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(54) LIQUID CRYSTAL DISPLAY APPARATUS USING AN ELECTRIC FIELD SUBSTANTIALLY PARALLEL TO THE SUBSTRATE SURFACES

FLÜSSIGKRISTALLANZEIGEVORRICHTUNG MIT EINEM IM WESENTLICHEN ZU DEN SUBSTRATOBERFLÄCHEN PARALLELEN ELEKTRISCHEN FELD

APPAREIL D’AFFICHAGE A CRISTAUX LIQUIDES UTILISANT UN CHAMP ELECTRIQUE SENSIBLEMENT PARALLELE AUX SURFACES DE SUBSTRAT

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Description

Technical Field

[0001] The present invention relates to a liquid crystal display apparatus which performs display by using an electric field parallel with substrate surfaces to control a direction of liquid crystal molecules in a plane parallel with the substrate surfaces.

Background Art

[0002] As a liquid crystal display apparatus, there is known one having a configuration in which a liquid crystal layer having liquid crystal molecules aligned in substantially parallel with substrate surfaces with long axes being aligned in one direction is provided between a pair of substrates facing each other with a gap therebetween. Pixel electrodes and a common electrode which are insulated from each other are provided on an inner surface of one of the substrates facing each other in order to generate an electric field which controls an alignment direction of the liquid crystal molecules in a plane substantially parallel with the substrate surfaces.

[0003] Conventionally, this liquid crystal display apparatus is configured to include on an inner surface corresponding to each pixel region, and a plurality of pixel electrodes provided on an insulating layer covering the common electrode in accordance with the common electrode. A plurality of thin film transistors respectively are connected with these pixel electrodes also, there are provided a plurality of scanning lines which supply gate signals to the thin film transistors in respective rows, and a plurality of signal lines which supply data signals to the thin film transistors in respective columns, such an apparatus is described in, for example, Jpn. Pat. Appln. KOKAI Publication No. 2002-82357.

[0004] In the conventional liquid crystal display apparatus, alignment of liquid crystal molecules in a peripheral region of each pixel is disordered, light leaks in a peripheral portion of the pixel and thus contrast is lowered, due to an influence of an electric field generated between the scanning lines or the signal lines and the pixel electrodes. Further, when a black mask is provided in order to avoid this light leak, there occurs a problem that an aperture ratio is reduced and a display image is darkened.

[0005] In the in-plane switching mode liquid crystal display device disclosed in US 2003/0184699, longitudinal cross-talk between pixels is prevented by providing a first substrate having a scanning line, a data line and a common electrode interconnect line formed thereon, and a second substrate disposed to face the first substrate while interposing a liquid crystal between the first and the second substrate, wherein between the first and the second substrate the data line is formed to cross the scanning line while interposing an insulation film, the common electrode interconnect line being located farther from the first substrate than the scanning line and the

data line, and having a width larger than those of the scanning line and the data line in order to geometrically cover the scanning line and the data line. By forming the common electrode interconnect line of a transparent conductive material the aperture ratio of the device is kept high. US 2003/0202140 discloses a scattering fringe field optical-compensated reflective and transreflective liquid crystal display comprising a pixel electrode and a common electrode consisting of a plurality of strips provided on a TFT plate to produce a fringe field to be applied to a liquid crystal layer, the pixel electrode having a rectangular shape covering substantially the whole surface of a pixel.

15 Disclosure of Invention

[0006] It is an object of the present invention to provide a liquid crystal display apparatus which can eliminate light leak in a peripheral portion of each pixel and increase contrast and an aperture ratio to display a bright image.

[0007] According to a first aspect of the present invention, there is provided a liquid crystal display as disclosed in claim 1.

25 Brief Description of Drawings

[0008] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one embodiment of the invention and some examples not falling within the scope of the claims and together with the general description given above and the detailed description of the embodiment given below, serve to explain the principles of the invention.

35 FIG. 1 is a plan view showing a part of a liquid crystal display apparatus according to a first example;

FIG. 2 is a cross-sectional view taken along a line II-II in FIG. 1;

40 FIG. 3 is a cross-sectional view taken along a line III-III in FIG. 1;

45 FIG. 4 is a cross-sectional view taken along a line IV-IV in FIG. 1;

FIG. 5 is a plan view showing a part of a liquid crystal display apparatus according to a second example;

50 FIG. 6 is a cross-sectional view taken along a line VI-VI in FIG. 5;

FIG. 7 is a plan view showing a part of a liquid crystal display apparatus according to a third example;

55 FIG. 8 is a cross-sectional view taken along a line VIII-VIII in FIG. 7;

FIG. 9 is a cross-sectional view taken along a line IX-IX in FIG. 7;

FIG. 10 is a plan view showing a part of a liquid crystal display apparatus according to an embodiment of the present invention;

FIG. 11 is a cross-sectional view taken along a line XI-XI in FIG. 10;

FIG. 12 is a plan view showing a part of a liquid crystal display apparatus according to fifth example ; and

FIG. 13 is a cross-sectional view showing a part of a liquid crystal display apparatus according to a sixth example.

Best Mode for Carrying Out the Invention

(First Example)

[0009] FIGS. 1 to 4 show a first example , in which FIG. 1 is a plan view showing a part of a liquid crystal display apparatus, FIG. 2 is a cross-sectional view taken along a line II-II in FIG. 1, FIG. 3 is a cross-sectional view taken along a line III-III in FIG. 1 and FIG. 4 is a cross-sectional view taken along a line IV-IV in FIG. 1.

[0010] This liquid crystal display apparatus is an active matrix liquid crystal display apparatus, and a liquid crystal layer 3 in which liquid crystal molecules are aligned in substantially parallel with surfaces of a pair of transparent substrates 1 and 2 facing each other with a gap therebetween with long axes being aligned in one direction is disposed between the substrates 1 and 2 as shown in FIGS. 1 to 4. On one of opposed inner surfaces of the pair of substrates 1 and 2, i.e., an inner surface of the one substrate, e.g., the substrate 2 on the opposite side of a display observation side (an upper side in FIGS. 2 and 3), there are provided follow members. A plurality of transparent pixel electrodes 4 which are arranged in a row direction (a lateral direction in FIG. 1) and a column direction (a vertical direction in FIG. 1). A plurality of thin film transistors (which will be referred to as TFTs hereinafter) 5 are respectively connected with these pixel electrodes 4. A plurality of scanning lines 12 are respectively formed along one side of each pixel electrode row and supply gate signals to the TFTs 5 in the respective rows. A plurality of signal lines 13 are respectively formed along one side of each pixel electrode column and supply data signals to the TFTs 5 in the respective columns. Finally, a transparent common electrode 15 is superimposed on the liquid crystal layer 3 side of the plurality of pixel electrodes 4 to cover the pixel electrodes 4 through an insulating film 14, at least one edge portion 15d being formed in accordance with a region corresponding to the pixel electrode 4. The common electrode 15 generates an electric field between the pixel electrode 4 and the edge portion 15d. The electric field controls an alignment

direction of the liquid crystal molecules of the liquid crystal layer 3 in a place substantially parallel with the surfaces of the substrates 1 and 2.

[0011] Respective rim portions of the pair of substrates 1 and 2 are bonded through a non-illustrated frame-like sealing material. The liquid crystal layer 3 is formed by sealing a nematic liquid crystal having a positive dielectric anisotropy in a region surrounded by the sealing material between the substrates 1 and 2.

[0012] The TFT 5 is constituted as follows, gate electrode 6 is formed on an upper surface of the substrate 2, a transparent gate insulating film 7 is formed on a substantially entire upper surface of the substrate 2 to cover the gate electrode 6. An i-type doped semiconductor film 8 is formed on this gate insulating film 7 to face the gate electrode 6. A source electrode 10 and a drain electrode 11 are respectively provided on both side portions of the i-type semiconductor film 8 with a channel region therebetween through an n-type semiconductor film 9.

[0013] The plurality of scanning lines 12 are formed on the upper surface of the substrate 2 to be electrically connected with the gate electrodes 6 of the TFTs 5, and the plurality of signal lines 13 are formed on the gate insulating film 7 to be electrically connected with the drain electrodes of TFTs 5.

[0014] Each of the plurality of pixel electrodes 4 is formed into a substantially rectangular shape which corresponds to an entire predetermined pixel region on the gate insulating film 7 by using a transparent electroconductive film such as an ITO film. The source electrode 10 of the TFT 5 corresponding to each pixel electrode 4 is electrically connected with one corner portion of this pixel electrode 4.

[0015] The transparent interlayer insulating film 14 which covers the plurality of pixel electrodes 4, TFTs 5, scanning lines 12 and signal lines 13 is formed on the substantially entire inner surface side of the substrate 2. The common electrode 15 is formed on an insulating layer constituted of the gate insulating film 7 and the interlayer insulating film 14 to cover the pixel electrodes 4.

[0016] The common electrode 15 is formed of one transparent electroconductive film such as an ITO film. This common electrode is formed to correspond to not only the upper side of the pixel electrodes 4 but also both a region between the pixel electrodes 4 adjacent each other with the scanning line 12 therebetween and a region between the pixel electrodes 4 adjacent to each other with the signal line 13 therebetween. The common electrode 15 is constituted of a plurality of elongated partial electrodes (electrode sections) 15a extending in parallel with each other at intervals along the column direction at a part corresponding to each pixel electrode 4. These electrode sections 15a are separated from each other except both end portions in a lateral direction (the column direction), by each slit 16 formed between these sub-electrodes 15a. Each partial electrode 15a has the edge portions 15d extending along each slit 16 on the slit 16 side.

[0017] In this example, the four slits 16 which are parallel to each other along the column direction are formed at a part corresponding to each of the plurality of pixel electrodes 4 of the transparent electroconductive film, and the three partial electrodes 15a are formed between these slits.

[0018] A width of each of the plurality of partial elongated electrodes 15a formed at the part of this common electrode 15 corresponding to each of the pixel electrodes 4 is set to be equal to a gap between the partial electrodes 15a adjacent to each other (a width of the slit 16).

[0019] Both side edge parts of a peripheral portion (an elongated portion extending in the column direction) 15b of the common electrode which is positioned in a region corresponding to a part of the common electrode 15 between the pixel electrodes 4 adjacent to each other with the signal line 13 therebetween are formed to have a width to face each of both peripheral portions of the pixel electrodes 4 adjacent to each other, as shown in FIG. 2.

[0020] Each of the slits 16 is formed to have a length substantially equal to a length of the pixel electrode 4 in the column direction (slightly longer as shown in FIG. 1 in this example). As shown in FIG. 3, in regard to a width of the peripheral portion 15c of the common electrode (an elongated portion extending in the row direction) between end portions of the slits 16, which is positioned in a region of the common electrode 15 corresponding to a part between the pixel electrodes 4 with the operation line 12 therebetween, its both side edge parts are formed to have a width overlapping both peripheral portions of the pixel electrodes 4 adjacent to each other.

[0021] A terminal arrangement portion which laterally extends toward the outside of the substrate 1 is formed on the substrate 2 in an edge portion at one end in at least one of the row direction and the column direction. The plurality of scanning lines 12 and signal lines 13 are electrically connected with a plurality of scanning line terminals and signal line terminals arranged and formed on the terminal arrangement portion. The common electrode 15 is electrically connected with a common electrode terminal formed on the terminal arrangement portion through a lead wiring line led from one or more positions of an outer rim thereof.

[0022] A plurality of light shielding films 17 which prevent an erroneous operation due to light of the TFTs 5 are provided on the inner surface of the other substrate 1 to respectively face the plurality of TFTs 5. Further, color filters 18R, 18G and 18B having three colors, i.e., red, green and blue are provided to respectively correspond to each of pixels (regions where an alignment state of the liquid crystal molecules is controlled by an electric field generated between the pixel electrodes 4 and side edges of the respective partial electrodes 15a of the common electrode 15) formed of the plurality of pixel electrodes 4 and the common electrode 15.

[0023] Homogeneous alignment films 19 and 20 are respectively provided on the inner surface sides of the

substrates 1 and 2 in a region surrounded by the frame-like sealing material to cover the color filters 18R, 18G and 18B and the common electrode 15.

[0024] These alignment films 19 and 20 are respectively subjected to an aligning treatment when oppositely rubbed along directions obliquely crossing each other at a predetermined angle in a range of 5° to 15° with respect to an elongated direction of each partial electrode 15a of the common electrode 15. The liquid crystal molecules in the liquid crystal layer 3, near the alignment films are aligned in substantially parallel with the surfaces of the substrates 1 and 2 with long axes being aligned in the aligning treatment direction of the corresponding alignment films 19 and 20.

[0025] Although not shown, this liquid crystal display apparatus includes a pair of polarizing plates respectively arranged on outer side of the pair of substrates 1 and 2. Of these polarizing plates, one polarizing plate is arranged in such a manner that its transmission axis becomes substantially parallel with the aligning treatment of the alignment films 19 and 20, and the other polarizing plate is arranged in such a manner that its transmission axis becomes substantially perpendicular or parallel with respect to the transmission axis of said one polarizing plate.

[0026] In this liquid crystal display apparatus, when a display signal is applied to each of the plurality of pixel electrodes 4 through each TFT 5, an electric field is generated between the edge portion of each partial electrode 15a of the common electrode 15 and the part of the pixel electrode 4 corresponding to the portion between the partial electrodes 15a, and an alignment direction of the liquid crystal molecules is controlled by this electric field in a plane substantially with the surfaces of the substrates 1 and 2, thereby effecting display.

[0027] In this liquid crystal display apparatus, the common electrode 15 is superimposed to cover the pixel electrodes 4 through the insulating film (the interlayer insulating film) 14 on the liquid crystal layer 3 side apart from the pixel electrodes 4, at least one edge portion 15d is formed in accordance with each region corresponding to each pixel electrode 4, and an electric field which controls an alignment direction of the liquid crystal molecules in a plane substantially parallel with the surfaces of the substrates 1 and 2 is generated between the pixel electrode 4 and the edge portion 15d. Therefore, an electric field which is generated in the peripheral portion of the pixel electrode 4 excluding the part between the pixel electrode 4 and the common electrode 15 is blocked off with respect to the liquid crystal layer 3. As a result, light leak can be avoided without disorder of alignment of the pixel peripheral portion.

[0028] In this liquid crystal display apparatus, the plurality of slits 16 which form the edges 15d facing the pixel electrode 4 are formed in the common electrode 15 in accordance with each region corresponding to each of the plurality of pixel electrodes 4. Thus, an electric field having a substantially uniform intensity can be generated

between each edge portion 15d of the common electrode 15 and the pixel electrode 4, thereby displaying a high-quality image.

[0029] Further, in the liquid crystal display apparatus, the plurality of scanning lines 12 which are formed along the respective pixel electrode rows and supply the gate signals to the TFTs 5 in the respective rows and the plurality of signal lines 13 which are formed along the respective pixel electrode columns and supply the data signals to the TFTs 5 in the respective columns are provided on the inner surface of the substrate 2. The common electrode 15 is formed into a shape extending in the pixel electrode row direction and the pixel electrode column direction on the insulating layer (a laminated film formed of the gate insulating film 7 covering the gate electrodes 6 of the TFTs 5 and scanning lines 12, and the interlayer insulating film 14 covering the pixel electrodes 4, the TFTs 5 and the signal lines 13) covering the plurality of pixel electrodes 4, TFTs 5, scanning lines 12 and signal lines 13 by the region covering both the region between the pixel electrodes 4 adjacent to each other with the scanning line 12 therebetween and the region between the pixel electrodes 4 adjacent to each other with the signal line 13 therebetween. The part of the common electrode 15 corresponding to the pixel electrode 4 is constituted of the plurality of partial electrodes 15a aligned in parallel with each other at intervals, and an electric field which controls an alignment direction of the liquid crystal molecules is generated between the edge portion 15d of each partial electrode 15a and the pixel electrode 4. Therefore, an electric field generated between the scanning and signal lines 12 and 13 and the edge portion of the pixel electrode 4 can be blocked off by the common electrode 15, and disorder of alignment of the liquid crystal molecules at the periphery of each pixel due to this electric field can be eliminated. Therefore, light leak between the pixels adjacent to each other can be eliminated, and an image having an excellent quality can be displayed.

[0030] That is, in this liquid crystal display apparatus, the common electrode 15 is constituted of the electroconductive film which is formed to correspond to both the region between the pixel electrodes 4 adjacent to each other with the scanning line 12 therebetween and the region between the pixel electrodes 4 adjacent to each other with the signal line 13 therebetween. The plurality of slits 16 forming the plurality of partial electrodes 15a aligned in parallel at intervals are provided at the parts of the electroconductive film corresponding to the plurality of pixel electrodes 4. Therefore, it is possible to block off both an electric field generated between the scanning line 12 and the edge portion of the pixel electrode 4 and an electric field generated between the signal line 13 and the edge portion of the pixel electrode 4 by the portions 15b and 15c of the common electrode 15 corresponding to the regions between the pixel electrodes 4 adjacent to each other.

[0031] Accordingly, an electric field generated be-

tween the scanning line 12 and the edge portion of the pixel electrode 4 and an electric field generated between the signal line 13 and the edge portion of the pixel electrode 4 do not affect the liquid crystal layer 3, and alignment of the liquid crystal molecules in the regions between the pixels adjacent to each other is not disordered. Therefore, light leak can be eliminated in the entire pixel peripheral portion.

[0032] Further, according to this liquid crystal display apparatus, the common electrode 15 is formed of the electroconductive film having the plurality of slits 16 forming the plurality of partial electrodes 15a provided at the parts corresponding to the plurality of pixel electrodes 4. Therefore, the plurality of partial electrodes 15a corresponding to the pixel electrode 4 and the portions 15b and 15c corresponding to the regions between the pixel electrodes 4 adjacent to each other in the common electrode 15 can have a substantially equal potential, and an electric field having a substantially uniform intensity can be generated between the edge portion of each partial electrode 15a of the common electrode 15 and the part of the pixel electrode 4 corresponding to the part between the partial electrodes 15a, thereby uniformly controlling the alignment direction of the liquid crystal molecules in the entire region of the pixels.

[0033] Therefore, in this liquid crystal display apparatus, there is no light leak in both the part between the adjacent pixels with the scanning line 12 therebetween and the part between the adjacent pixels with the signal line 13 therebetween. Therefore, a black mask which blocks off leak light around each pixel does not have to be provided, and an aperture ratio can be increased, thereby displaying a bright image with high contrast. Furthermore, since the pixel electrodes 4 are arranged to be closer to the substrate side as compared with the common electrode 15, a through hole or the like does not have to be provided to achieve connection with the source electrode of each TFT 5. Therefore, a manufacturing process becomes simple, and a reduction in an aperture ratio due to the through hole does not occur. Moreover, since the common electrode 15 is formed in a state where it is electrically connected with the substantially entire surface of the substrate, a high-quality image can be displayed with a uniform light transmission factor of each pixel on the entire region of the pixels.

[0034] Additionally, according to this liquid crystal display apparatus, since the plurality of pixel electrodes 4 are formed into shapes corresponding to the predetermined entire pixel region, the pixel electrodes 4 can have potentials which are substantially equal on the whole, an electric field having a further uniform intensity can be generated between the edge portion of each partial electrode 15a of the common electrode 15 and the portion of the pixel electrode 4 corresponding to the part between the partial electrodes 15a, and the alignment direction of the liquid crystal molecules can be further uniformly controlled in the entire region of the pixels, thereby displaying an image with a higher quality.

(Second Example)

[0035] FIGS. 5 and 6 show a second example, in which FIG. 5 is a plan view showing a part of a liquid crystal display apparatus and FIG. 6 is a cross-sectional view taken along a line VI-VI in FIG. 5.

[0036] In the liquid crystal display apparatus according to this example, a common electrode line 21 constituted of a metal electroconductive film having a low resistance is provided at a portion of the common electrode 15 corresponding to a region between the pixel electrodes 4 along an entire length of this region, and other structures are the same as those in the first example. Therefore, like reference numerals denote members equal to those in the first example, thereby eliminating their explanation.

[0037] Each common electrode line 21 is formed on the interlayer insulating film 14 in parallel with the scanning or line at a position overlapping the scanning or line to correspond to one of a region between the adjacent pixel electrodes 4 with the scanning line 12 therebetween, and a region between the adjacent pixel electrodes 4 with the signal line 13 therebetween. In this embodiment, the common electrode lines is provided in the region between the adjacent pixel electrodes 4 with the signal line 13 therebetween. The common electrode lines 21 are connected in common on the outer side of an arrangement region of the pixel electrodes 4, and its common connecting portion is connected with a common electrode terminal formed at a terminal arrangement portion of the substrate 2.

[0038] Additionally, the common electrode 15 is formed on the interlayer insulating film 14 to overlap the common electrode lines 21.

[0039] In this liquid crystal display apparatus according to this example, each common electrode line 21 formed of the metal electroconductive film having a low resistance is provided at the part of the common electrode 15 corresponding to the region between the pixel electrodes 4 along the entire length of this region. Therefore, a potential of the common electrode 15 of the plurality of pixels arranged in the row direction and column directions can be substantially homogenized, thereby displaying an image without luminance irregularities.

[0040] In this example, each common electrode line 21 is provided at the part of the common electrode 15 corresponding to the region between the pixel electrodes 4 adjacent to each other with the signal line 13 therebetween. However, the common electrode line 21 may be provided at a part corresponding to the region between the pixel electrodes 4 adjacent to each other with the scanning line 12 therebetween. Further, the common electrode line 21 may be provided on the common electrode 15.

[0041] In the first and second example, the common electrode 15 is formed to correspond to the plurality of pixel electrodes 4 and both the region between the pixel electrodes 4 adjacent to each other with the scanning line 12 therebetween and the region between the pixel

electrodes 4 adjacent to each other with the signal line 13 therebetween. However, the common electrode 15 may be formed to correspond to the plurality of pixel electrodes 4 and one of the region between the adjacent pixel electrodes 4 with the scanning line 12 therebetween and the region between the adjacent pixel electrodes 4 with the signal line 13 therebetween.

[0042] In this case, an electric field generated between at least one of the scanning line 12 and the signal line 13 and the edge portion of the pixel electrode 4 can be blocked off by the common electrode 15 so that disorder of alignment of the liquid crystal molecules in the region between the adjacent pixels due to this electric field can be eliminated. Therefore, light leak between the pixels adjacent to each other can be eliminated, thereby displaying an image with an excellent quality.

[0043] When the common electrode 15 is formed to correspond to the plurality of pixel electrodes 4 and one of the region between the adjacent pixel electrodes 4 with the scanning line 12 therebetween and the region between the adjacent pixel electrodes 4 with the signal line 13 therebetween in this manner, it is good enough to form the common electrode 15 of the electroconductive film which is formed to correspond to the plurality of pixel electrodes 4 and the regions between the pixel electrodes 4 in accordance with each pixel row or each pixel column, the electroconductive film being constituted of a plurality of partial electrode segment to which a plurality of slits or comb-like elongated notch portions forming a plurality of partial electrodes 15a aligned in parallel at intervals are provided at parts corresponding to the plurality of pixel electrodes 4, and a connecting portion which connects end portions of these partial electrodes in common.

(Third Example)

[0044] FIGS. 7, 8 and 9 show a third example, in which FIG. 7 is a plan view showing a part of a liquid crystal display apparatus, FIG. 8 is a cross-sectional view taken along a line VIII-VIII in FIG. 7 and FIG. 9 is a cross-sectional view taken along a line IX-IX in FIG. 7.

[0045] In the liquid crystal display apparatus according to this example, common electrode lines formed of a metal electroconductive film having a low resistance are formed in a reticular or grid pattern to correspond to both regions each positioned between adjacent pixel electrodes 4 with the signal line 13 therebetween and regions each provided between the adjacent pixel electrodes 4 with the scanning line 12 therebetween in addition to partial electrodes 15a. Other structures are the same as those in the second example. Therefore, like reference numerals denote members equal to those in the second example, thereby eliminating their explanation.

[0046] In this liquid crystal display apparatus, the common electrode line 121 constituted of the metal electroconductive film having a low resistance is formed on the interlayer insulating film 14. The common electrode line

121 as a grid-like shape includes a column wiring line portion 121a extending in parallel with the signal line 13 at a position overlapping the signal line 13 a row wiring line portion 121b electrically connected to the column wiring line portion 121a. The latter portion 121b extends in parallel with the scanning line 12 at a position overlapping the scanning line 12 between the adjacent pixel electrodes 4 with the scanning line 12 therebetween. That is, the grids common electrode line 121 is formed to surround all four outer sides of the pixel electrodes 4 by the column wiring line portions 121a and the column wiring line portions 121b. Furthermore, a part of the row wiring line portion 121b corresponding to the TFT 5 is widely formed with respect to the other portion of row wiring line portion 121b, thereby forming a light shielding portion 121c which covers the upper side of the TFT 5.

[0047] The common electrode 15 is formed to be superimposed on the interlayer insulating film 14 and the common electrode line or grid film 121.

[0048] Also, in this liquid crystal display apparatus, the common electrode 15 is constituted of a transparent electroconductive film in which a plurality of edge portions 15d aligned in parallel with each other at intervals in a region corresponding to each pixel are formed, and a metal electroconductive film formed along both the scanning line 12 extending in the row direction between the adjacent pixels and the signal line 13 extending in the column direction on the insulating film 14 of the substrate 2.

[0049] According to the liquid crystal display apparatus of this example, the parts of the common electrode line 121 extending along the scanning line 12 and the signal line 13 are provided at the portion of the common electrode 15 corresponding to the regions between the pixel electrodes 4 adjacent to each other. Therefore, a potential of the common electrode 15 of the plurality of pixels arranged in the row and column directions can be substantially homogenized, thereby displaying an image without luminance irregularities. Moreover, since the light shielding portion 121c is formed in the row wiring line portion 121b formed along the scanning line 13, the semiconductor layer of the TFT 5 can be shield against light. Therefore, a light shielding film does not have to be formed on the substrate on the opposed observation side, thus increasing a numerical apertures.

(Embodiment)

[0050] FIGS. 10 and 11 show an embodiment of the present invention, in which FIG. 10 is a plan view showing a part of a liquid crystal display apparatus, and FIG. 11 is a cross-sectional view taken along a line XI-XI in FIG. 10.

[0051] In the liquid crystal display apparatus according to this embodiment, a common electrode line or layer formed of a metal electroconductive film having a low resistance is formed in a reticular grid pattern to correspond to both regions between the adjacent pixel elec-

trodes 4 with the signal lines 13 therebetween and regions between the adjacent pixel electrodes 4 with the scanning lines 12 therebetween except regions corresponding to TFTs 5, and a light shielding film is formed in regions of the opposed substrate 1 facing the TFTs 5. Other structures are the same as those in the third example. Therefore, like reference numerals denote members equal to those in the third example, thereby eliminating their explanation.

[0052] In this liquid crystal display apparatus, a common electrode lines 221 formed of the metal electroconductive film having a low resistance is formed into a shape in which a column wiring line portion 221a extending in parallel with the signal line 13 at a position overlapping the signal line 13 is connected with a row wiring line portion 221b extending in parallel with the scanning line 12 at a position overlapping the scanning line 12 to correspond both the region between the adjacent pixel electrodes 4 with the scanning line 12 therebetween and the region between the adjacent pixel electrodes 4 with the signal line 13 therebetween on the interlayer insulating film 14. That is, this common electrode layer 221 is formed into a reticular pattern which surrounds all four outer sides of the pixel electrodes 4 by the column wiring line portions 221a and the row wiring line portions 221b. A wide portion 221c is formed in the row wiring line portion 221b of the common electrode line 221 formed in parallel with the scanning line 12 in a region corresponding to the TFT 5, and an opening 221d is formed in a part of this wide portion 221c. corresponding to the TFT 5.

[0053] A transparent electroconductive film of the common electrode 15 is formed to be superimposed on the interlayer insulating film 14 and the common electrode line 22 except the openings 221d of the row wiring line portion 221b. Therefore, the common electrode 15 formed of the transparent electroconductive film and the metal electroconductive film is formed in a region excluding the upper side of each TFT 5.

[0054] A light shielding film 217 is provided in a region corresponding to each TFT 5, on an inner surface of the second substrate 1 as an observation side facing the first substrate 2.

[0055] As described above, in this liquid crystal display apparatus, the common electrode 15 formed of the transparent electroconductive film and the metal electroconduction film, the transparent film being formed to correspond pixel electrodes 4 on the liquid crystal layer 3 side apart from each pixel electrodes 4 through the insulating film 14 and in which a plurality of edge portions aligned in parallel with each other at intervals in regions corresponding to pixels, and the metal film being formed along both the scanning lines 12 extending in the row direction between the pixels adjacent to each other and the signal lines 13 extending in the column direction in regions corresponding to the TFTs 5 to cover these scanning lines 12 and signal lines 13. Furthermore, the light shielding film 217 is arranged in the region corresponding to each TFT 5.

[0056] According to the liquid crystal display apparatus of this embodiment, the common electrode line 221 formed of the metal electroconductive film having a low resistance is provided at portions of the common electrode 15 corresponding to the regions between the pixel electrodes 4 adjacent to each other along the scanning lines 12 and the signal lines 13. Therefore, a potential of the common electrode 15 of the plurality of pixels arranged in the row direction and the column direction can be substantially homogenized, thereby displaying an image without luminance irregularities. Moreover, since the common electrode 15 formed of the transparent electroconductive film and the metal electroconductive film is formed in the regions excluding the upper sides of TFTs 5, a stray capacity formed between the common electrode 15 and the TFTs 5 can be reduced, and a load applied to a driver of the liquid crystal display apparatus can be decreased. Additionally, just forming the light shielding film 217 which shields each TFT 5 alone against light on the second substrate 1 can suffice, thus increasing a aperture ratio of each pixel.

(Fifth Example)

[0057] The description has been given as to the example in which each slit is formed in parallel with the signal line 13 and each partial electrode 15a is provided in parallel with the signal line 13 in the common electrode 15 in conjunction with the first to fourth embodiments. However, the liquid crystal display apparatus according to the present invention is not restricted thereto, and each slit may be obliquely formed with respect to the signal line 13 as shown in FIG. 12.

[0058] FIG. 12 shows a liquid crystal display apparatus according to the fifth example, and it is a plan view showing a planar shape of a common electrode formed on a first substrate when a structure of the common electrode according to this embodiment is applied to the third example. This fifth example is different from the third example in a shape of the common electrode alone, and other structures are the same. Therefore, like reference numerals denote like members, thereby eliminating their explanation.

[0059] As shown in FIG. 12, each slit 116 formed in a common electrode 115 is formed in a direction obliquely crossing an aligning treatment direction 20a of an alignment film 20 to form each edge portion 115d which crosses in an oblique state except perpendicular and parallel states a direction of long axes of liquid crystal molecules aligned by the alignment film 20 formed on an inner surface of the substrate 2. That is, in the common electrode 115, according to this example, the slits 116 forming the plurality of edge portions 115d aligned in parallel with each other at intervals are provided, and these slits are bent in a V-like shape to form the edge portions which cross in an oblique state except perpendicular and parallel states the aligning treatment direction 20a indicated by an arrow of the alignment film 20 formed on the inner

surface of the substrate 2.

[0060] According to this configuration, when a voltage is applied between each pixel electrode 4 and the common electrode 115 with respect to liquid crystal molecules initially aligned between the pair of substrates, an electric field in an oblique direction is applied to the liquid crystal molecules. Therefore, behaviors of the liquid crystal molecules can be uniformed, thereby avoiding disorder of alignment of the liquid crystal molecules in each pixel.

[0061] It is to be noted that the shape of this common electrode can be applied to the embodiment.

(Sixth Example)

[0062] Although each of the plurality of pixel electrodes 4 is formed into a substantially rectangular shape corresponding to a predetermined entire pixel region, in the first to fifth example, the pixel electrode 4 may be formed into a comb-like shape corresponding to regions between the plurality of partial electrodes 15a of the common electrode 15.

[0063] The pixel electrode is formed into a comb-like shape in the sixth example, and FIG. 13 shows an example in which this pixel electrode configuration is applied to the liquid crystal display apparatus according to the third example. The sixth example is different from the third example in a shape of the pixel electrode alone, and other structures are the same. Therefore, like reference numerals denote like members, thereby eliminating their explanation.

[0064] As shown in FIG. 13, in the pixel electrode configuration according to this example, a plurality of opening portions 104b are formed in each pixel electrode 104 to form a plurality of pixel partial electrodes 104a. This opening portion 104b has a shape corresponding to a slit 16 formed in the common electrode 15 in a region corresponding to this pixel electrode 104, and it is formed in a region overlapping the slit 16 of the common electrode 15.

[0065] Further, it is desirable to form both side edges of a part of this pixel electrode 104 corresponding to a region between the partial electrodes 104a to have widths respectively facing edge portions of the partial electrodes 15a adjacent to each other in the common electrode 15.

[0066] Such a shape of the common electrode also, can be applied to the embodiment.

[0067] According to this pixel electrode 104, since a total area overlapping the common electrode 15 is reduced, a stray capacity generated between the pixel electrode 104 and the common electrode 15 can be reduced, thereby decreasing a load applied to a driver of the liquid crystal display apparatus.

[0068] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiment shown and

described herein.

Claims

1. A liquid crystal display apparatus comprising:

a pair of substrates (1, 2) arranged to face each other with a gap therebetween;

a liquid crystal layer (3) which is disposed in the gap between the pair of substrates (1, 2) with long axes of liquid crystal molecules being aligned in one direction, substantially parallel to substrate surfaces;

a plurality of thin film transistors (5) which are arranged in a row direction and a column direction on an inner surface side of one (2) of the pair of substrates (1, 2) that faces the other substrate (1), and to which display signals corresponding to display data are supplied;

a plurality of pixel electrodes (4) which are provided on the inner surface side of said one substrate (2) to be electrically connected with the thin film transistors (5), and to which the display signals are supplied from the thin film transistors (5); and

a common electrode (15, 221) which is formed on the inner surface side of said one substrate (2) between the pixel electrodes (4) and the liquid crystal layer (3) to correspond to the pixel electrode (4) through an insulating film (14), and generates an electric field which controls an alignment direction of the liquid crystal molecules in a plane substantially parallel with the substrate surfaces between itself and the pixel electrode (4),

wherein a plurality of scanning lines (12) which are respectively arranged between respective pixel electrode rows along the row direction and supply scanning signals to the thin film transistors (5) in the respective rows, and a plurality of signal lines (13) which are respectively arranged between respective pixel electrode columns along the column direction and supply display signals to the thin film transistors (5) in the respective columns are further provided on the inner surface side of the one substrate (2), and the common electrode (15, 221) is formed on the insulating layer (14) covering the plurality of pixel electrodes (4), thin film transistors (5), scanning lines (12) and signal lines (13) to cover both a region between the pixel electrodes (4) adjacent to each other with the scanning line (12) therebetween and a region between the pixel electrodes (4) adjacent to each other with the signal line (13) therebetween, a plurality of slits having edge portions (15d) aligned in parallel with each other at intervals are formed in a region (15) of the common electrode correspond-

ing to the pixel electrode (4), such that an electric field which controls an alignment direction of the liquid crystal molecule can be generated between each of the edge portions (15d) and the pixel electrode (4),

characterized in that

the common electrode (15, 221) is constituted of a transparent electroconductive film in which the plurality of slits having edge portions (15d) aligned in parallel with each other at intervals in a region (15) corresponding to each pixel are formed, and of a metal electroconductive film (221) which is formed along at least one of the scanning lines (12) and the signal lines (13) and excluding a region (221 d) corresponding to the thin film transistor (5) thereby covering the scanning lines (12) or the signal lines (13) on the insulating film (14) of said one substrate (2).

2. A liquid crystal display apparatus according to claim 1, wherein the common electrode (15, 221) is constituted of a transparent electroconductive film, and a metal electroconductive film which is formed along both the scanning lines (12) extending in the row direction between pixels adjacent to each other and the signal lines (13) extending in the column direction between the same to cover the scanning lines (12) and the signal lines (13).

3. The liquid crystal display apparatus according to claim 1 or 2, further comprising a light shielding film (217) which is formed on an inner surface side of the other one (1) of the pair of substrates (1, 2) in a region corresponding to each of the thin film transistors (5).

4. The liquid crystal display apparatus according to claim 1, wherein the insulating film (14) interposed between the pixel electrode (4) and the common electrode (15, 221) on said one substrate (2) includes a flattened film which is formed to cover the pixel electrodes (4), the thin film transistor (5) and wiring lines (12, 13) connected with the transistors (5) and forms the inner surface side of said one substrate (2) as a flat surface.

5. The liquid crystal display apparatus according to claim 1, wherein the common electrode (15, 221) is formed on a substantially entire surface on an upper side of the insulating film (14) covering the plurality of pixel electrodes (4), and the thin film transistors (5), and slits (16) forming a plurality of edge portions (15d) aligned in parallel with each other at intervals in order to generate an electric field which controls an alignment direction of the liquid crystal molecules between the common electrode (15, 221) and the pixel electrode (4) are formed in a region (15) of the common electrode corresponding to the pixel electrode (4).

6. The liquid crystal display apparatus according to

claim 5, wherein the slits (16) formed in the common electrode (15, 221) are extended in a direction obliquely crossing a direction of aligning treatment of an alignment film (20) to form edge portions crossing in an oblique state except perpendicular and parallel states a direction of long axes of the liquid crystal molecules aligned by the alignment film (20) formed on the surface of said one substrate (2).

7. The liquid crystal display apparatus according to claim 5, wherein the slits (116) formed in the common electrode (115) are extended into a bent shape to form edge portions (115d) crossing in an oblique state except perpendicular and parallel states the aligning treatment direction of the alignment film (20) formed on the surface of said one substrate (2).
8. The liquid crystal display apparatus according to claim 5, wherein each of the pixel electrodes (104) has a shape corresponding to the slits (16) formed in the common electrode (15, 221) in the region (15) corresponding to the pixel, and is constituted of a transparent electroconductive film having opening portions (104b) formed in a region overlapping the slits (16) of the common electrode (15, 221).
9. The liquid crystal display apparatus according to claim 1, wherein each of the pixel electrodes (4) is constituted of one substantially rectangular transparent electroconductive film having an area corresponding to the pixel.

Patentansprüche

1. Flüssigkristall-Anzeigevorrichtung, die umfasst:

paarige Substrate (1, 2), die so angeordnet sind, dass sie einander mit einem Zwischenraum dazwischen zugewandt sind;

eine Flüssigkristallschicht (3), die in dem Zwischenraum zwischen den paarigen Substraten (1, 2) angeordnet ist, wobei Längsachsen von Flüssigkristallmolekülen in einer Richtung im Wesentlichen parallel zu Substratflächen ausgerichtet sind;

eine Vielzahl von Dünnschichttransistoren (5), die in einer Reihenrichtung und einer Spaltenrichtung an einer Innenflächenseite (1, 2) der paarigen Substrate (1, 2) angeordnet sind, die dem anderen Substrat (1) zugewandt sind, und an die Anzeigesignale angelegt werden, die zugeführten Anzeigedaten entsprechen;

eine Vielzahl von Pixelelektroden (4), die an der Innenflächenseite des einen Substrats (2) so vorhanden sind, dass sie elektrisch mit den Dünnschichttransistoren (5) verbunden sind, und denen die Anzeigesignale von den Dünnschichttransistoren (5) zugeführt werden;

und eine gemeinsame Elektrode (15, 221), die an der Innenflächenseite des einen Substrats (2) zwischen den Pixel-Elektroden (4) und der Flüssigkristallschicht (3) so ausgebildet ist, dass sie der Pixel-Elektrode (4) über einen Isolierfilm (14) entspricht, und

die ein elektrisches Feld erzeugt, das eine Ausrichtung der Flüssigkristallmoleküle in einer Ebene im Wesentlichen parallel zu den Substratflächen zwischen ihr und der Pixel-Elektrode steuert,

wobei des Weiteren eine Vielzahl von Abtastleitungen (12), die jeweils zwischen jeweiligen Reihen von Pixel-Elektroden in der Reihenrichtung angeordnet sind und den Dünnschichttransistoren (5) in den jeweiligen Reihen Abtastsignale zuführen, und eine Vielzahl von Signalleitungen (13), die jeweils zwischen jeweiligen Spalten von Pixel-Elektroden in der Spaltenrichtung angeordnet sind und den Dünnschichttransistoren (5) in den jeweiligen Spalten Anzeigesignale zuführen, an der Innenflächenseite des einen Substrats (2) vorhanden sind, und die gemeinsame Elektrode (15, 221) an der Isolierschicht (14) ausgebildet ist und die Vielzahl von Pixel-Elektroden (4), Dünnschichttransistoren (5), Abtastleitungen (12) und Signalleitungen (13) abdeckt und damit sowohl einen Bereich zwischen den Pixel-Elektroden, die über die dazwischen befindliche Abtastleitung (12) aneinander grenzen, als auch einen Bereich zwischen den Pixel-Elektroden (4) abdeckt, die über die dazwischen befindliche Signalleitung (13) aneinander grenzen, wobei eine Vielzahl von Schlitzen mit Randabschnitten (15d), die parallel zueinander in Intervallen ausgerichtet sind, in einem Bereich (15) der gemeinsamen Elektrode ausgebildet sind, der der Pixel-Elektrode (4) entspricht, so dass ein elektrisches Feld, das eine Ausrichtung der Flüssigkristall-Moleküle steuert, zwischen jedem der Randabschnitte (15d) und der Pixel-Elektrode (4) erzeugt werden kann,

dadurch gekennzeichnet, dass

die gemeinsame Elektrode (15, 221) aus einem transparenten, elektrisch leitenden Film, in dem die Vielzahl von Schlitzen mit Randabschnitten (15d), die parallel zueinander in Intervallen in einem Bereich (15) ausgerichtet sind, der jedem Pixel entspricht, ausgebildet sind, und einem elektrisch leitenden Film (221) aus Metall besteht, der entlang wenigstens einer der Abtastleitungen (12) und der Signalleitungen (13) mit Ausnahme eines Bereiches (221d) ausgebildet ist, der dem Dünnschichttransistor (5) entspricht, um so die Abtastleitungen (12) oder die Signalleitungen (13) auf dem isolierenden Film (14) des Substrats (2) abzudecken.

2. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1,

- wobei die gemeinsame Elektrode (15, 221) aus einem transparenten elektrisch leitenden Film und einem elektrisch leitenden Film aus Metall besteht, der entlang sowohl der Abtastzeilen (12), die in der Reihenrichtung zwischen aneinandergrenzenden Pixeln verlaufen, als auch der Signalleitungen (13), die in der Spaltenrichtung zwischen diesen verlaufen, so ausgebildet ist, dass er die Abtastleitungen (12) und die Signalleitungen (13) abdeckt.
3. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1 oder 2, die des Weiteren einen Lichtabschirmfilm (217) umfasst, der an einer Innenflächenseite des anderen (1) der paarigen Substrate (1, 2) in einem Bereich ausgebildet ist, der jedem der Dünnschichttransistoren (5) entspricht.
 4. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, wobei der isolierende Film (14), der zwischen der Pixel-Elektrode (4) und der gemeinsamen Elektrode (15, 221) auf dem Substrat (2) angeordnet ist, einen abgeflachten Film enthält, der so ausgebildet ist, dass er die Pixel-Elektroden (4), die Dünnschicht-Transistoren (5) und Verdrahtungsleitungen (12, 13) abdeckt, die mit den Transistoren (5) verbunden sind, und die Innenflächenseite des einen Substrats (2) als eine plane Fläche bildet.
 5. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, wobei die gemeinsame Elektrode (15, 221) im Wesentlichen auf einer gesamten Fläche an einer Oberseite des Isolierfilms (14) die Vielzahl von Pixel-Elektroden (4) und die Dünnschichttransistoren (5) abdeckend ausgebildet ist, und Schlitze (16), die eine Vielzahl von Randabschnitten (15d) aufweisen, die parallel zueinander in Intervallen ausgerichtet sind, um ein elektrisches Feld zu erzeugen, das eine Ausrichtrichtung der Flüssigkristallmoleküle zwischen der gemeinsamen Elektrode (15, 221) und der Pixel-Elektrode (4) steuert, in einem Bereich (15) der gemeinsamen Elektrode ausgebildet sind, der der Pixel-Elektrode (4) entspricht.
 6. Flüssigkristall-Anzeigevorrichtung nach Anspruch 5, wobei die Schlitze (16), die in der gemeinsamen Elektrode (15, 221) ausgebildet sind, in einer Richtung verlaufen, die eine Richtung der Ausrichtbehandlung eines Ausrichtfilms (20) schräg schneidet, so dass Randabschnitte entstehen, die in einem schrägen Zustand mit Ausnahme senkrechter und paralleler Zustände eine Richtung von Längsachsen der Flüssigkristallmoleküle schneiden, die durch den Ausrichtfilm (20) ausgerichtet werden, der an der Oberfläche des einen Substrats (2) ausgebildet ist.
 7. Flüssigkristall-Anzeigevorrichtung nach Anspruch 5, wobei die Schlitze (116), die in der gemeinsamen Elektrode (115) ausgebildet sind, in einer gebogenen Form verlaufen, so dass sie Randabschnitte (115d) bilden, die in einem schrägen Zustand mit Ausnahme senkrechter und paralleler Zustände die Ausrichtbehandlungs-Richtung des Ausrichtfilms (20) schneiden, der an der Oberfläche des einen Substrats (2) ausgebildet ist.
 8. Flüssigkristall-Anzeigevorrichtung nach Anspruch 5, wobei jede der Pixel-Elektroden (104) eine Form hat, die den Schlitzen (16) entspricht, die in der gemeinsamen Elektrode (15, 221) in dem Bereich (15) ausgebildet sind, der dem Pixel entspricht, und aus einem transparenten elektrisch leitenden Film besteht, der Öffnungsabschnitte (104b) aufweist, die in einem Bereich ausgebildet sind, der die Schlitze (16) der gemeinsamen Elektrode (15, 221) überlappt.
 9. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, wobei jede der Pixel-Elektroden (4) aus einem im Wesentlichen rechteckigen transparenten elektrisch leitenden Film besteht, der eine Flächenausdehnung hat, die dem Pixel entspricht.

Revendications

1. Appareil à écran à cristaux liquides comportant :

une paire de substrats (1, 2) disposés en vis-à-vis avec un intervalle entre eux ;
 une couche de cristaux liquides (3) qui est disposée dans l'intervalle entre la paire de substrats (1, 2) comportant des axes longs de molécules de cristaux liquides alignés dans une direction, sensiblement parallèles aux surfaces de substrat ;
 une pluralité de transistors à film mince (5) qui sont disposés dans une direction de rangée et dans une direction de colonne sur un côté de surface interne de l'un (2) de la paire de substrats (1, 2) qui est opposé à l'autre substrat (1), et auxquels des signaux d'affichage correspondant aux données d'affichage sont délivrés ;
 une pluralité d'électrodes de pixel (4) qui sont prévues sur un côté de surface interne dudit substrat (2) pour être électriquement reliées aux transistors à film mince (5), et auxquelles des signaux d'affichage sont délivrés depuis les transistors à film mince (5) ; et
 une électrode commune (15, 221) qui est formée sur le côté de surface interne dudit substrat (2) entre les électrodes de pixel (4) et la couche de cristaux liquides (3) pour correspondre à l'électrode de pixel (4) par l'intermédiaire d'un film isolant (14), et génère un champ électrique qui contrôle une direction d'alignement des molécules de cristaux liquides dans un plan sensiblement parallèle aux surfaces de substrat entre

elle et l'électrode de pixel (4), dans lequel une pluralité de lignes de balayage (12) qui sont respectivement disposées entre les rangées d'électrodes de pixel respectives le long de la direction de rangée et délivrent des signaux de balayage aux transistors à film mince (5) dans les rangées respectives, et une pluralité de lignes des signal (13) qui sont respectivement disposées entre des colonnes d'électrodes de pixel respectives le long de la direction de colonne et délivrent des signaux d'affichage aux transistors à film mince (5) dans les colonnes respectives sont en outre prévues sur le côté de surface interne du substrat (2), et l'électrode commune (15, 221) est formée sur la couche isolante (14) recouvrant la pluralité d'électrodes de pixel (4), les transistors à film mince (5), les lignes de balayage (12) et les lignes de signal (13) pour couvrir à la fois une région entre les électrodes de pixel (4) adjacentes les unes aux autres avec la ligne de balayage (12) entre elles et une région entre les électrodes pixel (4) adjacentes les unes aux autres avec la ligne du signal (13) entre elles, une pluralité de fentes possédant des parties de bord (15d) alignées en parallèle les unes aux autres selon des intervalles sont formées dans une région (15) de l'électrode commune correspondant à l'électrode de pixel (4) de sorte qu'un champ électrique qui contrôle une direction d'alignement des molécules de cristaux liquides peut être généré entre chacune des parties de bord (15d) et l'électrode de pixel (4),

caractérisé en ce que

l'électrode commune (15, 221) est constituée d'un film électroconducteur transparent dans lequel la pluralité de fentes possédant des parties de bord (15d) alignées en parallèle les unes avec les autres selon des intervalles dans une région (15) correspondant à chaque pixel sont formées, et un film électroconducteur métallique (221) qui est formé le long d'au moins une des lignes de balayage (12) et des lignes de signal (13) et excluant une région (221d) correspondant au transistor à film mince (5) recouvrant ainsi les lignes de balayage (12) ou les lignes de signal (13) sur le film isolant (14) dudit substrat (2).

2. Appareil à écran à cristaux liquides selon la revendication 1, dans lequel l'électrode commune (15, 221) est constituée d'un film électroconducteur transparent et d'un film électroconducteur métallique, qui est formée le long à la fois des ligne de balayage (12) s'étendant dans la direction de rangée entre des pixels adjacents les uns aux autres et les lignes de signal (13) s'étendant dans la direction de colonne entre ceux-ci pour recouvrir les lignes de

balayage (12) et les lignes de signal (13).

3. Appareil à écran à cristaux liquides selon la revendication 1 ou 2, comportant en outre un film de protection contre la lumière (217) qui est formé sur un côté de surface interne de l'autre (1) de la paire de substrats (1, 2) dans une région correspondant à chacun des transistors à film mince (5).
4. Appareil à écran à cristaux liquides selon la revendication 1, dans lequel le film isolant (14) interposé entre l'électrode de pixel (4) et l'électrode commune (15, 221) sur ledit substrat (2) comprend un film aplati qui est formé pour recouvrir les électrodes de pixel (4), le transistor à film mince (5) et les lignes de câblage (12, 13) reliées au transistor (5) et forme le côté de surface interne dudit substrat (2) en tant que surface plate.
5. Appareil à écran à cristaux liquides selon la revendication 1, dans lequel l'électrode commune (15, 221) est formée sur sensiblement toute la surface sur un côté supérieur du film isolant (14) recouvrant la pluralité d'électrodes de pixel (4), et les transistors à film mince (5), et les fentes (16) formant une pluralité de parties de bord (15d) alignées en parallèle les unes avec les autres selon des intervalles afin de générer un champ électrique qui contrôle une direction d'alignement des molécules à cristaux liquides entre l'électrode commune (15, 221) et l'électrode de pixel (4) sont formées dans une région (15) de l'électrode commune correspondant à l'électrode de pixel (4).
6. Appareil à écran à cristaux liquides selon la revendication 5, dans lequel les fentes (16) formées dans l'électrode commune (15, 221) s'étendent dans une direction croisant obliquement une direction de traitement d'alignement d'un film d'alignement (20) pour former des parties de bord croisant selon un état oblique sauf des états perpendiculaires et parallèles une direction d'axes longs des molécules à cristaux liquides alignés par le film d'alignement (20) formé sur la surface dudit substrat (2).
7. Appareil à écran à cristaux liquides selon la revendication 5, dans lequel les fentes (116) formées dans l'électrode commune (115) s'étendent selon une forme courbée pour former des parties de bord (115d) croisant dans un état oblique sauf des états perpendiculaires et parallèles la direction de traitement d'alignement du film d'alignement (20) formé sur la surface dudit substrat (2).
8. Appareil à écran à cristaux liquides selon la revendication 5, dans lequel chacune des électrodes de pixel (104) possède une forme correspondant aux fentes (16) formées dans l'électrode commune (15,

221) dans la région (15) correspondant au pixel, et est constituée d'un film électroconducteur transparent possédant des parties d'ouverture (104b) formées dans une région recouvrant les fentes (16) de l'électrode commune (15, 221).

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9. Appareil à écran à cristaux liquides selon la revendication 1, dans lequel chacune des électrodes de pixel (4) est constituée d'un film électroconducteur transparent sensiblement rectangulaire possédant une zone correspondant au pixel.

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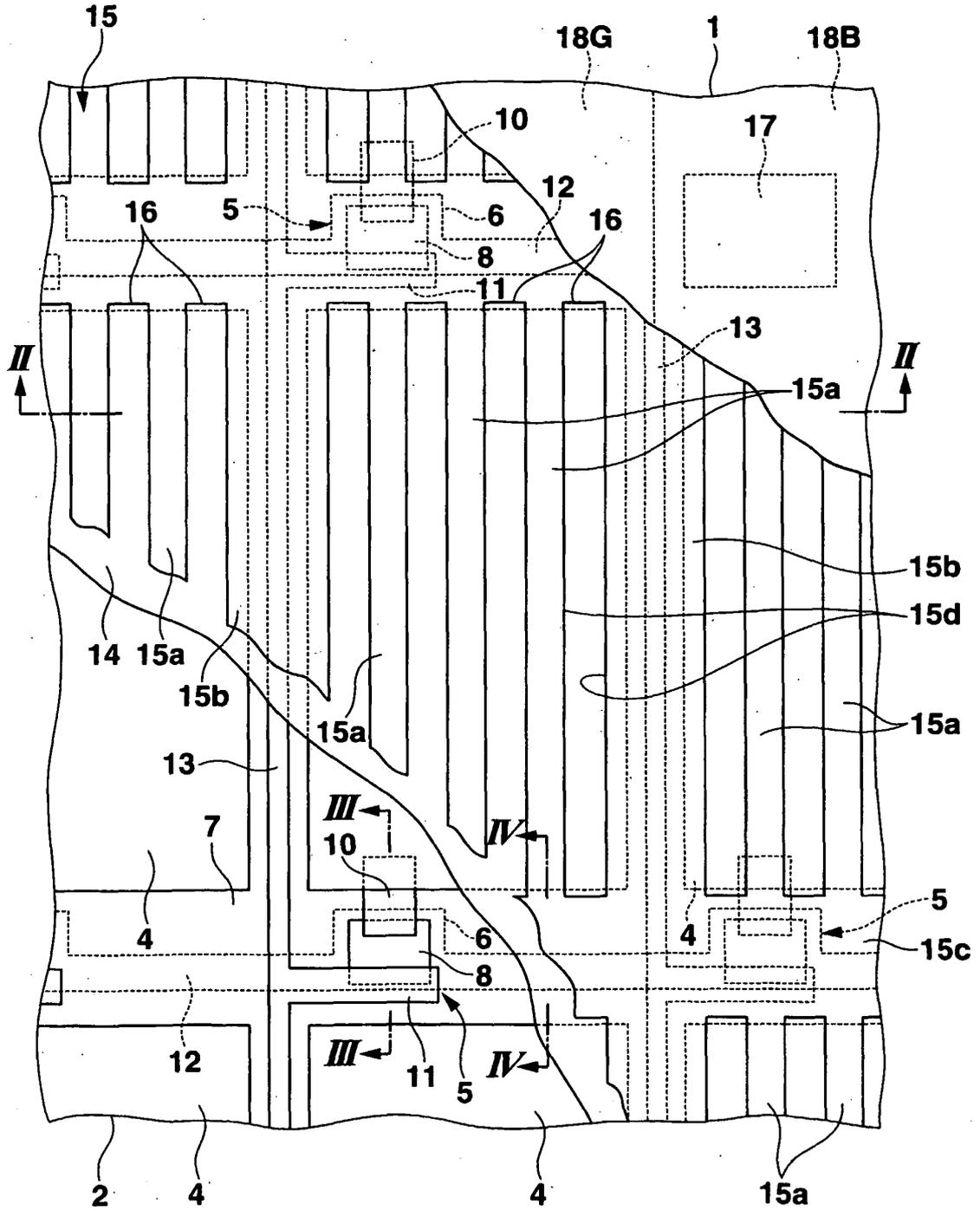


FIG. 1

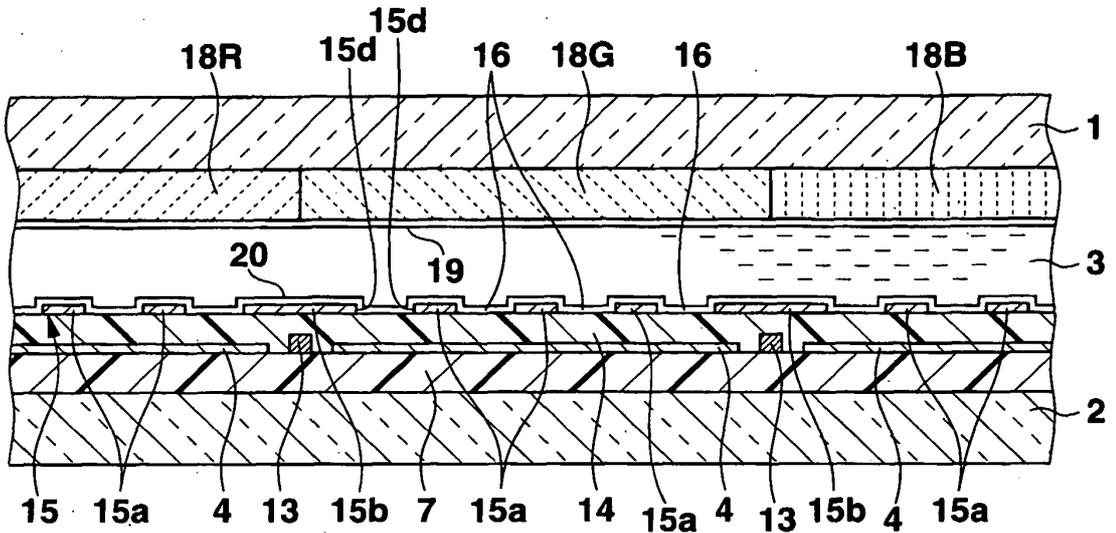


FIG.2

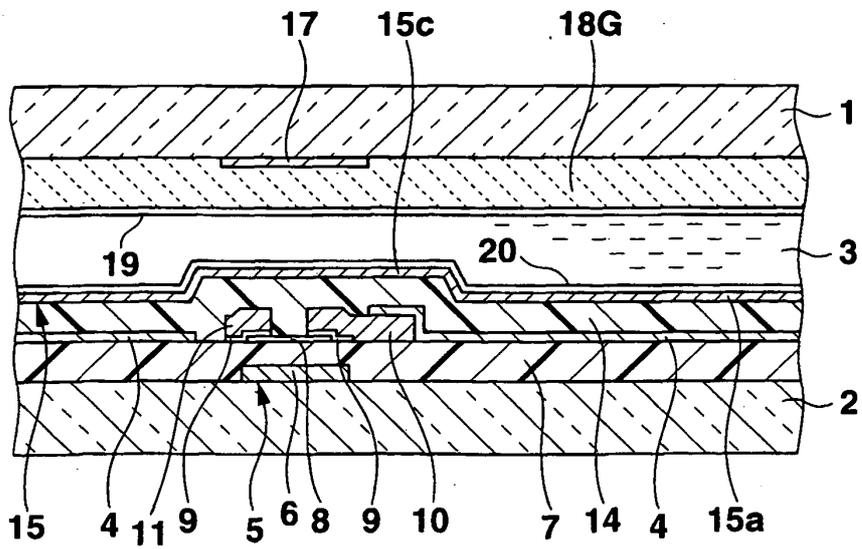


FIG.3

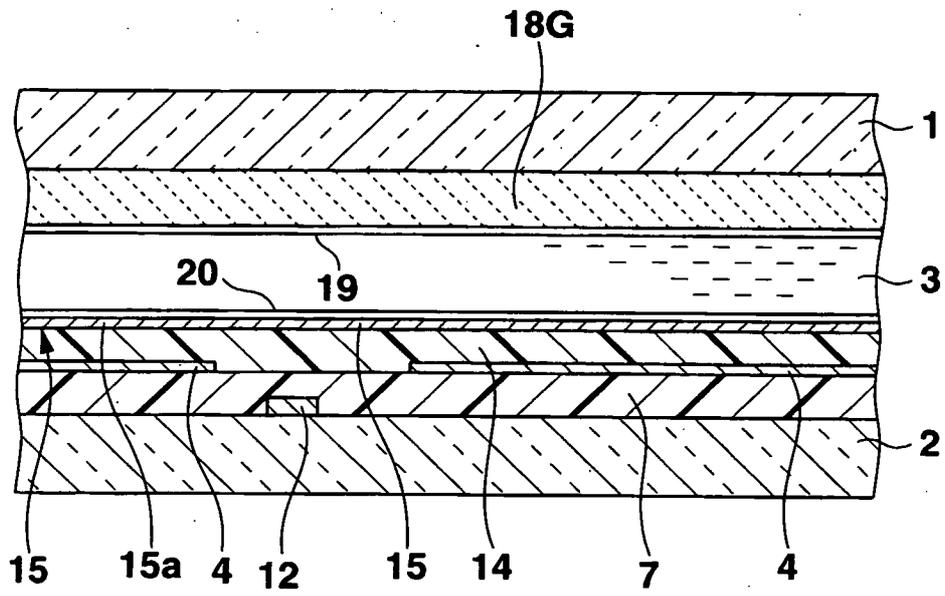


FIG.4

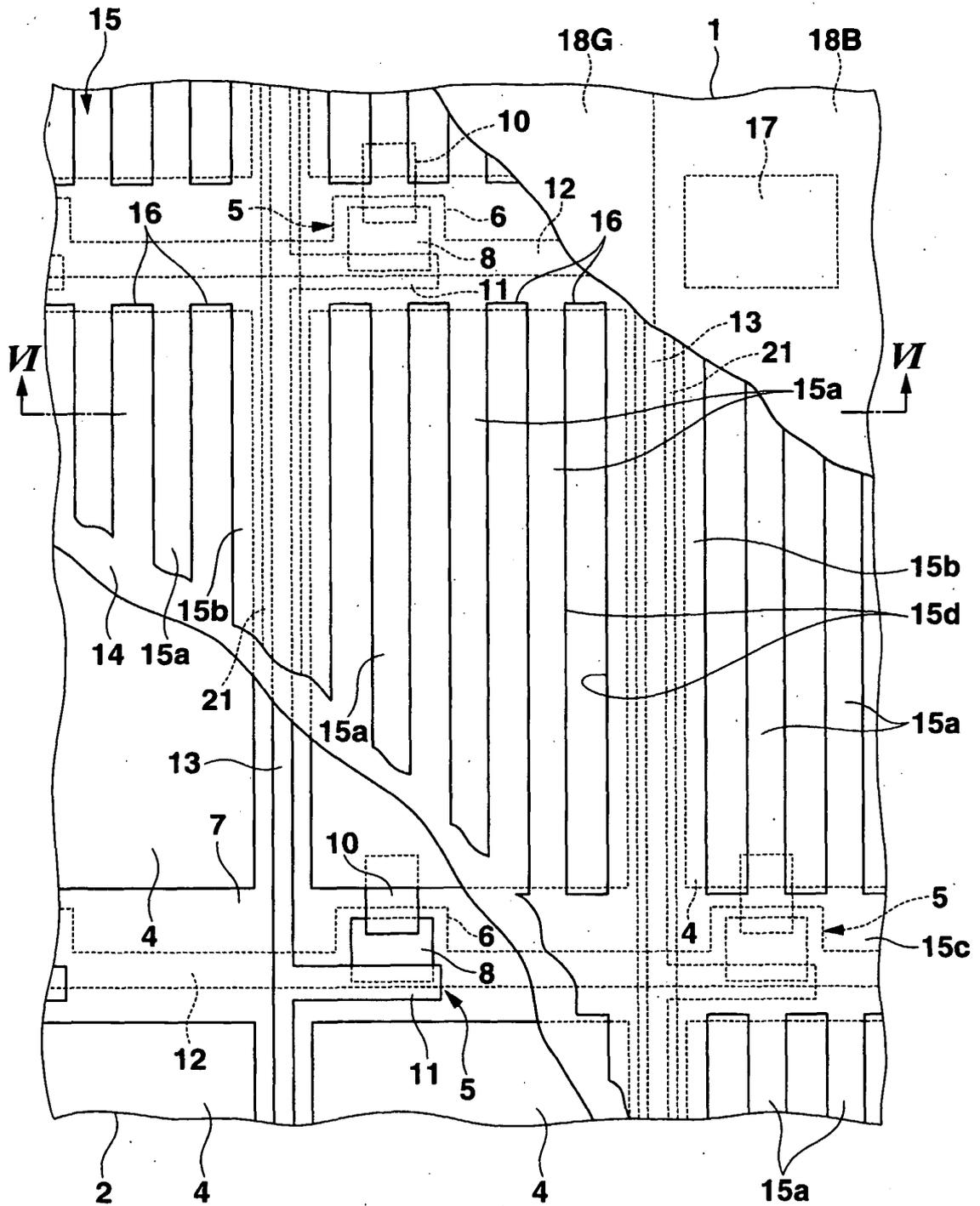


FIG.5

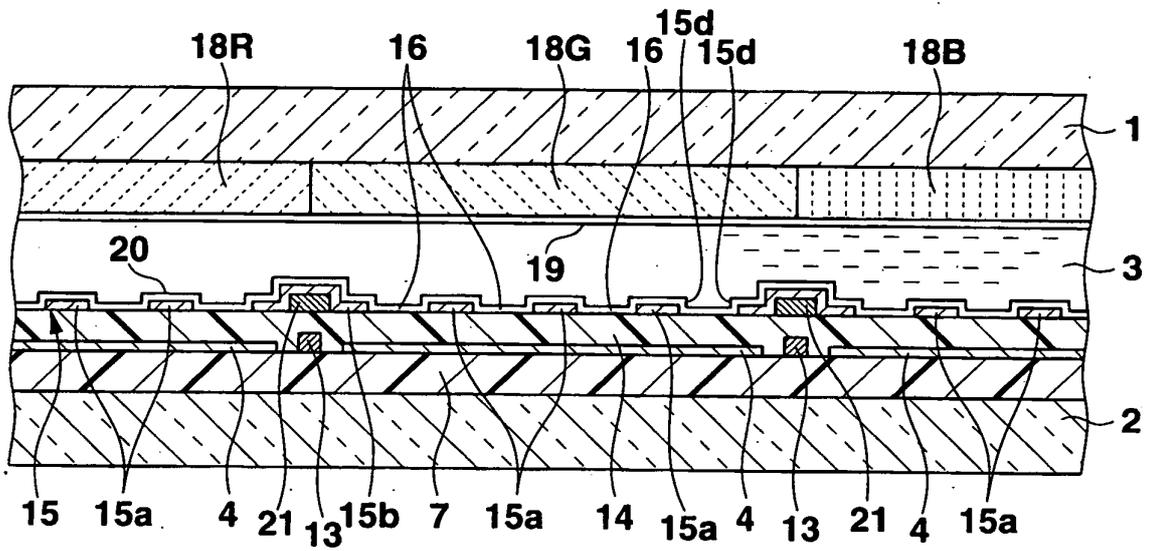


FIG.6

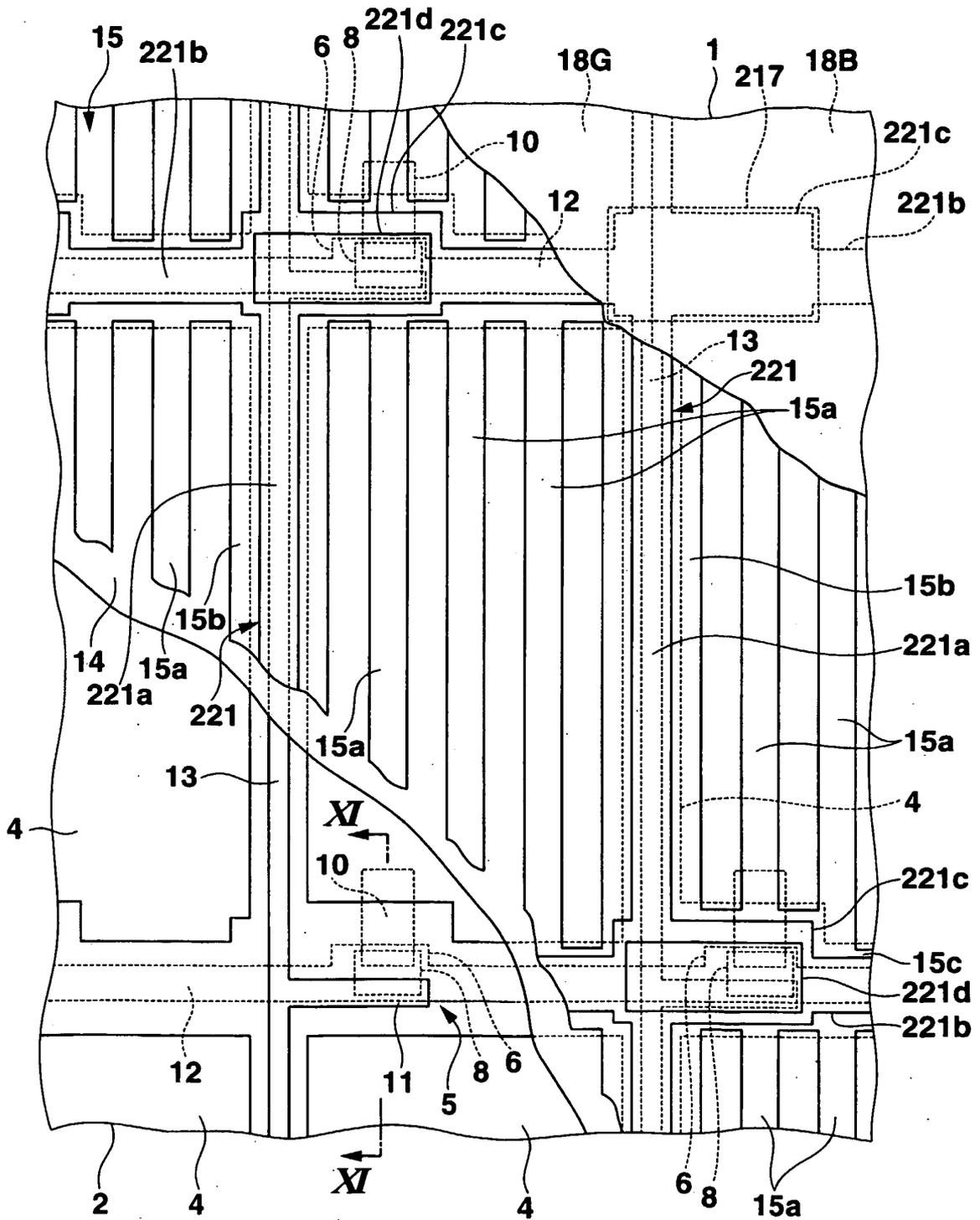


FIG.10

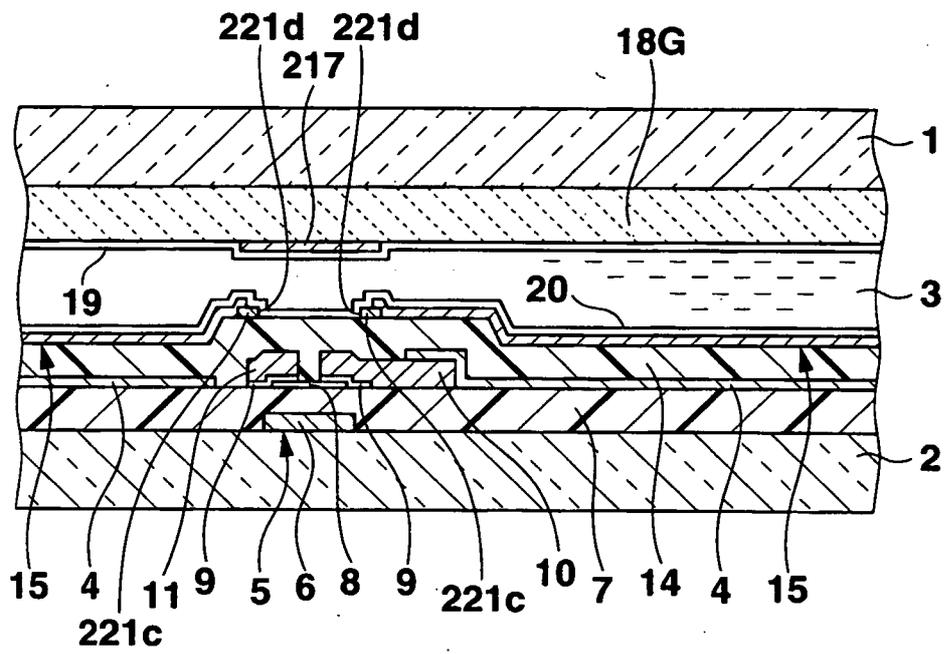


FIG.11

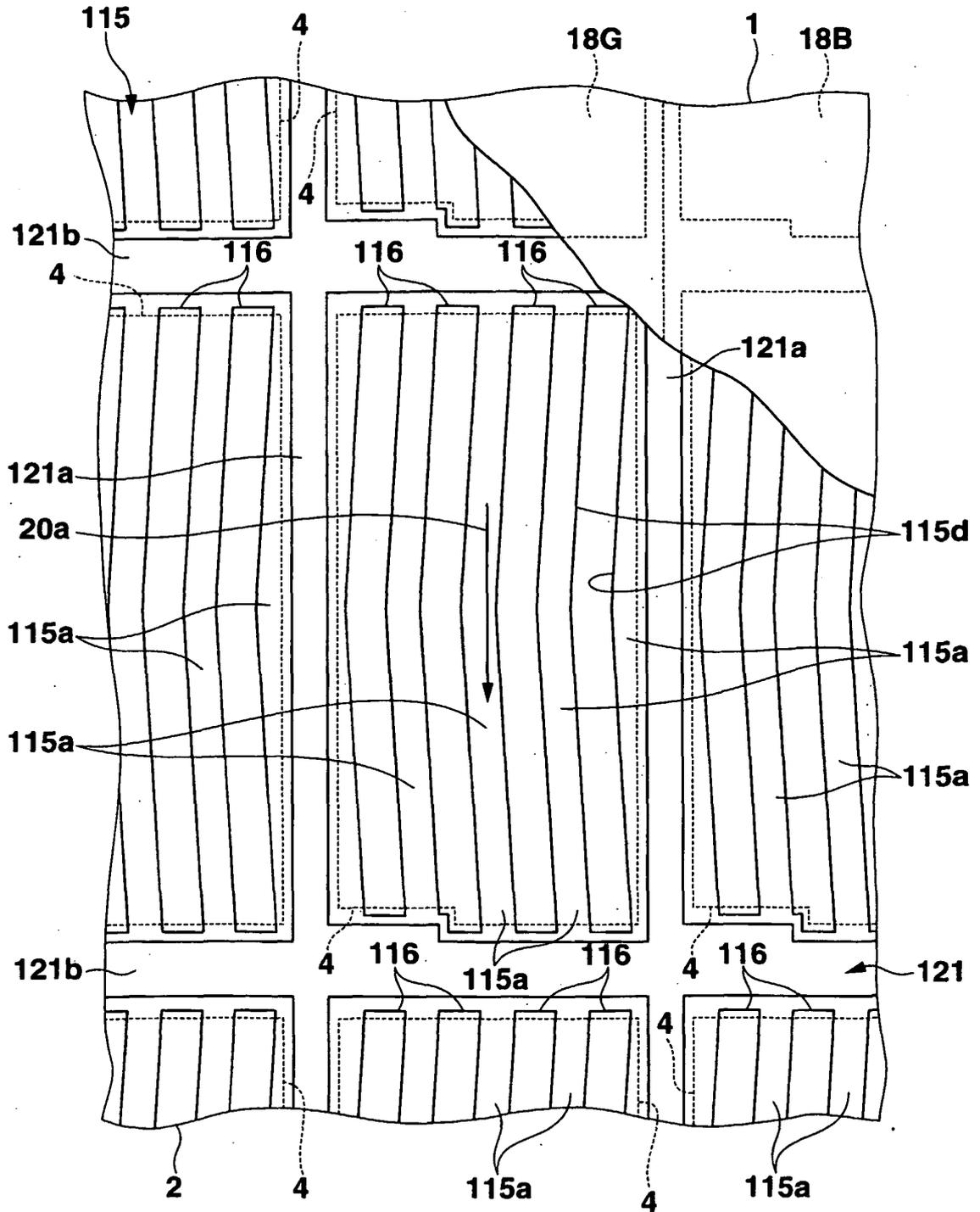


FIG.12

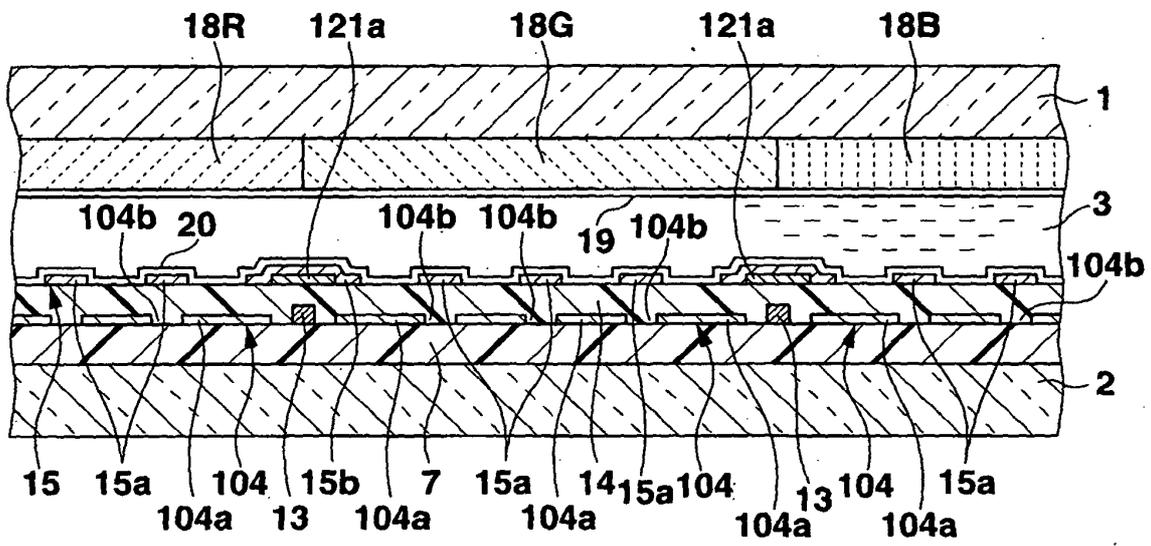


FIG.13

REFERENCES CITED IN THE DESCRIPTION

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- US 20030202140 A [0005]

专利名称(译)	使用基本平行于基板表面的电场的液晶显示装置		
公开(公告)号	EP1979784B1	公开(公告)日	2010-01-20
申请号	EP2006745981	申请日	2006-04-25
[标]申请(专利权)人(译)	卡西欧计算机株式会社		
申请(专利权)人(译)	CASIO COMPUTER CO., LTD.		
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摘要(译)

一种液晶显示装置，包括液晶层，该液晶层设置在第一和第二基板之间的间隙中，液晶分子的长轴在一个方向上排列，基本平行于基板表面。多个薄膜晶体管（8）沿行和列方向布置在第一基板的上侧。像素电极（4）设置在第一基板的上侧，并与薄膜晶体管（8）电连接。公共电极（15）形成在基板和液晶层之间的第一基板的上侧，以通过绝缘膜对应于像素电极，并产生控制液晶分子的排列方向的电场。在与其自身和像素电极之间的基板表面基本平行的平面中。

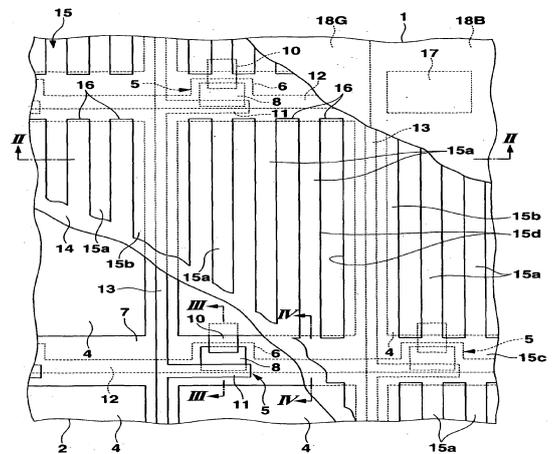


FIG. 1