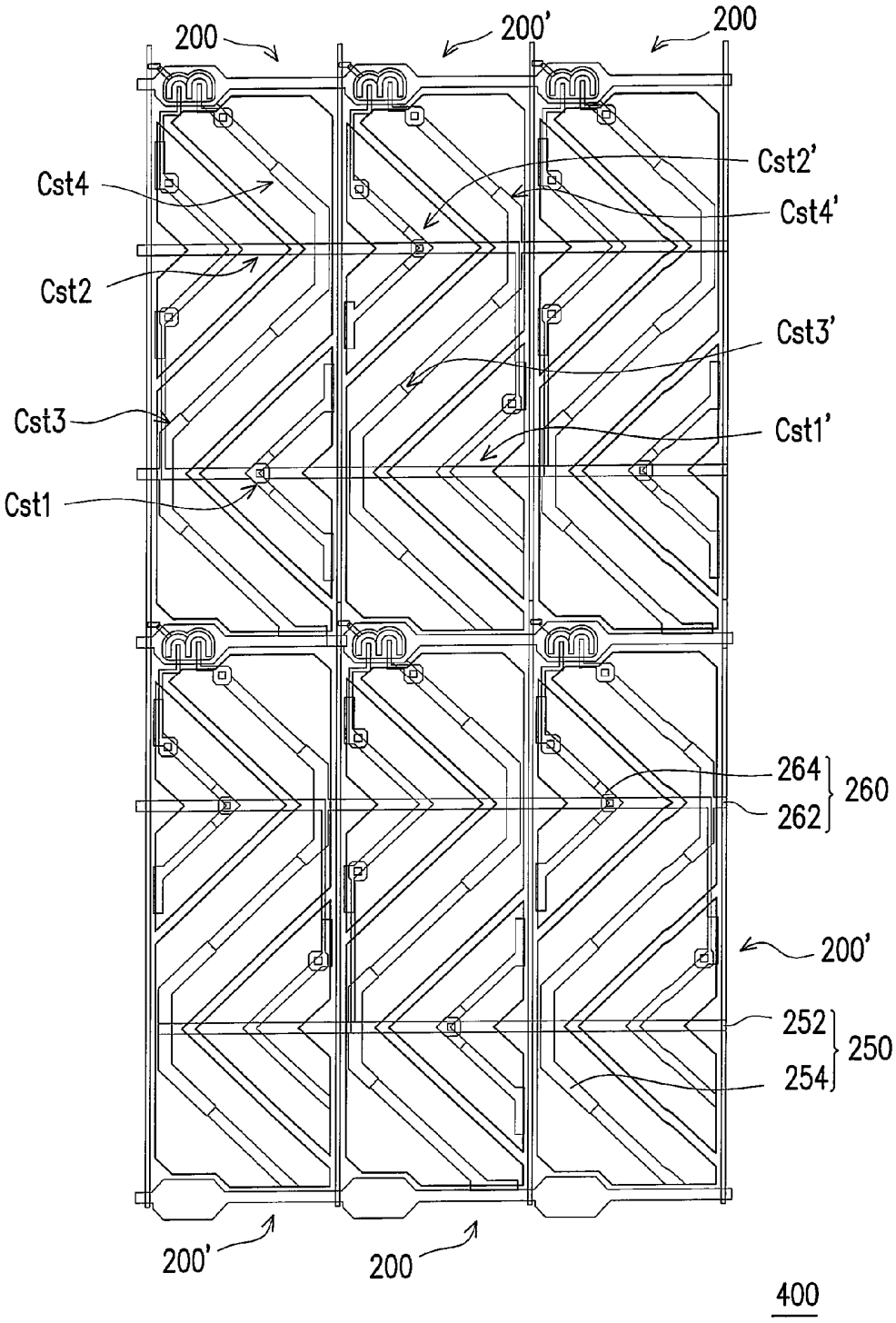

200
200'
200
Cst2'
Cst4
Cst4'
Cst2
Cst3'
Cst3
Cst1'
Cst1
264
262
260
200'
252
254
250
200'
200
400

FIG. 4

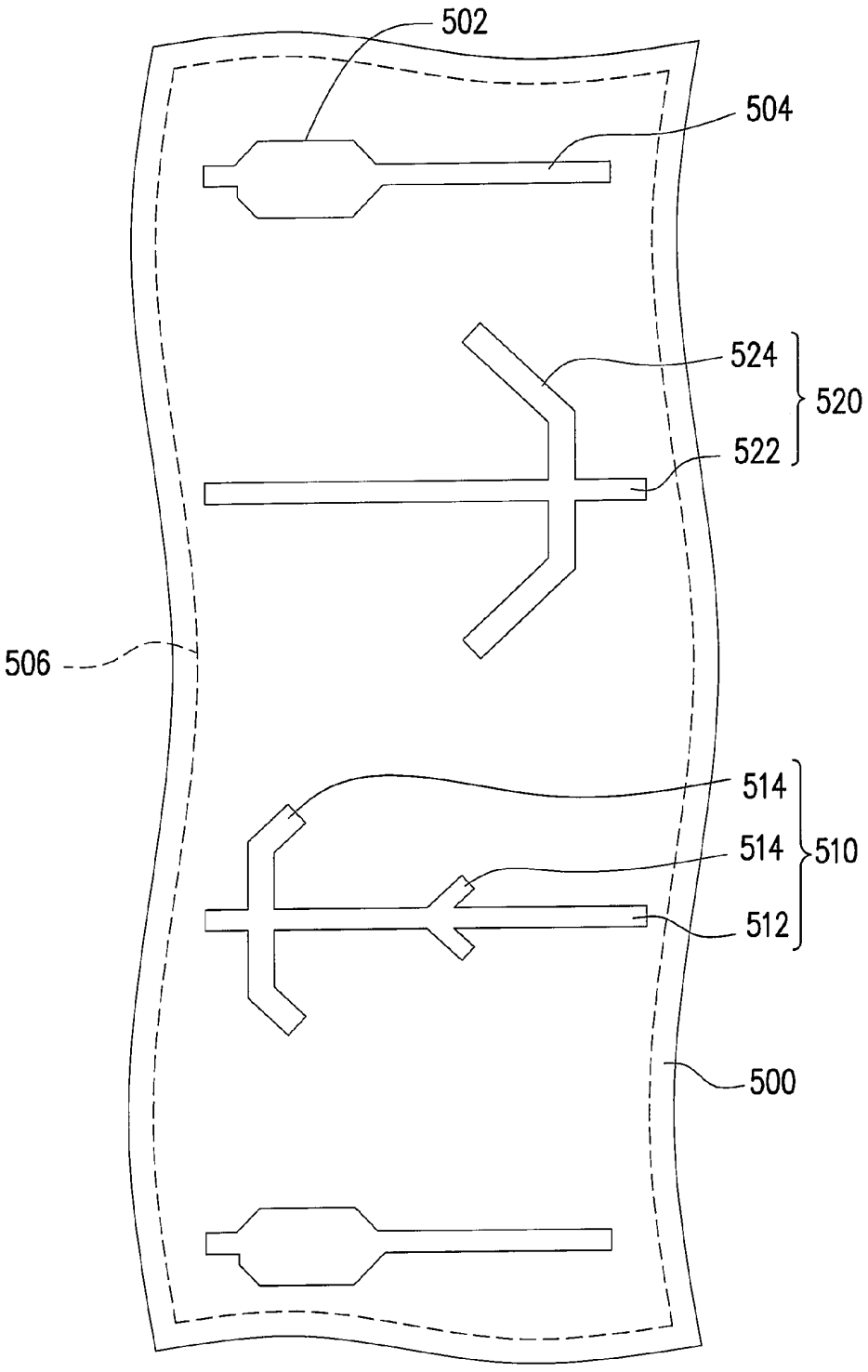


FIG. 5A

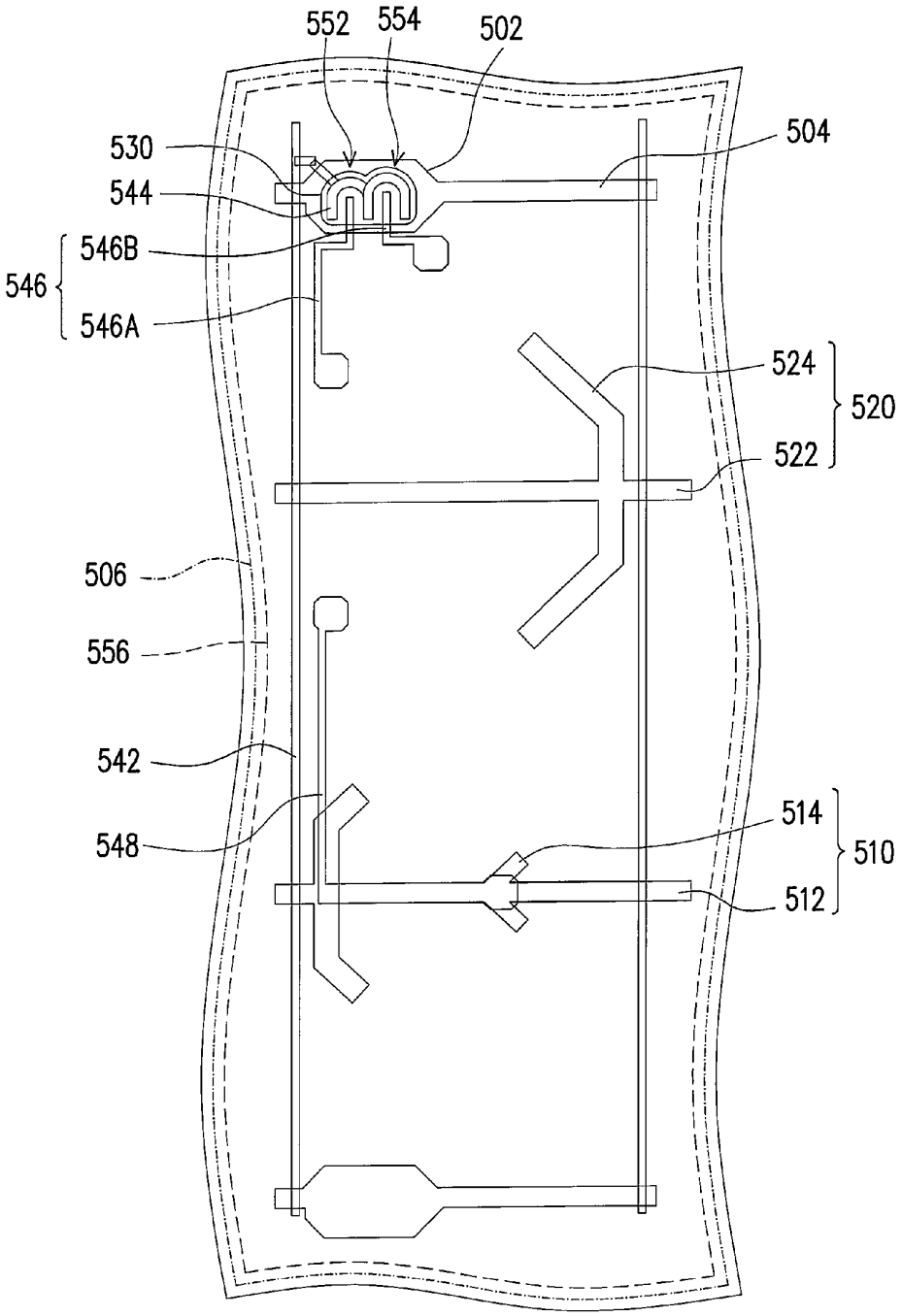

552
554
502
530
504
544
546B
546
546A
524
520
522
506
556
542
548
514
510
512

FIG. 5B

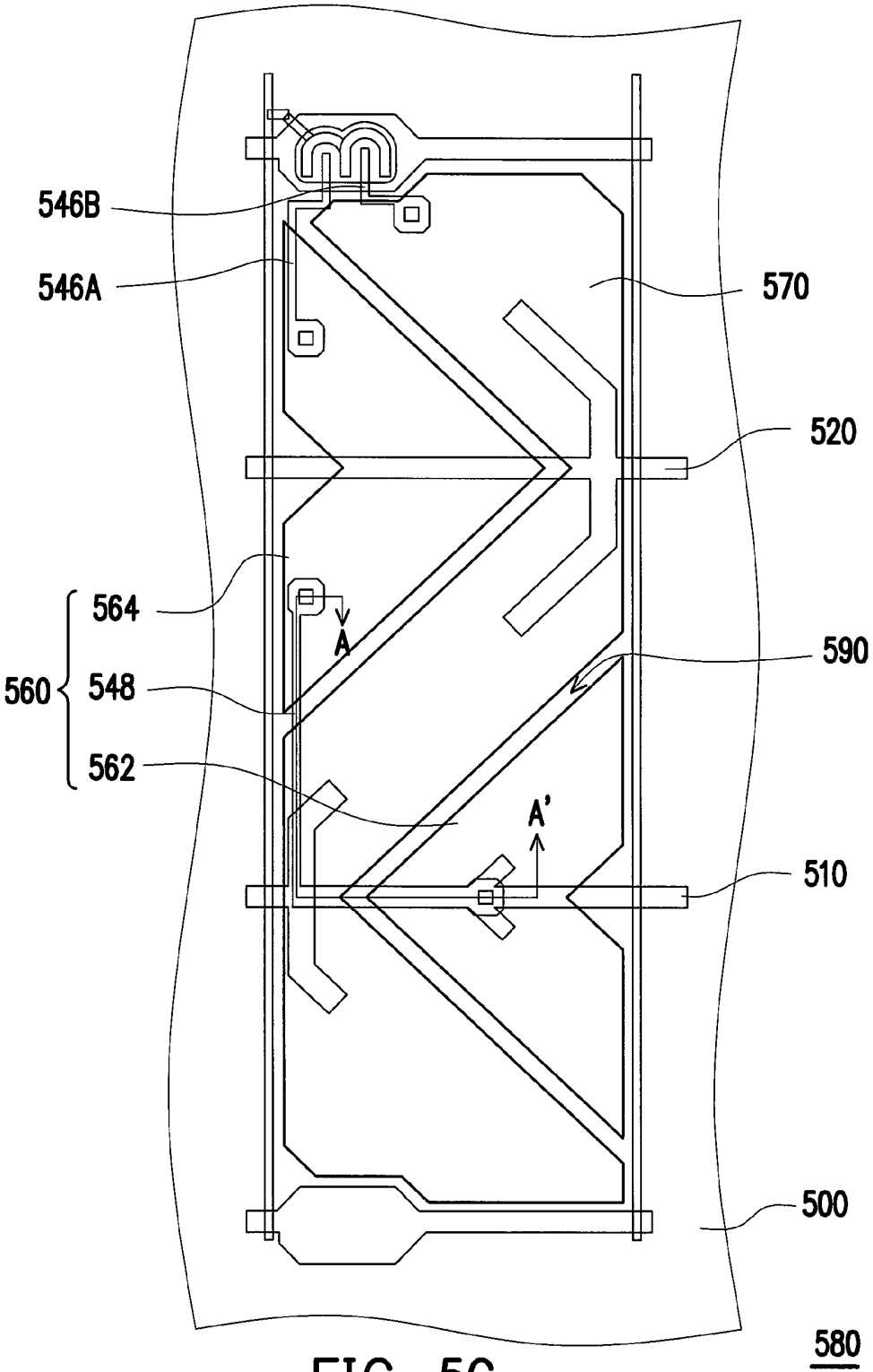


FIG. 5C

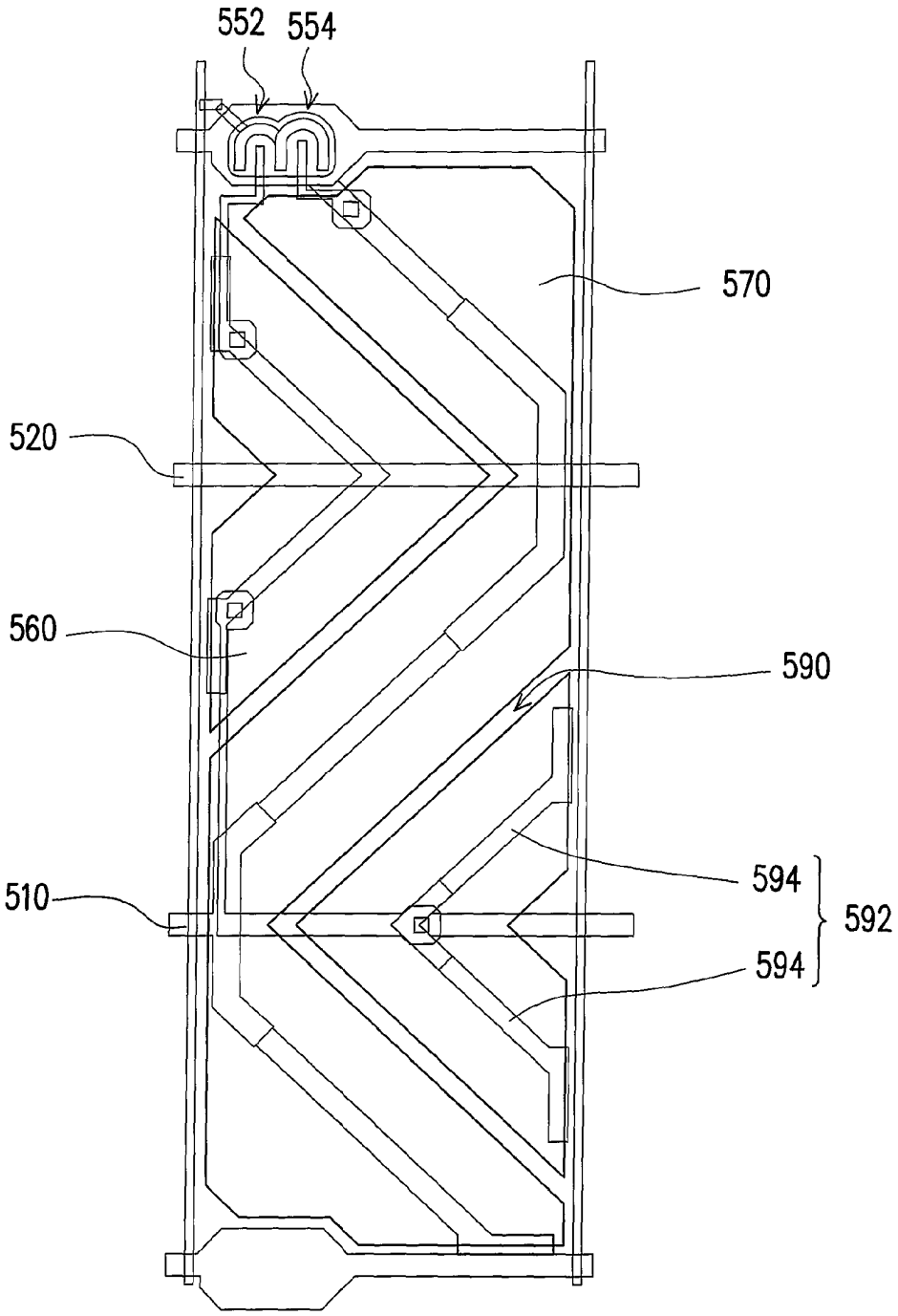


FIG. 5D

580

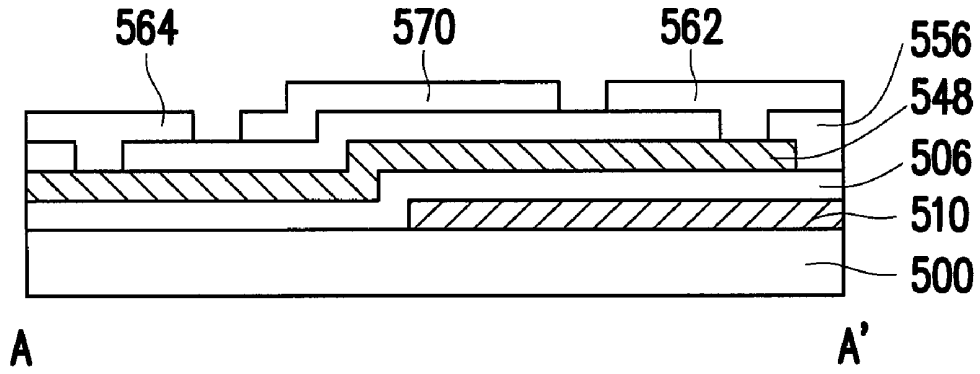


FIG. 5E

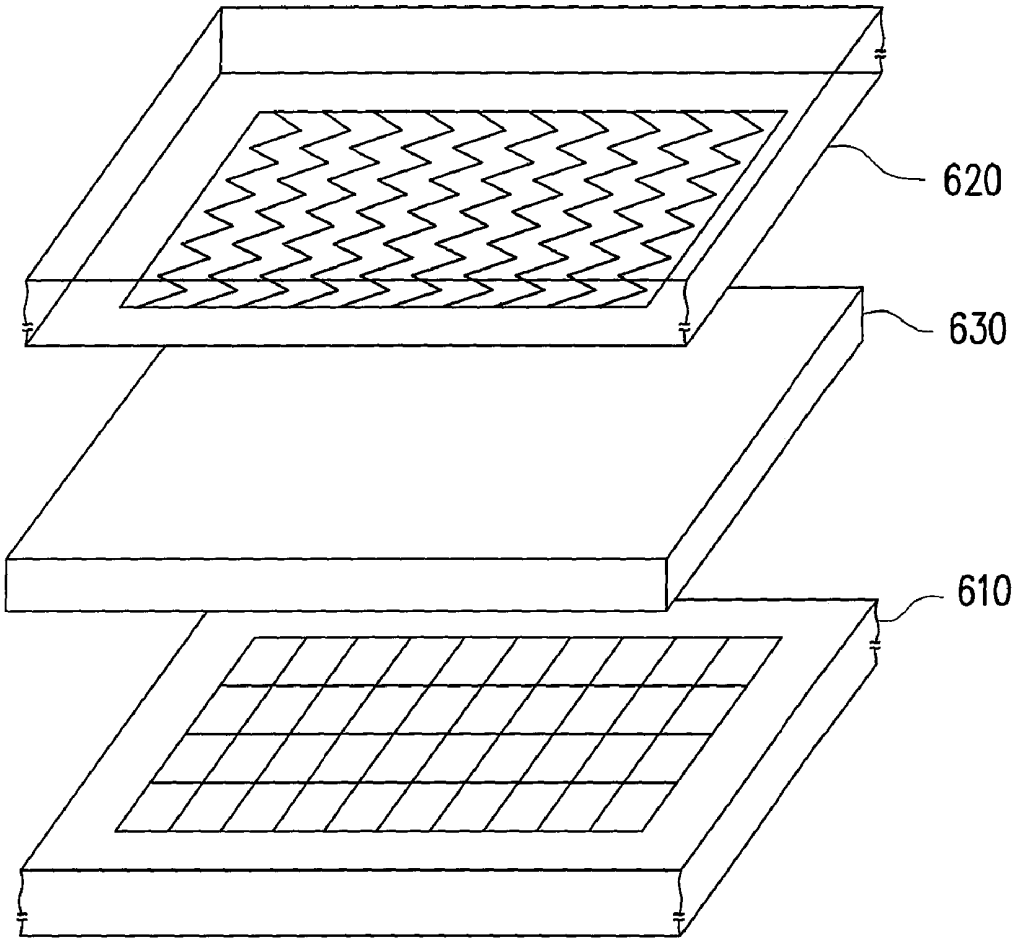


FIG. 6

PIXEL STRUCTURE, DRIVING METHOD THEREOF, PIXEL ARRAY STRUCTURE, AND LIQUID CRYSTAL DISPLAY PANEL

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the priority benefit of Taiwan application serial no. 96138669, filed on Oct. 16, 2007. The entirety the above-mentioned patent application is hereby incorporated by reference herein and made a part of specification.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a pixel structure, a driving method thereof, a pixel array structure, in particular and a liquid crystal display panel, to a pixel structure, a driving method thereof, a pixel array structure and a liquid crystal display panel having good display quality.

2. Description of Related Art

Thin film transistor liquid crystal display (TFT-LCD) has gradually become the mainstream in today's display market due to its characteristics such as high display quality, high space efficiency, low power consumption, and no radiation. Presently, the design of LCD is going towards high contrast ratio, rapid response, and wide viewing angle, wherein multi-domain vertically alignment (MVA)-LCD and in-plate switching (IPS) LCD are usually adopted to achieve wide-viewing angle display.

Even though wide-viewing angle display can be achieved by a MVA-LCD, color washout, namely, color shift, is usually produced in an image displayed by the MVA-LCD when a user looks at the image from a large viewing angle. FIG. **1** is a graph illustrating various γ (gamma) curves observed from different viewing angles (θ) of a conventional MVA LCD. Referring to FIG. **1**, the ordinate axis represents transmittance, and the abscissa axis represents gray level, wherein the curve having γ=2.2 is an ideal curve. As shown in FIG. **1**, the larger the viewing angle is (for example, θ=60°), the more the γ curve is deformed, namely, the further the γ curve is away from the ideal curve. To be specific, color shift will be produced in an image viewed from a large viewing angle because the image has high luminance at medium to low gray level from the large viewing angle. An existing method for reducing color shift is to align liquid crystal molecules at many different angles and divide each pixel into two sub display regions having different display voltages.

FIG. **2** is an equivalent circuit diagram of a conventional pixel structure with color washout solution. Referring to FIG. **2**, the pixel structure **100** is electrically connected to a data line **102** and a scan line **104**. The pixel structure **100** includes a first active device **110**, a second active device **112**, a first capacitance electrode **114**, a second capacitance electrode **116**, a first pixel electrode **120**, and a second pixel electrode **130**. The first pixel electrode **120** and the second pixel electrode **130** are respectively connected to the first active device **110** and the second active device **112** electrically. The first capacitance electrode **114** and the second capacitance electrode **116** respectively have a specific voltage level. Thus, the first pixel electrode **120** and the second pixel electrode **130** have different display voltages due to the capacitance coupling effect thereof with respectively the first capacitance electrode **114** and the second capacitance electrode **116**. Accordingly, at medium to low gray level, one of the regions of the first pixel electrode **120** and the second pixel electrode **130** can have low luminance, while at high gray level, both the regions of the first pixel electrode **120** and the second pixel electrode **130** can have similar luminance. As a result, color shift produced at large viewing angle is restrained in the pixel structure **100**.

However, the first pixel electrode **120** and the second pixel electrode **130** have to be arranged in a lattice pattern since they have to be disposed corresponding to capacitance electrodes (**114** and **116**) having different voltage levels, so that when the pixel structure **100** is provided in an LCD, images displayed in the LCD may look coarse-grained. Thereby, the display quality of the pixel structure **100** is still unsatisfactory.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a pixel structure in order to resolve the problem of coarseness in a displayed image caused by pixel electrodes arranged in a lattice pattern.

The present invention is directed to a driving method for improving the display quality of a pixel structure.

The present invention is also directed to a pixel array structure which can be applied in a liquid crystal display (LCD) and improve the display quality of the LCD.

The present invention is also directed to a liquid crystal display (LCD) having good displaying quality.

The present invention provides a pixel structure electrically connected to a data line and a scan line. The pixel structure includes a first active device, a second active device, a first pixel electrode, a second pixel electrode, a first capacitance electrode, and a second capacitance electrode. The first pixel electrode electrically connected to the first active device includes a first electrode block and a second electrode block electrically connected to each other. The second pixel electrode electrically connected to the second active device is electrically insulated from the first pixel electrode. The second pixel electrode electrically insulates the first electrode block and the second electrode block. The first pixel electrode respectively forms a first capacitor and a second capacitor with the first capacitance electrode and the second capacitance electrode, and the second pixel electrode respectively forms a third capacitor and a fourth capacitor with the first capacitance electrode and the second capacitance electrode. The first capacitor and the second capacitor have different capacitances, and the third capacitor and the fourth capacitor have different capacitances.

The present invention also provides a pixel array structure including a plurality of scan lines, a plurality of data lines, a plurality of first active devices, a plurality of second active devices, a plurality of first pixel electrodes, a plurality of second pixel electrodes, a plurality of first capacitance electrodes, and a plurality of second capacitance electrodes. The data lines and the scan lines intersect with each other to define a plurality of pixel regions. The first active devices and the second active devices are electrically connected to the data lines and the scan lines. The first pixel electrodes are electrically connected to the first active devices and are disposed in the pixel regions. Each of the first pixel electrodes includes a first electrode block and a second electrode block electrically connected to each other. The second pixel electrodes electrically connected to the second active devices are disposed in the pixel regions and are electrically insulated from the first pixel electrodes. The second pixel electrodes separate the first electrode blocks and the second electrode blocks. The second capacitance electrodes are disposed between the first capacitance electrodes and the scan lines. Each of the first capaci-

tance electrodes and each of the second capacitance electrodes have different patterns in adjacent pixel regions.

According to an embodiment of the present invention, the capacitance of the first capacitor is greater than the capacitance of the second capacitor.

According to an embodiment of the present invention, the capacitance of the third capacitor is smaller than the capacitance of the fourth capacitor.

According to an embodiment of the present invention, the capacitance of the first capacitor is smaller than the capacitance of the second capacitor.

According to an embodiment of the present invention, the capacitance of the third capacitor is greater than the capacitance of the fourth capacitor.

According to an embodiment of the present invention, the first pixel electrode further includes a connecting portion disposed between the first electrode block and the second electrode block and electrically connecting the two. The material of the connecting portion is metal or a transparent conductive material.

According to an embodiment of the present invention, the first electrode block and the second electrode block are in approximately triangular or rectangular shape.

According to an embodiment of the present invention, the second pixel electrode includes a central electrode block and a first end electrode block and a second end electrode block respectively connected to two ends of the central electrode block. The central electrode block may be disposed between the first electrode block and the second electrode block of the first pixel electrode.

The present invention further provides a liquid crystal display (LCD) panel. The LCD panel comprises an array substrate, an opposite substrate and a liquid crystal layer. The array substrate has a plurality of the abovementioned pixels. The opposite substrate is disposed opposite to the array substrate. The liquid crystal layer is disposed between the array substrate and the opposite substrate.

The present invention further provides a driving method suitable for driving a pixel structure. In the driving method, a first voltage is provided to a first capacitance electrode, and a second voltage is provided to a second capacitance electrode, wherein the first voltage is different from the second voltage so that the luminance in the region of the first pixel electrode is made different from the luminance in the region of the second pixel electrode.

According to an embodiment of the present invention, the difference between the first voltage and the second voltage is higher than 0V and lower than 20V.

According to an embodiment of the present invention, the driving method further includes providing an image data signal to the first pixel electrode and the second pixel electrode.

In the present invention, the first pixel electrodes and the second pixel electrodes having different display voltages are arranged evenly so that when the pixel array structure provided by the present invention is applied in an LCD, coarseness in lattice pattern is not produced in images displayed by the LCD and accordingly the display quality of the LCD is improved. Moreover, in the present invention, the first pixel electrodes and the second pixel electrodes are disposed along with different patterns of capacitance electrodes so that the display voltages of the pixel electrodes can be adjusted or changed according to different design requirement.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a graph illustrating various γ curves observed from different viewing angles of a conventional multi-domain vertically alignment (MVA) liquid crystal display (LCD).

FIG. **2** is an equivalent circuit diagram of a conventional pixel structure.

FIG. **3**A is a schematic view of a pixel structure according to an embodiment of the present invention.

FIG. **3**B is an equivalent circuit diagram of a pixel structure according to an embodiment of the present invention.

FIG. **4** is a schematic view of a pixel array structure according to an embodiment of the present invention.

FIGS. **5**A~**5**D illustrate a manufacturing method of a pixel structure according to an embodiment of the present invention, and FIG. **5**E is a cross-sectional view along cross-sectional line A-A' in FIG. **5**C.

FIG. **6** illustrates an LCD panel applying the technique provided by the present invention.

DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

FIG. **3**A is a schematic view of a pixel structure according to an embodiment of the present invention, and FIG. **3**B is an equivalent circuit diagram of a pixel structure according to an embodiment of the present invention. Referring to FIG. **3**A and FIG. **3**B, the pixel structure **200** is electrically connected to a data line **202** and a scan line **204**, and the pixel structure **200** includes a first active device **210**, a second active device **220**, a first pixel electrode **230**, a second pixel electrode **240**, a first capacitance electrode **250**, and a second capacitance electrode **260**. The first pixel electrode **230** is electrically connected to the first active device **210**, and the first pixel electrode **230** includes a first electrode block **232** and a second electrode block **234** which are electrically connected to each other. The second pixel electrode **240** is electrically connected to the second active device **220** and is electrically insulated from the first pixel electrode **230**. The second pixel electrode **240** may spatially separate the first electrode block **232** and the second electrode block **234**.

When the pixel structure **200** is applied in a liquid crystal display (LCD) for displaying images, color shift produced at large viewing angles can be reduced because the first pixel electrode **230** and the second pixel electrode **240** have different display voltages. Additionally, in the present embodiment, the first pixel electrode **230** and the second pixel electrode **240** in the pixel structure **200** are further disposed in a staggered way so that the coarseness in a displayed image caused by pixel electrodes arranged in lattice pattern can be avoided. To be specific, in the present embodiment, the first pixel electrode **230** and the second pixel electrode **240** are disposed approximately in a region defined by the scan line **204** and the data line **202**, namely, the first pixel electrode **230** and the second pixel electrode **240** form approximately a rectangular display region. The second pixel electrode **240** includes a central electrode block **242**, a first end electrode block **244**, and a second end electrode block **246**. The central electrode block **242** is located between the first electrode block **232** and the second electrode block **234** so as to separate the two. The first end electrode block **244** and the second end electrode block **246** are respectively connected to two ends of

the central electrode block **242**. The first electrode block **232** and the second electrode block **234** are in approximately triangular shape. However, in other embodiments of the present invention, the first electrode block **232** and the second electrode block **234** may also be in rectangular shape or in other shapes.

Substantially, the first pixel electrode **230** further includes a connecting portion **236** which may be a strip-shaped metal pattern and is connected between the first electrode block **232** and the second electrode block **234**. The first electrode block **232** and the second electrode block **234** may be connected through a contact hole and the connecting portion **236**. Because the second pixel electrode **240** separates the first electrode block **232** and the second electrode block **234**, the connecting portion **236** partially overlaps the second pixel electrode **240** and accordingly a parasitic capacitor CC is produced. One end of the connecting portion **236** is connected to the second electrode block **234** and the other end thereof is electrically coupled to the first electrode block **232** so that the first electrode block **232** and the second electrode block **234** can be electrically coupled. However, the connecting portion **236** may also be electrically connected to the first electrode block **232** directly. The first electrode block **232** and the second electrode block **234** can have the same display voltage through the connection of the connecting portion **236**.

As described above, the first pixel electrode **230** and the second pixel electrode **240** are evenly distributed in the rectangular region defined by the scan line **204** and the data line **202**, so that when the pixel structure **200** is applied in an LCD, display areas having different luminance are evenly distributed so that coarseness will not be felt in an image displayed by the LCD. In addition, a plurality of alignment protrusions or main slits **206** may be selectively disposed in the pixel structure **200** in order to allow the pixel structure **200** to achieve a wide-angel display. The disposition of the alignment protrusions or main slits **206** is determined according to the actual requirement; however, the present invention is not limited herein.

The design of the first pixel electrode **230** and the second pixel electrode **240** can reduce the coarseness in a displayed image and accordingly improve the display quality of the pixel structure **200**. However, a driving method or capacitor design corresponding to foregoing design has to be provided in order to allow the first pixel electrode **230** and the second pixel electrode **240** to have different display voltages. In the present disclosure, a capacitor design is provided to allow the first pixel electrode **230** and the second pixel electrode **240** to have different display voltages without adopting any additional device; however, the present invention is not limited to the capacitor design.

Referring to FIG. **3**A and FIG. **3**B, in the pixel structure **200**, the first capacitance electrode **250** and the second capacitance electrode **260** cross over the entire pixel structure **200**. Part of the first pixel electrode **230** and part of the second pixel electrode **240** overlap the first capacitance electrode **250**, and another part of the first pixel electrode **230** and another part of the second pixel electrode **240** overlap the second capacitance electrode **260**. As a result, the first pixel electrode **230** respectively forms a first capacitor Cst**1** and a second capacitor Cst**2** with the first capacitance electrode **250** and the second capacitance electrode **260**, and the second pixel electrode **240** respectively forms a third capacitor Cst**3** and a fourth capacitor Cst**4** with the first capacitance electrode **250** and the second capacitance electrode **260**.

In a driving method of the pixel structure **200**, an image data signal may be first provided to the first pixel electrode **230** and the second pixel electrode **240**. In addition, a first voltage is provided to the first capacitance electrode **250**, and a second voltage is provided to the second capacitance electrode **260**, wherein the first voltage is different from the second voltage, and the difference between the two is higher than 0V and lower than 20V. The first capacitance electrode **250** and the second capacitance electrode **260** may produce coupling effect with the first pixel electrode **230** and the second pixel electrode **240** so as to produce the first capacitor Cst**1**, the second capacitor Cst**2**, the third capacitor Cst**3**, and the fourth capacitor Cst**4**.

When an LCD having the pixel structure **200** is displaying an image, the luminance of the region of the first pixel electrode **230** is affected by the first capacitor Cst**1** and the second capacitor Cst**2**, and the luminance of the region of the second pixel electrode **240** is affected by the third capacitor Cst**3** and the fourth capacitor Cst**4**. Thus, the first capacitor Cst**1**, the second capacitor Cst**2**, the third capacitor Cst**3**, and the fourth capacitor Cst**4** have to be appropriately adjusted so as to allow the first pixel electrode **230** and the second pixel electrode **240** to have different display voltages when the first pixel electrode **230** and the second pixel electrode **240** are connected to the same scan line **204** and the same data line **202**.

In the present embodiment, the first capacitance electrode **250** includes a main portion **252** and a plurality of branch portions **254**, and the second capacitance electrode **260** also includes a main portion **262** and a plurality of branch portions **264**. The main portion **252** and the branch portions **254** may form a bow-shaped pattern, and the main portion **262** and the branch portions **264** may also form a bow-shaped pattern. As shown in FIG. **3**A, in the first capacitance electrode **250**, the size of the branch portion **254** located at the right side of the pixel structure **200** is smaller than the size of the branch portion **254** located at the left side of the pixel structure **200**, and the size of the branch portions **264** in the second capacitance electrode **260** is greater than the size of the branch portion **254** located at the left side of the pixel structure **200** in the first capacitance electrode **250**; however, the present invention is not limited thereto. The branch portions **254** below the first pixel electrode **230** and the second pixel electrode **240** respectively have patterns of different sizes. Accordingly, the capacitances of the first capacitor Cst**1**, the second capacitor Cst**2**, the third capacitor Cst**3**, and the fourth capacitor Cst**4** can be adjusted. In other words, in the present embodiment, the display voltages of the first pixel electrode **230** and the second pixel electrode **240** are adjusted by changing the sizes of the first capacitance electrode **250** and the second capacitance electrode **260**.

Referring to both FIG. **3**A and FIG. **3**B, when the pixel structure **200** is applied in an LCD, a substrate (not shown) disposed with the pixel structure **200** is assembled with an opposite substrate (not shown) disposed with an opposite electrode **270**. The pixel structure **200** is a pixel structure of positive polarity design when the display voltage of the pixel structure **200** is higher than the voltage of the opposite electrode **270**, and the pixel structure **200** is a pixel structure of negative polarity design when the display voltage of the pixel structure **200** is lower than the voltage of the opposite electrode **270**. In order to allow the pixel structure **200** to present different luminance, the capacitances of the first capacitor Cst**1**, the second capacitor Cst**2**, the third capacitor Cst**3**, and the fourth capacitor Cst**4** should be adjusted according to the polarity of the pixel structure **200**. Below, the pixel structure **200** will be described as a pixel structure having positive polarity design.

In the present embodiment, different voltage levels are provided to the first capacitance electrode **250** and the second capacitance electrode **260**. Assuming that the coupling effect

of the first capacitance electrode **250** increases the display voltage of the positive pixel structure **200** and the coupling effect of the second capacitance electrode **260** reduces the display voltage of the positive pixel structure **200**, the first capacitor Cst**1** should be greater than the second capacitor Cst**2** in order to allow the first pixel electrode **230** to have higher display voltage, namely, to present higher luminance, and the fourth capacitor Cst**4** should be greater than the third capacitor Cst**3** in order to allow the second pixel electrode **240** to present lower luminance.

Thereby, the overlapped area of the first capacitance electrode **250** and the first pixel electrode **230** may be larger than the overlapped area of the second capacitance electrode **260** and the first pixel electrode **230**, and the overlapped area of the first capacitance electrode **250** and the second pixel electrode **240** may be smaller than the overlapped area of the second capacitance electrode **260** and the second pixel electrode **240**. Accordingly, the capacitance of the first capacitor Cst**1** is greater than the capacitance of the second capacitor Cst**2**, and the capacitance of the third capacitor Cst**3** is smaller than the capacitance of the fourth capacitor Cst**4**. In other words, the capacitances of the first capacitor Cst**1** and the second capacitor Cst**2**, and the capacitances of the third capacitor Cst**3** and the fourth capacitor Cst**4** can be made different through different design of the overlapped areas. As a result, the first pixel electrode **230** and the second pixel electrode **240** can present different luminance.

Based on the design concept of the present embodiment, when the pixel structure **200** is a pixel structure having negative polarity design, the capacitance of the first capacitor Cst**1** is smaller than the capacitance of the second capacitor Cst**2**, and the capacitance of the fourth capacitor Cst**4** is smaller than the capacitance of the third capacitor Cst**3**. Thus, the branch portions **254** and **264** located below the first pixel electrode **230** and the second pixel electrode **240** are designed to have other different sizes as shown in FIG. **3**A. However, the shapes and sizes of the branch portions **254** and **264** are not limited in the present invention. Substantially, the branch portions **254** and **264** can have circular, rectangular, triangular, or other geometrical shapes, and the sizes of the branch portions **254** and **264** can have different combination according to the polarity of the pixel structure **200**.

FIG. **4** is a schematic view of a pixel array structure according to an embodiment of the present invention. Referring to FIG. **4**, the pixel array structure **400** may be composed of a plurality of pixel structures **200** and a plurality of pixel structures **200'** as described in foregoing embodiment, wherein the pixel structures **200** and **200'** are arranged in a staggered way. The pixel structures **200'** and the pixel structures **200** are designed to have different polarities. If the pixel structure **200'** are negative, with the driving method described above, the capacitance of the first capacitor Cst**1'** is smaller than the capacitance of the second capacitor Cst**2'**, and the capacitance of the fourth capacitor Cst**4'** is smaller than the capacitance of the third capacitor Cst**3'**. Thus, the branch portions **254** and **264** in the first capacitance electrode **250** and the second capacitance electrode **260** of the pixel structures **200'** present different distribution as those in the first capacitance electrode **250** and the second capacitance electrode **260** of the pixel structures **200**. As shown in FIG. **4**, the size of the branch portion **264** of the second capacitance electrode **260** corresponding to the fourth capacitor Cst**4'** in the pixel structure **200'** is different from the size of the branch portion **264** of the second capacitance electrode **260** corresponding to the fourth capacitor Cst**4** in the pixel structure **200**.

FIGS. **5**A~**5**D illustrate a manufacturing method of a pixel structure according to an embodiment of the present invention. Referring to FIG. **5**A, first, a gate **502**, at least one scan line **504**, a first capacitance electrode **510**, and a second capacitance electrode **520** are formed on a substrate **500** with a conductive material. The first capacitance electrode **510** includes a main portion **512** and a plurality of branch portions **514**, and the second capacitance electrode **520** also includes a main portion **522** and a plurality of branch portions **524**. The conductive material may be a metal, an alloy, or a plurality of metal layers. In addition, a gate insulation layer **506** is formed on the substrate **500** for covering the gate **502**, the scan line **504**, the first capacitance electrode **510**, and the second capacitance electrode **520**.

Next, referring to FIG. **5**B, a semiconductor layer **530**, a data line **542**, a source **544**, a drain **546**, and a connecting portion **548** are formed on the gate insulation layer **506**. The semiconductor layer **530** may be made of a semiconductive material and is disposed above the gate **502**. The data line **542**, the source **544**, the drain **546**, and the connecting portion **548** are made of a conductive material such as a metal, an alloy, or a plurality of metal layers etc. In addition, the connecting portion **548** may also be made of a transparent conductive material. The data line **542** and the scan line **504** intersect with each other, and the source **544** and the drain **546** are disposed on the semiconductor layer **530**. The drain **546** includes a first drain **546**A and a second drain **546**B. The connecting portion **548** is located within a region defined by the scan line **504** and the data line **542**, and part of the connecting portion **548** is located above the first capacitance electrode **510**. In the present embodiment, the gate **502**, the source **544**, and the first drain **546**A may form a first active device **552**, and the gate **502**, the source **544**, and the second drain **546**B may form a second active device **554**. Additionally, a passivation layer **556** may be further disposed on the data line **542**, the first active device **552**, and the second active device **554**.

After that, referring to FIG. **5**C, a first electrode block **562**, a second electrode block **564**, and a second pixel electrode **570** are formed on the substrate **500** with a transparent conductive material, and by now the manufacturing of a pixel structure **580** is completed. The transparent conductive material may be indium tin oxide (ITO) or indium zinc oxide (IZO). The first electrode block **562** and the second electrode block **564** may be in triangular shape, and the connecting portion **548** is connected to the second electrode block **564**. The first electrode block **562** is electrically coupled with the second electrode block **564** through the connecting portion **548**. The first electrode block **562**, the connecting portion **548**, and the second electrode block **564** form a first pixel electrode **560**. Besides, the first drain **546**A is electrically connected to the first pixel electrode **560**, and the second drain **546**B is electrically connected to the second pixel electrode **570**. As seen in FIG. **5**E, the connecting portion **548** is disposed between the first electrode block **562** and the second electrode block **564**, and electrically connects the first electrode block **562** and the second electrode block **564**.

Substantially, the first electrode block **562** and the second electrode block **564** are in approximately triangular shape or other geometrical shapes, and the second pixel electrode **570** separates the first electrode block **562** and the second electrode block **564**. Besides, the first pixel electrode **560** is electrically insulated from the second pixel electrode **570**. Part of the first pixel electrode **560** overlaps the first capacitance electrode **510**, and another part of the first pixel electrode **560** overlaps the second capacitance electrode **520**. Similarly, part of the second pixel electrode **570** overlaps the first capacitance electrode **510**, and another part of the second pixel electrode **570** overlaps the second capacitance electrode **520**. These overlapped areas form a plurality of capacitors

which affect the voltages of the first pixel electrode **560** and the second pixel electrode **570** and accordingly improve the display quality of the pixel structure **580**.

A plurality of V-shaped slits **590** is located between the first pixel electrode **560** and the second pixel electrode **570**. In order to allow the pixel structure **580** to achieve a wide-angle display, the step in FIG. **5**D can be executed to form a plurality of alignment protrusions or main slits **592** in the pixel structure **580**. For the present embodiment, if the alignment is controlled by alignment protrusions, the alignment protrusions are located on the opposite substrate (not shown), as shown in FIG. **5**D, but if the alignment is controlled by alignment slits, the slits are formed with the pixel electrodes. The alignment protrusions or main slits **592** may be composed of strip patterns **594** which form V-shaped patterns similar to the slits **590**. As shown in FIG. **6**, the alignment protrusions or main slits **592** may be formed on an opposite substrate **620** of the LCD panel **60**, wherein the opposite substrate **620** may be a color filter substrate. Whether the alignment protrusions or main slits **592** are formed is not restricted by the present invention. In addition, the alignment protrusions or main slits **592** may be disposed in the first pixel electrode **560** and the second pixel electrode **570**. In the pixel structure **580**, the regions of first pixel electrode **560** and the second pixel electrode **570** can present different luminance through the capacitance coupling effect thereof with the first capacitance electrode **510** and the second capacitance electrode **520**. Meanwhile, the first pixel electrode **560** and the second pixel electrode **570** are evenly distributed in the pixel structure **580** so that color shift at large viewing angles is reduced and coarseness in images displayed by the pixel structure **580** is avoided. As a result, the display quality of the pixel structure **580** is improved. It should be mentioned here that the pixel structure **580** can have a design as any one of the pixel structures **200** and **200'** described in foregoing embodiments or any other pixel structure within the scope of the present invention.

FIG. **6** illustrates an LCD panel **60** applying the technique provided by the present invention. The LCD panel **60** includes an opposite substrate **620**, an array substrate **610**, and a liquid crystal layer **630**. The opposite substrate **620** and the array substrate **610** are disposed opposite to each other, and the liquid crystal layer **630** is disposed between the opposite substrate **620** and the array substrate **610**. The opposite substrate **620** may be a color filter substrate, and the array substrate **610** includes a plurality of pixel structures or a pixel array structure as described in foregoing embodiments.

In overview, according to the present invention, a first pixel electrode and a second pixel electrode are evenly distributed in a pixel structure in a staggered way, and meanwhile, the regions of the first pixel electrode and the second pixel electrode present different luminance. Thus, when the pixel structure and pixel array structure provided by the present invention is provided in an LCD, color shift produced at large viewing angles can be reduced and coarseness in images displayed by the LCD caused by uneven luminance can be avoided. In other words, the pixel structure in the present invention offers good display quality. Moreover, in the present invention, the voltages of the first pixel electrode and the second pixel electrode can be adjusted or affected by simply adjusting the pattern of the capacitance electrodes. Accordingly, a good display quality can be achieved by the pixel structure and the pixel array structure provided by the present invention without any complicated driving method or additional device.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. A pixel structure, electrically connected to a data line and a scan line, the pixel structure comprising:

a first active device, electrically connected to the data line and the scan line;

a second active device, electrically connected to the data line and the scan line;

a first pixel electrode, electrically connected to the first active device, the first pixel electrode comprising a first electrode block and a second electrode block electrically connected to each other;

a second pixel electrode, electrically connected to the second active device, the second pixel electrode being electrically insulated from the first pixel electrode, and the second pixel electrode separating the first electrode block and the second electrode block;

a first capacitance electrode; and

a second capacitance electrode, a first overlapping region between the first pixel electrode and the first capacitance electrode forming a first capacitor, a second overlapping region between the first pixel electrode and the second capacitance electrode forming a second capacitor, a third overlapping region between the second pixel electrode and the first capacitance electrode forming a third capacitor, a fourth overlapping region between the second pixel electrode and the second capacitance electrode forming a fourth capacitor, wherein an overlapping area of first overlapping region is different from that of the second overlapping region such that the first capacitor and the second capacitor have different capacitances, and an overlapping area of third overlapping region is different from that of the fourth overlapping region such that the third capacitor and the fourth capacitor have different capacitances.

2. The pixel structure according to claim **1**, wherein the capacitance of the first capacitor is greater than the capacitance of the second capacitor.

3. The pixel structure according to claim **1**, wherein the capacitance of the third capacitor is smaller than the capacitance of the fourth capacitor.

4. The pixel structure according to claim **1**, wherein the capacitance of the first capacitor is smaller than the capacitance of the second capacitor.

5. The pixel structure according to claim **1**, wherein the capacitance of the third capacitor is greater than the capacitance of the fourth capacitor.

6. The pixel structure according to claim **1**, wherein the first pixel electrode further comprises a connecting portion disposed between the first electrode block and the second electrode block, and electrically connecting the first electrode block and the second electrode block.

7. The pixel structure according to claim **6**, wherein the material of the connecting portion is a metal or a transparent conductive material.

8. The pixel structure according to claim **1**, wherein the first electrode block and the second electrode block are in triangular or rectangular shape.

9. The pixel structure according to claim **1**, wherein the second pixel electrode comprises a central electrode block, and a first end electrode block and a second end electrode block respectively connected to two ends of the central electrode block, and the central electrode block is disposed

between the first electrode block and the second electrode block of the first pixel electrode.

10. A driving method for driving a pixel structure as claimed in claim **1**, the driving method comprising:

providing a first voltage to the first capacitance electrode; and

providing a second voltage to the second capacitance electrode, wherein the first voltage is different from the second voltage so that the luminance in the region of the first pixel electrode is made different from the luminance in the region of the second pixel electrode.

11. The driving method according to claim **10**, wherein the difference between the first voltage and the second voltage is higher than 0V and lower than 20V.

12. The driving method according to claim **10**, further comprising providing an image data signal to the first pixel electrode and the second pixel electrode.

13. A liquid crystal display (LCD) panel, comprising:

an array substrate, comprising a plurality of pixel structures as claimed in claim **1**;

an opposite substrate, disposed opposite to the array substrate; and

a liquid crystal layer, disposed between the array substrate and the opposite substrate.

14. A pixel structure, electrically connected to a data line and a scan line, the pixel structure comprising:

a first active device, electrically connected to the data line and the scan line;

a second active device, electrically connected to the data line and the scan line;

a first pixel electrode, electrically connected to the first active device, the first pixel electrode comprising a first electrode block and a second electrode block electrically connected to each other;

a second pixel electrode, electrically connected to the second active device, the second pixel electrode being electrically insulated from the first pixel electrode, and the second pixel electrode separating the first electrode block and the second electrode block;

a first capacitance electrode having a first main portion and a plurality of first branch portions; and

a second capacitance electrode having a second main portion and a plurality of second branch portions, the first pixel electrode and a part of first branch portions of the first capacitance electrode forming a first capacitor, the first pixel electrode and a part of second branch portions of the second capacitance electrode forming a second capacitor, the second pixel electrode and another part of first branch portions of the first capacitance electrode forming a third capacitor, the second pixel electrode and another part of second branch portions of the second capacitance electrode forming a fourth capacitor, wherein a size of said part of first branch portions of the first capacitance electrode and a size of said part of second branch portions of the second capacitance electrode are different such that the first capacitor and the second capacitor have different capacitances, and a size of said another part of first branch portions of the first capacitance electrode and a size of said another part of second branch portions of the second capacitance electrode are different such that the third capacitor and the fourth capacitor have different capacitances.

15. A pixel structure having a right side and a left side, electrically connected to a data line and a scan line, the pixel structure comprising:

a first active device, electrically connected to the data line and the scan line;

a second active device, electrically connected to the data line and the scan line;

a first pixel electrode, electrically connected to the first active device, the first pixel electrode comprising a first electrode block and a second electrode block electrically connected to each other;

a second pixel electrode, electrically connected to the second active device;

a first capacitance electrode having a first main portion and a plurality of first branch portions; and

a second capacitance electrode having a second main portion and a plurality of second branch portions, the first pixel electrode and a part of first branch portions of the first capacitance electrode forming a first capacitor, the first pixel electrode and a part of second branch portions of the second capacitance electrode forming a second capacitor, the second pixel electrode and another part of first branch portions of the first capacitance electrode forming a third capacitor, the second pixel electrode and another part of second branch portions of the second capacitance electrode forming a fourth capacitor, wherein a size of said first branch portion at the right side is small than that of said first branch portion at the left side.

16. The pixel structure according to claim **15**, wherein a size of the second branch portion is greater than that of the first branch portion at the left side.

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专利名称(译)	像素结构，其驱动方法，像素阵列结构和液晶显示面板		
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摘要(译)

提供一种电连接到数据线和扫描线的像素结构，包括第一和第二有源器件，第一和第二像素电极，以及第一和第二电容电极。与第一有源器件电连接的第一像素电极包括彼此电连接的第一和第二电极块。与第二有源器件电连接的第二像素电极与第一像素电极电绝缘，并分离第一和第二电极块。第一像素电极分别与第一和第二电容电极形成第一和第二电容器。第二像素电极分别与第一和第二电容电极形成第三和第四电容器。第一和第二电容器具有不同的电容。第三和第四电容器具有不同的电容。