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(54) **LIQUID CRYSTAL DISPLAY DEVICE**

FLÜSSIGKRISTALLANZEIGEVORRICHTUNG

DISPOSITIF D’AFFICHAGE À CRISTAUX LIQUIDES

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Description

TECHNICAL FIELD

[0001] The present invention relates to a liquid crystal display device, and specifically to a liquid crystal display device having a plurality of alignment domains in a pixel.

BACKGROUND ART

[0002] Currently, as liquid crystal display devices having a wide viewing angle characteristic, the following liquid crystal display devices have been developed, for example: liquid crystal display devices using an IPS (In-Plane-Switching) mode or an FFS (Fringe Field Switching) mode, which are transverse electric field modes, and liquid crystal display devices using a VA (Vertical Alignment) mode.

[0003] VA-mode liquid crystal display devices include, for example, liquid crystal display devices of an MVA (Multidomain Vertical Alignment) mode in which a plurality of domains having different alignment directions of liquid crystal molecules are formed in one pixel, and liquid crystal display devices of a CPA (Continuous Pinwheel Alignment) mode in which the alignment direction of liquid crystal molecules is continuously varied around a rivet or the like formed on an electrode at a central position of the pixel.

[0004] An example of MVA-mode liquid crystal display device is described in Patent Document 1. In the liquid crystal display device described in Patent Document 1, alignment regulation means extending in two directions perpendicular to each other is provided. Owing to this, four liquid crystal domains are formed in one pixel in which an azimuthal angle of directors which are representative of the respective liquid crystal domains is 45° with respect to polarization axes (transmission axes) of a pair of polarizing plates placed in crossed Nicols. Where the azimuthal angle of 0° corresponds to a direction of the polarization axis of one of the polarizing plates and the counterclockwise direction is the positive direction, the azimuthal angles of the directors of the four liquid crystal domains are 45°, 135°, 225°, and 315°. Such a structure in which four domains are formed in one pixel is referred to as the "4-domain alignment structure" or simply as the "4D structure".

[0005] Other examples of MVA-mode liquid crystal display device are described in Patent Documents 2, 3 and 4. The liquid crystal display devices described in these patent documents each include pixel electrodes having many tiny slits (cutouts) extending in an azimuthal angle direction of 45°-225° and an azimuthal angle direction of 135°-315° (such pixel electrodes are referred to as the "comb-shaped pixel electrodes" or "fishbone-type pixel electrodes"). The 4-domain alignment structure is realized by aligning liquid crystal molecules to be parallel to these slits.

[0006] JP 2009 151204 A discloses that a liquid crystal

display device which is a liquid crystal display device of vertical alignment type provided with a plurality of pixels includes: a first substrate provided with a pixel electrode arranged on each of the plurality of pixels and a signal line extended in a first direction for supplying a signal for display; a second substrate with a common electrode facing the pixel electrode; and a liquid crystal layer being arranged between the first substrate and the second substrate, including liquid crystal having negative dielectric anisotropy. Therein, the pixel electrode has a stem, a first fringe and a second fringe extended in the first direction, a plurality of first branches extended in a second direction different from the first direction between the stem and the first fringe and a plurality of second branches extended in a third direction different from the first direction and the second direction between the stem and the second fringe.

CITATION LIST

PATENT LITERATURE

[0007]

Patent Document 1: Japanese Laid-Open Patent Publication No. 11-242225

Patent Document 2: Japanese Laid-Open Patent Publication No. 2002-357830

Patent Document 3: Japanese Laid-Open Patent Publication No. 2004-302168

Patent Document 4: Japanese Laid-Open Patent Publication No. 2009-151204

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0008] FIG. 33 is a plan view showing a shape of a fishbone-type pixel electrode 7 in a liquid crystal display device described in Patent Document 2. The pixel electrode 7 has a trunk slit 8 and a branch slit 9 formed therein. The trunk slit 8 includes a trunk portion extending in a 0°-180° direction (left-right direction in the figure) and a trunk portion extending in a 90°-270° direction (top-bottom direction in the figure). The branch slit 9 includes a plurality of branch portions extending in a direction of 45° from the trunk slit 8, a plurality of branch portions extending in a direction of 135° from the trunk slit 8, a plurality of branch portions extending in a direction of 225° from the trunk slit 8, and a plurality of branch portions extending in a direction of 315° from the trunk slit 8. The 4D structure is provided by locating the branch slit 9 extending in four directions as described above.

[0009] In general, a TFT (Thin Film Transistor) substrate of a liquid crystal display device includes scanning lines (source bus lines) located on a base plate, TFTs formed on the scanning lines with a gate insulating film interposed therebetween, and pixel electrodes provided

on the TFTs with an insulating layer interposed therebetween. A drain electrode of each TFT and the corresponding pixel electrode are electrically connected to each other via a contact hole formed in the insulating layer. The pixel electrode has a part which is formed along an inner face of the contact hole and thus has a recessed portion. The alignment of liquid crystal molecules may be disturbed by the recessed portion.

[0010] In many liquid crystal display devices, column-like spacers are located between the TFT substrate and a counter electrode in order to maintain the thickness of a liquid crystal layer at a prescribed value and thus to provide a high display quality. These spacers may also occasionally disturb the alignment of the liquid crystal molecules.

[0011] When the alignment of the liquid crystal molecules is disturbed by the elements such as the contact holes, the spacers or the like, there occurs a problem that the number of the liquid crystal molecules which effectively contribute to the formation of four domains of the 4D structure is decreased, which results in reduction of the transmittance or the viewing angle characteristic.

[0012] The above-described patent documents do not discuss, or propose any measure against, such a problem which may occur in a liquid crystal display device including fishbone-type pixel electrodes. Patent Document 4 describes a structure of forming contact holes and storage capacitance counter electrodes below the pixel electrode, but does not provide any measure for preventing the alignment disturbance of the liquid crystal molecules which is caused by the contact holes or the storage capacitance electrodes. In addition, these documents do not provide any consideration on a positional relationship, between the fishbone-type pixel electrode and the lines located below the pixel electrode, which provides an appropriate alignment of the liquid crystal molecules.

[0013] The present invention made to solve at least one of these problems has an object of providing a vertical alignment type liquid crystal display device having a high transmittance or a high viewing angle characteristic.

SOLUTION TO PROBLEM

[0014] The above objects are solved by the claimed matter according to the independent claims.

[0015] In an embodiment, ends of all the plurality of branch portions opposite to the peripheral portion are separated from the island portion, and the peripheral portion and the island portion are electrically connected to each other by only one connection portion.

[0016] In an embodiment, ends of all the plurality of branch portions opposite to the peripheral portion are separated from the island portion, and the peripheral portion and the island portion are electrically connected to each other by only two connection portions.

[0017] In an embodiment, when seen in the direction

vertical to the surface of the TFT substrate, the two connection portions are located to be symmetrical to each other with respect to the center of the island portion or the center of the pixel.

[0018] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, one of the first branch portions and one of the second branch portions are located to be symmetrical to one of the third second branch portions and one of the fourth branch portions with respect to the center of the island portion or a line which equally divides the pixel into two.

[0019] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the island portion has a shape which is symmetrical with respect to the center thereof or the center of the pixel.

[0020] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, an outer edge of the island portion is surrounded by two among the four regions of a first pixel and two among the four regions of a second pixel adjoining the first pixel.

[0021] In an embodiment, ends of all the plurality of branch portions opposite to the peripheral portion are separated from the island portion, and the peripheral portion and the island portion are electrically connected to each other with none of the plurality of branch portions being connected therebetween.

[0022] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, an outer edge of the island portion includes a first end facing the first region, a second end facing the second region, a third end facing the third region, and a fourth end facing the fourth region; and the first end includes an end portion extending along the first branch portions, the second end includes an end portion extending along the second branch portions, the third end includes an end portion extending along the third branch portions, and the fourth end includes an end portion extending along the fourth branch portions.

[0023] In an embodiment, the first end extends in the first direction, the second end extends in the second direction, the third end extends in the third direction, and the fourth end extends in the fourth direction.

[0024] In an embodiment, the first end and the third end extend parallel to each other, and the second end and the fourth end extend parallel to each other in a direction different by 90° from the first end.

[0025] In an embodiment, the liquid crystal display device further includes a first polarizing plate and a second polarizing plate located so as to hold the liquid crystal layer therebetween. An absorption axis of the first polarizing plate and an absorption axis of the second polarizing plate cross each other perpendicularly, and the first direction, the second direction, the third direction and the fourth direction are each different by 45° from the absorption axis of the first polarizing plate or the second polarizing plate.

[0026] In an embodiment, the liquid crystal display device further includes a spacer located between the TFT

substrate and the counter substrate. When seen in the direction vertical to the surface of the TFT substrate, the spacer is located so as not to overlap the pixel electrode.

[0027] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at least at one of four corners of each of the plurality of pixels.

[0028] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, in the vicinity of the spacer, a part of the peripheral portion of the pixel electrode extends perpendicularly to a direction in which the plurality of corresponding branch portions extend.

[0029] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at a central position of at least one of four sides of each of the plurality of pixels.

[0030] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, in the vicinity of the spacer, a part of the peripheral portion of the pixel electrode extends along a direction in which the plurality of corresponding branch portions extend.

[0031] In an embodiment, the liquid crystal display device further includes a spacer located between the TFT substrate and the counter substrate. When seen in the direction vertical to the surface of the TFT substrate, the spacer is located so as to overlap the pixel electrode.

[0032] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at least at one of four corners of each of the plurality of pixels.

[0033] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at a central position of at least one of four sides of each of the plurality of pixels.

[0034] In an embodiment, the liquid crystal display device further includes a first polarizing plate and a second polarizing plate located so as to hold the liquid crystal layer therebetween. An absorption axis of the first polarizing plate and an absorption axis of the second polarizing plate cross each other perpendicularly, and the first direction, the second direction, the third direction and the fourth direction are each different by 45° from the absorption axis of the first polarizing plate or the second polarizing plate.

[0035] In an embodiment, the liquid crystal display device further includes a spacer located between the TFT substrate and the counter substrate. When seen in the direction vertical to the surface of the TFT substrate, the spacer is located so as not to overlap the pixel electrode.

[0036] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at a central position of at least one of four sides of each of the plurality of pixels.

[0037] In an embodiment, when seen in the direction vertical to the surface of the TFT substrate, in the vicinity of the spacer, a part of the peripheral portion of the pixel electrode extends along a direction in which the plurality of corresponding branch portions extend.

ADVANTAGEOUS EFFECTS OF INVENTION

[0038] According to the present invention, a liquid crystal display device having a high transmittance or a high viewing angle characteristic can be provided.

[0039] Embodiments 1 and 4-6 are embodiments of the claimed invention, whereas the second modification of embodiment 1, and embodiments 2 and 3, and corresponding figures 8 and 12-20 relate to another invention which is not claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0040]

[FIG. 1] FIG. 1 is an isometric view schematically showing a structure of a liquid crystal display device **100** according to the present invention.

[FIG. 2] FIG. 2 is a plan view schematically showing a structure of a plurality of pixels **50** of the liquid crystal display device **100**.

[FIG. 3] FIG. 3 is a plan view showing a structure of a pixel **50** of a liquid crystal display device **100** in Embodiment 1 according to the present invention.

[FIG. 4] FIG. 4 is a cross-sectional view showing a structure of an A-D cross-section of the pixel **50** shown in FIG. 3 in Embodiment 1.

[FIG. 5] FIG. 5 is a plan view showing a line configuration of the pixel **50** in Embodiment 1.

[FIG. 6] FIG. 6 is a plan view showing a shape of a pixel electrode **30** in Embodiment 1.

[FIG. 7] FIG. 7 is a plan view showing a shape of a pixel electrode **30A** in a first modification of Embodiment 1.

[FIG. 8] FIG. 8 is a plan view showing a shape of a pixel electrode **30B** in a second modification of Embodiment 1.

[FIG. 9] FIG. 9 is a plan view showing a shape of a pixel electrode **30C** in a third modification of Embodiment 1.

[FIG. 10] FIG. 10 is a plan view showing a modification of the line configuration of the pixel **50** in Embodiment 1.

[FIG. 11] FIG. 11 is a plan view showing a modification of the structure of the pixel **50** in Embodiment 1.

[FIG. 12] FIG. 12 is a plan view showing a structure of a pixel **50** of a liquid crystal display device **100** in Embodiment 2.

[FIG. 13] FIG. 13 is a plan view showing a line configuration of the pixel **50** in Embodiment 2.

[FIG. 14] FIG. 14 is a plan view showing a shape of a pixel electrode **230** in Embodiment 2.

[FIG. 15] FIG. 15 is a plan view showing a modification of the line configuration of the pixel 50 in Embodiment 2.

[FIG. 16] FIG. 16 is a plan view showing a structure of a pixel 50 of a liquid crystal display device 100 in Embodiment 3.

[FIG. 17] FIG. 17 is a plan view showing a line configuration of the pixel 50 in Embodiment 3.

[FIG. 18] FIG. 18 is a plan view showing a shape of a pixel electrode 330 in Embodiment 3.

[FIG. 19] FIG. 19 is a plan view showing a shape of a pixel electrode 330B, which is a comparative example to the pixel electrode 330 in Embodiment 3.

[FIG. 20] FIG. 20 is a plan view showing a modification of the line configuration of the pixel 50 in Embodiment 3.

[FIG. 21] FIG. 21 is a plan view showing a structure of a pixel 50 of a liquid crystal display device 100 in Embodiment 4 according to the present invention.

[FIG. 22] FIG. 22 is a plan view showing a line configuration of the pixel 50 in Embodiment 4.

[FIG. 23] FIG. 23 is a plan view showing a shape of a pixel electrode 430 in Embodiment 4.

[FIG. 24] FIG. 24 is a plan view showing a structure of a pixel 50 of a liquid crystal display device 100 in Embodiment 5 according to the present invention.

[FIG. 25] FIG. 25 is a plan view showing a line configuration of the pixel 50 in Embodiment 5.

[FIG. 26] FIG. 26 is a plan view showing a structure of a pixel 50 of a liquid crystal display device 100 in Embodiment 6 according to the present invention.

[FIG. 27] FIG. 27 is a plan view showing a line configuration of the pixel 50 in Embodiment 6.

[FIG. 28] FIG. 28 is a plan view showing a shape of a pixel electrode 630 in Embodiment 6.

[FIG. 29] FIG. 29 is a plan view showing a shape of a pixel electrode 630B in a modification in Embodiment 6.

[FIG. 30] FIG. 30 is a plan view showing a structure of a pixel 50 of a liquid crystal display device 100 in an example useful for understanding the present invention.

[FIG. 31] FIG. 31 is a plan view showing a line configuration of the pixel 50 in the example useful for understanding the present invention.

[FIG. 32] FIG. 32 is a plan view showing a shape of a pixel electrode 730 in the example useful for understanding the present invention.

[FIG. 33] FIG. 33 is a plan view showing a shape of a fishbone-type pixel electrode 7 of a liquid crystal display device described in Patent Document 2.

DESCRIPTION OF EMBODIMENTS

[0041] Hereinafter, structures of vertical alignment type liquid crystal display devices 100 in embodiments according to the present invention will be described with reference to the drawings. It should be noted that the

present invention is not limited to the following embodiments.

[0042] FIG. 1 is an isometric view schematically showing a structure of the liquid crystal display device 100, and FIG. 2 is a plan view schematically showing a structure of a plurality of pixels 50 of the liquid crystal display device 100.

[0043] As shown in FIG. 1, the liquid crystal display device 100 includes a TFT substrate 10 and a counter substrate (CF substrate) 20 which face each other while holding a liquid crystal layer 21 therebetween, polarizing plates 26 and 27 respectively located outer to the TFT substrate 10 and the counter substrate 20, and a backlight unit 28 for outputting light for display toward the polarizing plate 26.

[0044] The liquid crystal display device 100 is a vertical alignment type liquid crystal display device for providing display in a normally black mode by means of the pixels 50 which are, as shown in FIG. 2, arrayed in a matrix in an X direction (left-right direction in the figure) and a Y direction (top-bottom direction in the figure). A minimum display unit is formed of three primary colors of red (R), green (G) and blue (B). Each of the pixels 50 corresponds to a display area of one color among R, G and B. The minimum display unit may be formed of four or more primary colors (multi-color display). In such a case, each pixel 50 corresponds to a display area of one color among a plurality of primary colors which form the minimum display unit.

[0045] The TFT substrate 10 includes a plurality of scanning lines (gate bus lines) 14 and a plurality of signal lines (data bus lines) 16 which are located so as to cross each other perpendicularly. In the vicinity of each of intersections of the plurality of scanning lines 14 and the plurality of signal lines 16, a TFT 12 as an active element is formed in correspondence with each pixel 50. Each pixel 50 includes a pixel electrode 30 which is electrically connected to a drain electrode of the TFT 12 and is formed of, for example, ITO (Indium Tin Oxide) or IZO (Indium Zinc Oxide). Each two adjoining scanning lines 14 may have therebetween a storage capacitance line (also referred to as the "storage capacitance bus line" or the "Cs line") 18 extending parallel to the scanning lines 14. The scanning lines 14 and the storage capacitance lines 18 may be positionally replaced with each other so that the TFTs 12 are located in the vicinity of the corresponding scanning lines.

[0046] The plurality of scanning lines 14 are each connected to a scanning line driving circuit 22 shown in FIG. 1, and the plurality of signal lines 16 are each connected to a signal line driving circuit 23 shown in FIG. 1. The scanning line driving circuit 22 and the signal line driving circuit 23 are connected to a control circuit 24. In accordance with the control by the control circuit 24, a scanning signal for turning the TFT 12 on or off is supplied from the scanning line driving circuit 22 to the corresponding scanning line 14. In accordance with the control by the control circuit 24, a display signal (voltage to be applied

to the pixel electrodes **30**) is supplied from the signal line driving circuit **23** to the plurality of signal lines **16**.

[0047] As described later with reference to FIG. 4, the counter substrate **20** includes color filters **13**, a common electrode (counter electrode) **25** and a black matrix (BM) **11**. In the case where the liquid crystal display device **100** provides display by three primary colors, the color filters **13** include an R (red) filter, a G (green) filter and a B (blue) filter each located in correspondence with a pixel. The common electrode **25** is formed so as to cover the plurality of pixel electrodes **30**. In accordance with the difference in potentials given between the common electrode **25** and each pixel electrode **30**, liquid crystal molecules between these electrodes are aligned in each pixel and thus display is provided.

(EMBODIMENT 1)

[0048] FIG. 3 is a plan view showing a structure of a pixel **50** of a liquid crystal display device **100** in Embodiment 1 according to the present invention. FIG. 4 is a cross-sectional view showing a structure of an A-D cross-section of the pixel **50** shown in FIG. 3. FIG. 5 is a plan view showing a line configuration, of the pixel **50**, below the pixel electrode **30** of the TFT substrate. FIG. 6 is a plan view schematically showing a shape of the pixel electrode **30**. FIG. 5 and FIG. 6 show a location arrangement of spacers **40** in addition to the line configuration or the pixel electrode **30**.

[0049] As shown in FIG. 3 through FIG. 5, the TFT substrate **10** of the liquid crystal display device **100** includes the scanning lines **14**, storage capacitance lines **18**, the TFTs **12**, the signal lines **16**, storage capacitance counter electrodes **19** and the fishbone-type pixel electrodes **30** formed on a transparent plate. On the scanning lines **14** and the storage capacitance lines **18**, a gate insulating film **15** is formed. Each TFT **12** is formed on the corresponding scanning line **14** with the gate insulating film **15** interposed therebetween, and each storage capacitance counter electrode **19** is formed on the corresponding storage capacitance line **18** with the gate insulating film **15** interposed therebetween. The scanning lines **14**, the storage capacitance lines **18**, the signal lines **16** and the storage capacitance counter electrodes **19** each have a single layer structure formed of Al (aluminum), Ti (titanium), TiN (titanium nitride), Mo (molybdenum) or the like, or an alloy thereof, or alternatively have a stacking structure including a plurality of such metal layers stacked.

[0050] Each TFT **12** includes a semiconductor layer **17** formed on the gate insulating film **15**. A source electrode of the TFT **12** is electrically connected to the corresponding signal line **16**, and the drain electrode **46** of the TFT **12** is electrically connected to the corresponding storage capacitance counter electrode **19** as shown in FIG. 3 and FIG. 5. A part of the storage capacitance line **18** and the storage capacitance counter electrode **19** which face each other while holding the gate insulating

film **15** therebetween form a storage capacitance. As shown in FIG. 4, the TFT **12**, the signal line **16**, and the storage capacitance counter electrode **19** are covered with a protective insulating film **43**, and an interlayer insulating film **44** is formed on the protective insulating film **43**. One of, or both of, the protective insulating film **43** and the interlayer insulating film **44** may occasionally be referred to as the "insulating film".

[0051] In the protective insulating film **43** and the interlayer insulating film **44**, a contact hole **42** is formed at a position above the storage capacitance counter electrode **19**. The drain electrode **46** of the TFT **12** and the pixel electrode **30** are electrically connected to each other via the contact hole **42**. More specifically, a part of the pixel electrode **30** which is formed on an inner face of the contact hole **42** is connected to the storage capacitance counter electrode **19** or an electrode extending from the storage capacitance counter electrode **19** at a bottom of the contact hole **42**, and thus the pixel electrode **30** and the drain electrode **46** are electrically connected to each other.

[0052] As shown in FIG. 4, the counter substrate **20** includes the common electrode **25**, the color filters **13**, and the black matrix **11**. Between the TFT substrate **10** and the counter substrate **20**, a liquid crystal layer **21** containing a nematic liquid crystal molecules having a negative dielectric anisotropy ($\Delta \epsilon < 0$) is located. The liquid crystal layer **21** has a thickness of 3.1 μm . Preferably, the thickness of the liquid crystal layer **21** is 2.0 μm or greater and 5.0 μm or less. The liquid crystal layer **21** may contain a chiral agent. Although not shown, an alignment film (vertical alignment film) is formed on the interlayer insulating film **44** and the pixel electrodes **30** in the TFT substrate **10** (on the liquid crystal layer **21** side), and an alignment film (vertical alignment film) is formed on the common electrode **25** (on the liquid crystal layer **21** side). By the action of the alignment films, the liquid crystal molecules of the liquid crystal layer **21** are aligned vertically with respect to a surface of the TFT substrate **10** or the counter substrate **20** in the absence of a voltage.

[0053] On the alignment film of each of the TFT substrate **10** and the counter substrate **20**, an alignment sustaining layer may be formed for providing the liquid crystal molecules with a pretilt in the absence of a voltage. The alignment sustaining layer is a polymer layer which is formed as follows. A photopolymerizable monomer is mixed in a liquid crystal material in advance, and after the liquid crystal cell is formed, the photopolymerizable monomer is photo-polymerized in the state where a voltage is applied to the liquid crystal layer. Owing to the alignment sustaining layers, a pretilt of the liquid crystal molecules in a direction tilted slightly (e.g., about 2 to 3°) from the direction vertical to the substrate surface, and the alignment direction (pretilt azimuth), can be sustained (stored) even in the absence of a voltage. This technology is referred to as the PSA (Polymer Sustained Alignment) technology, and use of this technology can improve the response speed regarding the alignment of liquid crystal

molecules at the time of voltage application.

[0054] Between the TFT substrate **10** and the counter substrate **20**, column-like spacers **40** are located for maintaining the thickness of the liquid crystal layer **21** to a prescribed value or in a prescribed range. In this embodiment, the spacers are located above the TFTs **12** in the vicinity of four corners of the pixel electrode **30**, which has an approximately rectangular outer edge shape.

[0055] Now, with reference to FIG. **6**, the pixel electrode **30** and the spacers **40** will be described in more detail. In the description of this embodiment, the direction in which the scanning lines **14** extend (left-right direction in the figure) is the X direction, the direction in which the signal lines **16** extend (top-bottom direction in the figure) is the Y direction, and the direction vertical to the surface of the substrates of the liquid crystal display device **100** is the Z direction. A positive X direction (direction from the left to the right in the figure) is the direction of an azimuthal angle of 0°, and the azimuthal angle is set counterclockwise. A positive Y direction (direction from the bottom to the top in the figure) is the direction of an azimuthal angle of 90°.

[0056] The pixel electrode **30** includes a peripheral portion **36** extending along an outer edge thereof, an island portion **32** formed so as to cover the contact hole **42** when seen in the Z direction, and a plurality of branch portions **34** extending from the peripheral portion **36** inward in the pixel **50**. The peripheral portion **36** includes portions extending in the X direction and portions extending in the Y direction. The plurality of branch portions **34** are formed of a plurality of first branch portions **34A** extending in a direction of 225° (first direction) from the peripheral portion **36**, a plurality of second branch portions **34B** extending in a direction of 315° (second direction) from the peripheral portion **36**, a plurality of third branch portions **34C** extending in a direction of 45° (third direction) from the peripheral portion **36**, and a plurality of fourth branch portions **34D** extending in a direction of 135° (fourth direction) from the peripheral portion **36**.

[0057] The island portion **32** is electrically connected to the peripheral portion **36** by one connection portion **38** of the pixel electrode **30** extending from the peripheral portion **36**, but not by any of the plurality of branch portions **34**. A narrowest part of the connection portion **38** has a length of 6.0 μm . Such a length of the narrowest part prevents the connection **38** from being broken, which can suppress production of defective products. In addition, all the branch portions **34** are connected to the peripheral portion **36**. Therefore, even if a part of the peripheral portion **36** is broken, all the branch portions **34** can be supplied with a voltage. In this manner, the peripheral portion **36** acts as redundant means for voltage supply (or means for avoiding disconnection of voltage supply) to the branch portions **34**.

[0058] None of ends of all the plurality of branch portions **34** opposite to the peripheral portion **36** is connected to any other portion of the pixel electrode or the island portion **32**. Namely, there is an insulating portion (or an

electrode-absent portion) between the ends of all the plurality of branch portions **34** and the island portion **32**. The plurality of branch portions **34** all have an identical width and extend with the same width. The width of each branch portion **34** is 3.5 μm . Preferably, the width of each branch portion **34** is in the range of 1.0 μm or greater and 5.0 μm or less.

[0059] Regarding each of the first through fourth branch portions **34A** through **34D**, each two adjoining branch portions have a branch slit (portion with no electrode material) therebetween. Each branch slit extends along the adjoining first branch portions **34A**, second branch portions **34B**, third branch portions **34C** or fourth branch portions **34D**. Each branch slit has a width of 3.0 μm . Preferably, the width of each branch slit is in the range of 1.0 μm or greater and 5.0 μm or less.

[0060] Between the first branch portions **34A** and the fourth branch portions **34D**, and between the second branch portions **34B** and the third branch portions **34C**, trunk slits are formed so as to extend on a straight line which equally divides the pixel electrode **30** into two in the Y direction. Between the third branch portions **34C** and the fourth branch portions **34D**, a trunk slit is formed so as to extend on a straight line which equally divides the pixel electrode **30** into two in the X direction. The trunk slits have a width of 3.5 μm . When the width of the trunk slits is 2.0 μm or less, the liquid crystal molecules may undesirably be aligned in a direction opposite to a desired direction from the trunk slits as the starting point at the time of voltage application. Therefore, the width of the trunk slits is preferably greater than 2.0 μm .

[0061] A border between each two pixel electrodes **30** adjoining each other in the Y direction is on the scanning line **14**, and a border between each two pixel electrodes **30** adjoining each other in the X direction is on the signal line **16**. Each two adjoining pixel electrodes **30** are away from each other by a distance of 3.5 μm . Preferably, the distance is 6.0 μm or less in order to widen the border between such two adjoining pixel electrodes **30** and thus to increase the area contributing to the display.

[0062] When a voltage is applied to liquid crystal molecules **52**, four liquid crystal alignment domains **35A**, **35B**, **35C** and **35D** are formed by the first branch portions **34A**, the second branch portions **34B**, the third branch portions **34C** and the fourth branch portions **34D**. The liquid crystal molecules **52** are aligned along the first branch portions **34A** in the alignment domain **35A**, along the second branch portions **34B** in the alignment domain **35B**, along the third branch portions **34C** in the alignment domain **35C**, and along the fourth branch portions **34D** in the alignment domain **35D**. It should be noted that the directions in which the liquid crystal molecules **52** are tilted in the alignment domains **35A**, **35B**, **35C** and **35D** at the time of voltage application are respectively opposite to the first, second, third and fourth directions mentioned above. As shown in FIG. **6**, the liquid crystal molecules are each tilted such that a tip thereof (end on the counter substrate **20** side) is directed toward the periph-

eral portion **36** of the pixel electrode **30**.

[0063] As shown in FIG. 6, absorption axes **48** and **49** of the polarizing plates **26** and **27** extend in the X direction and the Y direction. The directions of the absorption axes **48** and **49** are different by 45° from any of the first through fourth directions. Accordingly, the alignment direction of the liquid crystal molecules in each alignment domain is different by 45° from the directions of the absorption axes **48** and **49**. This realizes display with little viewing angle dependence.

[0064] When seen in the Z direction, an outer edge **32S** of the island portion **32** faces all the four domains **35A**, **35B**, **35C** and **35D**. None of the ends of the first branch portions **34A**, the second branch portions **34B**, the third branch portions **34C** and the fourth branch portions **34D** (collectively referred to as the "plurality of branch portions") is connected to the island portion **32**. Therefore, there is a gap (slit, or electrode-absent portion) between the outer edge **32S** of the island portion **32** and the plurality of branch portions. Owing to this gap, the liquid crystal molecules **52** in each of the alignment domains are not influenced easily by an electric field generated on the island portion **32** at the time of voltage application. Therefore, alignment disturbance of the liquid crystal molecules in each alignment domain can be reduced. This realizes display having a high transmittance or a high viewing angle characteristic. In order to provide superb display, it is preferable that at least 80% of the outer edge **32S** of the island portion **32** is surrounded by the gap.

[0065] The scanning lines **14**, the signal lines **16**, the storage capacitance lines **18**, and the storage capacitance counter electrodes **19** block light. In this embodiment, gaps each sandwiched by two pixel electrodes **30** are present above the scanning lines **14** and the signal lines **16**, the trunk slits are present above the storage capacitance lines **18**, and the island portions **32** are present above the storage capacitance counter electrodes **19**. The gaps, the trunk slits and the island portions **32** do not greatly contribute to the luminance. Therefore, in this embodiment, superb display in which the luminance, which is reduced due to the metal lines, is not reduced much is provided.

[0066] When seen in the Z direction, the pixel **50** is rectangular, and the spacers **40** are located at four corners of the pixel **50** so as not to overlap the pixel electrode **30**. The four corners of the pixel electrode **30** are recessed inward (the four corners are cut off), and a portion of the peripheral portion **36** in the vicinity of each spacer **40** includes a portion **36S** extending parallel to an outer edge of the spacer **40**. The portion **36S** of the peripheral portion **36** extends perpendicularly to a direction in which the plurality of branch portions **34** in the vicinity thereof extend. Owing to the portions **36S** of the peripheral portion **36**, the liquid crystal molecules at each of the corners can be aligned in a direction closer to the perpendicular direction to the direction in which the corresponding branch portions **34** extend at the time of voltage applica-

tion. Therefore, display with a high luminance can be provided.

[0067] Since the spacers **40** are located at the corners, one of side surfaces of each spacer **40** on the pixel electrode **30** side is perpendicular to the direction in which the branch portions **34** in the vicinity of the corresponding spacer **40** extend. Namely, at each of the corners, the alignment direction of the liquid crystal molecules urged by an electric field generated by the plurality of branch portions **34** and the gaps therebetween, or the alignment direction of the liquid crystal molecules urged by a polymer layer formed in order to sustain (store) the initial alignment of the liquid crystal molecules, is not counteracted by the alignment direction of the liquid crystal molecules urged by the spacer **40** and an alignment film on a surface thereof, at the time of voltage application. Therefore, an area in the vicinity of each spacer **40** in which the alignment of the liquid crystal molecules is disturbed can be decreased. As a result, superb display having a high luminance with no coarseness can be provided. In addition, since gaps are present between the spacers **40** and the pixel electrode **30**, the alignment disturbance of the liquid crystal molecules which is caused by the surfaces of each spacer **40** other than the surface perpendicular to the direction in which the corresponding branch portions **34** extend is suppressed from being conveyed to the liquid crystal molecules on the pixel electrode **30**.

[0068] In this embodiment, the spacers **40** are located at all the four corners of the pixel **50**, but the spacers **40** do not need to be located at all the corners. The location arrangement of the spacers **40** may be different for each pixel **50**. All the spacers **40** do not need to have the same size or shape. In this embodiment, the spacers **40** have an octagonal cross-section, but there is no limitation on the cross-sectional shape of the spacers **40**. For example, the spacers **40** may have a cross-section of any other polygonal shape or a cylindrical cross-section.

[0069] On the TFT **12**, the black matrix **11** is located so as to cover the TFT **12**. The presence of the spacers **40** may undesirably disturb the liquid crystal molecules **52** in the vicinity of the spacers **40** and this may cause inappropriate light transmission which may reduce the display quality. However, since the spacers **40** are located above the TFTs **12**, such transmitted light is blocked by the black matrix **11** and thus reduction of the display quality is prevented.

[0070] Since the spacers **40** do not overlap the pixel electrode **30**, even if a pressure is applied on the liquid crystal display device **100** during the production or use thereof, the spacers **40** do not contact the pixel electrode **30**. Therefore, the pixel electrode **30** is prevented from being broken or delaminated, which reduces a leak current or variance of the cell thickness.

[0071] In this embodiment, when seen in the Z direction, each scanning line **14** overlaps the peripheral portion **36** of the pixel electrode **30**. Therefore, the electric field leaking from the scanning line **14** is blocked by the

peripheral portion **36**. This reduces abnormal alignment of the liquid crystal molecules **52** or generation of flickers in the display area, which realizes high quality display. Since the storage capacitance counter electrode **19** is located also on the scanning line **14**, a larger storage capacitance is provided. Since the storage capacitance counter electrode **19** can also block the electric field leaking from the scanning line **14**, still higher quality display can be provided.

[0072] Now, with reference to FIG. 7, a pixel electrode **30A** in a first modification of the liquid crystal display device **100** in Embodiment 1 will be described.

[0073] Regarding each of the following modifications and embodiments, identical elements, or elements having identical functions, to those of the liquid crystal display device **100** in Embodiment 1 will bear identical reference signs, and descriptions of these elements and descriptions of the effects provided by these elements will be omitted. The liquid crystal display devices **100** in the modifications and the embodiments include the same elements unless any difference is shown in a figure or described.

[0074] The pixel electrode **30A** in the first modification includes two connection portions **38A** and **38B** for electrically connecting the island portion **32** and the peripheral portion **36** to each other. The ends of all the branch portions **34** are separated from the island portion **32**. An outer edge of the peripheral portion **36** is surrounded by a gap except for the connection portions **38A** and **38B**.

[0075] When seen in the Z direction, the connection portion **38A** and the connection portion **38B** are located to be symmetrical to each other with respect to the center of the island portion **32**, the center of the pixel electrode **30** or the center of the pixel **50**. Therefore, even if slight alignment disturbance occurs by the connection portions **38A** and **38B**, the amount of alignment disturbance can be uniform among the alignment domains **35A** through **35D**. Accordingly, the transmittance is relatively uniform among the alignment domains **35A** through **35D**, which realizes display with a high viewing angle characteristic.

[0076] Since the two connection portions **38A** and **38B** are provided, even if one of the connection portions is broken, all the branch portions **34** can be supplied with a voltage by the other connection portion. This has an advantage that quality inferiority does not occur easily.

[0077] Now, with reference to FIG. 8, a pixel electrode **30B** in a second modification of the liquid crystal display device **100** in Embodiment 1 will be described.

[0078] In the pixel electrode **30B** in the second modification, the island portion **32** and the peripheral portion **36** are electrically connected to each other by one branch portion **34AC** among the first branch portions **34A**, one branch portion **34BC** among the second branch portions **34B**, one branch portion **34CC** among the third branch portions **34C**, and one branch portion **34DC** among the second branch portions **34D**.

[0079] When seen in the Z direction, the branch portions **34AC** and **34BC** are formed symmetrically to the

branch portions **34CC** and **34DC** with respect to a line which equally divides the island portion **32** or the pixel **50** into two in the Y direction (central line of the pixel **50** extending in the X direction). The branch portions **34AC** and **34DC** are formed symmetrically to the branch portions **34BC** and **34CC** with respect to a line which equally divides the island portion **32** or the pixel **50** into two in the X direction (central line of the pixel **50** extending in the Y direction). By locating the branch portions **34A** through **34D** symmetrically to each other in this manner, the transmittance can be uniformized among the alignment domains **35A** through **35D** and thus the viewing angle characteristic can be improved.

[0080] In addition, the four branch portions **34AC**, **34BC**, **34CC** and **34DC** are in contact with the island portion **32**. Therefore, even if one through three among these four branch portions are broken, all the branch portions **34** can be supplied with a voltage by the other branch portion(s). Accordingly, quality inferiority does not occur easily.

[0081] Now, with reference to FIG. 9, a pixel electrode **30C** in a third modification of the liquid crystal display device **100** in Embodiment 1 will be described.

[0082] The pixel electrode **30C** in the third modification is formed to have a rectangular outer edge. Four corners **36E** of the peripheral portion **36** are not recessed unlike in the pixel electrode **30** but are bent at a right angle. When seen in the Z direction, the spacers **40** overlap the corners **36E** of the pixel electrode **30C**. The pixel electrode **30C** has a larger area contributing to display than the pixel electrode **30**, and thus can provide display having a higher luminance.

[0083] Now, with reference to FIG. 10, a modification of the line configuration of the pixel **50** in Embodiment 1 will be described.

[0084] In this modification, the storage capacitance counter electrode **19** is mainly formed on the storage capacitance line **18**, and is not formed on the scanning line **14** of the pixel **50**. In the case where, for example, a liquid crystal display system of inputting an AC signal to the common electrode **25** and inputting a DC signal to the scanning line **14** during a gate-off period of the TFT **12** is adopted, a parasitic capacitance formed by the scanning line **14** and the storage capacitance counter electrode **19** may reduce an effective voltage value during a period in which the voltage is kept in the liquid crystal layer **21**. This modification has an advantage that such reduction of the voltage applied to the liquid crystal layer due to the parasitic capacitance can be suppressed. In addition, this modification can reduce the load on the scanning line **14** and thus can contribute to reduction of the power consumption.

[0085] Now, with reference to FIG. 11, a modification of the structure of the pixel **50** in Embodiment 1 will be described.

[0086] In this modification, the storage capacitance counter electrodes **19** are formed on the storage capacitance line **18** and the scanning line **14**. However, when

seen in the Z direction, the storage capacitance counter electrode **19** on the scanning line **14** does not overlap the peripheral portion **36** of the pixel electrode **30**.

[0087] When the storage capacitance counter electrode **19** of one pixel **50** overlaps the pixel electrode **30** of another pixel **50** adjoining the one pixel **50**, a relatively large parasitic capacitance as compared with the pixel electrode **30** of the another pixel **50** may be generated. In the case where, for example, a driving system of inverting the polarity of the voltage to be applied to the pixel electrode **30** at every third scanning line **14** is adopted, when the parasitic capacitance is large, there occurs a relatively large difference between the applied voltage kept by the storage capacitance counter electrodes **19** on the two outer scanning lines **14** among the three scanning lines **14** and the applied voltage kept by the storage capacitance counter electrode **19** on the central scanning line **14** among the three scanning lines **14**. Especially in the case of a liquid crystal display device in which color filters of three primary colors are arrayed in the Y direction, when there is a difference between the applied voltages kept at different pixels **50**, a fault may occur that the gray scales appear to have a tint of a specific color.

[0088] According to this modification, the applied voltages kept at the different pixels **50** do not differ easily. Therefore, higher quality display can be provided.

(EMBODIMENT 2)

[0089] Now, with reference to FIG. **12** through FIG. **14**, a liquid crystal display device **100** in Embodiment 2.

[0090] FIG. **12** is a plan view showing a structure of a pixel **50** of the liquid crystal display device **100** in Embodiment 2. FIG. **13** is a plan view showing a line configuration of the pixel **50** in Embodiment 2. FIG. **14** is a plan view showing a shape of a pixel electrode **230** in Embodiment 2.

[0091] The pixel electrode **230** in Embodiment 2 does not include the connection portion **38** included in the pixel electrode **30** in Embodiment 1, and the island portion **32** is connected to the peripheral portion **36** by only one branch portion **34BC** among the second branch portions **34B**. Since the connection portion **38** is not formed, the area of the pixel which contributes to display can be increased. Therefore, display having a higher luminance is realized. The one branch portion which connects the island portion **32** and the peripheral portion **36** to each other does not need to be one of the second branch portions **34B**, and may be one of the first branch portions **34A**, one of the third branch portions **34C** or one of the fourth branch portions **34D**.

[0092] In this embodiment, the spacers **40** are located as being shifted by, for example, 7 μm in the Y direction from the spacers **40** in Embodiment 1. In the vicinity of each spacer **40**, the peripheral portion **36** includes a portion **36S** extending perpendicularly to the direction in which the corresponding branch portions **34** extend. Owing to this, the alignment disturbance of the liquid crystal

molecules in the vicinity of the spacer **40** is prevented from being conveyed to the liquid crystal molecules on the pixel electrode **230**.

[0093] For each two pixels adjoining each other in the Y direction, color filters **13** of different colors are used. A border between such two pixels **50** is a border between two color filters **13** of different colors in the counter substrate **20**. In a step of stacking the color filters **13**, the color filters **13** of two colors may overlap at the border due to a shift of the stacking positions. When this occurs, a color filter layer having a thickness larger than a prescribed thickness may be formed.

[0094] In this embodiment, when seen in the Z direction, the border between the color filters **13** does not overlap the spacer **40**. Accordingly, even if a color filter layer having a thickness larger than a prescribed thickness is formed at the border between the color filters **13**, this does not make the thickness of the liquid crystal layer **21** larger than a prescribed thickness. Therefore, liquid crystal display devices providing a high display quality can be produced at a high production efficiency. In addition, it is not necessary to form an overcoat film or the like in order to stabilize the layer on which the spacer **40** is to be provided. Therefore, the liquid crystal display devices can be produced at low cost.

[0095] The thickness of the liquid crystal layer **21** is about 2.0 μm or greater and about 5.0 μm or less. In the case where, for example, color filters having a thickness of 2.0 μm overlap each other and a spacer **40** is located below the overlapping color filters, there occurs a significant difference in the thickness of the liquid crystal layer **21** and the display quality is deteriorated. In this embodiment, even if the color filters overlap each other, such an adverse influence thereof on the display can be prevented.

[0096] With reference to FIG. **15**, a modification of the line configuration of the pixel **50** in Embodiment 2 will be described.

[0097] In the liquid crystal display device **100** in Embodiment 2, the storage capacitance counter electrode **19** is not formed on the scanning line **14**. By contrast, according to the line configuration of this modification, the storage capacitance counter electrodes **19** are formed on the scanning line **14** and the storage capacitance line **18** as in Embodiment 1.

(EMBODIMENT 3)

[0098] Now, with reference to FIG. **16** through FIG. **19**, a liquid crystal display device **100** in Embodiment 3.

[0099] FIG. **16** is a plan view showing a structure of a pixel **50** of the liquid crystal display device **100** in Embodiment 3. FIG. **17** is a plan view showing a line configuration of the pixel **50** in Embodiment 3. FIG. **18** is a plan view showing a shape of a pixel electrode **330** in Embodiment 3. FIG. **19** is a plan view showing a shape of a pixel electrode **330B**, which is an comparative example to the pixel electrode **330**.

[0100] In the pixel 50 in Embodiment 3, the spacer 40 is located at a central position of each of two sides of the pixel 50 extending in the Y direction. The storage capacitance line 18 bypasses so as not to pass below the TFT 12. The storage capacitance counter electrode 19 on the storage capacitance line 18 and the storage capacitance counter electrode 19 on the scanning line 14 are connected to each other on the right side among the four sides of the pixel 50. Except for these points, this embodiment basically has the same structure as that of Embodiment 2, and provides the same effects as those of Embodiment 2. Since the pixel electrode 330 can have a shape in which a top half and a bottom half are symmetrical to each other, display with little viewing angle dependence can be provided.

[0101] The pixel electrode 330B shown in FIG. 19 as a comparative example does not have a recessed portion in the vicinity of each spacer 40. Therefore, the liquid crystal molecules 52 in the vicinity of the right and left sides among the four sides of the pixel electrode 330B are easily aligned along the top-bottom direction (toward the spacers 40) by the influence of the spacers 40. Since this direction is different from the alignment direction of the liquid crystal molecules regulated by the branch portions 34, the transmittance is reduced.

[0102] In this embodiment, the peripheral portion 36 has the plurality of portions 36S mentioned above, and there is a gap between each spacer 40 and the peripheral portion 36. Therefore, the liquid crystal molecules are not disturbed easily and thus display having a higher luminance is realized. In a comparison conducted by use of 4.3-type liquid crystal display devices (dot size: $198\ \mu\text{m} \times 66\ \mu\text{m}$), a liquid crystal display device using the pixel electrode 330 in this embodiment provided a transmittance 1.5% higher than a liquid crystal display device using the pixel electrode 330B of the comparative example.

[0103] Now, with reference to FIG. 20, a modification of the line configuration of the pixel 50 in Embodiment 3 will be described.

[0104] According to the line configuration of this modification, the storage capacitance counter electrode 19 connected to the drain electrode 46 is formed on the storage capacitance line 18 but not on the scanning line 14. On the scanning line 14, an electrode 19B electrically separated from the drain electrode 46 and also from the storage capacitance counter electrode 19 is formed.

[0105] In the case where a topmost layer of the scanning line 14 is formed of Al or an Al alloy, or in the case where the entire scanning line 14 is formed of a single layer of Al or an Al alloy, external light incident from the counter substrate 20 side may occasionally be reflected by the scanning line 14 to reduce the contrast or cause a tint of a specific color. Such reduction of the display quality caused by external light can be suppressed by providing an opaque film formed of a material having a lower reflectance on the scanning line 14.

(EMBODIMENT 4)

[0106] Now, with reference to FIG. 21 through FIG. 23, a liquid crystal display device 100 in Embodiment 4 according to the present invention will be described.

[0107] FIG. 21 is a plan view showing a structure of a pixel 50 of the liquid crystal display device 100 in Embodiment 4. FIG. 22 is a plan view showing a line configuration of the pixel 50 in Embodiment 4. FIG. 23 is a plan view showing a shape of a pixel electrode 430 in Embodiment 4.

[0108] In Embodiment 4, the island portion 32 and the contact hole 42 are formed at a position which is in the vicinity of a border between each two pixel electrodes 430 adjoining each other in the Y direction and also is in the vicinity of the center of the pixels 50 in the X direction. The island portion 32 is surrounded by four regions, namely, the third region 35C and the fourth region 35D of a pixel 50 (first pixel) and the first region 35A and the second region 35B of a pixel 50 (second pixel) adjoining to the first pixel in the Y direction.

[0109] Ends of all the branch portions 34 opposite to the peripheral portion 36 are separated from the island portion 32, and the peripheral portion 36 and the island portion 32 are directly connected to each other at two positions. Herein, these two positions will be referred to as the connection portions 38A and 38B.

[0110] When seen in the Z direction, the outer edge 32S of the island portion 32 includes a first edge facing the first region 35A of the second pixel, a second edge facing the second region 35B of the second pixel, a third edge facing the third region 35C of the first pixel, and a fourth edge facing the fourth region 35D of the first pixel. The first edge includes a portion extending along the first branch portions 34A, the second edge includes a portion extending along the second branch portions 34B, the third edge includes a portion extending along the third branch portions 34C, and the fourth edge includes a portion extending along the fourth branch portions 34D.

[0111] Accordingly, a desired alignment of the liquid crystal molecules is also provided by the outer edge 32S of the island portion 32. As a result, high quality display in which the alignment disturbance of the liquid crystal molecules caused by the outer edge 32S is suppressed is realized. Since the island portion 32 and the peripheral portion 36 do not have a narrow connection portion therebetween, there is an advantage that the lines for the pixel electrode 430 are not broken easily.

(EMBODIMENT 5)

[0112] Now, with reference to FIG. 24 and FIG. 25, a liquid crystal display device 100 in Embodiment 5 according to the present invention will be described.

[0113] FIG. 24 is a plan view showing a structure of a pixel 50 of the liquid crystal display device 100 in Embodiment 5. FIG. 25 is a plan view showing a line configuration of the pixel 50 in Embodiment 5.

[0114] In the liquid crystal display device **100** in Embodiment 5, the scanning line **14** extends in the X direction through the center of the pixel **50**, and the storage capacitance line **18** extends in the X direction along a border between each two pixels **50** adjoining each other in the Y direction. The storage capacitance counter electrode **19** is formed on the storage capacitance line **18**.

[0115] According to this line configuration, a trunk slit of the pixel electrode **530** is located above the scanning line **14**. Therefore, the load on the scanning line **14** can be alleviated, which contributes to reduction of the power consumption. The form of any of the pixel electrodes described in Embodiments 1 through 3 may be applied to this embodiment.

[0116] The location arrangement of the spacers **40** in this embodiment is the same as that in Embodiment 3, and thus is not described. Any of the location arrangements of the spacers **40** described in Embodiments 1 and 2 may be applied to this embodiment.

(EMBODIMENT 6)

[0117] Now, with reference to FIG. 26 through FIG. 28, a liquid crystal display device **100** in Embodiment 6 according to the present invention will be described.

[0118] FIG. 26 is a plan view showing a structure of a pixel **50** of the liquid crystal display device **100** in Embodiment 6. FIG. 27 is a plan view showing a line configuration of the pixel **50** in Embodiment 6. FIG. 28 is a plan view showing a shape of a pixel electrode **630** in Embodiment 6.

[0119] The pixel electrode **630** includes a peripheral portion **36**, an island portion **32**, and a plurality of branch portions **34** extending from the peripheral portion **36** inward in the pixel **50**. The plurality of branch portions **34** are formed of a plurality of first branch portions **34A** extending in a direction of 315° from the peripheral portion **36**, a plurality of second branch portions **34B** extending in a direction of 225° from the peripheral portion **36**, a plurality of third branch portions **34C** extending in a direction of 135° from the peripheral portion **36**, and a plurality of fourth branch portions **34D** extending in a direction of 45° from the peripheral portion **36**.

[0120] The island portion **32** is generally square, and is connected to the peripheral portion **36** by one connection portion **38** but not by any of the plurality of branch portions **34**. An outer edge **32S** of the island portion **32** includes four ends respectively extending parallel to the branch portions **34A** through **34D**. Accordingly, a desired alignment of the liquid crystal molecules is also provided by the outer edge **32S**. As a result, the alignment disturbance caused by the presence of the island portion **32** can be significantly suppressed.

[0121] In order to provide high quality display having a high transmittance with no coarseness, it is more preferable that the island portion **32** is smaller. In this embodiment, the interlayer insulating film **44** has a thickness of 3.0 μm . The contact hole **42** has a size of 10.5 $\mu\text{m} \times$

7.5 μm when seen in the Z direction. Each of the straight line portions of the outer edge **32S** has a length of 18.0 μm . The island portion **32** may be formed to be smaller by forming the interlayer insulating film **44** to be thinner and making the contact hole **42** smaller. For example, the thickness of the interlayer insulating film **44** may be 1.0 μm , the size of the contact hole may be 4.0 $\mu\text{m} \times$ 4.0 μm , and the length of each of the straight line portions of the outer edge **32S** may be 8.0 μm .

[0122] By contrast, the island portion **32** may be formed to be larger. FIG. 29 is a plan view showing a shape of a pixel electrode **630B** in a modification of Embodiment 6. The island portion **32** of the pixel electrode **630B** is larger than the island portion **32** of the pixel electrode **630** described above. Each of straight line portions of the outer edge **32S** of the island portion **32** of the pixel electrode **630B** has a length of 31 μm . This structure allows an alignment margin of the island portion **32** for the contact hole **42** to be larger. Therefore, during the formation of the island portion **32** by photolithography, a situation is avoided that a layer below the contact hole **42** (e.g., drain electrode layer) cannot be sufficiently covered with a resist material used for patterning for forming the island portion **32** and thus is exposed, resulting in being exposed to an etching solution. Since such a situation is avoided, reduction of the production yield or the like can be suppressed.

[0123] With the structure shown in FIG. 28, the shortest distance between the outer edge **32S** of the island portion **32** and the contact hole **42** is 2.6 μm . By contrast, with the structure shown in FIG. 29, the shortest distance is 9.2 μm . The contact hole **42** may be formed to be larger. In such a case, even where the interlayer insulating film **44** is thicker than 3.0 μm , the above-mentioned fault which can occur during the photolithography can be suppressed.

[0124] In a comparison conducted by use of 4.3-type liquid crystal display devices, a liquid crystal display device using the pixel electrode **630** including the smaller island portion **32** provided display having a transmittance 10% higher and less coarseness than a liquid crystal display device using the pixel electrode **630B** having the larger island portion **32**.

[0125] The line configuration of this embodiment is the same as that of Embodiment 5 and thus is not described. Any of the line configurations and any of the location arrangements of the spacers **40** described in Embodiments 1 through 4 may be applied to this embodiment.

(EXAMPLE USEFUL FOR UNDERSTANDING THE PRESENT INVENTION)

[0126] Now, with reference to FIG. 30 through FIG. 32, a liquid crystal display device **100** in the example useful for understanding the present invention will be described.

[0127] FIG. 30 is a plan view showing a structure of a pixel **50** of the liquid crystal display device **100** in the example useful for understanding the present invention.

FIG. 31 is a plan view showing a line configuration of the pixel 50 in the example useful for understanding the present invention. FIG. 32 is a plan view showing a shape of a pixel electrode 730 in the example useful for understanding the present invention.

[0128] The pixel electrode 730 includes a peripheral portion 36, an island portion 32, trunk portions 31A and 31B extending in directions of 0° and 180° from the island portion 32, and a plurality of branch portions 34 extending from the trunk portion 31A or 31B or from the island portion 32. The plurality of branch portions 34 are formed of a plurality of first branch portions 34A extending in a direction of 45°, a plurality of second branch portions 34B extending in a direction of 135°, a plurality of third branch portions 34C extending in a direction of 225°, and a plurality of fourth branch portions 34D extending in a direction of 315°.

[0129] When a voltage is applied to the liquid crystal molecules 52, four alignment domains 35A, 35B, 35C and 35D are formed by the first branch portions 34A, the second branch portions 34B, the third branch portions 34C and the fourth branch portions 34D.

[0130] None of ends of the plurality of branch portions 34 is connected to the peripheral portion 36, and there is a gap (insulating portion) therebetween. The island portion 32 is connected to the peripheral portion 36 by a connection portion 38 but not by any of the plurality of branch portions 34. When seen in the Z direction, the island portion 32 is surrounded by the first through fourth regions 35A through 35D.

[0131] In the vicinity of the spacers 40, the peripheral portion 36 is bent along the shape of the corresponding spacer 40 and includes a plurality of portions 36S each extending perpendicularly to the direction in which the corresponding branch portions 34 extend. Since there is a gap between each spacer 40 and the peripheral portion 36, the alignment disturbance of the liquid crystal molecules is suppressed from being conveyed to the liquid crystal molecules on the pixel electrode 30.

[0132] The line configuration of this example is the same as that of Embodiment 5 and the location arrangement of the spacers 40 are the same as those of Embodiment 3, and thus these are not described. Any of the line configurations described in Embodiments 1 through 4, and any of the location arrangements of the spacers 40 described in Embodiments 1 and 2 may be applied to this example.

INDUSTRIAL APPLICABILITY

[0133] The present invention is usable for improving the display characteristics of a vertical alignment type liquid crystal display device.

REFERENCE SIGNS LIST

[0134]

7 Pixel electrode
8 Branch slit
9 Trunk slit
10 TFT substrate
11 Black matrix (BM)
12 TFT
13 Color filter
14 Scanning line
15 Gate insulating film
16 Signal line
17 Semiconductor layer
18 Storage capacitance line
19 Storage capacitance counter electrode
20 Counter substrate
21 Liquid crystal layer
22 Scanning line driving circuit
23 Signal line driving circuit
24 Control circuit
25 Common electrode (counter electrode)
26, 27 Polarizing plate
28 Backlight unit
30, 230, 330, 430, 630, 730 Pixel electrode
30A, 30B, 30C, 330B, 630B Pixel electrode in a modification
31A First trunk portion
31B Second trunk portion
32 Island portion
32A Outer edge (edge of the island portion)
34 Branch portion
34A - 34D First through fourth branch portions
35A - 35D Alignment domains (first through fourth regions)
36 Peripheral portion
36S Portion of the peripheral portion
36E Corner (corner of the peripheral portion)
38 Connection portion
40 Spacer
42 Contact hole
43 Protective insulating film
44 Interlayer insulating film (insulating layer)
46 Drain electrode
48, 49 Absorption axis
50 Pixel
52 Liquid crystal molecules
100 Liquid crystal display device

[0135] Support for the claims is defined in the following itemized list:

1. A liquid crystal display device including a plurality of pixels arrayed in a matrix, the liquid crystal display device comprising:

a TFT substrate including pixel electrodes respectively formed in correspondence with the plurality of pixels, TFTs respectively formed in correspondence with the plurality of pixels, and an insulating layer having a contact hole formed

therein for electrically connecting a drain electrode of each of the TFTs and each of the pixel electrodes to each other;
 a counter substrate including a counter electrode facing the pixel electrodes; and
 a liquid crystal layer located between the TFT substrate and the counter substrate, the liquid crystal layer containing liquid crystal molecules having a negative dielectric anisotropy;
 wherein:

the pixel electrodes each include a peripheral portion, an island portion including a portion which electrically contacts the drain electrode in the contact hole, and a plurality of branch portions extending from the peripheral portion;

the plurality of branch portions include a plurality of first branch portions extending in a first direction, a plurality of second branch portions extending in a second direction, a plurality of third branch portions extending in a third direction, and a plurality of fourth branch portions extending in a fourth direction;

the first direction, the second direction, the third direction and the fourth direction are different from each other;

a first region in which the liquid crystal molecules are aligned along the first branch portions at the time of voltage application, a second region in which the liquid crystal molecules are aligned along the second branch portions at the time of voltage application, a third region in which the liquid crystal molecules are aligned along the third branch portions at the time of voltage application, and a fourth region in which the liquid crystal molecules are aligned along the fourth branch portions at the time of voltage application are formed by the first branch portions, the second branch portions, the third branch portions and the fourth branch portions; and

when seen in a direction vertical to a surface of the TFT substrate, the island portion is surrounded by the first region, the second region, the third region and the fourth region; and the island portion is electrically connected to the peripheral portion by a connection portion other than the plurality of branch portions but not by any of the plurality of branch portions, or electrically connected to the peripheral portion by one of the first branch portions, one of the second branch portions, one of the third branch portions or one of the fourth branch portions.

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2. The liquid crystal display device of item 1, wherein ends of all the plurality of branch portions opposite to the peripheral portion are separated from the island portion, and the peripheral portion and the island portion are electrically connected to each other by only one connection portion.

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3. The liquid crystal display device of item 1, wherein ends of all the plurality of branch portions opposite to the peripheral portion are separated from the island portion, and the peripheral portion and the island portion are electrically connected to each other by only two connection portions.

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4. The liquid crystal display device of item 3, wherein when seen in the direction vertical to the surface of the TFT substrate, the two connection portions are located to be symmetrical to each other with respect to the center of the island portion or the center of the pixel.

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5. The liquid crystal display device of item 1, wherein the island portion is electrically connected to only one of the first branch portions, only one of the second branch portions, only one of the third branch portions and only one of the fourth branch portions.

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6. The liquid crystal display device of item 5, wherein when seen in the direction vertical to the surface of the TFT substrate, one of the first branch portions and one of the second branch portions are located to be symmetrical to one of the third second branch portions and one of the fourth branch portions with respect to the center of the island portion or a line which equally divides the pixel into two.

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7. The liquid crystal display device of any one of items 1 through 6, wherein when seen in the direction vertical to the surface of the TFT substrate, the island portion has a shape which is symmetrical with respect to the center thereof or the center of the pixel.

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8. The liquid crystal display device of item 1, wherein the island portion is electrically connected to only one branch portion among all the first branch portions, the second branch portions, the third branch portions and the fourth branch portions.

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9. The liquid crystal display device of item 1, wherein when seen in the direction vertical to the surface of the TFT substrate, an outer edge of the island portion is surrounded by two among the four regions of a first pixel and two among the four regions of a second pixel adjoining the first pixel.

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10. The liquid crystal display device of item 9, wherein ends of all the plurality of branch portions opposite to the peripheral portion are separated from the is-

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land portion, and the peripheral portion and the island portion are electrically connected to each other with none of the plurality of branch portions being connected therebetween.

11. The liquid crystal display device of any one of items 1 through 10, wherein:

when seen in the direction vertical to the surface of the TFT substrate, an outer edge of the island portion includes a first end facing the first region, a second end facing the second region, a third end facing the third region, and a fourth end facing the fourth region; and

the first end includes an end portion extending along the first branch portions, the second end includes an end portion extending along the second branch portions, the third end includes an end portion extending along the third branch portions, and the fourth end includes an end portion extending along the fourth branch portions.

12. The liquid crystal display device of item 11, wherein the first end extends in the first direction, the second end extends in the second direction, the third end extends in the third direction, and the fourth end extends in the fourth direction.

13. The liquid crystal display device of item 12, wherein the first end and the third end extend parallel to each other, and the second end and the fourth end extend parallel to each other in a direction different by 90° from the first end.

14. The liquid crystal display device of any one of items 1 through 12, further comprising a first polarizing plate and a second polarizing plate located so as to hold the liquid crystal layer therebetween; wherein an absorption axis of the first polarizing plate and an absorption axis of the second polarizing plate cross each other perpendicularly, and the first direction, the second direction, the third direction and the fourth direction are each different by 45° from the absorption axis of the first polarizing plate or the second polarizing plate.

15. The liquid crystal display device of any one of items 1 through 14, further comprising a spacer located between the TFT substrate and the counter substrate; wherein when seen in the direction vertical to the surface of the TFT substrate, the spacer is located so as not to overlap the pixel electrode.

16. The liquid crystal display device of item 15, wherein when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at least at one of four corners of each of the plurality of

pixels.

17. The liquid crystal display device of item 16, wherein when seen in the direction vertical to the surface of the TFT substrate, in the vicinity of the spacer, a part of the peripheral portion of the pixel electrode extends perpendicularly to a direction in which the plurality of corresponding branch portions extend.

18. The liquid crystal display device of item 15, wherein when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at a central position of at least one of four sides of each of the plurality of pixels.

19. The liquid crystal display device of item 18, wherein when seen in the direction vertical to the surface of the TFT substrate, in the vicinity of the spacer, a part of the peripheral portion of the pixel electrode extends along a direction in which the plurality of corresponding branch portions extend.

20. The liquid crystal display device of any one of items 1 through 14, further comprising a spacer located between the TFT substrate and the counter substrate; wherein when seen in the direction vertical to the surface of the TFT substrate, the spacer is located so as to overlap the pixel electrode.

21. The liquid crystal display device of claim 20, wherein when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at least at one of four corners of each of the plurality of pixels.

22. The liquid crystal display device of item 20, wherein when seen in the direction vertical to the surface of the TFT substrate, the plurality of pixels are each rectangular, and the spacer is located at a central position of at least one of four sides of each of the plurality of pixels.

23. A liquid crystal display device including a plurality of pixels arrayed in a matrix, the liquid crystal display device comprising:

a TFT substrate including pixel electrodes respectively formed in correspondence with the plurality of pixels, TFTs respectively formed in correspondence with the plurality of pixels, and an insulating layer having a contact hole formed therein for electrically connecting a drain electrode of each of the TFTs and each of the pixel electrodes to each other;
a counter substrate including a counter elec-

trode facing the pixel electrodes; and
a liquid crystal layer located between the TFT
substrate and the counter substrate, the liquid
crystal layer containing liquid crystal molecules
having a negative dielectric anisotropy;
wherein:

the pixel electrodes each include a peripheral
portion, an island portion including a
portion which electrically contacts the drain
electrode in the contact hole, a plurality of
trunk portions extending from the island portion,
and a plurality of branch portions extending
from the plurality of trunk portions
or the island portion;

the plurality of branch portions include a plurality
of first branch portions extending in a first
direction, a plurality of second branch
portions extending in a second direction, a
plurality of third branch portions extending
in a third direction, and a plurality of fourth
branch portions extending in a fourth direction;

the first direction, the second direction, the
third direction and the fourth direction are
different from each other;

a first region in which the liquid crystal molecules
are aligned along the first branch
portions at the time of voltage application,
a second region in which the liquid crystal
molecules are aligned along the second
branch portions at the time of voltage application,
a third region in which the liquid crystal
molecules are aligned along the third
branch portions at the time of voltage application,
and a fourth region in which the liquid
crystal molecules are aligned along the
fourth branch portions at the time of voltage
application are formed by the first branch
portions, the second branch portions, the
third branch portions and the fourth branch
portions; and

when seen in a direction vertical to a surface
of the TFT substrate, the island portion is
surrounded by the first region, the second
region, the third region and the fourth region;
there is an insulating portion between
ends of all the plurality of branch portions
and the peripheral portion; and the island
portion is electrically connected to the peripheral
portion by a connection portion other than
the plurality of branch portions.

24. The liquid crystal display device of item 23,
wherein ends of all the branch portions opposite to
the trunk portions or the island portion are separated
from the peripheral portion, and the peripheral portion
and the island portion are electrically connected

to each other by only one connection portion.

25. The liquid crystal display device of item 23 or 24,
further comprising a first polarizing plate and a second
polarizing plate located so as to hold the liquid
crystal layer therebetween; wherein an absorption
axis of the first polarizing plate and an absorption
axis of the second polarizing plate cross each other
perpendicularly, and the first direction, the second
direction, the third direction and the fourth direction
are each different by 45° from the absorption axis of
the first polarizing plate or the second polarizing
plate.

26. The liquid crystal display device of any one of
items 23 through 25, further comprising a spacer located
between the TFT substrate and the counter
substrate; wherein when seen in the direction vertical
to the surface of the TFT substrate, the spacer is
located so as not to overlap the pixel electrode.

27. The liquid crystal display device of item 26,
wherein when seen in the direction vertical to the
surface of the TFT substrate, the plurality of pixels
are each rectangular, and the spacer is located at a
central position of at least one of four sides of each
of the plurality of pixels.

28. The liquid crystal display device of item 27,
wherein when seen in the direction vertical to the
surface of the TFT substrate, in the vicinity of the
spacer, a part of the peripheral portion of the pixel
electrode extends along a direction in which the plurality
of corresponding branch portions extend.

Claims

1. A liquid crystal display device (100) including a plurality
of pixels (50) arrayed in a matrix, the liquid crystal
display device (100) comprising:

a TFT substrate (10) including pixel electrodes
respectively formed in correspondence with the
plurality of pixels (50), TFTs (12) respectively
formed in correspondence with the plurality of
pixels (50), and an insulating layer (44) having
a contact hole (42) formed therein for electrically
connecting a drain electrode (46) of each of the
TFTs (12) and each of the pixel electrodes to
each other;

a counter substrate (20) including a counter
electrode (25) facing the pixel electrodes; and
a liquid crystal layer (21) located between the
TFT substrate (10) and the counter substrate
(20), the liquid crystal layer (21) containing liquid
crystal molecules (52) having a negative dielectric
anisotropy;

wherein:

the pixel electrodes each include a peripheral portion (36), an island portion (32) including a portion which electrically contacts the drain electrode (46) in the contact hole (42), and a plurality of branch portions (34) extending from the peripheral portion (36); the plurality of branch portions (34) is formed of a plurality of first branch portions (34A) extending in a first direction, a plurality of second branch portions (34B) extending in a second direction, a plurality of third branch portions (34C) extending in a third direction, and a plurality of fourth branch portions (34D) extending in a fourth direction;

the first direction, the second direction, the third direction and the fourth direction are different from each other;

a first region (35A) in which the liquid crystal molecules (52) are aligned along the first branch portions (34A) at the time of voltage application, a second region (35B) in which the liquid crystal molecules (52) are aligned along the second branch portions (34B) at the time of voltage application, a third region (35C) in which the liquid crystal molecules (52) are aligned along the third branch portions (34C) at the time of voltage application, and a fourth region (35D) in which the liquid crystal molecules (52) are aligned along the fourth branch portions (34D) at the time of voltage application are formed by the first branch portions (34A), the second branch portions (34B), the third branch portions (34C) and the fourth branch portions (34D), respectively;

when seen in a direction vertical to a surface of the TFT substrate (10), the island portion (32) is surrounded by the first region (35A), the second region (35B), the third region (35C) and the fourth region (35D); and the island portion (32) is electrically connected to the peripheral portion (36) by a connection portion (38) other than the plurality of branch portions (34); and

ends of all of the plurality of branch portions (34) opposite to the peripheral portion (36) are separated from the island portion (32).

2. A liquid crystal display device (100) including a plurality of pixels (50) arrayed in a matrix, the liquid crystal display device (100) comprising:

a TFT substrate (10) including pixel electrodes respectively formed in correspondence with the plurality of pixels (50), TFTs (12) respectively

formed in correspondence with the plurality of pixels (50), and an insulating layer (44) having a contact hole (42) formed therein for electrically connecting a drain electrode (46) of each of the TFTs (12) and each of the pixel electrodes to each other;

a counter substrate (20) including a counter electrode (25) facing the pixel electrodes; and a liquid crystal layer (21) located between the TFT substrate (10) and the counter substrate (20), the liquid crystal layer (21) containing liquid crystal molecules (52) having a negative dielectric anisotropy;

wherein:

the pixel electrodes each include a peripheral portion (36), an island portion (32) including a portion which electrically contacts the drain electrode (46) in the contact hole (42), and a plurality of branch portions (34) extending from the peripheral portion (36); the plurality of branch portions (34) is formed of a plurality of first branch portions (34A) extending in a first direction, a plurality of second branch portions (34B) extending in a second direction, a plurality of third branch portions (34C) extending in a third direction, and a plurality of fourth branch portions (34D) extending in a fourth direction;

the first direction, the second direction, the third direction and the fourth direction are different from each other;

a first region (35A) in which the liquid crystal molecules (52) are aligned along the first branch portions (34A) at the time of voltage application, a second region (35B) in which the liquid crystal molecules (52) are aligned along the second branch portions (34B) at the time of voltage application, a third region (35C) in which the liquid crystal molecules (52) are aligned along the third branch portions (34C) at the time of voltage application, and a fourth region (35D) in which the liquid crystal molecules (52) are aligned along the fourth branch portions (34D) at the time of voltage application are formed by the first branch portions (34A), the second branch portions (34B), the third branch portions (34C) and the fourth branch portions (34D), respectively;

when seen in a direction vertical to a surface of the TFT substrate (10), an outer edge of the island portion (32) of a first pixel surrounded by two among the four regions (35A, 35B, 35C, 35D) of the first pixel and two among the four regions (35A, 35B, 35C, 35D) of a second pixel adjoining the first pixel

- el; and the island portion (32) is directly connected to the peripheral portion (36) of the first pixel; and
ends of all of the plurality of branch portions (34) opposite to the peripheral portion (36) are separated from the island portion (32).
3. The liquid crystal display device (100) of claim 1, wherein the peripheral portion (36) and the island portion (32) are electrically connected to each other by only one connection portion (38).
4. The liquid crystal display device (100) of claim 1, wherein the peripheral portion (36) and the island portion (32) are electrically connected to each other by only two connection portions (38).
5. The liquid crystal display device (100) of any one of claims 1, 3 and 4, wherein when seen in the direction vertical to the surface of the TFT substrate (10), the island portion (32) has a shape which is symmetrical with respect to the center thereof or the center of the pixel (50).
6. The liquid crystal display device (100) of claim 2, wherein the peripheral portion (36) and the island portion (32) are electrically connected to each other with none of the plurality of branch portions (34) being connected therebetween.
7. The liquid crystal display device (100) of any one of claims 1 through 6, wherein:
when seen in the direction vertical to the surface of the TFT substrate, an outer edge of the island portion (32) includes a first end facing the first region (35A), a second end facing the second region (35B), a third end facing the third region (35C), and a fourth end facing the fourth region (35D); and
the first end includes an end portion extending along the first branch portions (34A), the second end includes an end portion extending along the second branch portions (34B), the third end includes an end portion extending along the third branch portions (34C), and the fourth end includes an end portion extending along the fourth branch portions (34D).
8. The liquid crystal display device (100) of any one of claims 1 through 7, further comprising a spacer (40) located between the TFT substrate (10) and the counter substrate (20).
9. The liquid crystal display device (100) of claim 8, wherein when seen in the direction vertical to the surface of the TFT substrate (10), the plurality of pixels (50) are each rectangular, and the spacer (40) is located at least at one of four corners of each of the plurality of pixels (50).
10. The liquid crystal display device (100) of claim 9, wherein:
when seen in the direction vertical to the surface of the TFT substrate (10), the spacer (40) is located so as not to overlap the pixel electrode; and
when seen in the direction vertical to the surface of the TFT substrate (10), in the vicinity of the spacer (40), a part of the peripheral portion (36) of the pixel electrode extends perpendicularly to a direction in which the plurality of corresponding branch portions (34) extend.
11. The liquid crystal display device (100) of claim 8, wherein when seen in the direction vertical to the surface of the TFT substrate (10), the plurality of pixels (50) are each rectangular, and the spacer (40) is located at a central position of at least one of four sides of each of the plurality of pixels (50).
12. The liquid crystal display device (100) of claim 11, wherein:
when seen in the direction vertical to the surface of the TFT substrate (10), the spacer (40) is located so as not to overlap the pixel electrode; and
when seen in the direction vertical to the surface of the TFT substrate (10), in the vicinity of the spacer (40), a part of the peripheral portion (36) of the pixel electrode extends along a direction in which the plurality of corresponding branch portions (34) extend.

40 Patentansprüche

1. Flüssigkristallanzeigevorrichtung (100), die eine Vielzahl von Pixel (50) enthält, die in einer Matrix angeordnet sind, wobei die Flüssigkristallanzeigevorrichtung (100) umfasst:

ein TFT-Substrat (10), das Pixelelektroden enthält, die jeweils in Entsprechung zu der Vielzahl von Pixel (50) ausgebildet sind, TFTs (12), die jeweils in Entsprechung zu der Vielzahl von Pixel (50) ausgebildet sind, und eine Isolierschicht (44) mit einem darin ausgebildeten Kontaktloch (42), um eine Drainelektrode (46) von jedem der TFTs (12) und jede der Pixelelektroden miteinander elektrisch zu verbinden;
ein Gegensubstrat (20), das eine Gegenelektrode (25) enthält, die den Pixelelektroden zugewandt ist; und

eine zwischen dem TFT-Substrat (10) und dem Gegensubstrat (20) gelegene Flüssigkristallschicht (21), wobei die Flüssigkristallschicht (21) Flüssigkristallmoleküle (52) mit einer negativen dielektrischen Anisotropie enthält;
wobei:

die Pixelelektroden jeweils einen peripheren Bereich (36), einen Inselbereich (32), der einen Bereich enthält, welcher die Drainelektrode (46) im Kontaktloch (42) elektrisch kontaktiert, und eine Vielzahl von Zweigbereichen (34) umfassen, die vom peripheren Bereich (36) ausgehen;
die Vielzahl von Zweigbereichen (34) von einer Vielzahl erster Zweigbereiche (34A), die in einer ersten Richtung verlaufen, einer Vielzahl zweiter Zweigbereiche (34B), die in einer zweiten Richtung verlaufen, einer Vielzahl dritter Zweigbereiche (34C), die in einer dritten Richtung verlaufen, und einer Vielzahl vierter Zweigbereiche (34D) gebildet wird, die in einer vierten Richtung verlaufen;

die erste Richtung, die zweite Richtung, die dritte Richtung und die vierte Richtung voneinander verschieden sind;

ein erstes Gebiet (35A), in welchem die Flüssigkristallmoleküle (52) entlang den ersten Zweigbereichen (34A) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, ein zweites Gebiet (35B), in welchem die Flüssigkristallmoleküle (52) entlang den zweiten Zweigbereichen (34B) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, ein drittes Gebiet (35C), in welchem die Flüssigkristallmoleküle (52) entlang den dritten Zweigbereichen (34C) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, und ein viertes Gebiet (35D), in welchem die Flüssigkristallmoleküle (52) entlang den vierten Zweigbereichen (34D) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, durch die ersten Zweigbereiche (34A), die zweiten Zweigbereiche (34B), die dritten Zweigbereiche (34C) bzw. die vierten Zweigbereiche (34D) gebildet werden;

wenn man in eine Richtung senkrecht zu einer Oberfläche des TFT-Substrats (10) blickt, der Inselbereich (32) von dem ersten Gebiet (35A), dem zweiten Gebiet (35B), dem dritten Gebiet (35C) und dem vierten Gebiet (35D) umgeben ist; und der Inselbereich (32) mit dem peripheren Bereich (36) durch einen anderen Verbindungsbereich (38) als die Vielzahl von Zweigbereichen (34) elektrisch verbunden ist; und

Enden von allen der Vielzahl von Zweigbereichen (34), die dem peripheren Bereich (36) entgegengesetzt sind, vom Inselbereich (32) getrennt sind.

2. Flüssigkristallanzeigevorrichtung (100), die eine Vielzahl von Pixel (50) enthält, die in einer Matrix angeordnet sind, wobei die Flüssigkristallanzeigevorrichtung (100) umfasst:

ein TFT-Substrat (10), das Pixelelektroden enthält, die jeweils in Entsprechung zu der Vielzahl von Pixel (50) ausgebildet sind, TFTs (12), die jeweils in Entsprechung zu der Vielzahl von Pixel (50) ausgebildet sind, und eine Isolierschicht (44) mit einem darin ausgebildeten Kontaktloch (42), um eine Drainelektrode (46) von jedem der TFTs (12) und jede der Pixelelektroden miteinander elektrisch zu verbinden;

ein Gegensubstrat (20), das eine Gegenelektrode (25) enthält, die den Pixelelektroden zugewandt ist; und

eine zwischen dem TFT-Substrat (10) und dem Gegensubstrat (20) gelegene Flüssigkristallschicht (21), wobei die Flüssigkristallschicht (21) Flüssigkristallmoleküle (52) mit einer negativen dielektrischen Anisotropie enthält;
wobei:

die Pixelelektroden jeweils einen peripheren Bereich (36), einen Inselbereich (32), der einen Bereich enthält, welcher die Drainelektrode (46) im Kontaktloch (42) elektrisch kontaktiert, und eine Vielzahl von Zweigbereichen (34) umfassen, die vom peripheren Bereich (36) ausgehen;
die Vielzahl von Zweigbereichen (34) von einer Vielzahl erster Zweigbereiche (34A), die in einer ersten Richtung verlaufen, einer Vielzahl zweiter Zweigbereiche (34B), die in einer zweiten Richtung verlaufen, einer Vielzahl dritter Zweigbereiche (34C), die in einer dritten Richtung verlaufen, und einer Vielzahl vierter Zweigbereiche (34D) gebildet wird, die in einer vierten Richtung verlaufen;

die erste Richtung, die zweite Richtung, die dritte Richtung und die vierte Richtung voneinander verschieden sind;

ein erstes Gebiet (35A), in welchem die Flüssigkristallmoleküle (52) entlang den ersten Zweigbereichen (34A) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, ein zweites Gebiet (35B), in welchem die Flüssigkristallmoleküle (52) entlang den zweiten Zweigbereichen (34B) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, ein drittes Gebiet (35C), in welchem

- die Flüssigkristallmoleküle (52) entlang den dritten Zweigbereichen (34C) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, und ein viertes Gebiet (35D), in welchem die Flüssigkristallmoleküle (52) entlang den vierten Zweigbereichen (34D) zur Zeit einer Spannungsbeaufschlagung ausgerichtet sind, durch die ersten Zweigbereiche (34A), die zweiten Zweigbereiche (34B), die dritten Zweigbereiche (34C) bzw. die vierten Zweigbereiche (34D) gebildet werden;
- wenn man in eine Richtung senkrecht zu einer Oberfläche des TFT-Substrats (10) blickt, ein äußerer Rand des Inselbereichs (32) eines ersten Pixels von zwei unter den vier Gebieten (35A, 35B, 35C, 35D) des ersten Pixels und zwei unter den vier Gebieten (35A, 35B, 35C, 35D) eines zweiten Pixels umgeben ist, das an das erste Pixel grenzt; und der Inselbereich (32) mit dem peripheren Bereich (36) des ersten Pixels direkt verbunden ist; und
- Enden von allen der Vielzahl von Zweigbereichen (34), die dem peripheren Bereich (36) entgegengesetzt sind, vom Inselbereich (32) getrennt sind.
3. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 1, wobei:
- der periphere Bereich (36) und der Inselbereich (32) durch nur einen Verbindungsbereich (38) miteinander elektrisch verbunden sind.
4. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 1, wobei:
- der periphere Bereich (36) und der Inselbereich (32) durch nur zwei Verbindungsbereiche (38) miteinander elektrisch verbunden sind.
5. Flüssigkristallanzeigevorrichtung (100) nach einem der Ansprüche 1, 3 und 4, wobei, wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, der Inselbereich (32) eine Form aufweist, welche bezüglich dessen Mitte oder der Mitte des Pixels (50) symmetrisch ist.
6. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 2, wobei
- der periphere Bereich (36) und der Inselbereich (32) miteinander elektrisch verbunden sind, wobei keiner der Vielzahl von Zweigbereichen (34) dazwischen verbunden ist.
7. Flüssigkristallanzeigevorrichtung (100) nach einem der Ansprüche 1 bis 6, wobei:
- wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats blickt, ein äußerer Rand des Inselbereichs (32) ein erstes Ende umfasst, das dem ersten Gebiet (35A) zugewandt ist, ein zweites Ende, das dem zweiten Gebiet (35B) zugewandt ist, ein drittes Ende, das dem dritten Gebiet (35C) zugewandt ist, und viertes Ende, das dem vierten Gebiet (35D) zugewandt ist; und
- das erste Ende einen Endbereich umfasst, der entlang den ersten Zweigbereichen (34A) verläuft, das zweite Ende einen Endbereich umfasst, der entlang den zweiten Zweigbereichen (34B) verläuft, das dritte Ende einen Endbereich umfasst, der entlang den dritten Zweigbereichen (34C) verläuft, und das vierte Ende einen Endbereich umfasst, der entlang den vierten Zweigbereichen (34D) verläuft.
8. Flüssigkristallanzeigevorrichtung (100) nach einem der Ansprüche 1 bis 7, ferner umfassend einen zwischen dem TFT-Substrat (10) und dem Gegensubstrat (20) gelegenen Abstandshalter (40).
9. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 8, wobei, wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, die Vielzahl von Pixel (50) jeweils viereckig ist und der Abstandshalter (40) zumindest an einer von vier Ecken von jedem der Vielzahl von Pixel (50) gelegen ist.
10. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 9, wobei:
- wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, der Abstandshalter (40) so gelegen ist, dass er die Pixelelektrode nicht überdeckt; und
- wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, in der Nähe des Abstandshalters (40) ein Teil des peripheren Bereichs (36) der Pixelelektrode senkrecht zu einer Richtung verläuft, in der die Vielzahl entsprechender Zweigbereiche (34) verläuft.
11. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 8, wobei, wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, die Vielzahl von Pixel (50) jeweils viereckig ist und der Abstandshalter (40) bei einer zentralen Position von zumindest einer von vier Seiten von jedem der Vielzahl von Pixel (50) gelegen ist.
12. Flüssigkristallanzeigevorrichtung (100) nach Anspruch 11, wobei:
- wenn man in die Richtung senkrecht zur Ober-

fläche des TFT-Substrats (10) blickt, der Abstandshalter (40) so gelegen ist, dass er die Pixelelektrode nicht überdeckt; und wenn man in die Richtung senkrecht zur Oberfläche des TFT-Substrats (10) blickt, in der Nähe des Abstandshalters (40) ein Teil des peripheren Bereichs (36) der Pixelelektrode entlang einer Richtung verläuft, in der die Vielzahl entsprechender Zweigbereiche (34) verläuft.

Revendications

1. Dispositif d'affichage à cristaux liquides (100) comprenant une pluralité de pixels (50) agencés en une matrice, le dispositif d'affichage à cristaux liquides (100) comprenant :

un substrat TFT (10) comprenant des électrodes de pixel formées respectivement en correspondance avec la pluralité de pixels (50), des TFT (12) formés respectivement en correspondance avec la pluralité de pixels (50), et une couche isolante (44) comportant un trou de contact (42) formé dans celle-ci pour connecter électriquement entre elles une électrode de drain (46) de chacun des TFT (12) et chacune des électrodes de pixel ;
un contre-substrat (20) comprenant une contre-électrode (25) faisant face aux électrodes de pixel ; et
une couche de cristaux liquides (21) située entre le substrat TFT (10) et le contre-substrat (20), la couche de cristaux liquides (21) contenant des molécules de cristaux liquides (52) présentant une anisotropie diélectrique négative ;
dans lequel :

chacune des électrodes de pixel comprend une partie périphérique (36), une partie d'îlot (32) comprenant une partie qui vient en contact électrique avec l'électrode de drain (46) dans le trou de contact (42), et une pluralité de parties de ramification (34) s'étendant à partir de la partie périphérique (36) ;
la pluralité de parties de ramification (34) est formée d'une pluralité de premières parties de ramification (34A) s'étendant dans une première direction, d'une pluralité de deuxièmes parties de ramification (34B) s'étendant dans une deuxième direction, d'une pluralité de troisièmes parties de ramification (34C) s'étendant dans une troisième direction, et d'une pluralité de quatrièmes parties de ramification (34D) s'étendant dans une quatrième direction ;
la première direction, la deuxième direction,

la troisième direction et la quatrième direction sont différentes les unes des autres ;
une première région (35A) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des premières parties de ramification (34A) au moment de l'application d'une tension, une deuxième région (35B) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des deuxièmes parties de ramification (34B) au moment de l'application d'une tension, une troisième région (35C) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des troisièmes parties de ramification (34C) au moment de l'application d'une tension, et une quatrième région (35D) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des quatrièmes parties de ramification (34D) au moment de l'application d'une tension, sont formées par les premières parties de ramification (34A), les deuxièmes parties de ramification (34B), les troisièmes parties de ramification (34C) et les quatrièmes parties de ramification (34D), respectivement ;
lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), la partie d'îlot (32) est entourée par la première région (35A), la deuxième région (35B), la troisième région (35C) et la quatrième région (35D) ; et la partie d'îlot (32) est connectée électriquement à la partie périphérique (36) par une partie de connexion (38) autre que la pluralité de parties de ramification (34) ; et
les extrémités de toutes parmi la pluralité de parties de ramification (34) opposées à la partie périphérique (36) sont séparées de la partie d'îlot (32).

2. Dispositif d'affichage à cristaux liquides (100) comprenant une pluralité de pixels (50) agencés en une matrice, le dispositif d'affichage à cristaux liquides (100) comprenant :

un substrat TFT (10) comprenant des électrodes de pixel formées respectivement en correspondance avec la pluralité de pixels (50), des TFT (12) formés respectivement en correspondance avec la pluralité de pixels (50), et une couche isolante (44) comportant un trou de contact (42) formé dans celle-ci pour connecter électriquement entre elles une électrode de drain (46) de chacun des TFT (12) et chacune des électrodes de pixel ;
un contre-substrat (20) comprenant une contre-électrode (25) faisant face aux électrodes de pixel ; et

une couche de cristaux liquides (21) située entre le substrat TFT (10) et le contre-substrat (20), la couche de cristaux liquides (21) contenant des molécules de cristaux liquides (52) présentant une anisotropie diélectrique négative ; dans lequel :

chacune des électrodes de pixel comprend une partie périphérique (36), une partie d'îlot (32) comprenant une partie qui vient en contact électrique avec l'électrode de drain (46) dans le trou de contact (42), et une pluralité de parties de ramification (34) s'étendant à partir de la partie périphérique (36) ;

la pluralité de parties de ramification (34) est formée d'une pluralité de premières parties de ramification (34A) s'étendant dans une première direction, d'une pluralité de deuxième parties de ramification (34B) s'étendant dans une deuxième direction, d'une pluralité de troisièmes parties de ramification (34C) s'étendant dans une troisième direction, et d'une pluralité de quatrième parties de ramification (34D) s'étendant dans une quatrième direction ;

la première direction, la deuxième direction, la troisième direction et la quatrième direction sont différentes les unes des autres ; une première région (35A) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des premières parties de ramification (34A) au moment de l'application d'une tension, une deuxième région (35B) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des deuxième parties de ramification (34B) au moment de l'application d'une tension, une troisième région (35C) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des troisièmes parties de ramification (34C) au moment de l'application d'une tension, et une quatrième région (35D) dans laquelle les molécules de cristaux liquides (52) sont alignées le long des quatrième parties de ramification (34D) au moment de l'application d'une tension, sont formées par les premières parties de ramification (34A), les deuxième parties de ramification (34B), les troisièmes parties de ramification (34C) et les quatrième parties de ramification (34D), respectivement ;

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), un bord extérieur de la partie d'îlot (32) d'un premier pixel est entouré par deux parmi les quatre régions (35A, 35B, 35C, 35D) du premier pixel et par deux parmi les

quatre régions (35A, 35B, 35C, 35D) d'un deuxième pixel attenant au premier pixel ; et la partie d'îlot (32) est directement connectée à la partie périphérique (36) du premier pixel ; et

les extrémités de toutes parmi la pluralité de parties de ramification (34) opposées à la partie périphérique (36) sont séparées de la partie d'îlot (32).

3. Dispositif d'affichage à cristaux liquides (100) selon la revendication 1, dans lequel la partie périphérique (36) et la partie d'îlot (32) sont électriquement connectées l'une à l'autre par une seule partie de connexion (38).

4. Dispositif d'affichage à cristaux liquides (100) selon la revendication 1, dans lequel la partie périphérique (36) et la partie d'îlot (32) sont électriquement connectées l'une à l'autre par seulement deux parties de connexion (38).

5. Dispositif d'affichage à cristaux liquides (100) selon l'une quelconque des revendications 1, 3 et 4, dans lequel, lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), la partie d'îlot (32) présente une forme qui est symétrique par rapport au centre de celle-ci ou au centre du pixel (50).

6. Dispositif d'affichage à cristaux liquides (100) selon la revendication 2, dans lequel la partie périphérique (36) et la partie d'îlot (32) sont électriquement connectées l'une à l'autre sans qu'aucune parmi la pluralité de parties de ramification (34) soit connectée entre elles.

7. Dispositif d'affichage à cristaux liquides (100) selon l'une quelconque des revendications 1 à 6, dans lequel :

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), un bord extérieur de la première partie d'îlot (32) comprend une première extrémité faisant face à la première région (35A), une deuxième extrémité faisant face à la deuxième région (35B), une troisième extrémité faisant face à la troisième région (35C), et une quatrième extrémité faisant face à la quatrième région (35D) ; et la première extrémité comprend une partie d'extrémité s'étendant le long des premières parties de ramification (34A), la deuxième extrémité comprend une partie d'extrémité s'étendant le long des deuxième parties de ramification (34B), la troisième extrémité comprend une partie d'extrémité s'étendant le long des troisièmes parties de ramification (34C), et la quatrième ex-

trémité comprend une partie d'extrémité s'étendant le long des quatrièmes parties de ramification (34D).

8. Dispositif d'affichage à cristaux liquides (100) selon l'une quelconque des revendications 1 à 7, comprenant en outre un écarteur (40) situé entre le substrat TFT (10) et le contre-substrat (20). 5

9. Dispositif d'affichage à cristaux liquides (100) selon la revendication 8, dans lequel, lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), chacun parmi la pluralité de pixels (50) est rectangulaire, et l'écarteur (40) est situé au moins à l'un de quatre coins de chacun parmi la pluralité de pixels (50). 10
15

10. Dispositif d'affichage à cristaux liquides (100) selon la revendication 9, dans lequel : 20

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), l'écarteur (40) est situé de façon à ne pas chevaucher l'électrode de pixel ; et

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), au voisinage de l'écarteur (40), une part de la partie périphérique (36) de l'électrode de pixel s'étend perpendiculairement à une direction dans laquelle s'étend la pluralité de parties de ramification (34) correspondantes. 25
30

11. Dispositif d'affichage à cristaux liquides (100) selon la revendication 8, dans lequel, lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), chacun parmi la pluralité de pixels (50) est rectangulaire, et l'écarteur (40) est situé en une position centrale d'au moins l'un des quatre côtés de chacun parmi la pluralité de pixels (50). 35
40

12. Dispositif d'affichage à cristaux liquides (100) selon la revendication 11, dans lequel :

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), l'écarteur (40) est situé de façon à ne pas chevaucher l'électrode de pixel ; et

lorsqu'on l'observe dans une direction verticale par rapport à la surface du substrat TFT (10), au voisinage de l'écarteur (40), une part de la partie périphérique (36) de l'électrode de pixel s'étend le long d'une direction dans laquelle s'étend la pluralité de parties de ramification (34) correspondantes. 45
50
55

FIG. 1

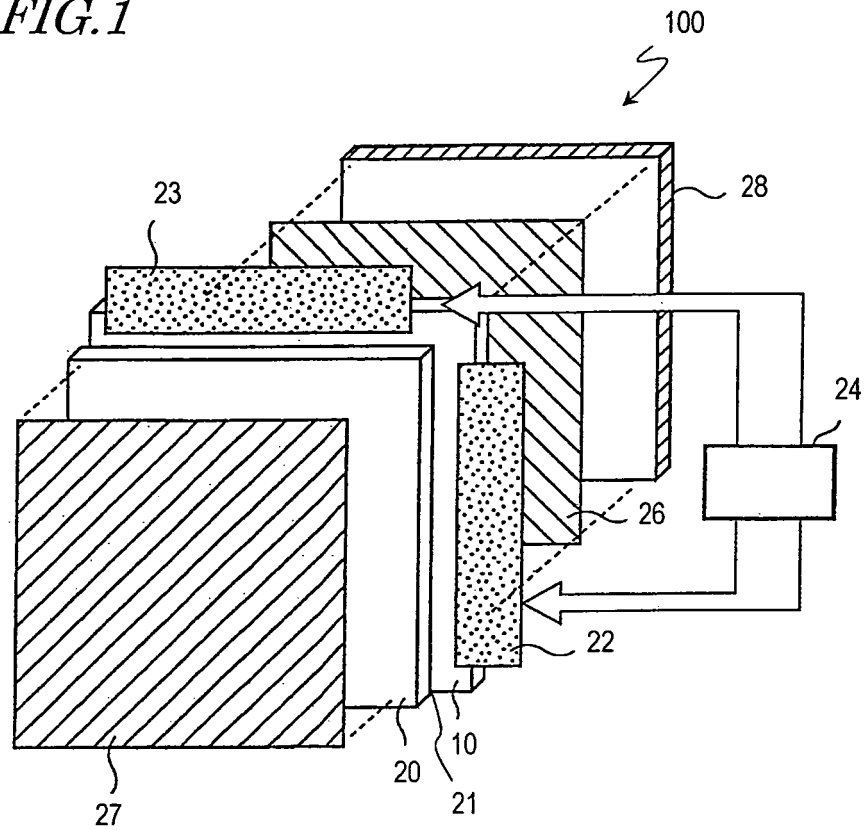
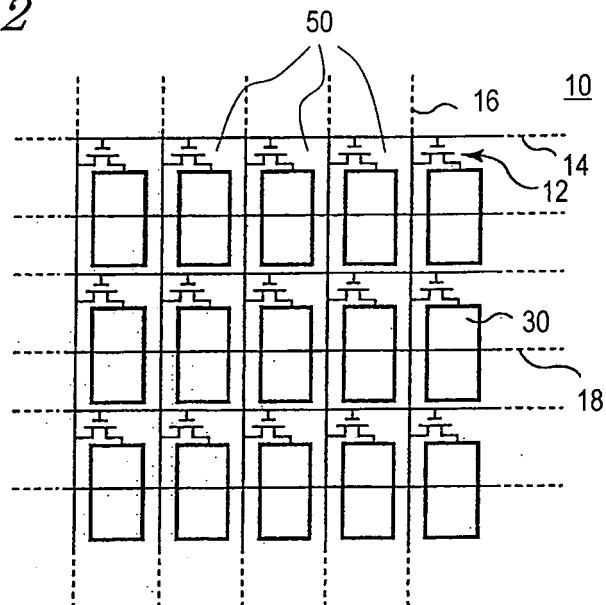


FIG. 2



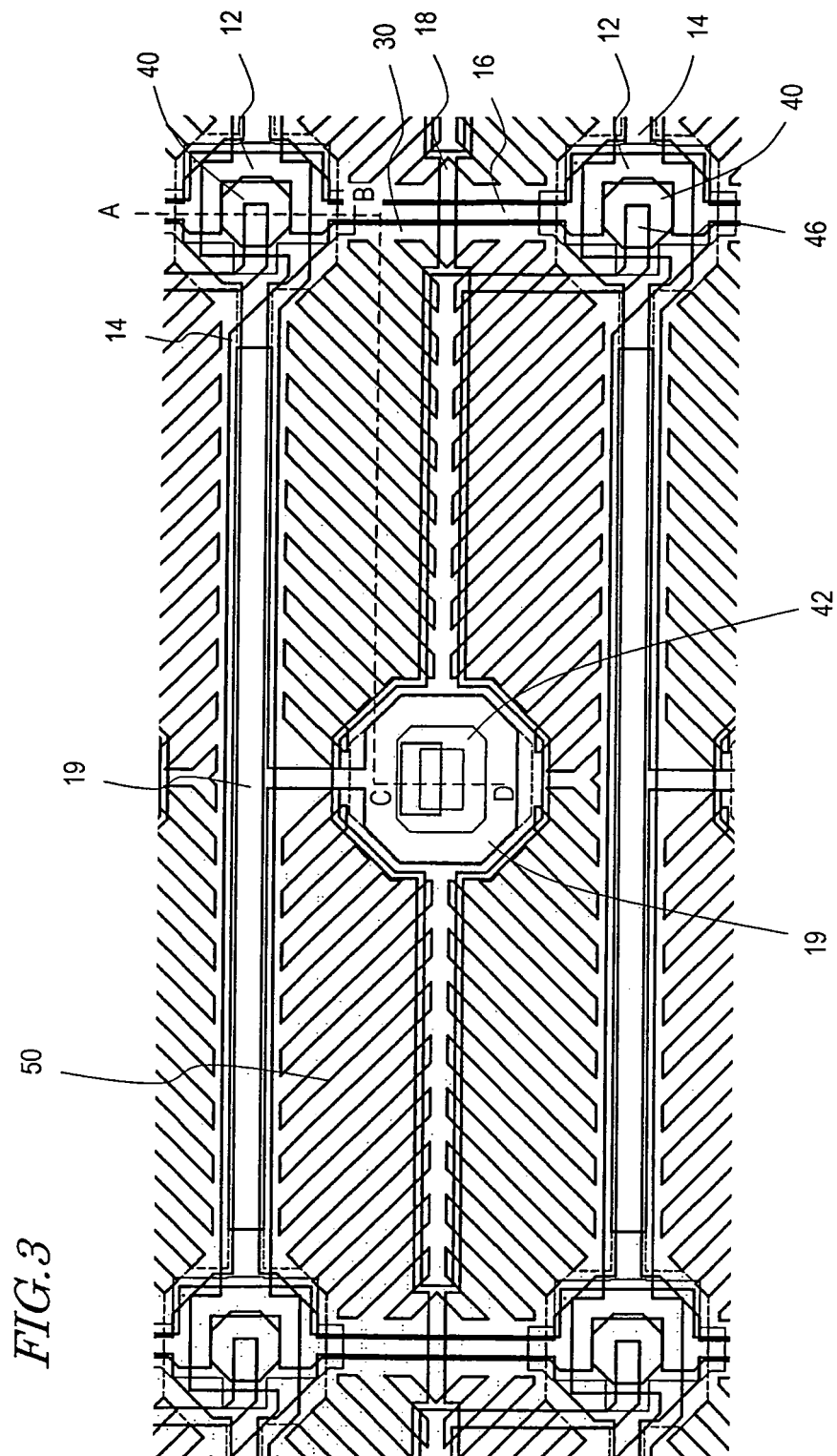
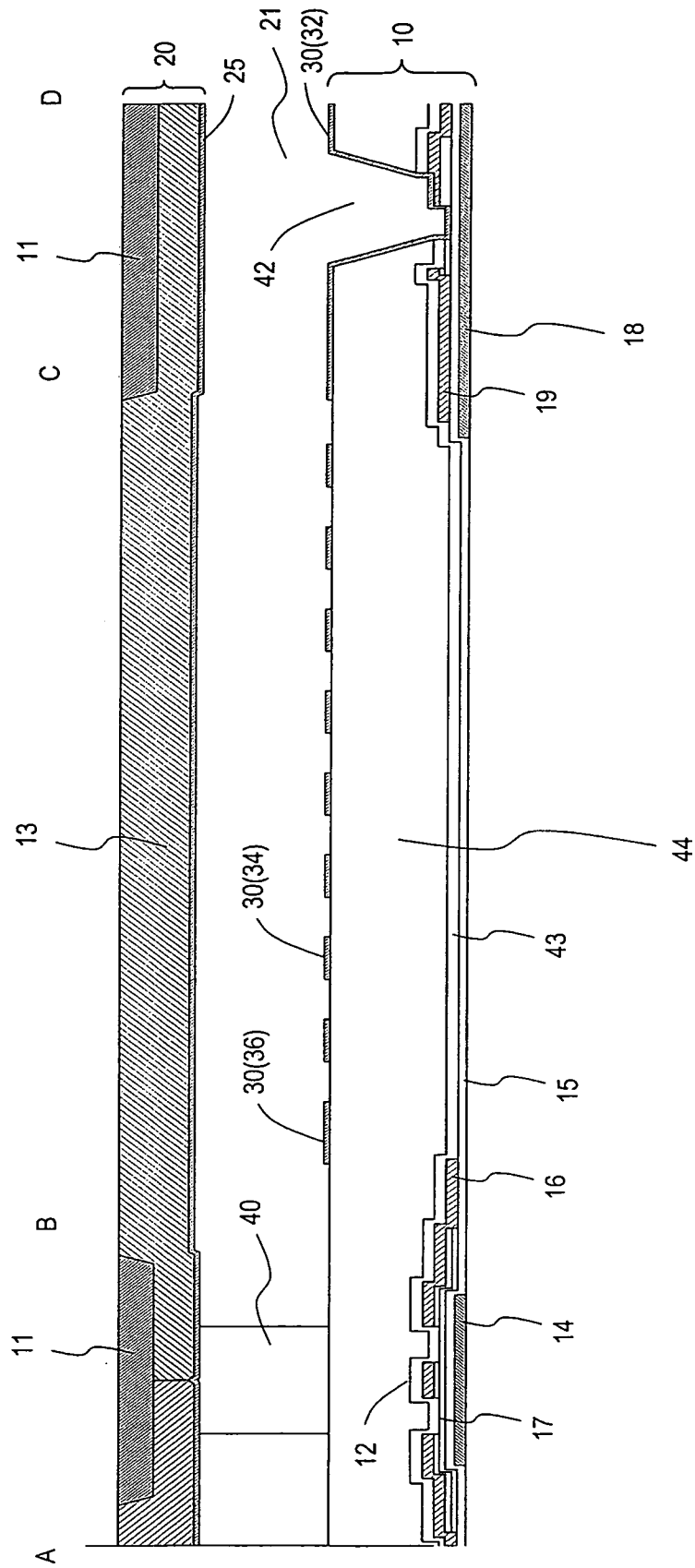


FIG. 4



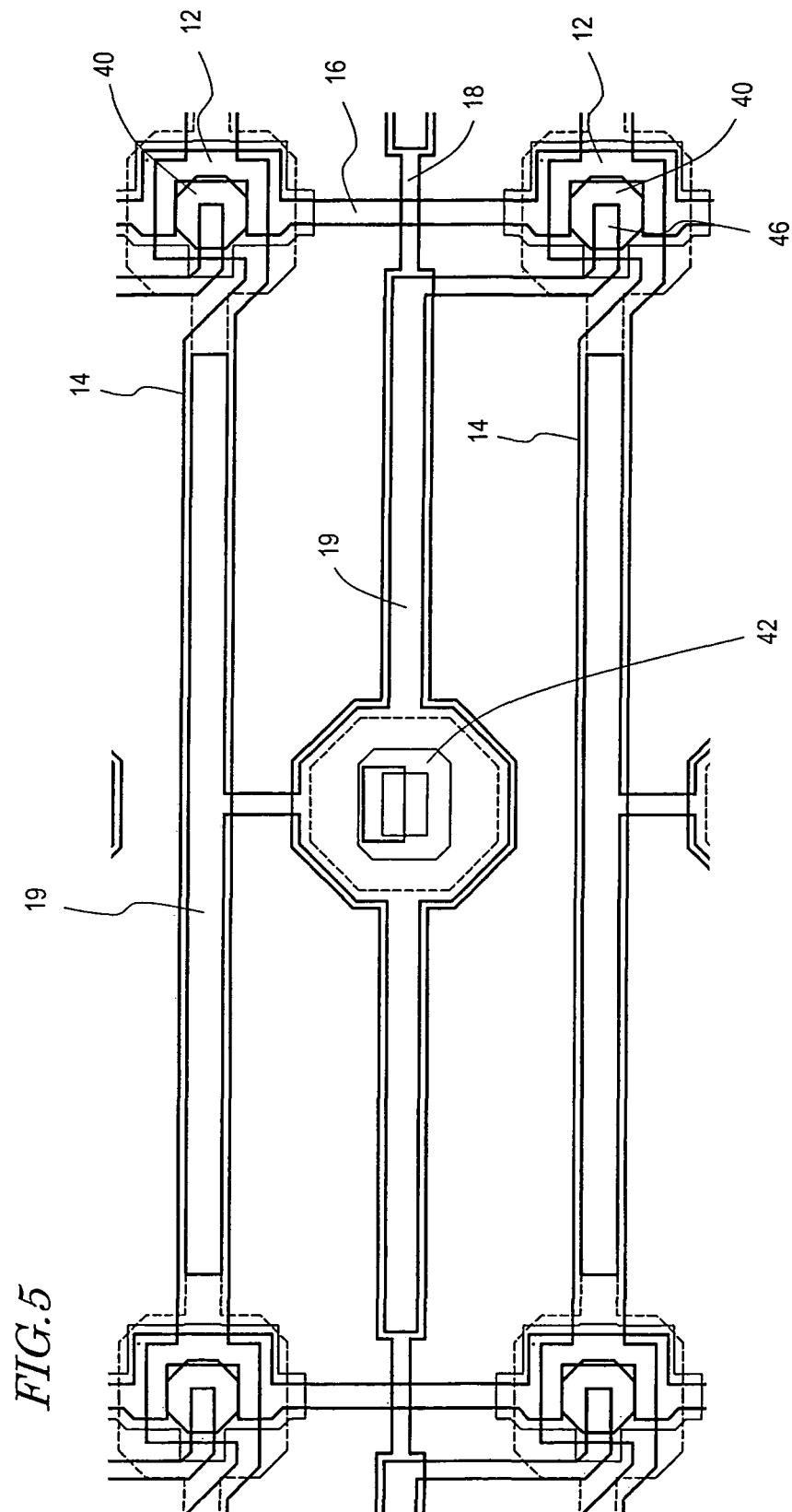


FIG. 6

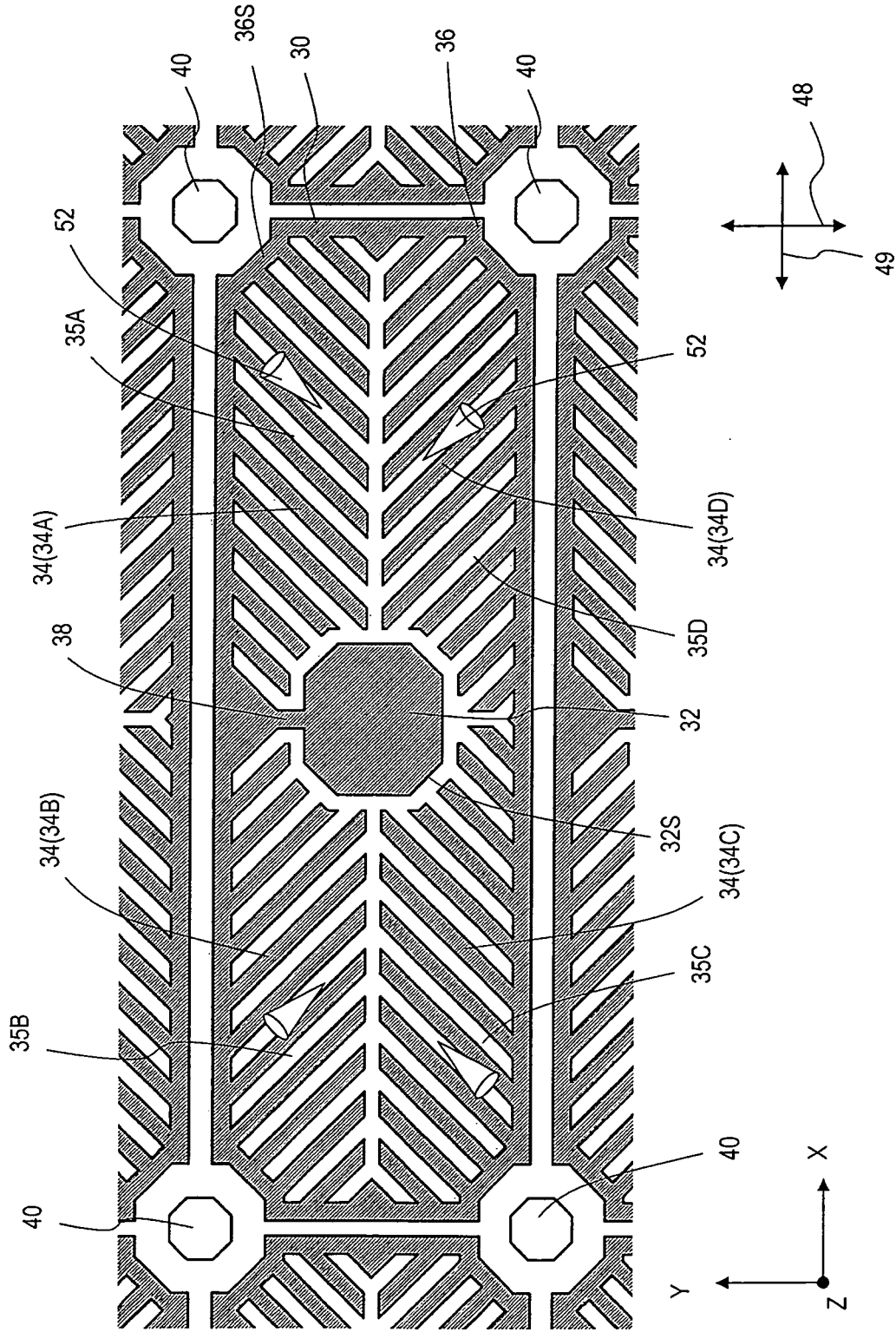
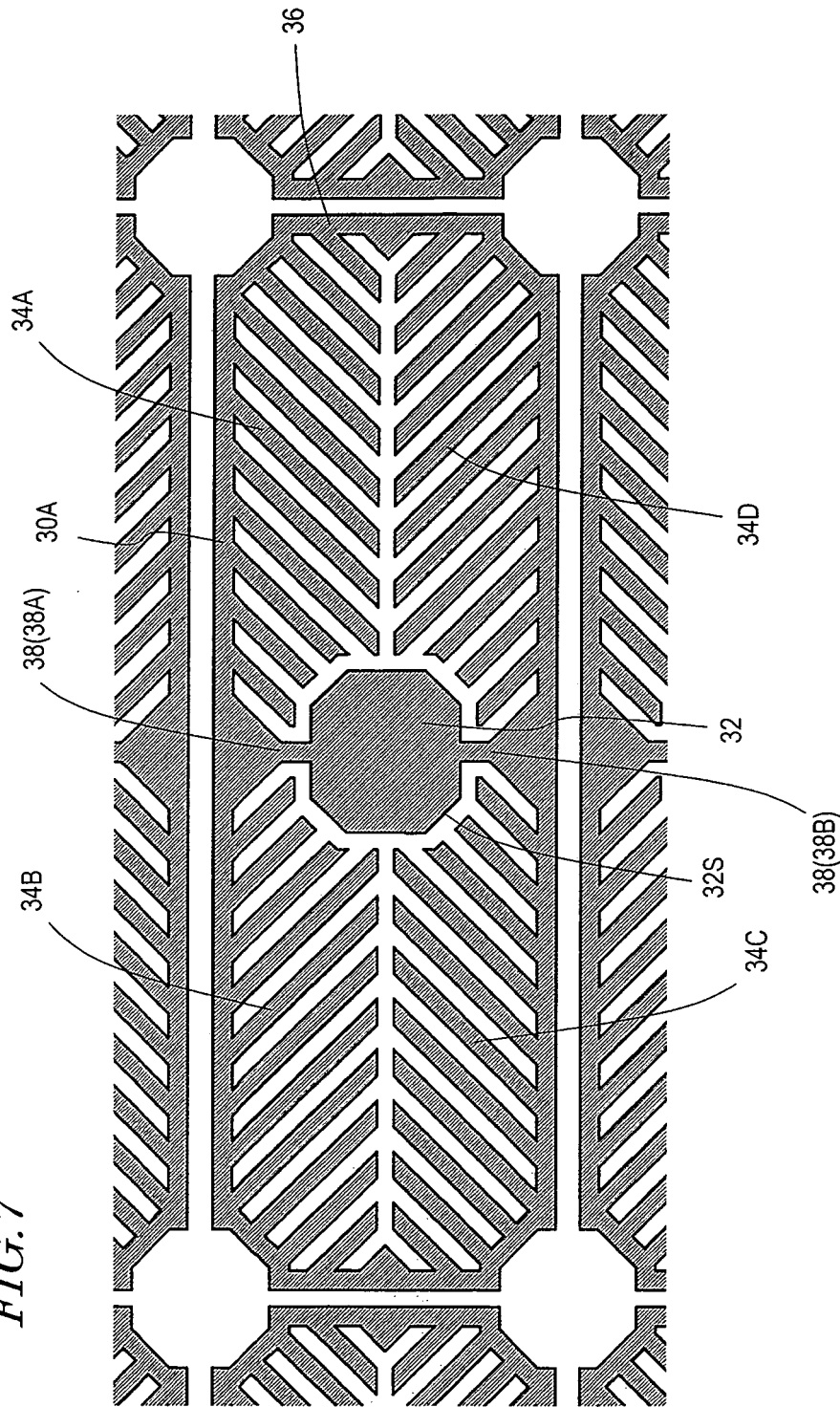


FIG. 7



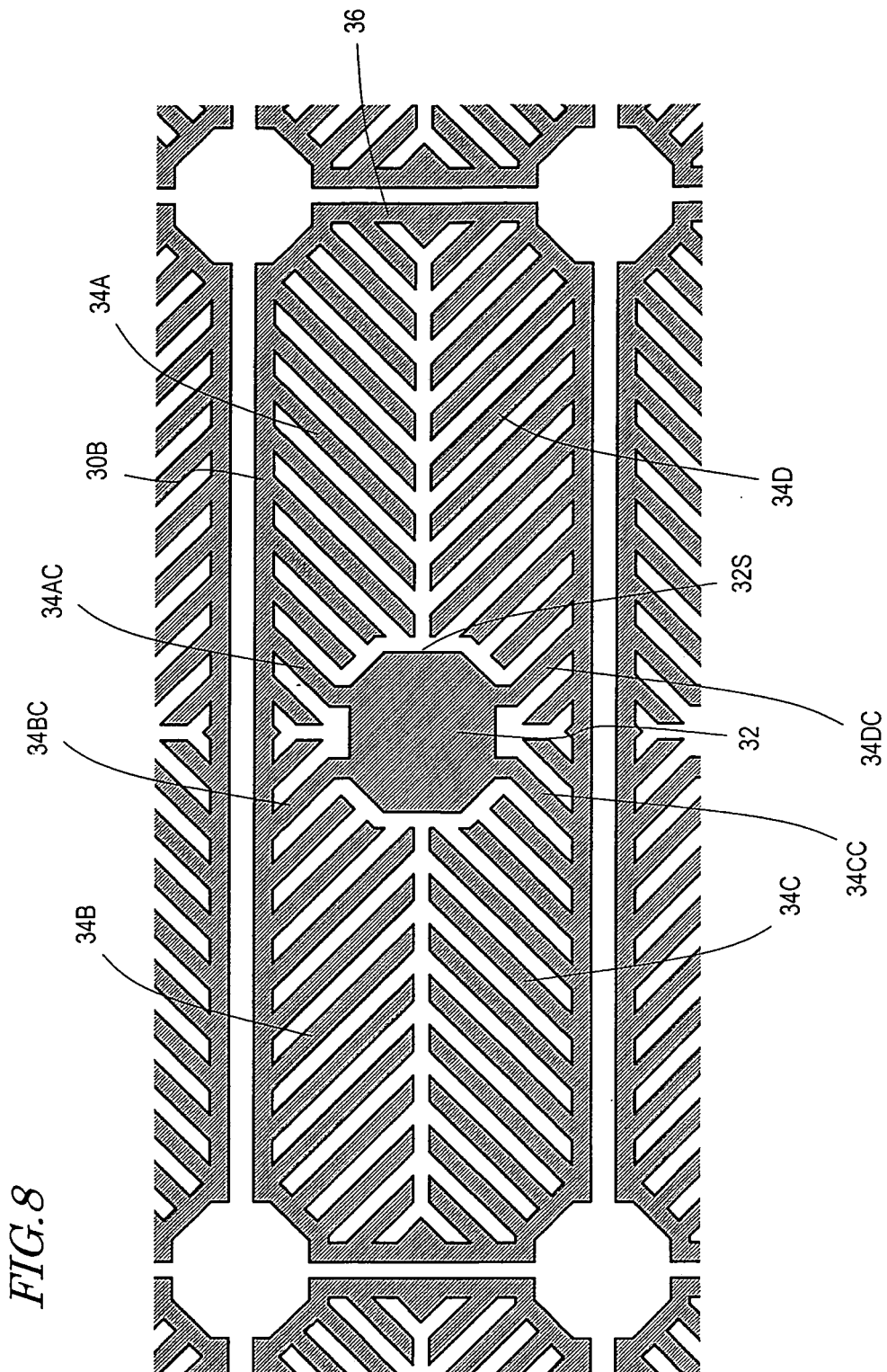


FIG. 9

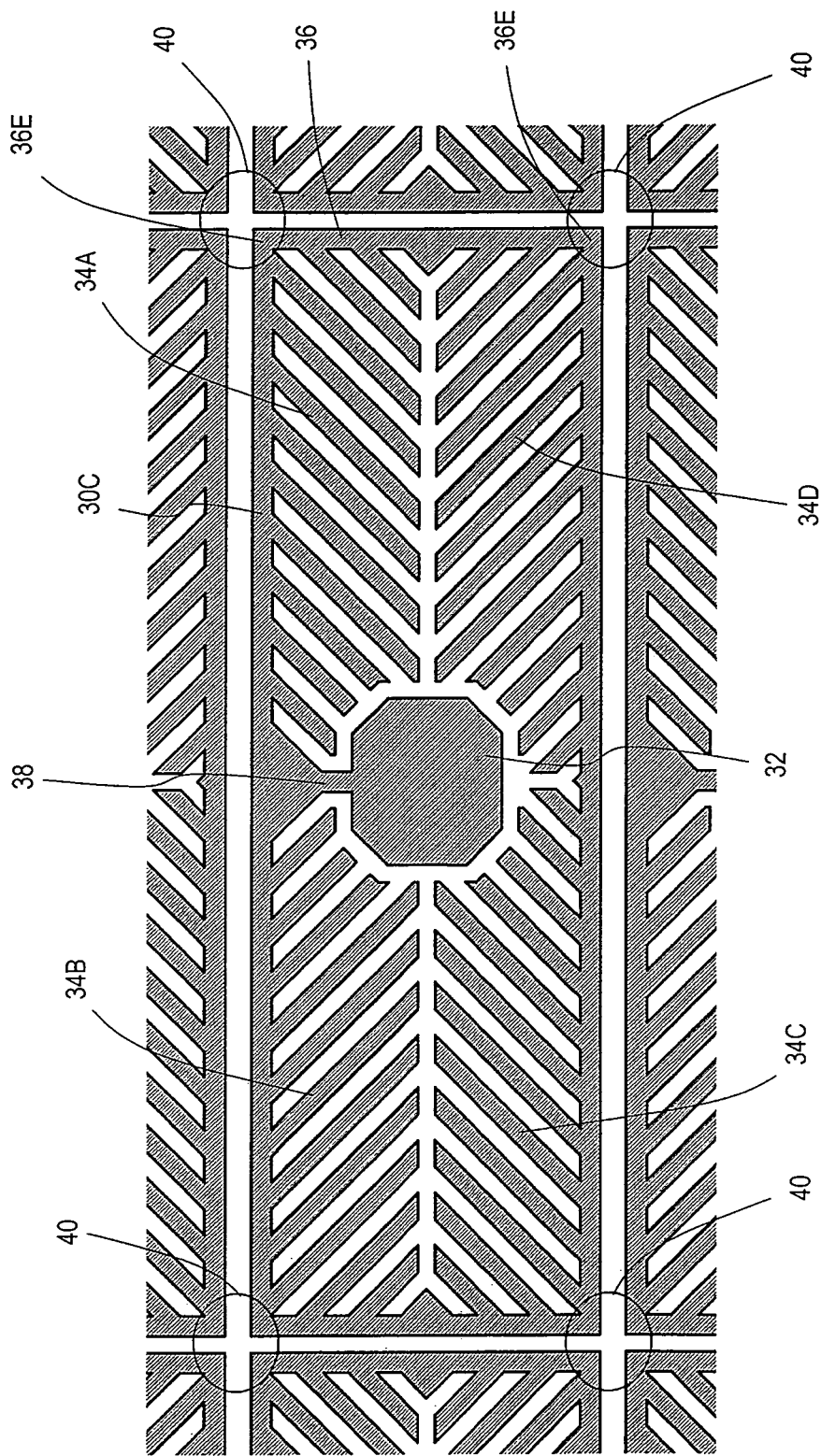
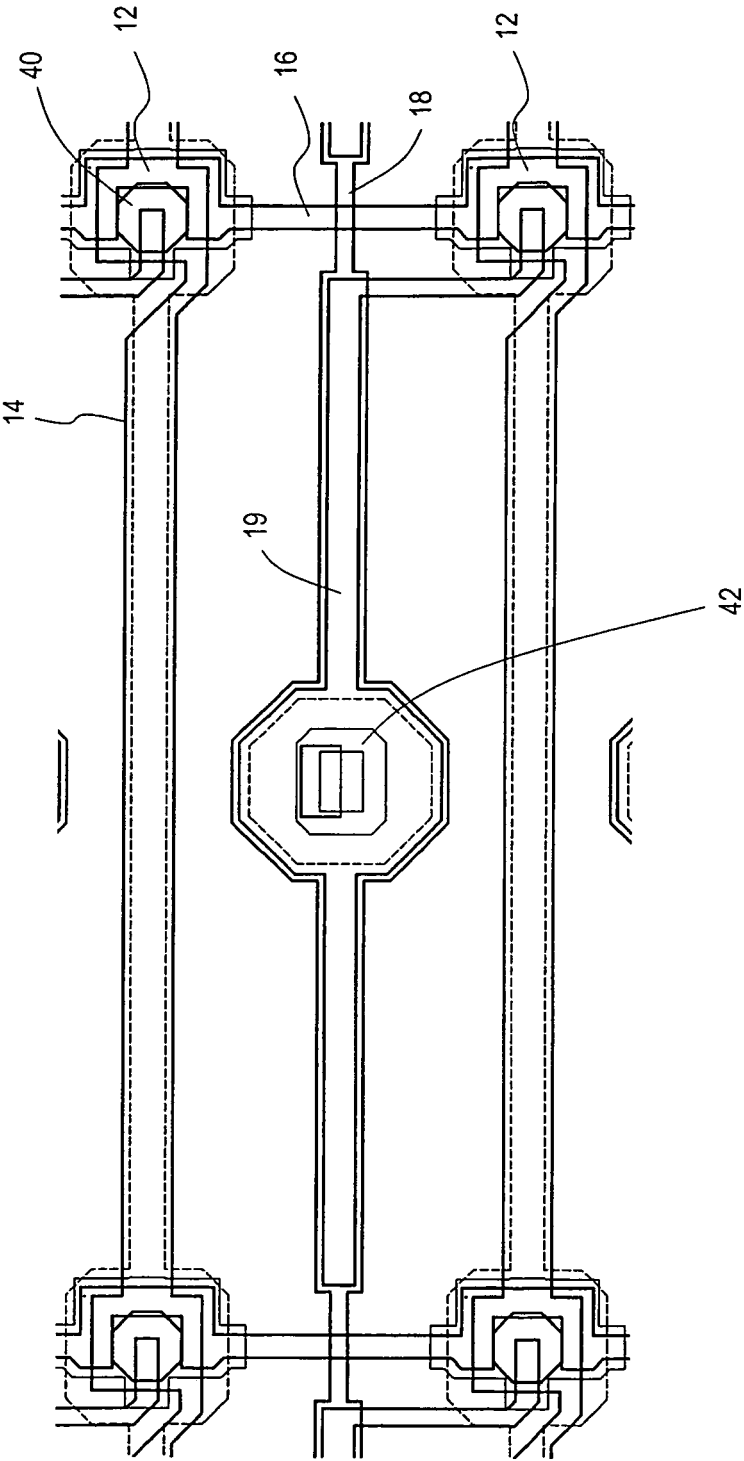
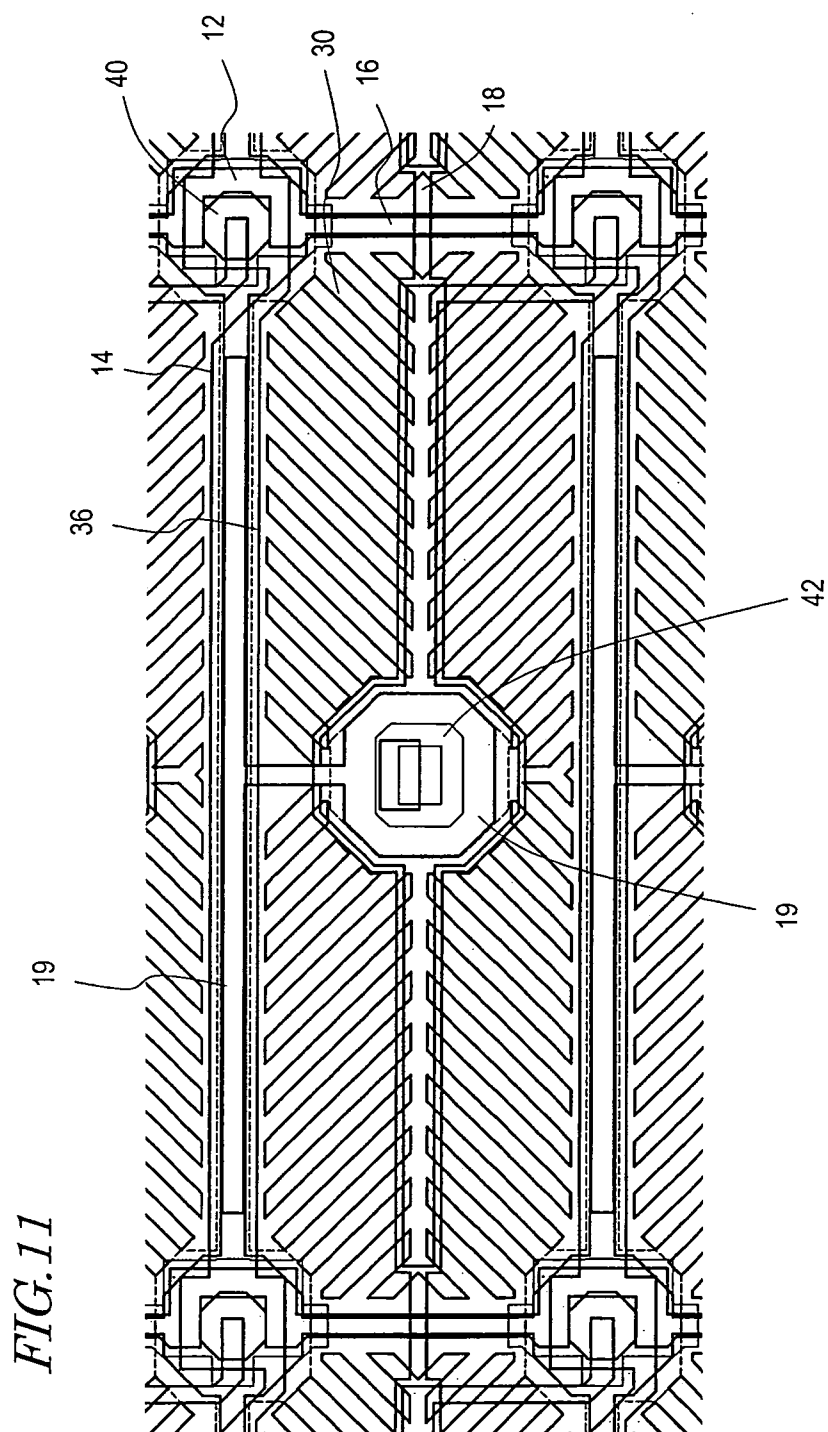


FIG.10





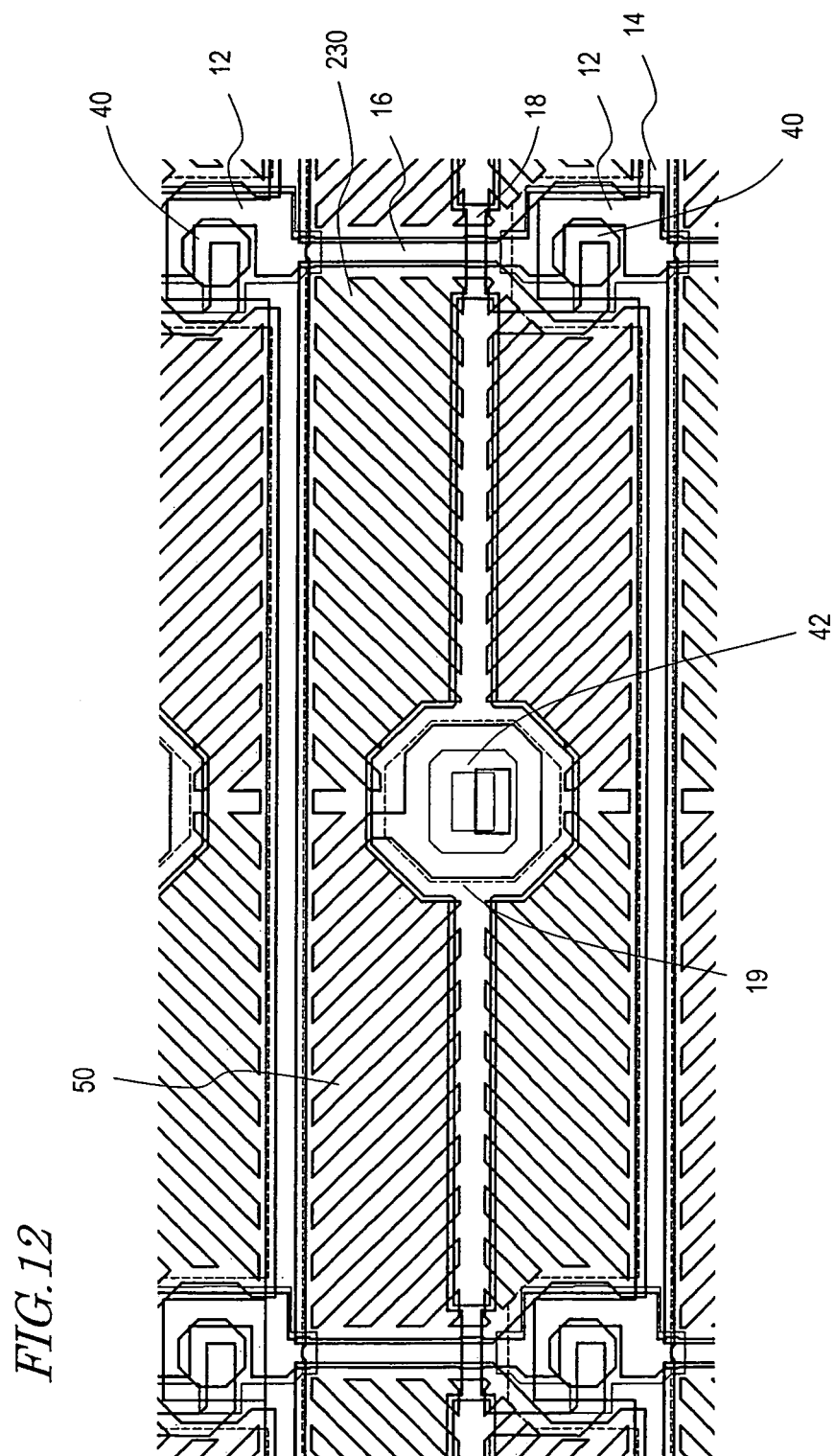


FIG. 13

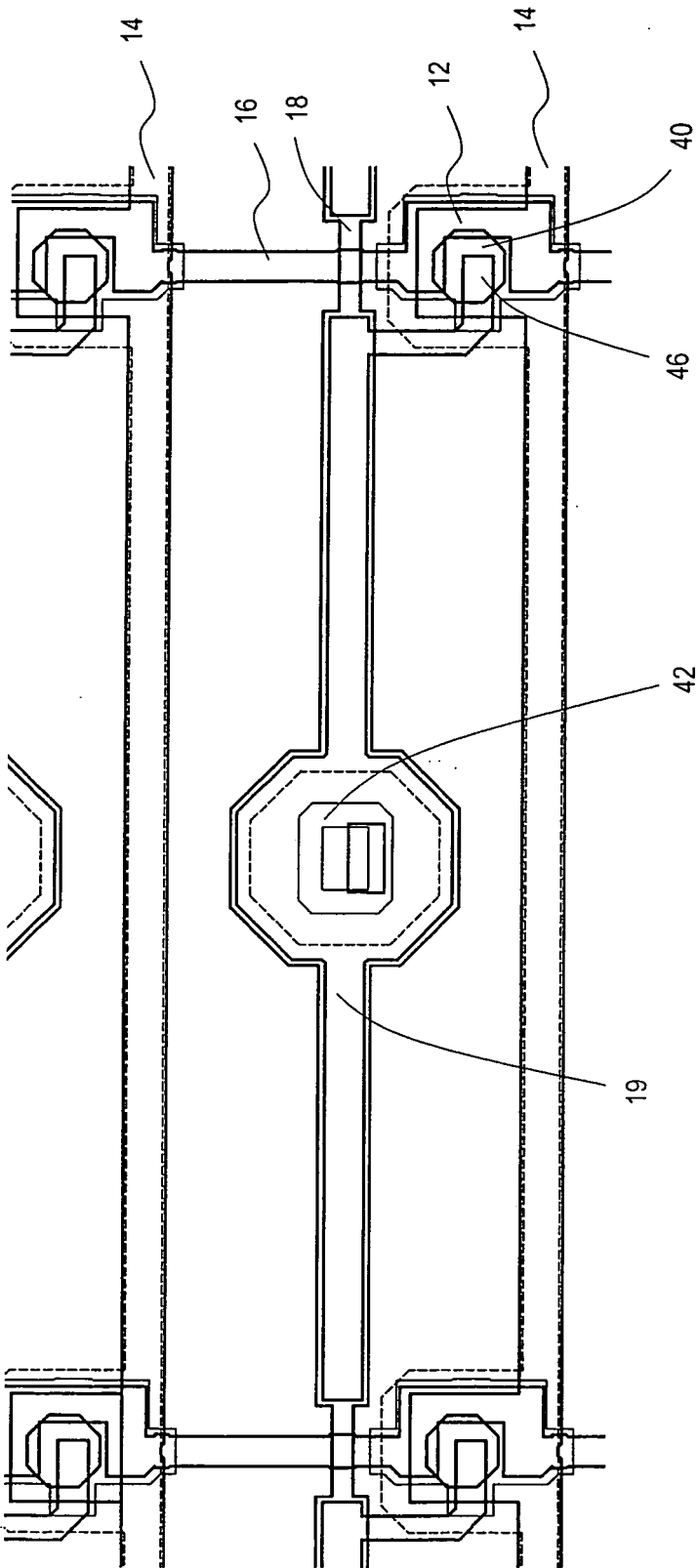


FIG. 14

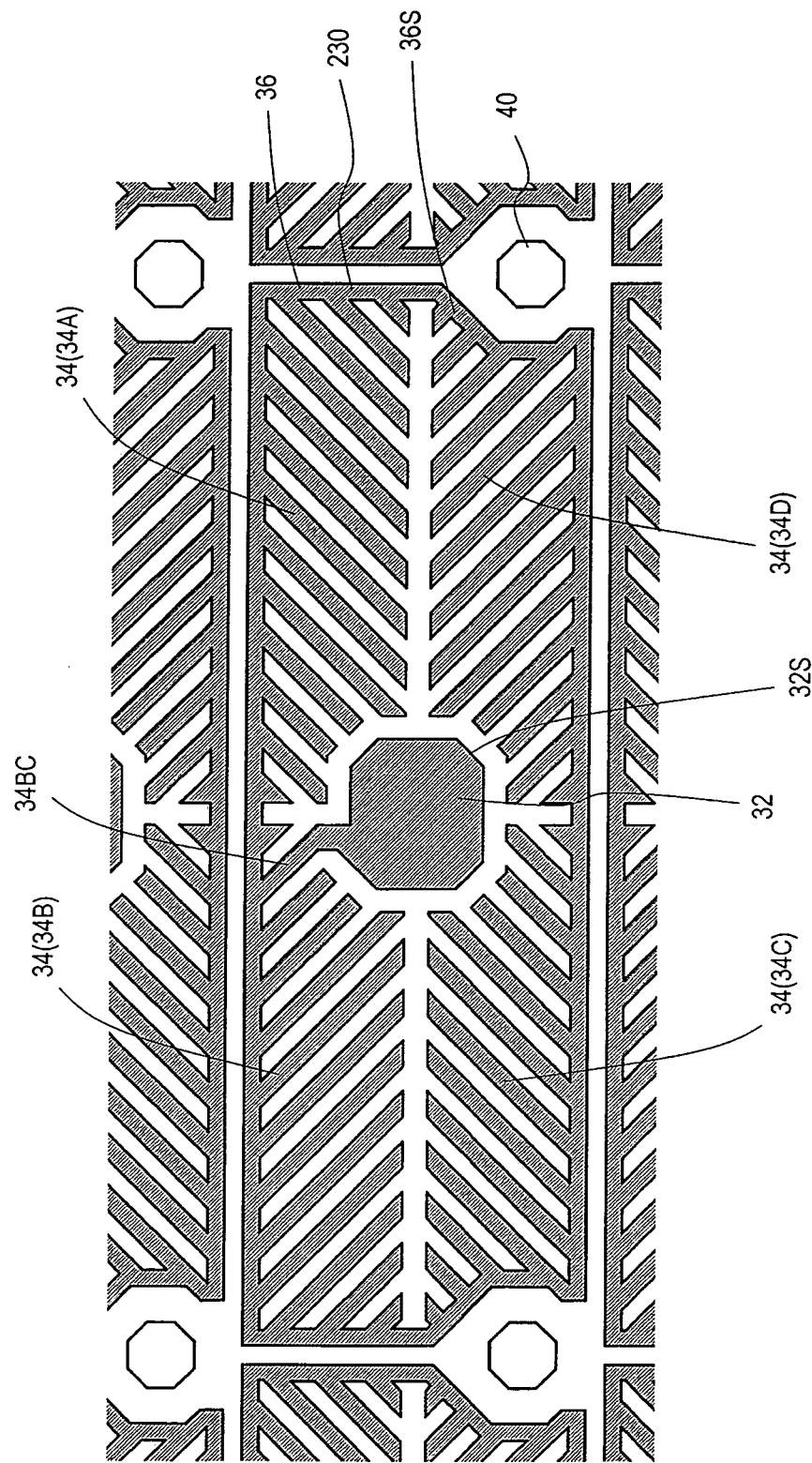


FIG. 15

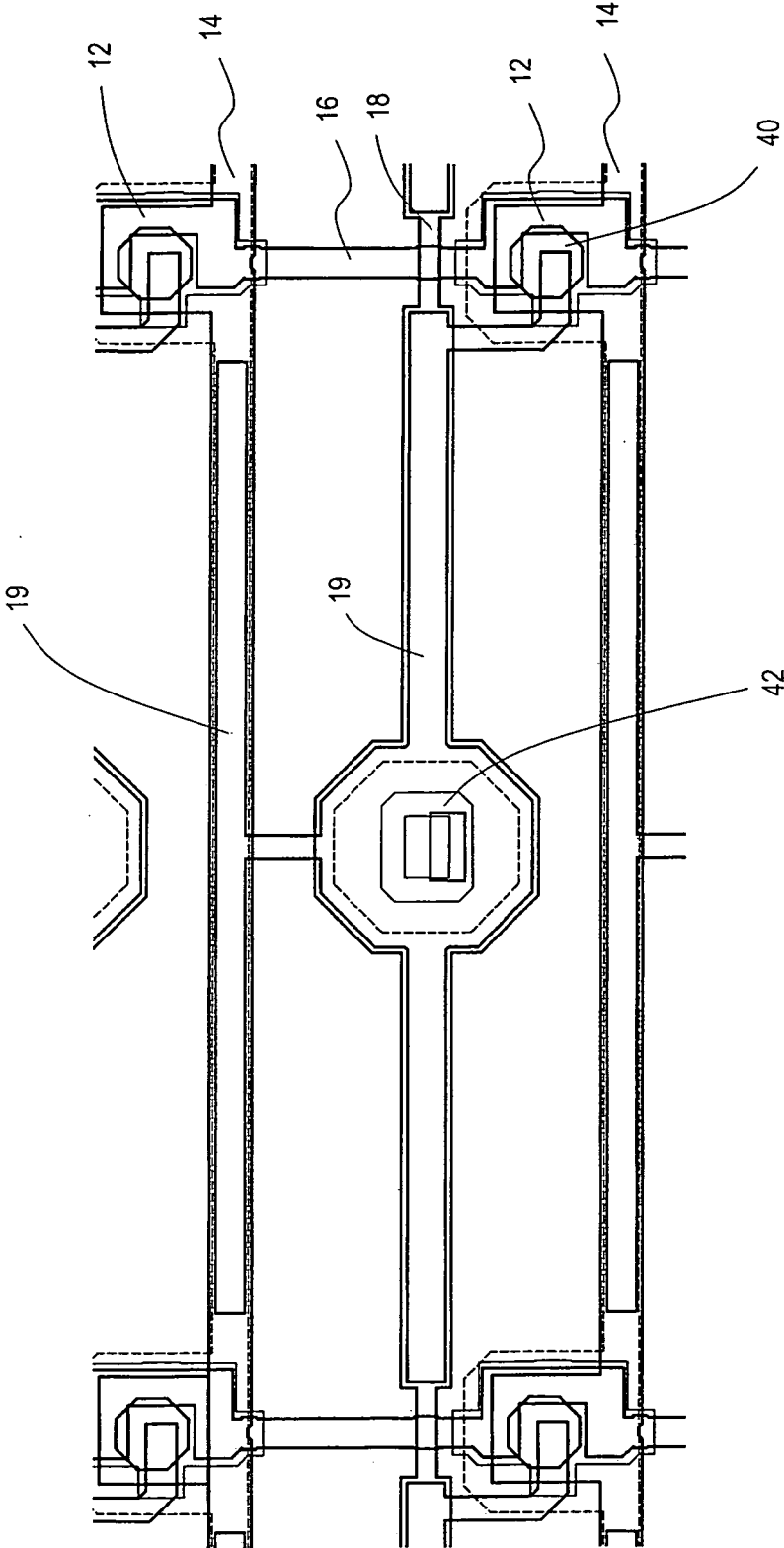


FIG. 16

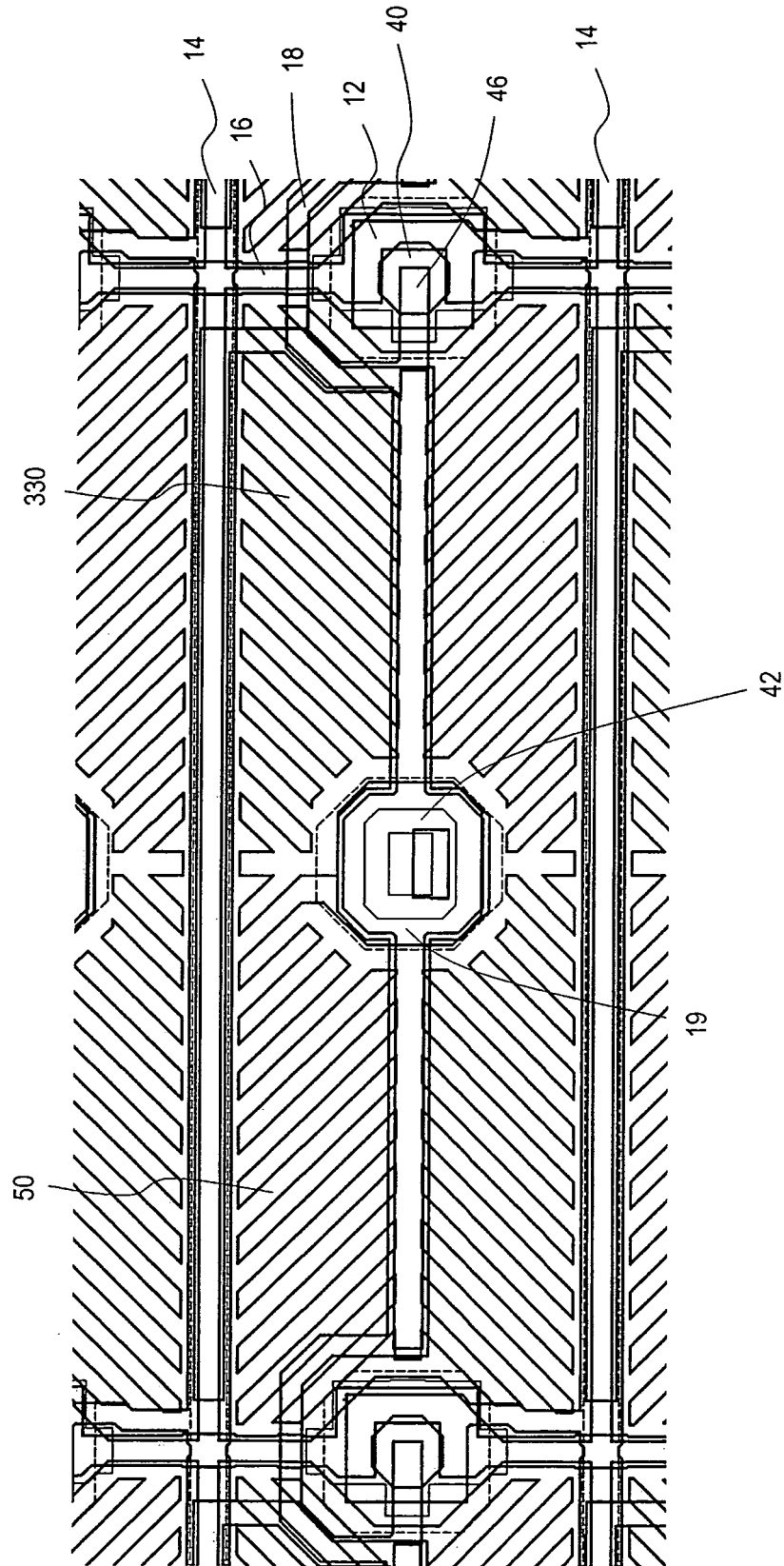
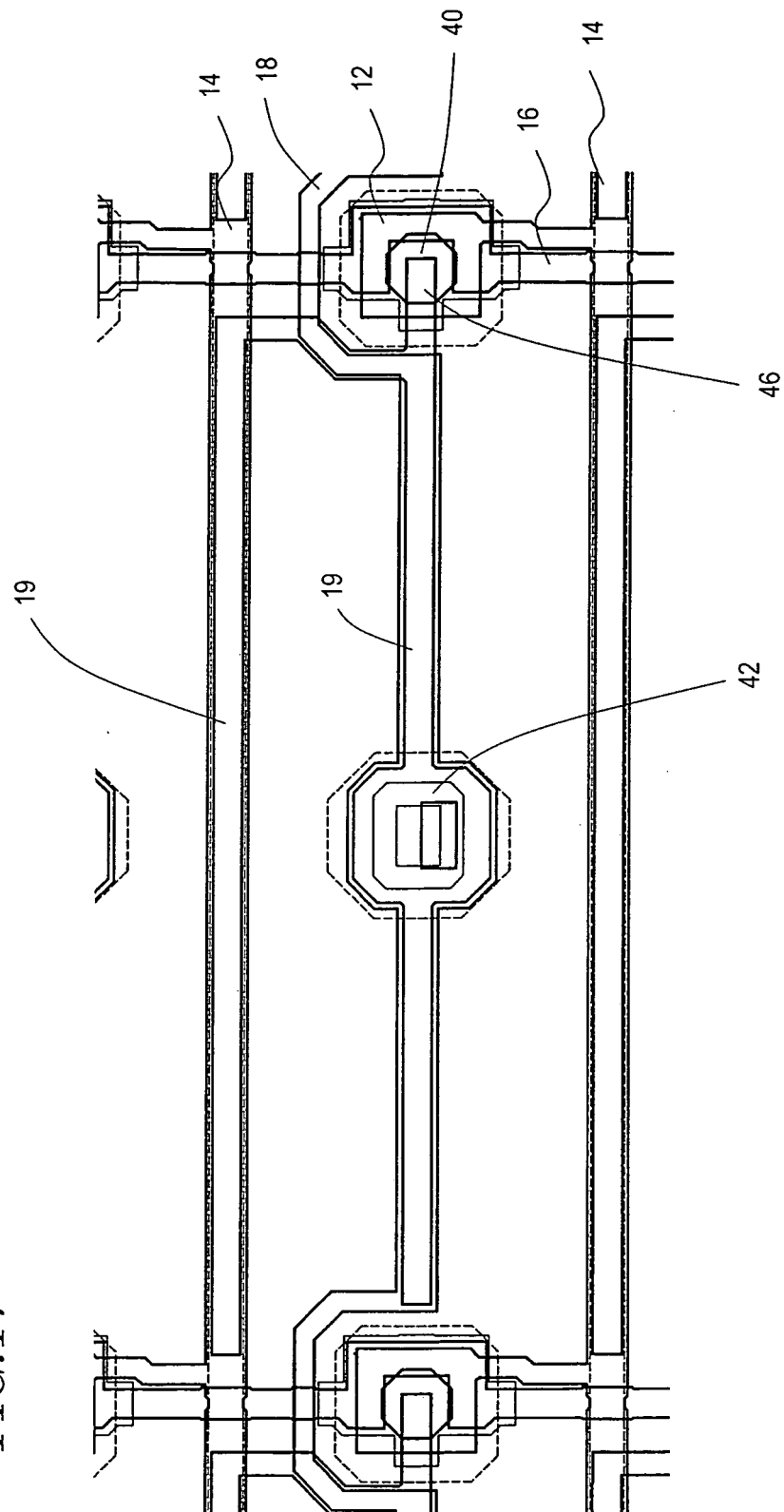


FIG.17



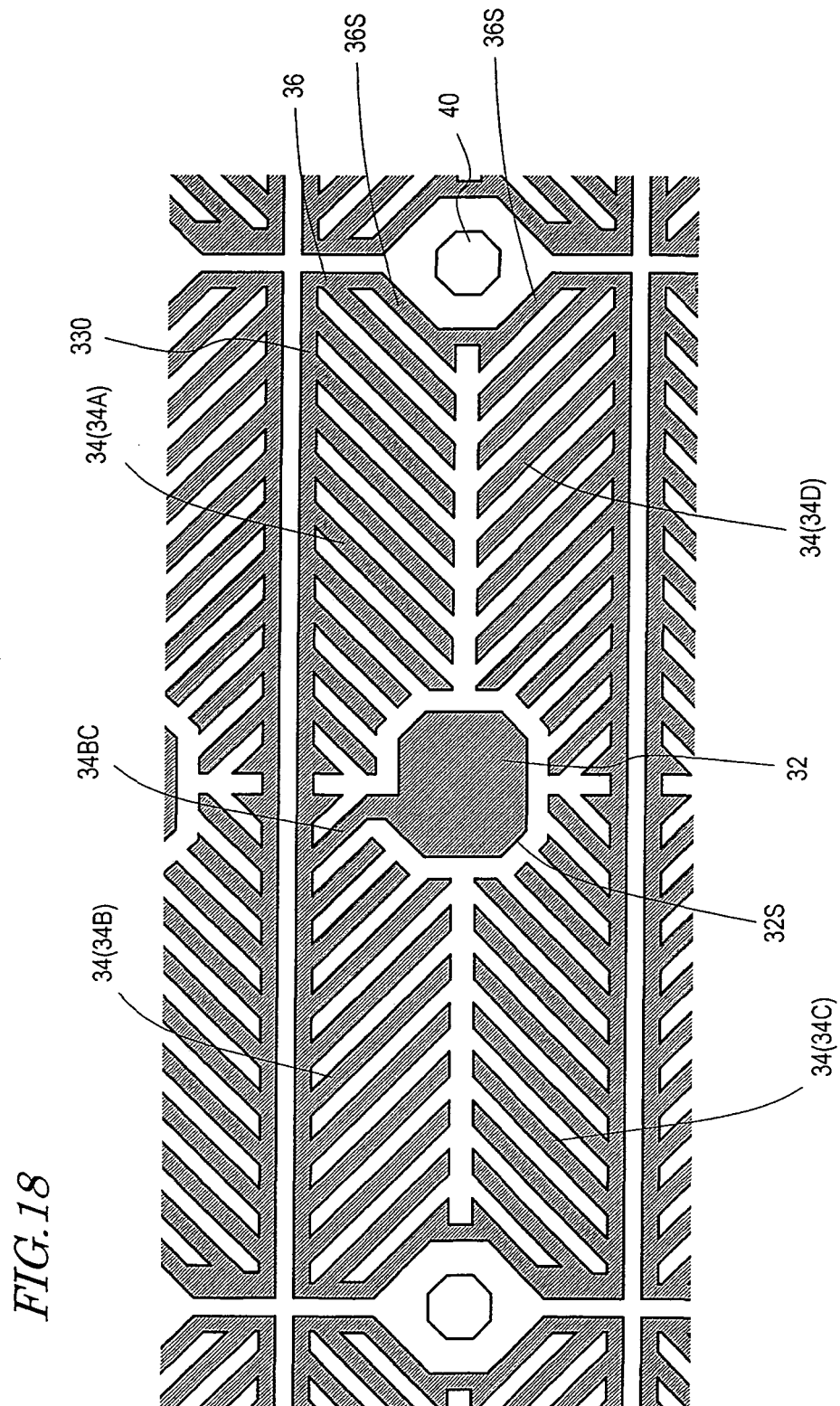


FIG. 19

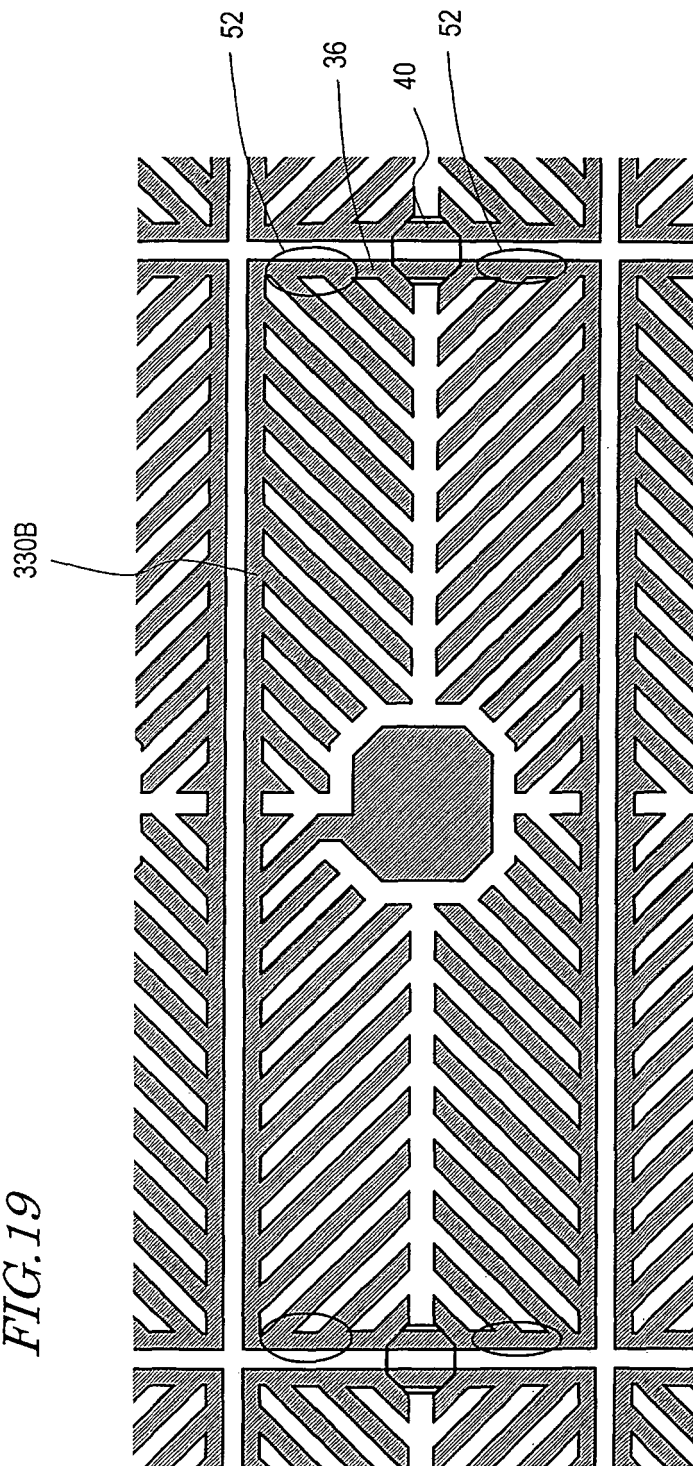
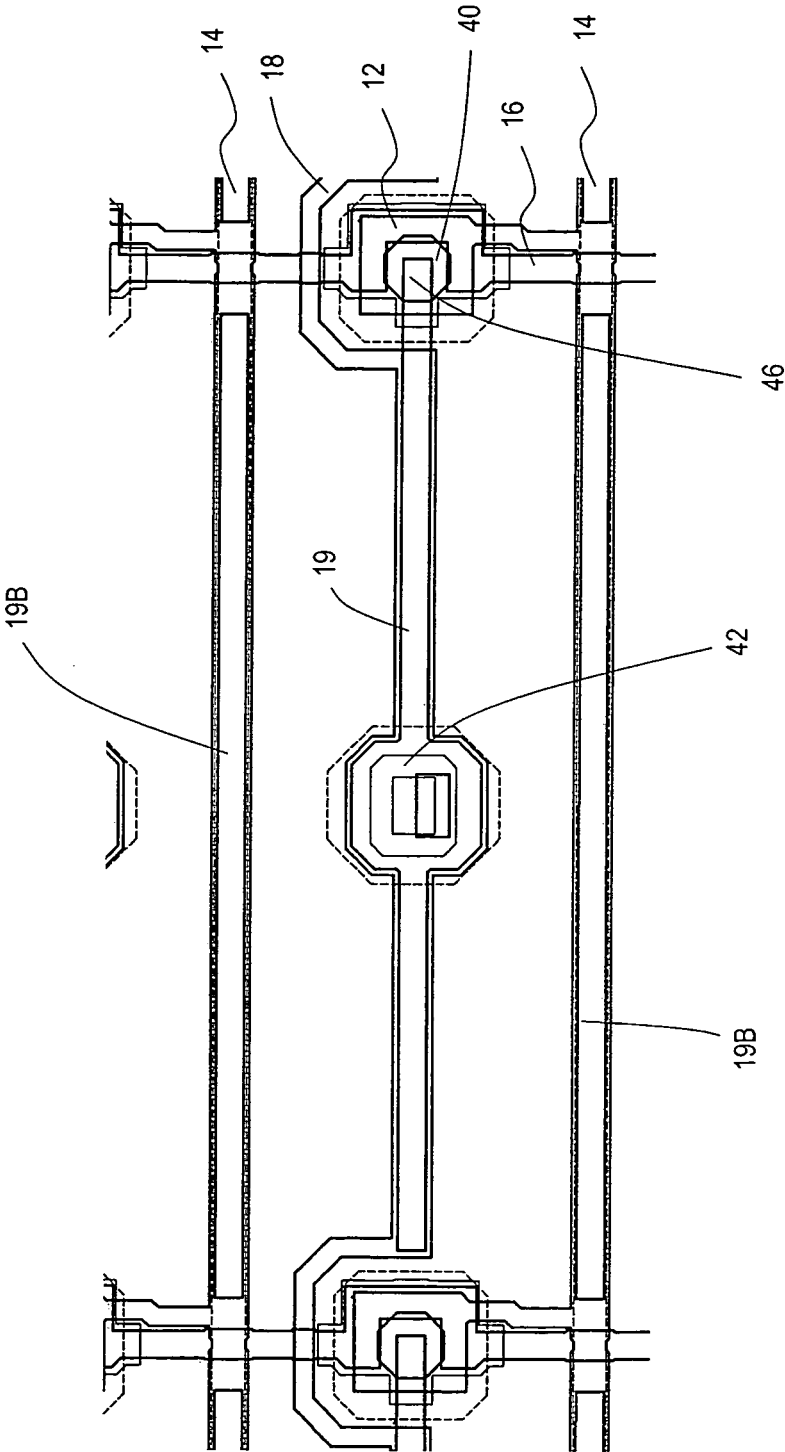


FIG. 20



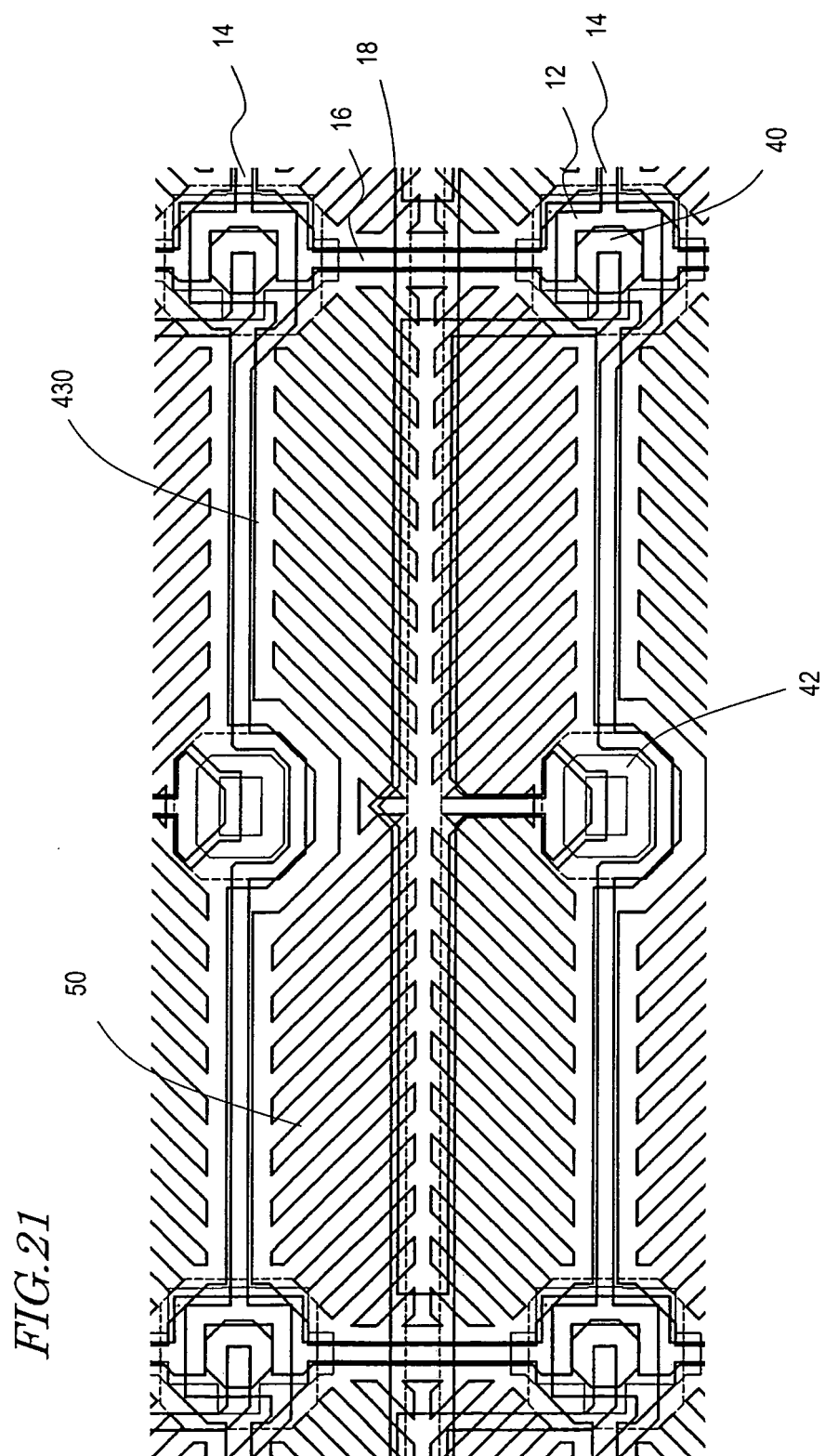


FIG. 22

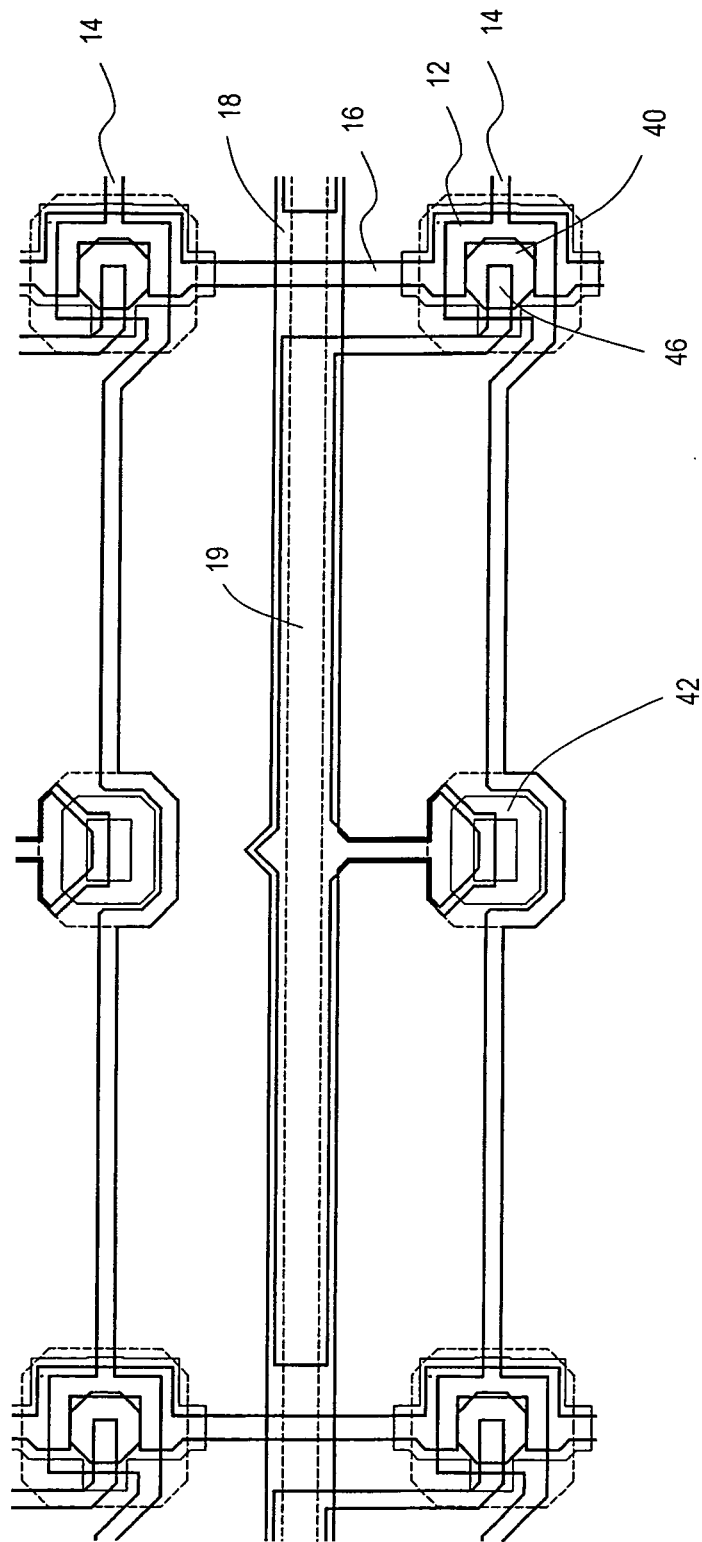


FIG. 23

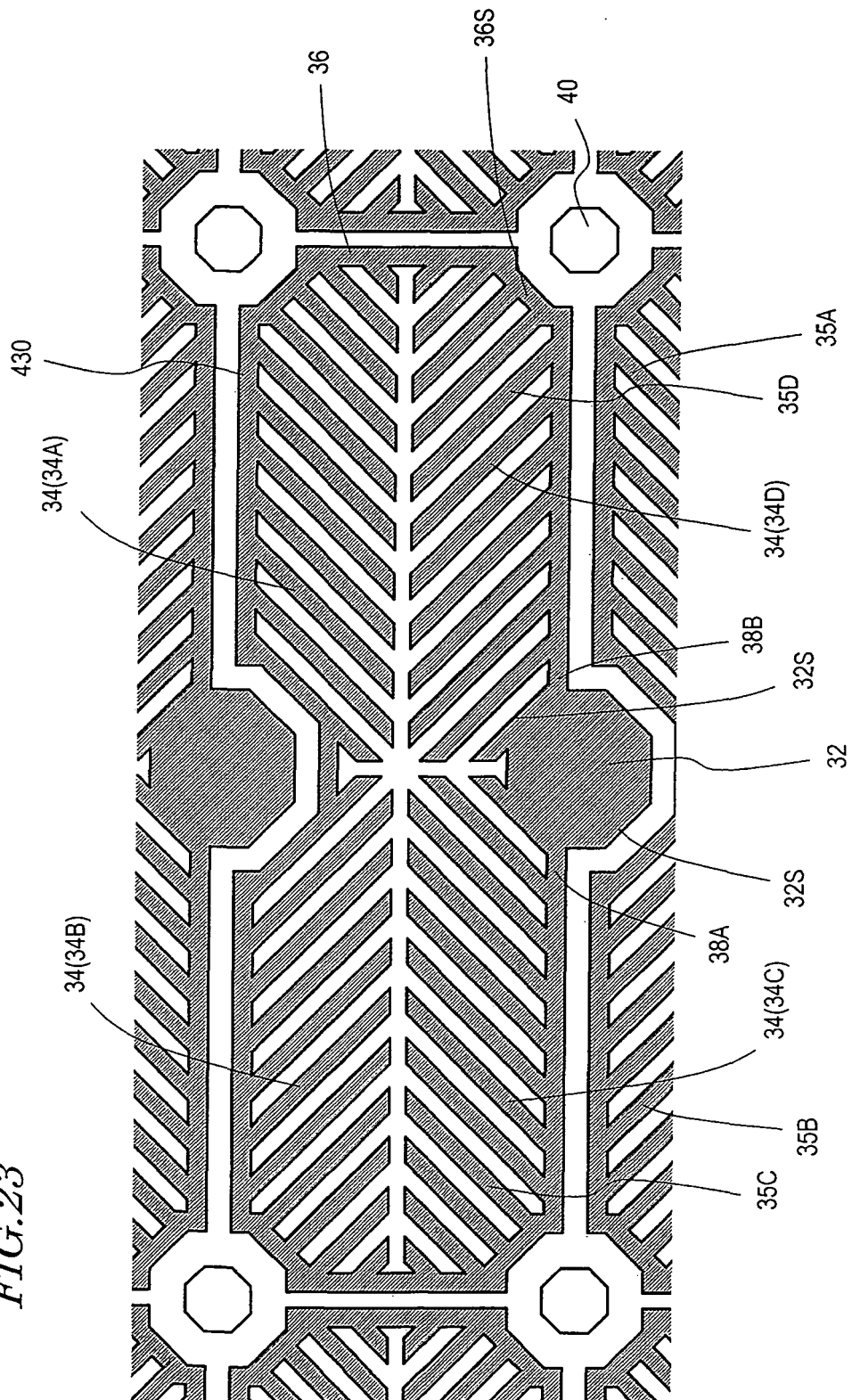


FIG. 24

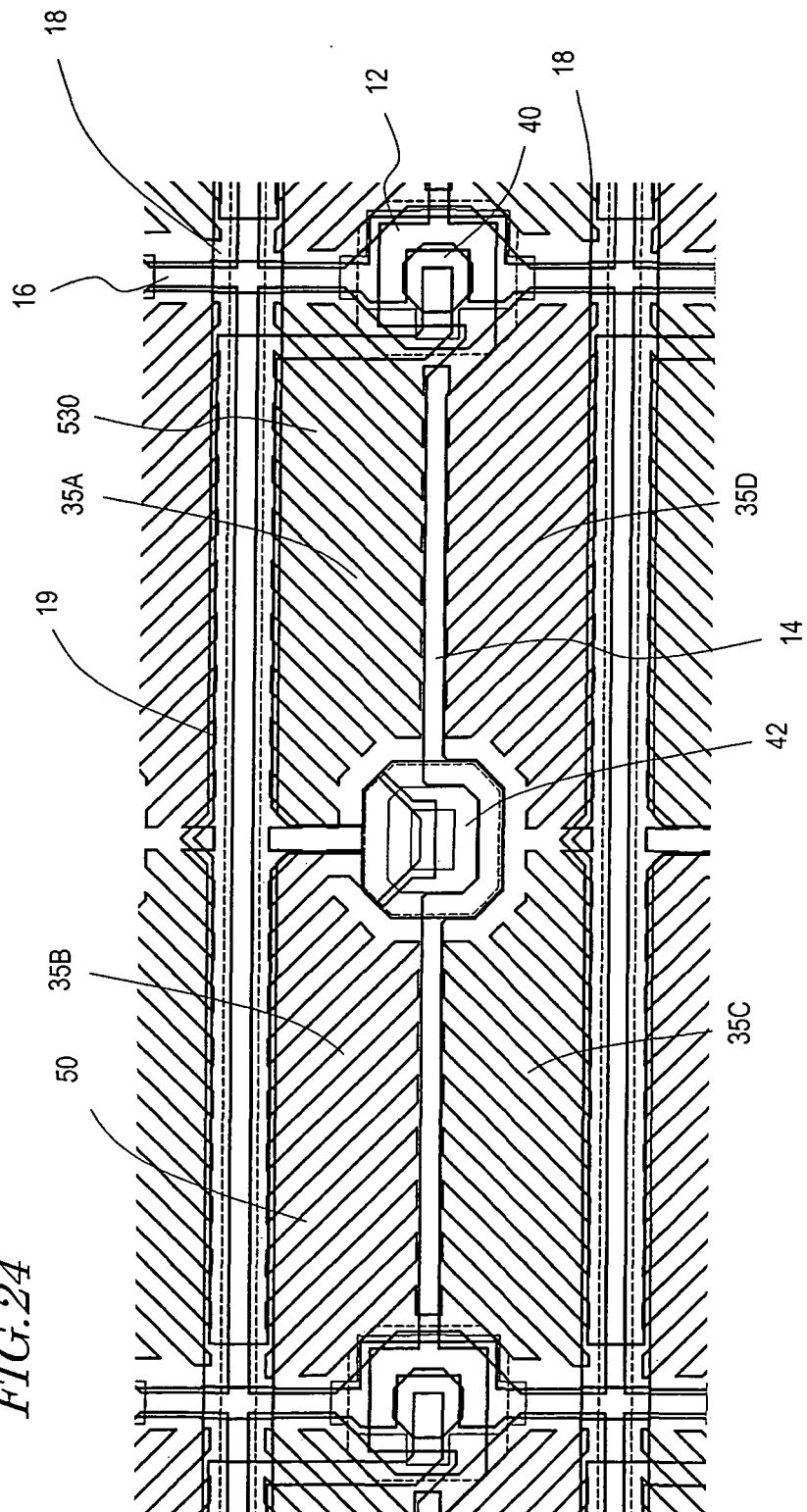


FIG. 25

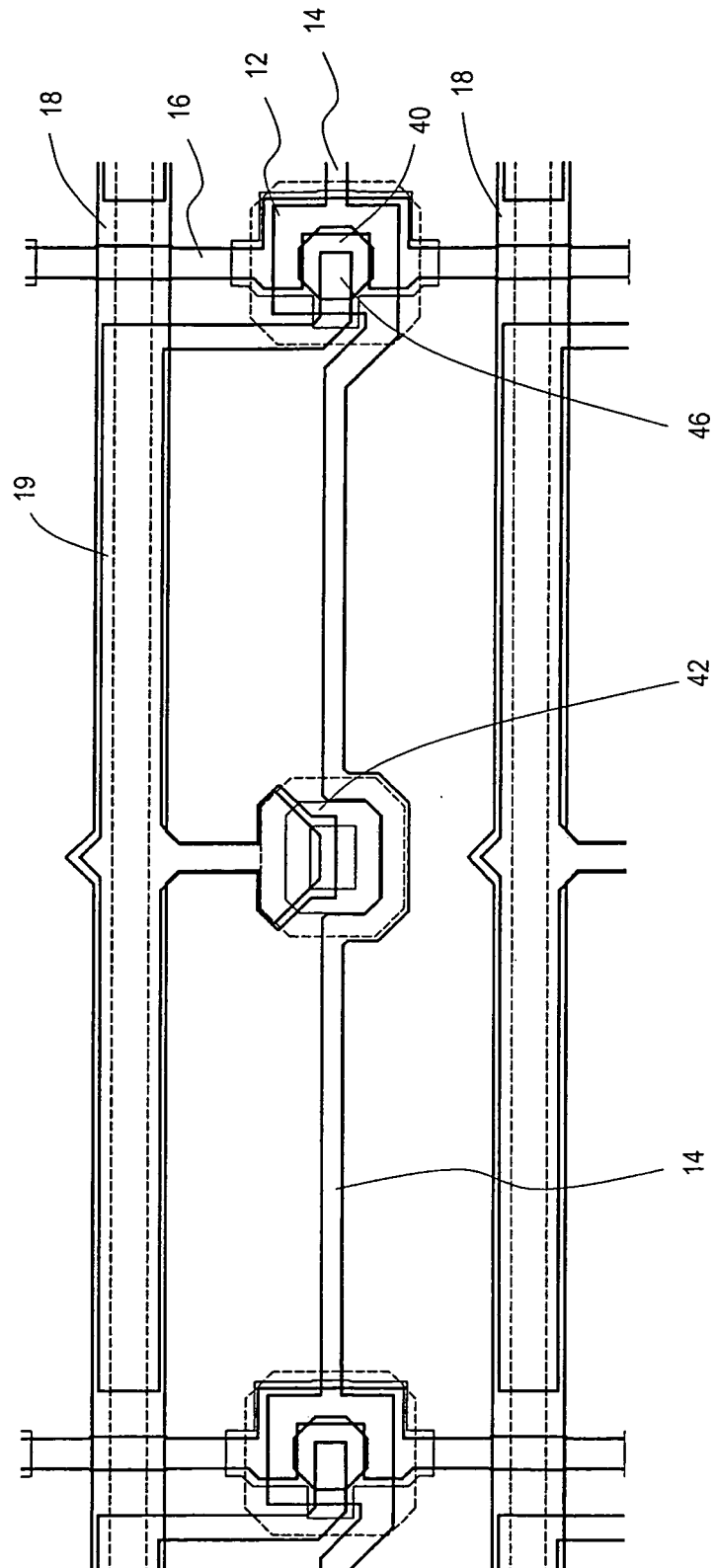


FIG. 26

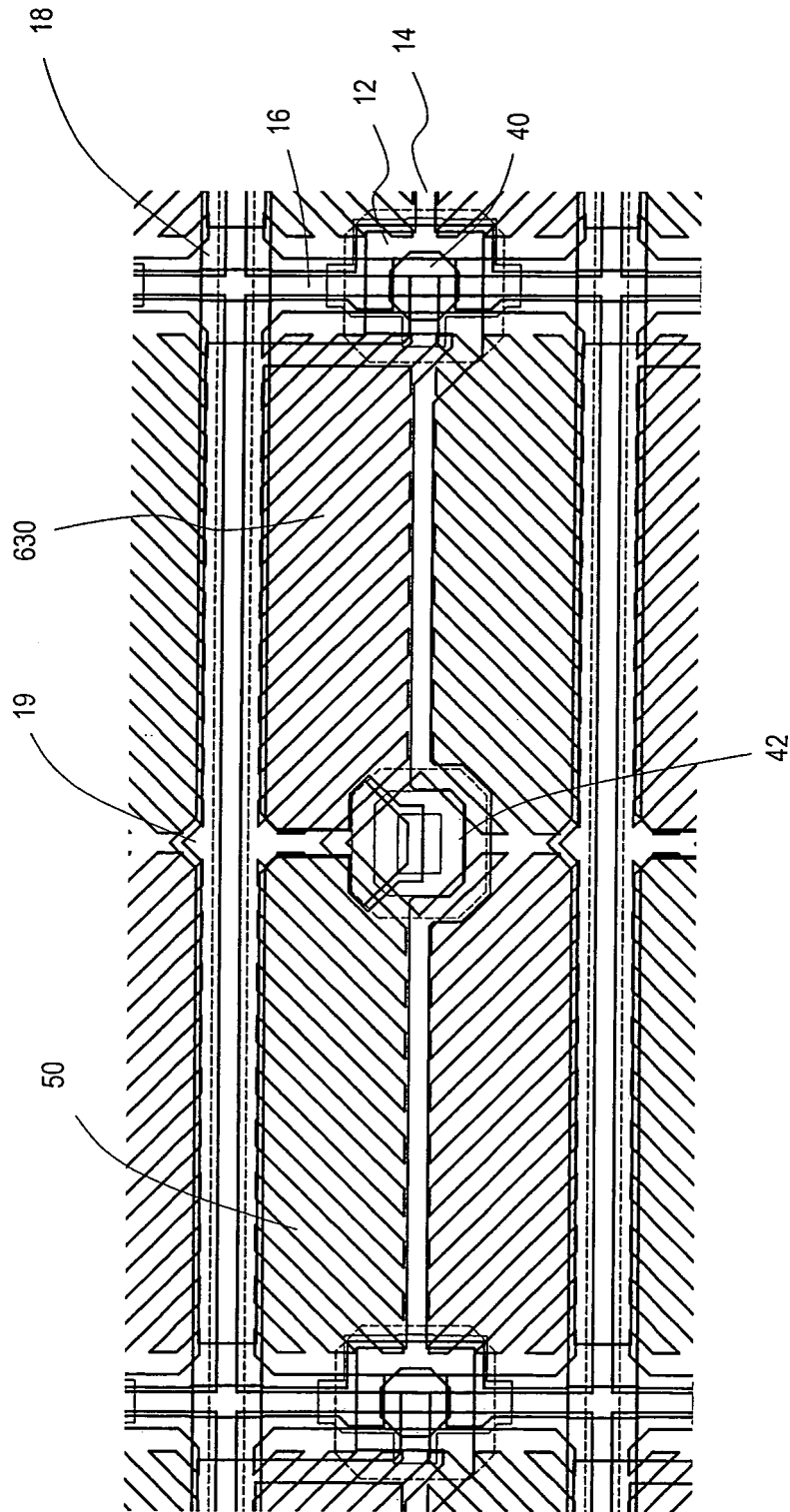


FIG. 27

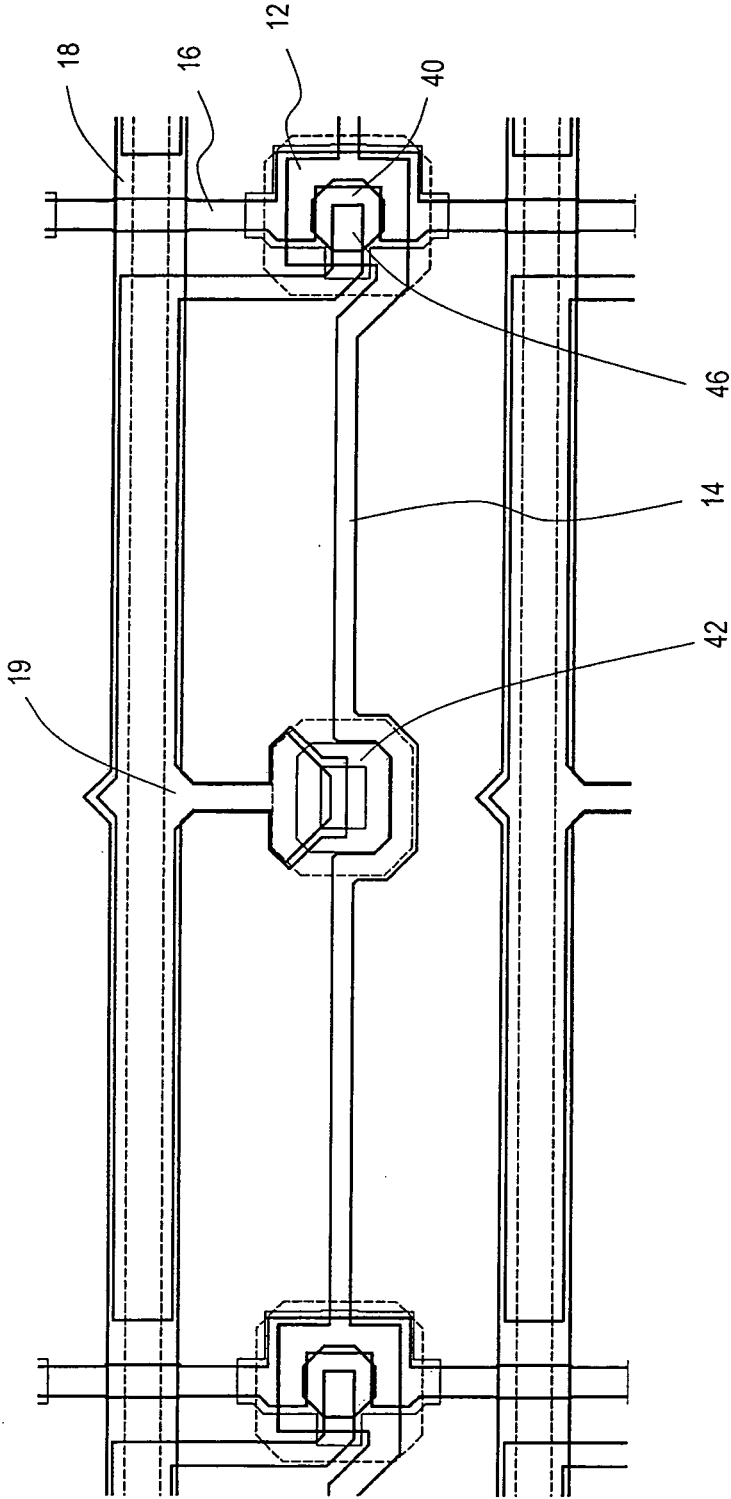


FIG. 28

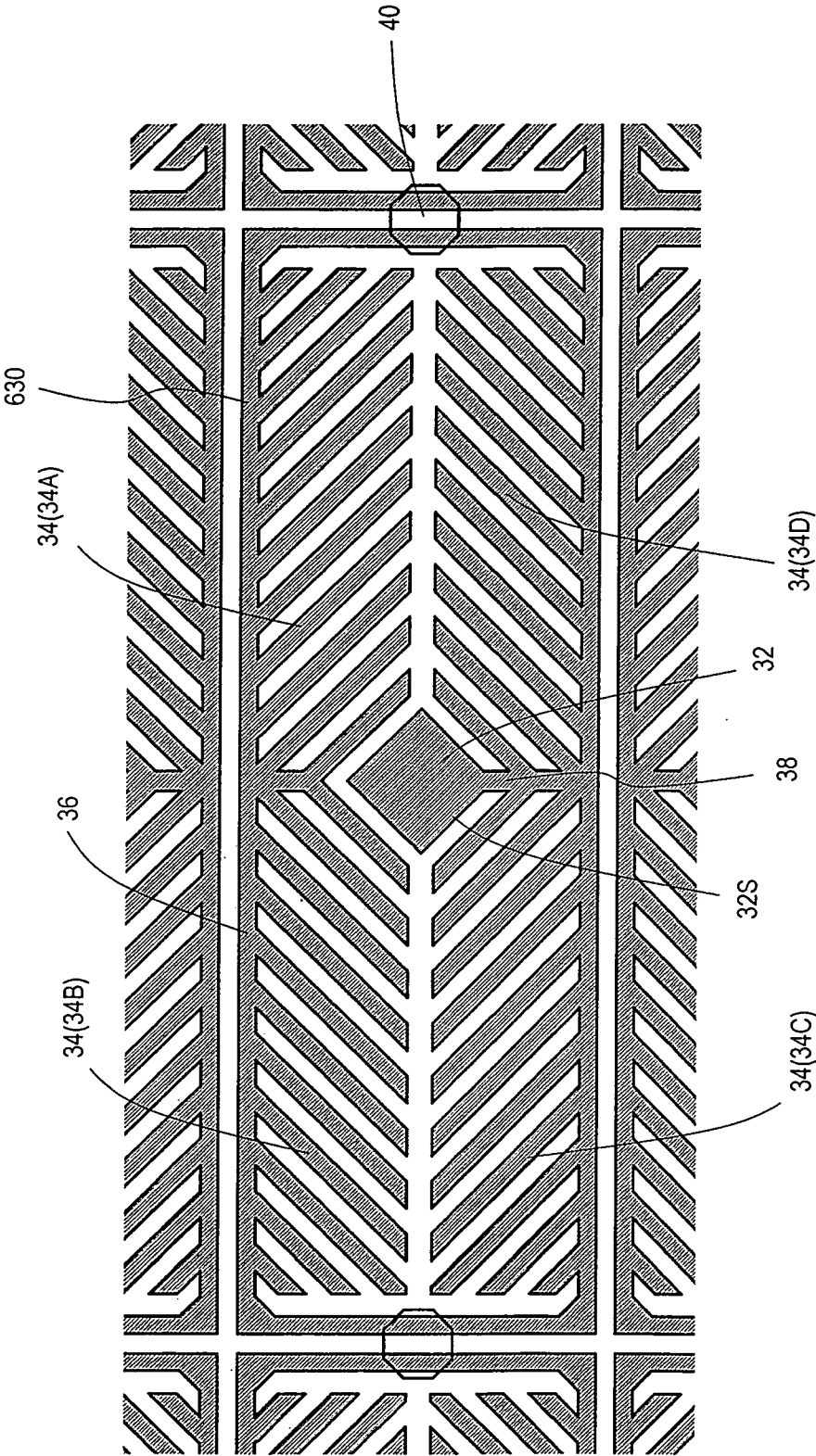


FIG. 29

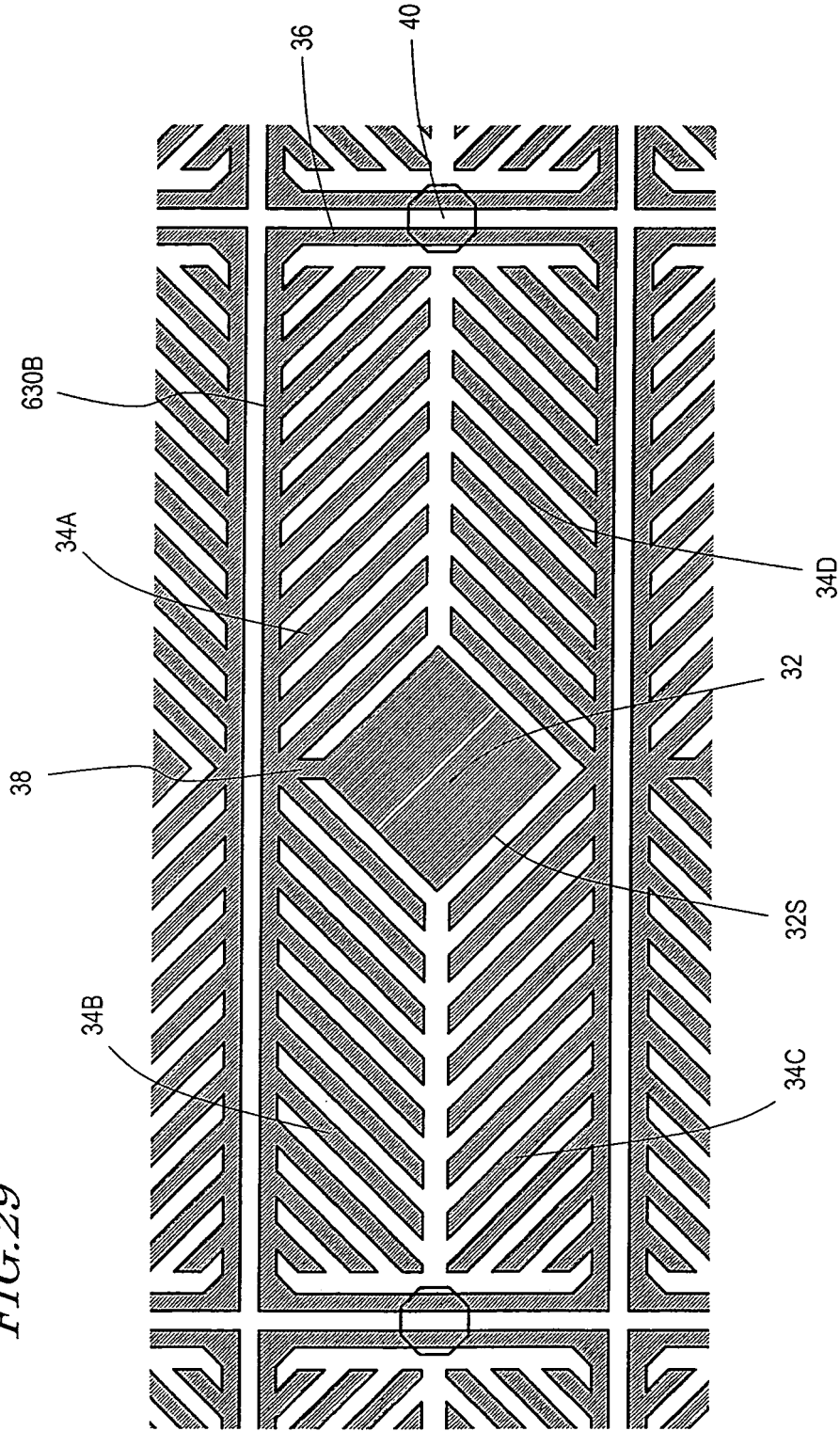


FIG.30

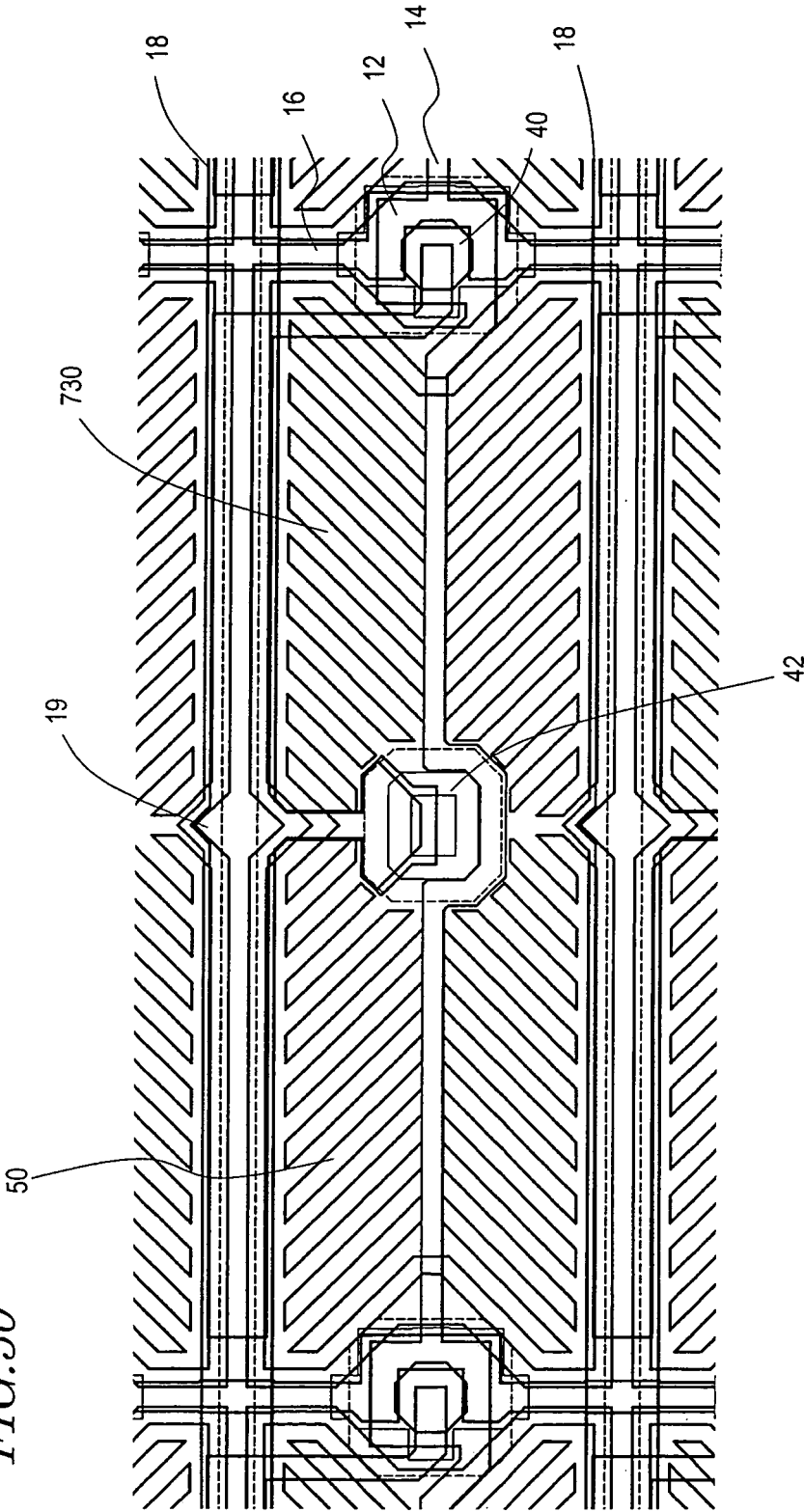
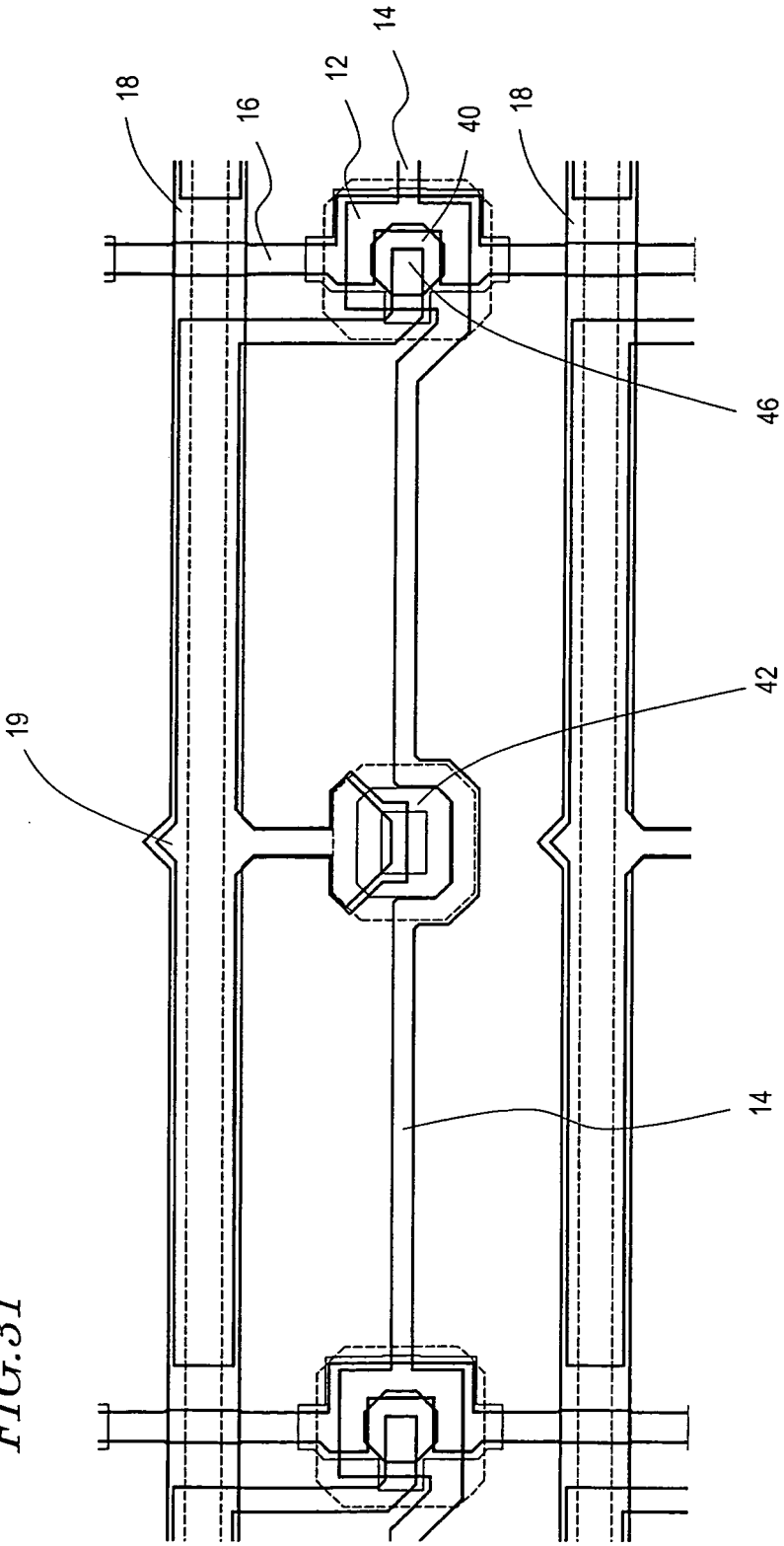


FIG.31



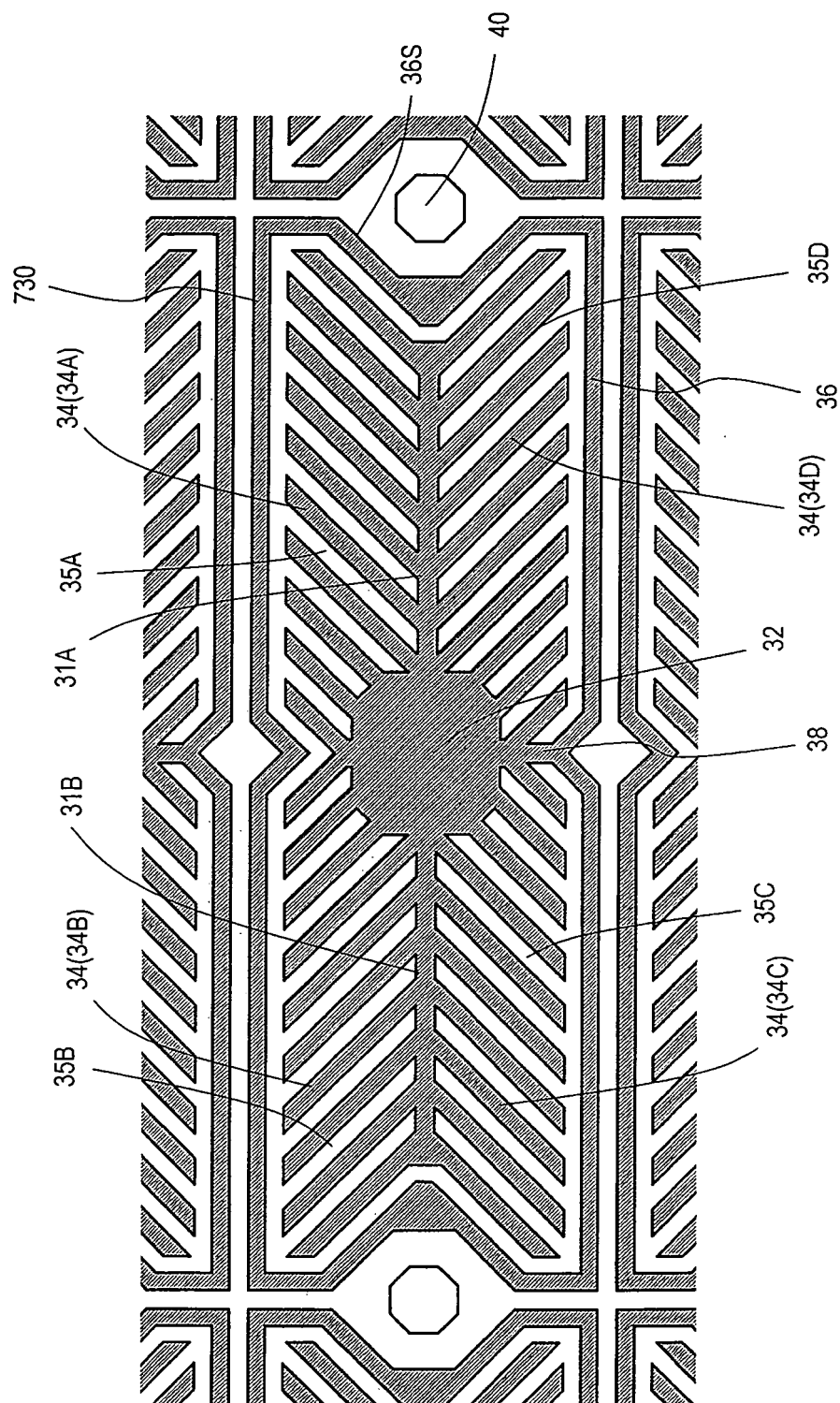
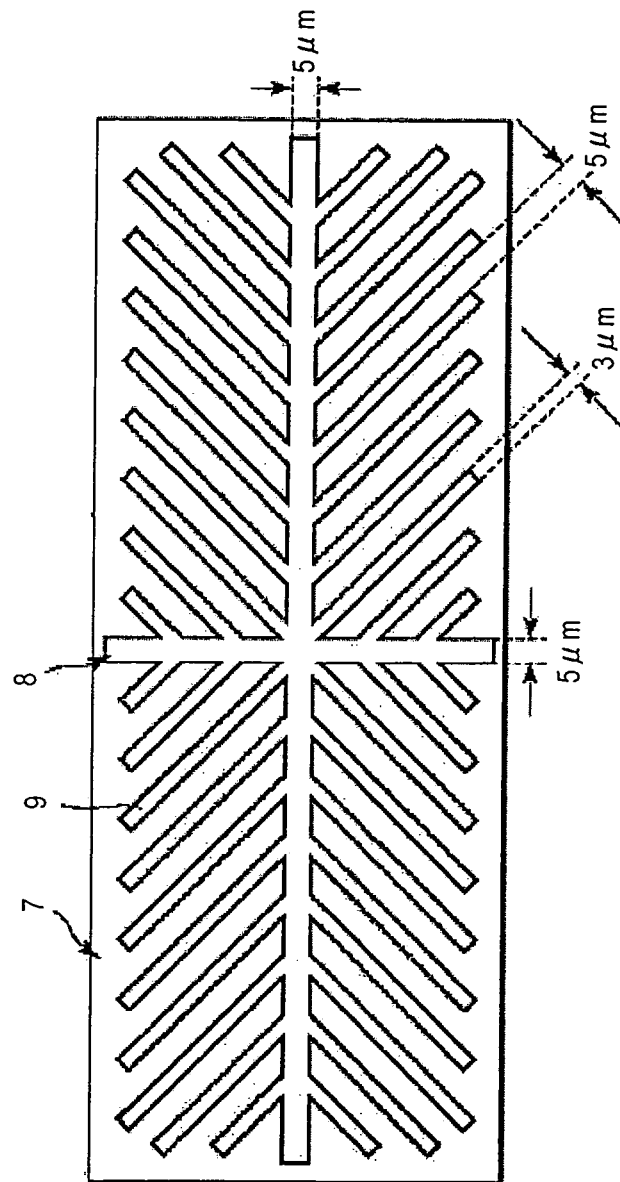


FIG. 32

FIG. 33



REFERENCES CITED IN THE DESCRIPTION

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- JP 11242225 A [0007]
- JP 2002357830 A [0007]
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专利名称(译)	液晶显示装置		
公开(公告)号	EP2472311B1	公开(公告)日	2017-05-03
申请号	EP2010811753	申请日	2010-08-19
[标]申请(专利权)人(译)	夏普株式会社		
申请(专利权)人(译)	夏普株式会社		
当前申请(专利权)人(译)	夏普株式会社		
[标]发明人	YOSHIDA MASAHIRO TASHIRO KUNIHIRO		
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摘要(译)

本发明的目的是提供一种具有高透射率或高视角特性的液晶显示装置。根据本发明的液晶显示装置包括像素电极 (30)，该像素电极包括外围部分 (36)，岛部分 (32) 和多个分支部分 (34)。多个分支部分 (34) 由分别在第一至第四方向上延伸的多个第一至第四分支部分 (34A至34D) 形成。通过这些分支部分，形成第一至第四区域 (35A至35D)，其中液晶分子在施加电压时在彼此不同的方向上排列。岛部分 (32) 由第一至第四区域 (35A至35D) 围绕，并且通过连接部分 (38) 连接到周边部分 (36)，但不通过多个分支部分 (34) 中的任何一个连接到周边部分 (36)。或者通过第一至第四分支部分 (34A至34D) 之一连接至外围部分 (36)。

FIG. 1

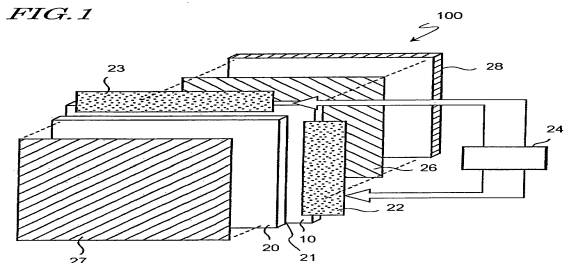


FIG. 2

