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(54) **LIGHT GUIDE PLATE AND LIQUID CRYSTAL DISPLAY HAVING THE SAME**

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(51) **Int. Cl.**
G02F 1/1335 (2006.01)

(52) **U.S. Cl.** **349/12**; 349/119

(58) **Field of Classification Search** 349/12, 349/119
See application file for complete search history.

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(57) **ABSTRACT**

A liquid crystal display apparatus (**100**) comprising a liquid crystal display panel (**2009** and a touch panel (**300**) is disclosed. A first transparent electrode (**350**) is disposed on an upper surface of the liquid crystal display panel (**200**) for displaying an image. A second transparent electrode (**360**) is disposed on a lower surface of a retardation member (**320**) and the second transparent electrode (**360**) is opposite to the first transparent electrode (**350**). Accordingly, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

17 Claims, 12 Drawing Sheets

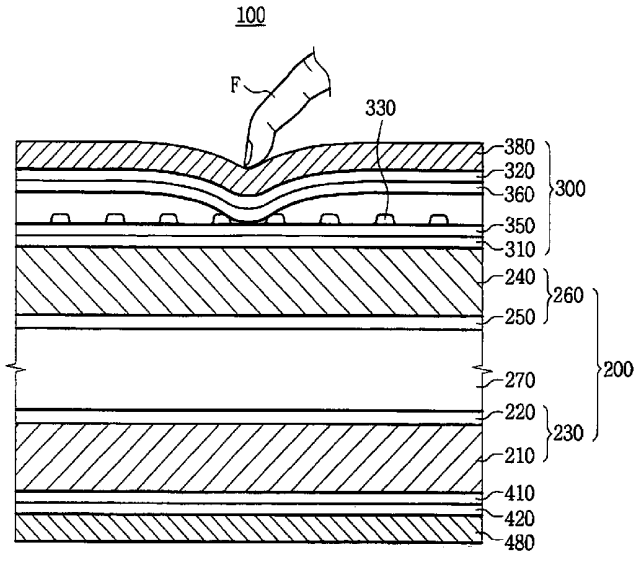


FIG. 1

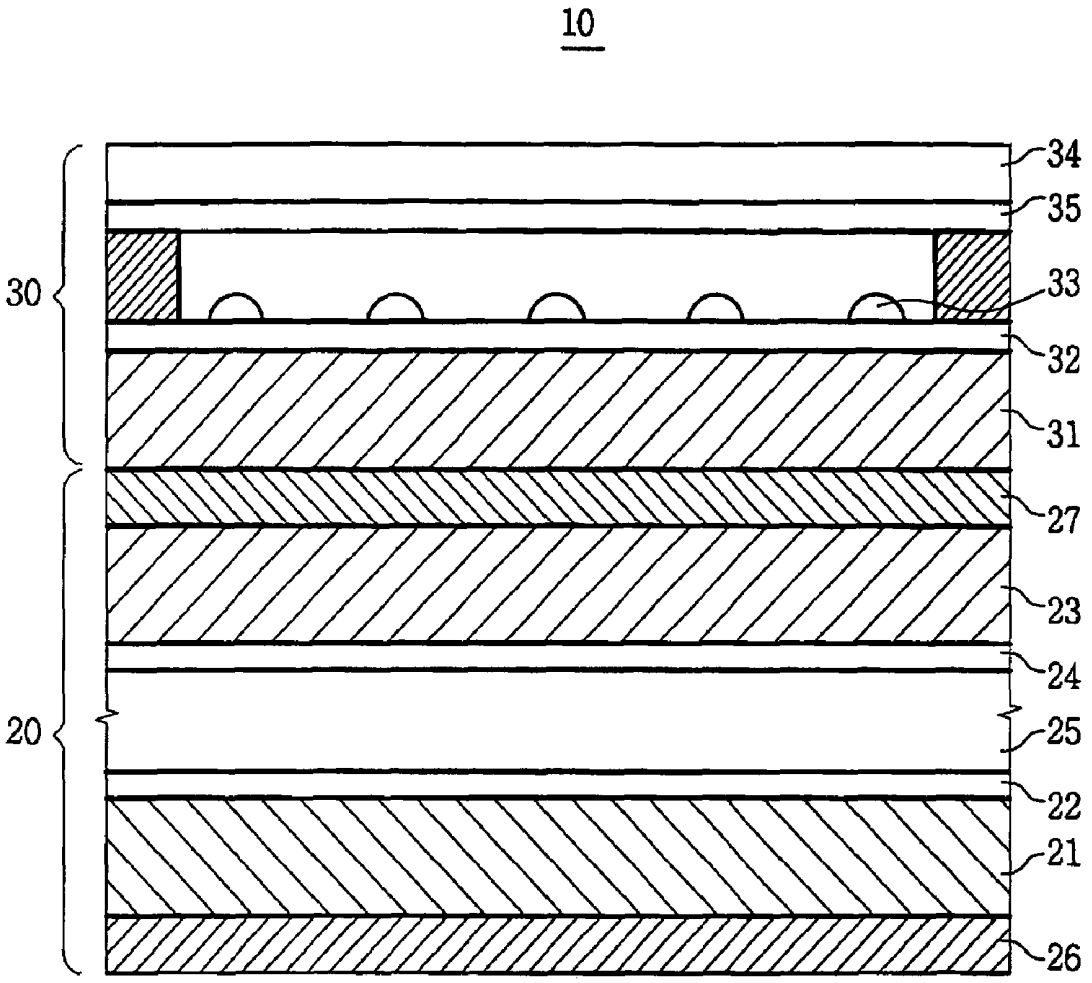
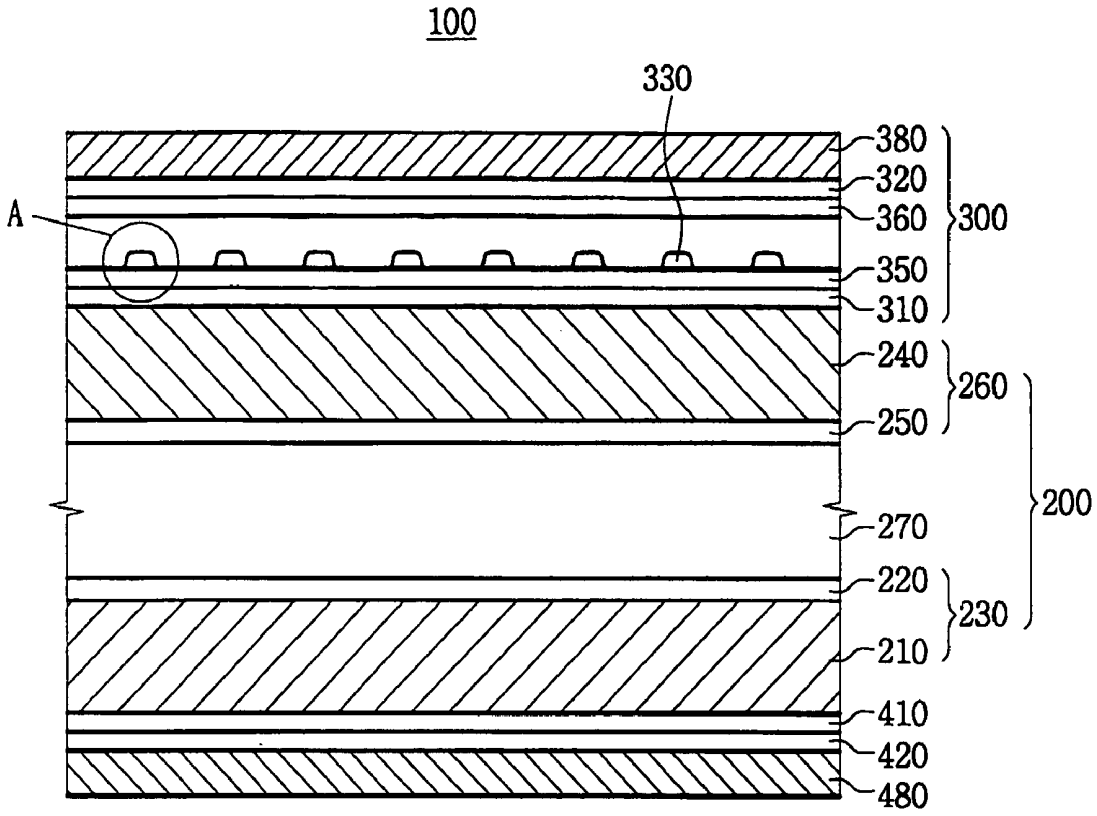


FIG.2


100
330
A
380
320
360
300
350
310
240
260
250
200
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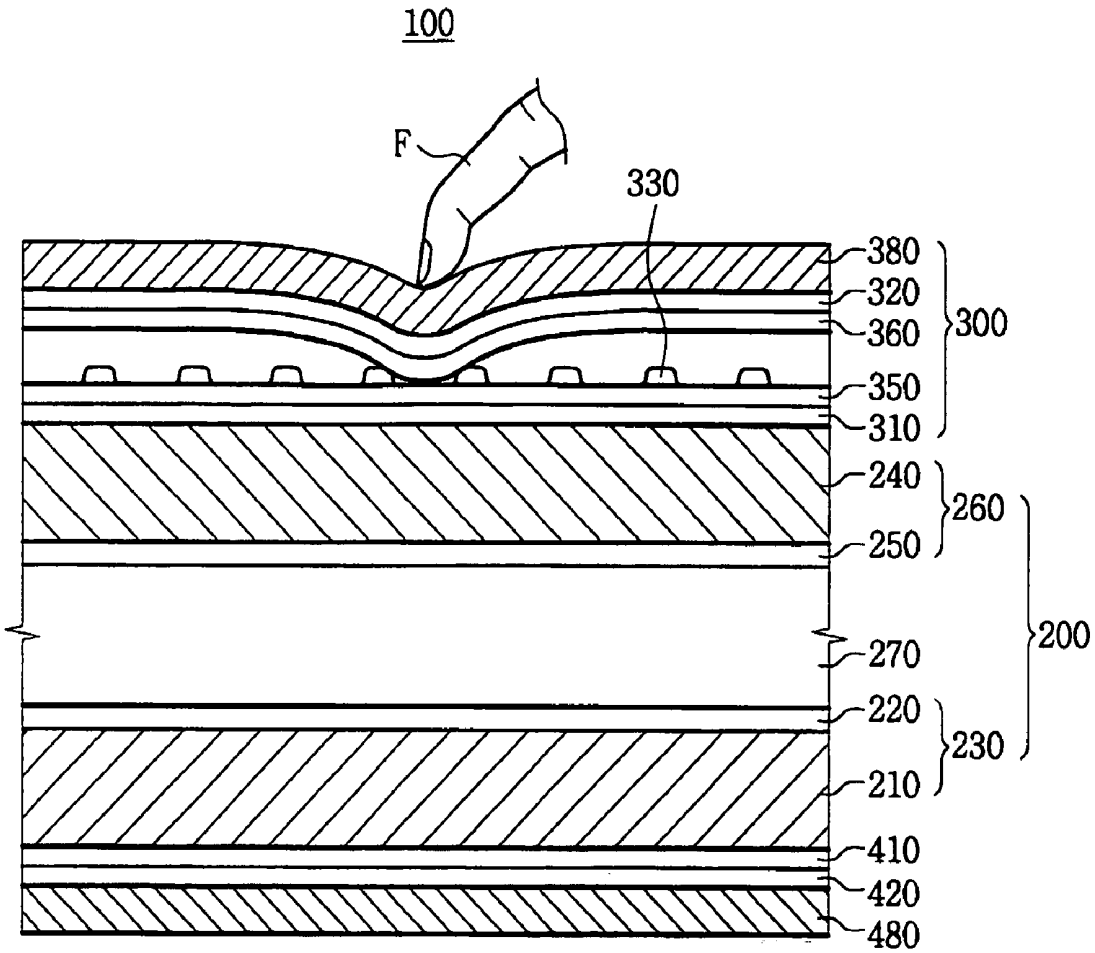
220
230
210
410
420
480

FIG.3


100
F
330
380
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300
350
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240
260
250
270
200
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230
210
410
420
480

FIG.4

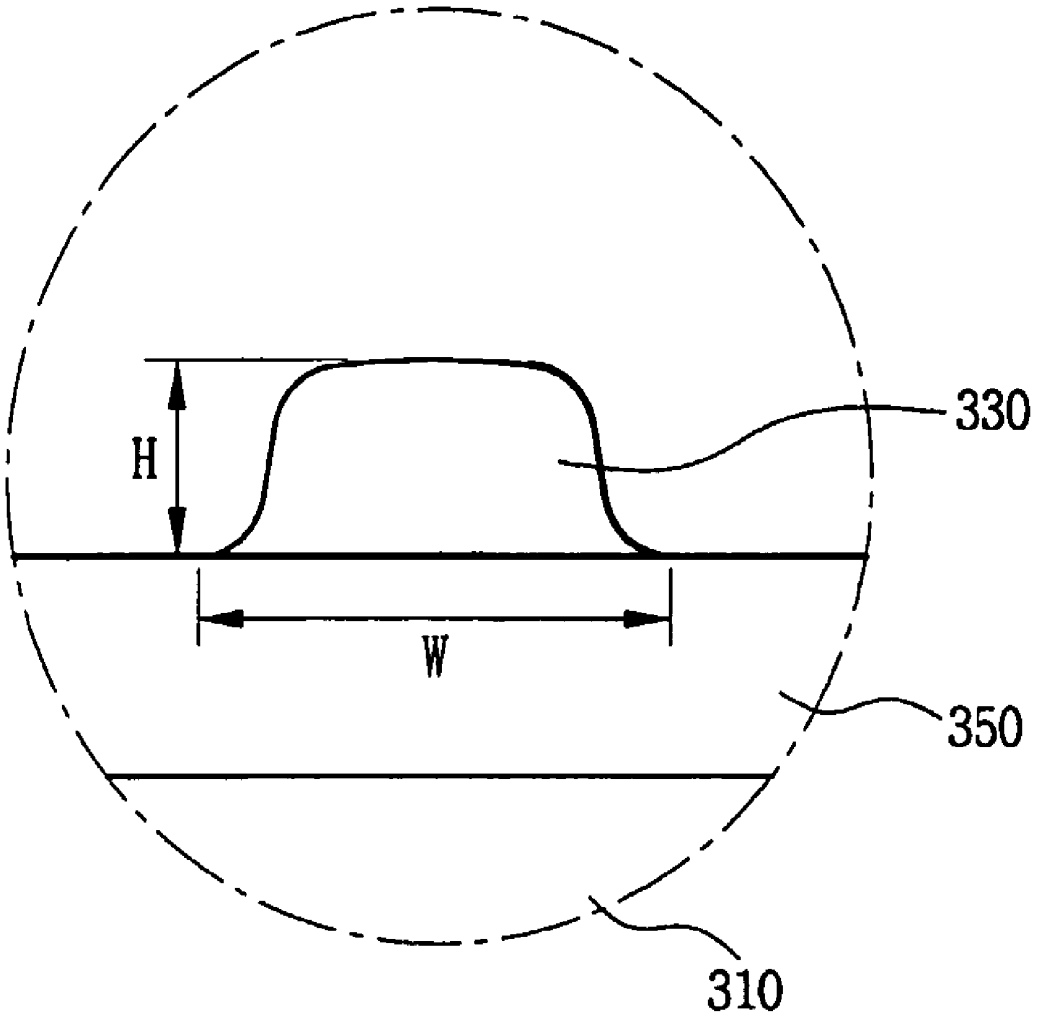


FIG.5

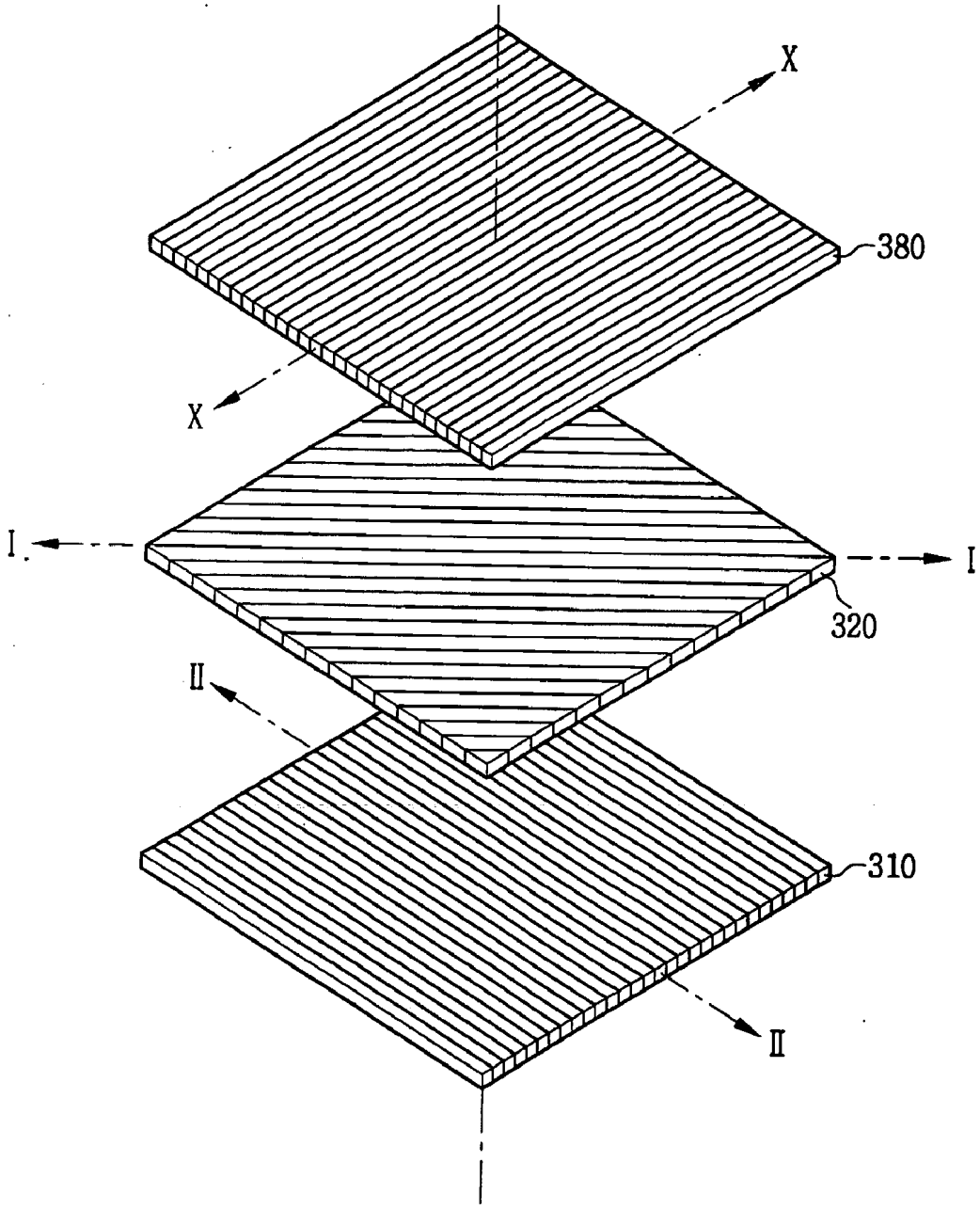


FIG.6

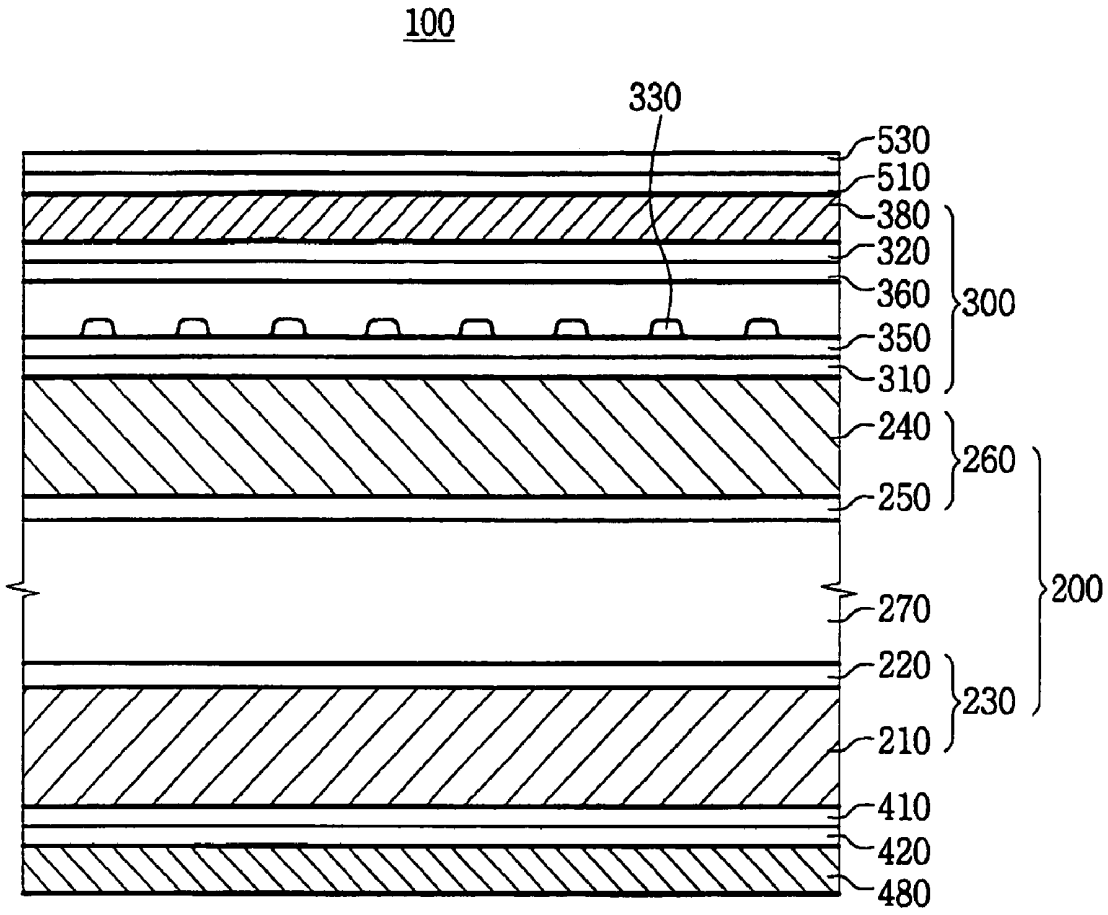

100
330
530
510
380
320
360
350
310
300
240
250
260
270
200
220
210
230
410
420
480

FIG. 7

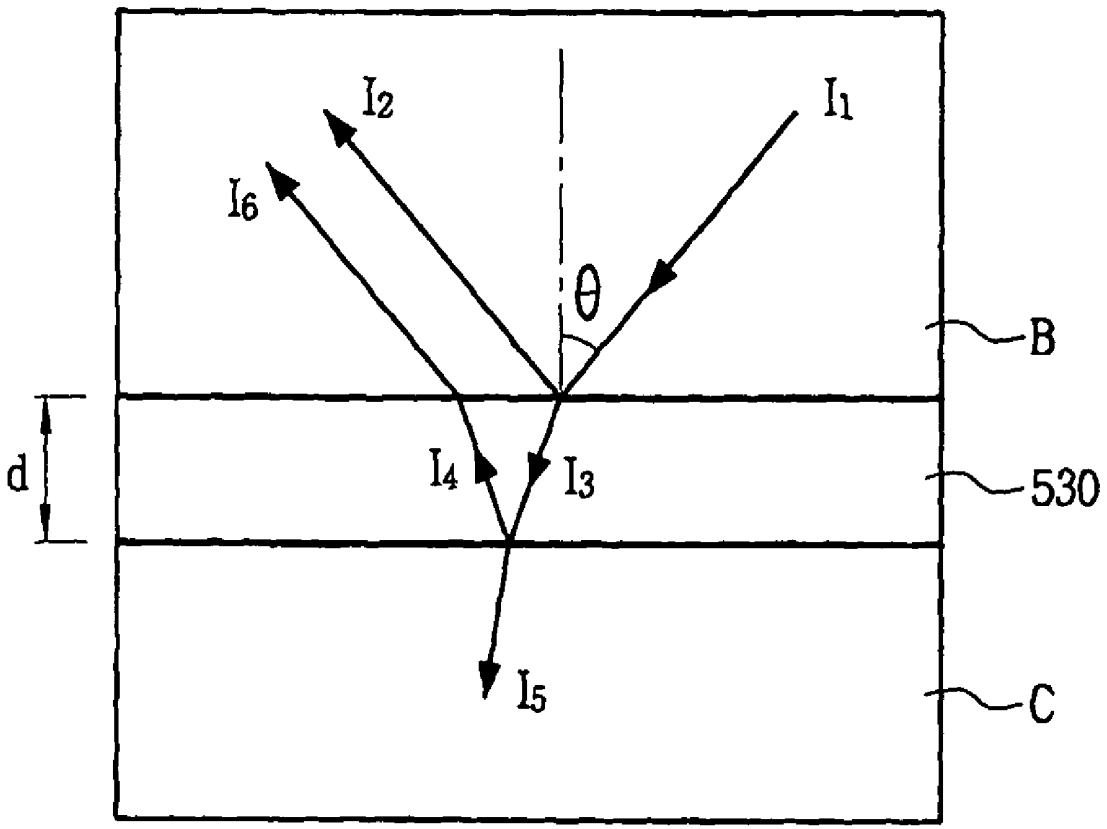
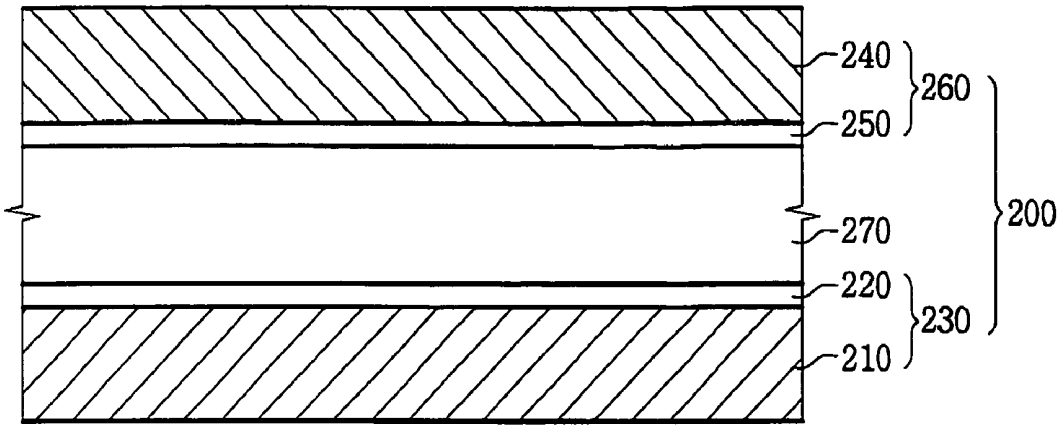


FIG.8A


240
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200
270
220
230
210

FIG.8B

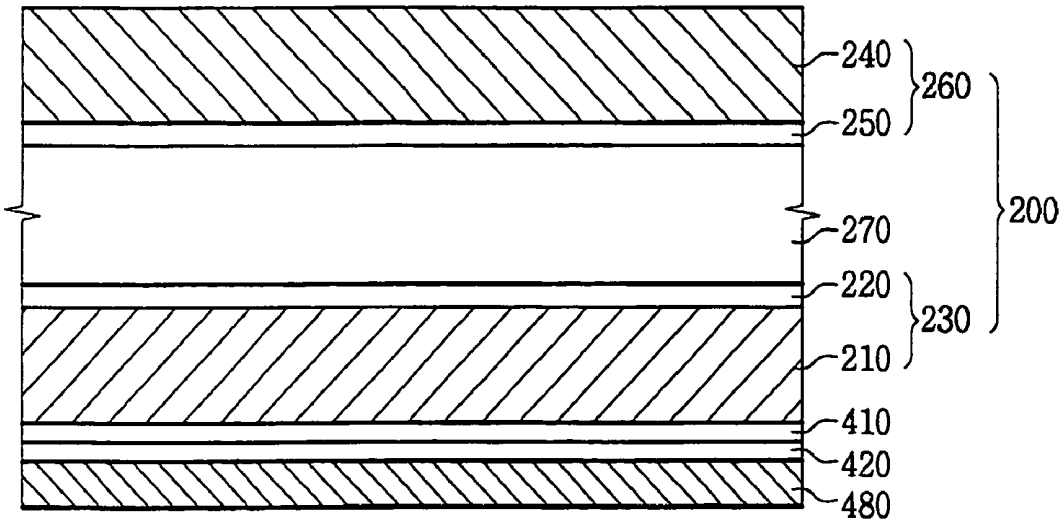

240
260
250
200
270
220
230
210
410
420
480

FIG. 8C

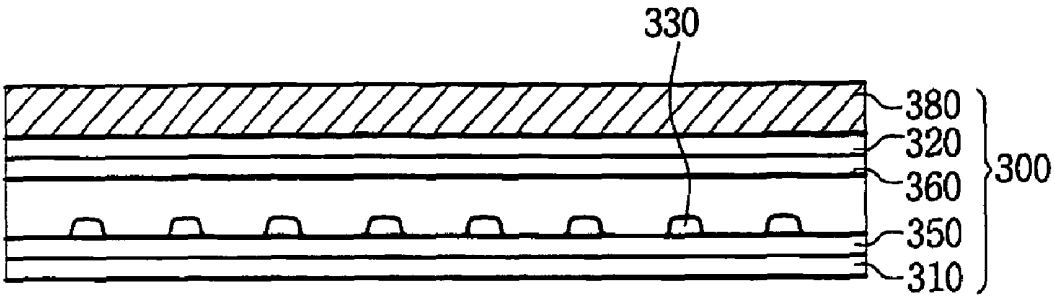


FIG. 9A

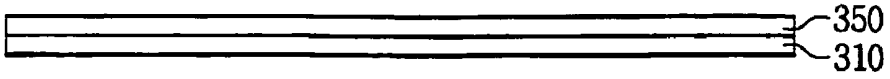


FIG. 9B

FIG. 9C

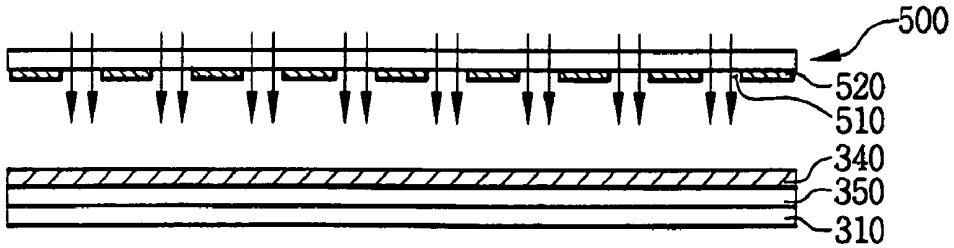


FIG. 9D

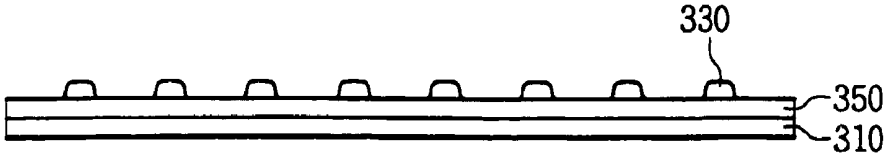


FIG. 10

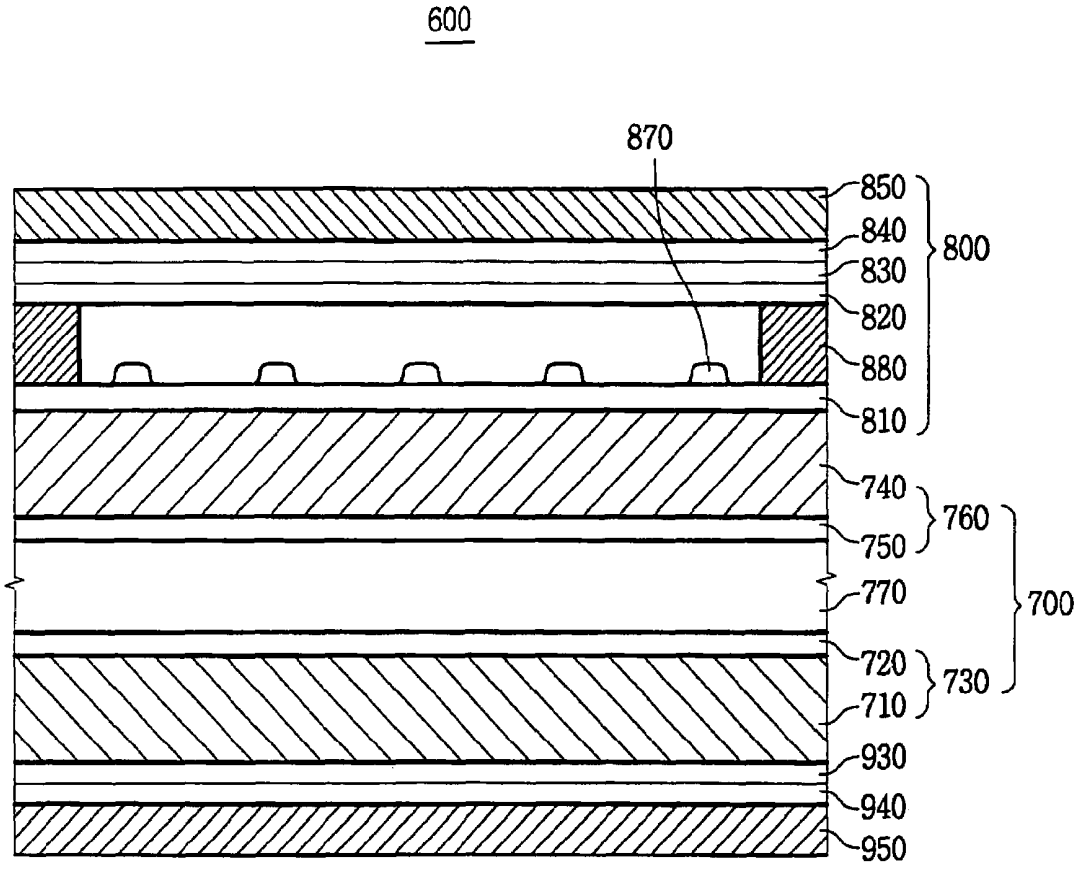
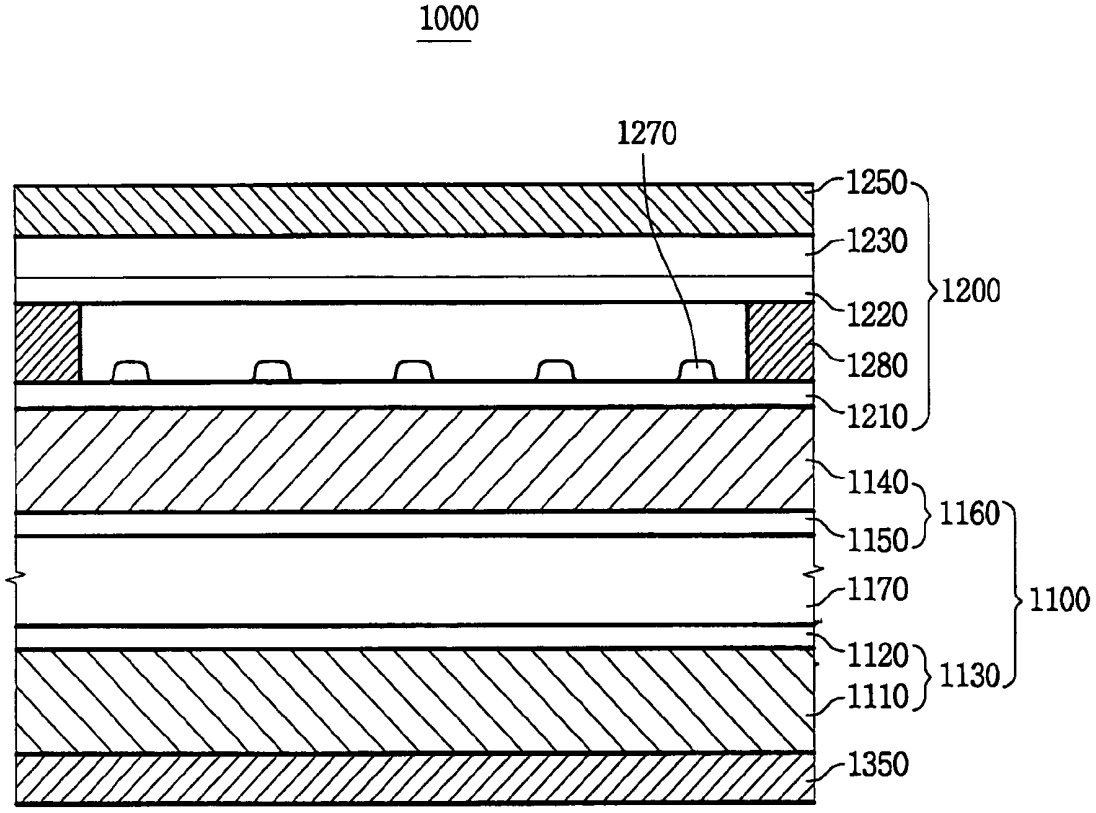

600
870
850
840
830
820
880
810
800
740
750
760
770
700
720
710
730
930
940
950

FIG. 11


1000
1270
1250
1230
1220
1280
1210
1200
1140
1160
1150
1170
1100
1120
1130
1110
1350

LIGHT GUIDE PLATE AND LIQUID CRYSTAL DISPLAY HAVING THE SAME

TECHNICAL FIELD

The disclosure relates to a liquid crystal display (LCD) apparatus, and more particularly to a liquid crystal display apparatus having a touch panel.

BACKGROUND ART

A touch panel is a device for detecting a position of an object or a finger while the object or finger is touched on a point of the screen of a display device.

FIG. **1** is a cross sectional view showing a conventional liquid crystal display apparatus.

Referring to FIG. **1**, the liquid crystal display apparatus includes a liquid crystal display panel **20** for displaying an image and a touch panel for detecting a position of an object that touches an outer surface of the touch panel.

The liquid crystal display panel **20** includes a thin film transistor (TFT) substrate **21**, a color filter (C/F) substrate **23** and a liquid crystal layer **25** interposed between the TFT substrate **21** and the color filter substrate **23**. A pixel electrode **22** is formed on an upper surface of the TFT substrate. The color filter substrate **23** faces the TFT substrate **21**, and a common electrode **24** is formed on a lower surface of the color filter substrate.

A first polarizer **26** is formed on a lower surface of the TFT substrate **21**, and a second polarizer **27** is formed on an upper surface of the color filter substrate **23**.

The touch panel **30** includes a first substrate **31**, a second substrate **34**, a first transparent electrode **32** and a second transparent electrode **35**. The second substrate is spaced apart from the first substrate by a predetermined distance. The first transparent electrode **32** is formed on an upper surface of the first substrate **31**, and the second transparent electrodes **35** is formed on a lower surface of the second substrate **34**. The upper surface of the first substrate **31** is opposite to the lower surface of the second substrate **34**.

The first substrate **31** is comprised of a transparent material so that the light from the liquid crystal display panel may be transmitted through the first substrate **31**. The second substrate **34** is comprised of an optical film having an isotropic refractivity.

The entire thickness of the liquid crystal display apparatus **10** is increased due to two substrates such as the color filter substrate **23** and the first substrate **31** disposed on both surfaces of the second polarizer **27**.

In addition, loss of light is increased since the light incident into the liquid crystal display panel **20** and the light exiting from the liquid crystal display panel **20** pass through both color filter substrate **23** and first substrate **31**.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention is provided to substantially obviate one or more problems due to limitations and disadvantages of the related art.

It is one feature of the present invention to provide a liquid crystal display apparatus having a reduced thickness and manufacturing cost.

According to an aspect of the present invention for achieving one feature of the present invention, there is provided a liquid crystal display apparatus comprising: a liquid crystal display panel for displaying an image; and a touch panel including i) a first retardation member being disposed on an upper surface of the liquid crystal display panel, ii) a first transparent electrode disposed on the first retardation member iii) a second transparent electrode separated from the first transparent electrode by a predetermined distance, iv) a second retardation member disposed on the second transparent electrode, and v) a first polarizing member disposed on the second retardation member, and the touch panel detecting a point where the first transparent electrode is electrically connected to the second transparent electrode to detect a position of an object that touches an outer surface of the touch panel.

According to another aspect of the present invention for achieving the fifth feature of the present invention, there is provided a liquid crystal display apparatus comprising: a liquid crystal display panel for displaying an image; and a touch panel including i) a first transparent electrode disposed on an upper surface of the liquid crystal display panel, ii) a second transparent electrode separated from the first transparent electrode by a predetermined distance, iii) a first retardation member disposed on the second transparent electrode, iv) a second retardation member disposed on the first retardation member, and v) a first polarizing member disposed on the second retardation member, and the touch panel detecting a point at which the first transparent electrode is electrically connected to the second transparent electrode to detect a position of an object that touches an outer surface of the touch panel.

According to still another aspect of the present invention for achieving the fifth feature of the present invention, there is provided a liquid crystal display apparatus comprising: a liquid crystal display panel for displaying an image; and a touch panel including i) a first transparent electrode disposed on an upper surface of the liquid crystal display panel, ii) a second transparent electrode separated from the first transparent electrode by a predetermined distance, iii) an optical film disposed on the second transparent electrode, iv) a first polarizing member disposed on the optical film, and v) a spacer disposed between the first and second transparent electrodes, and the touch panel detecting a point at which the first transparent electrode is electrically connected to the second transparent electrode to detect a position of an object that touches an outer surface of the touch panel.

According to above liquid crystal display apparatus, the liquid crystal display panel and the polarizing member respectively substitute for a first substrate for supporting the first transparent electrode and a second substrate for supporting the second transparent electrode. Accordingly, an unnecessary substrate that causes the increase of the thickness of the liquid crystal display apparatus may be removed, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

According to the present invention, the liquid crystal display apparatus includes first and second transparent electrodes. The first and second transparent electrodes are comprised of a transparent conductive material and are spaced apart from each other by a predetermined distance.

The first transparent electrode is supported by the second transparent substrate of the color filter substrate. The second transparent electrode is supported by the polarizer.

Accordingly, another substrate that supports the first and second transparent electrodes may be removed, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

In addition, the number of the transparent substrates, through which the light incident into the liquid crystal display panel or the light exiting from the liquid crystal display panel

is transmitted, is reduced, thereby reducing loss of light and enhancing optical characteristics of the liquid crystal display apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

FIG. **1** is a cross sectional view showing a conventional liquid crystal display apparatus;

FIG. **2** is a cross sectional view showing a liquid crystal display apparatus according to a first exemplary embodiment of the present invention;

FIG. **3** is a schematic view showing the liquid crystal display apparatus of FIG. **2** when a touch screen is pressed down;

FIG. **4** is an enlarged view of a portion 'A' in FIG. **2**;

FIG. **5** is a schematic view showing an arrangement among a first polarizing film, a first retardation film and a second retardation film;

FIG. **6** is a cross sectional view showing a liquid crystal display apparatus that further includes a hard coated film and a reflection protection film in addition to the liquid crystal display apparatus of FIG. **2**;

FIG. **7** is a schematic view showing the reflection protection film;

FIGS. **8**A, **8**B and **8**C are cross sectional views showing a method of manufacturing the liquid crystal display apparatus according to the first exemplary embodiment of the present invention;

FIGS. **9**A, **9**B, **9**C and **9**D are cross sectional views showing a method of forming the spacer of FIG. **4**;

FIG. **10** is a cross sectional view showing a liquid crystal display apparatus according to a second exemplary embodiment of the present invention; and

FIG. **11** is a cross sectional view showing a liquid crystal display apparatus according to a third exemplary embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter the preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

FIG. **2** is a cross sectional view showing a liquid crystal display apparatus according to a first exemplary embodiment of the present invention.

Referring to FIG. **2**, the liquid crystal display apparatus **100** according to the first embodiment of the present invention includes a liquid crystal display panel **200**, a touch panel **300** and a plurality of optical plates **410**, **420** and **480** disposed on a lower surface of the liquid crystal display panel **200**. The liquid crystal display panel **200** displays an image. The touch panel **300** detects a position of an object that touches an outer surface of the touch panel.

The liquid crystal display panel **200** includes a TFT substrate **230**, a color filter substrate **260** facing the TFT substrate **230**, and a liquid crystal layer **270** interposed between the TFT substrate **230** and the color filter substrate **260**.

The TFT substrate **230** includes a plurality of switching devices (not shown) and a plurality of pixel electrodes each electrically connected with each of the switching devices. The switching devices are formed on the first transparent substrate **210**. The color filter substrate **260** includes color filters (not shown) and a common electrode **250** formed on the color filters. The color filters are formed on the second transparent substrate **240**.

The touch panel **300** includes a first retardation film (or phase difference film) **310**, a second retardation film **320** and a first polarizer **380** disposed on an upper surface of the second retardation film **320**. The first retardation film **310** is disposed on an upper surface of the color filter substrate **260**, and a first transparent electrode **350** is formed on the first retardation film **310**. A second transparent electrode **360** that is spaced apart from the first transparent electrode **350** by a predetermined distance is formed on the second retardation film **320**. The first retardation film **310** is a $\lambda/4$ retardation film, and the second retardation film **320** is a $\lambda/2$ retardation film.

The first and second transparent electrodes **350** and **360** are comprised of a transparent conductive material such as indium tin oxide (ITO) or indium zinc oxide (IZO).

An adhesive (not shown) comprised of insulating material is interposed between the first and second transparent electrodes **350** and **360**. The adhesive combines the first and second transparent electrodes **350** and **360** with each other. The first transparent electrode **350** is separated from the second transparent electrode **360** by the thickness of the adhesive interposed between the first and second transparent electrodes **350** and **360**.

A plurality of spacers **330** is formed on the first transparent electrode **350**. The spacers **330** may be formed on the second transparent electrode **360**.

A third retardation film **410**, a fourth retardation film **420** and a second polarizer **480** may be disposed on a lower surface of the liquid crystal display panel **200**.

The third retardation film **410** is disposed on the lower surface of the liquid crystal display panel **200**, the fourth retardation film **420** is disposed on a lower surface of the third retardation film **410**, and the second polarizer **480** is disposed on a lower surface of the fourth retardation film **420**. The third retardation film **410** is a $\lambda/4$ retardation film, and the fourth retardation film **420** is a $\lambda/2$ retardation film.

The first, second, third and fourth retardation films **310**, **320**, **410** and **420** are comprised of polyarylate or polyether sulfone. The polyarylate is thermoplastic resin of aromatic polyester.

The first retardation film **310** on which the first transparent electrode **350** is formed is supported by the second transparent substrate **240** or the color filter substrate. The second retardation film **320** on which the second transparent electrode **360** is formed is supported by the first polarizer **380**. Accordingly, an unnecessary substrate that causes the increase in the thickness of the liquid crystal display apparatus may be removed, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

Although the above embodiments show a reflective and transmissive type liquid crystal display panel, a reflective liquid crystal display panel could be utilized to display an image, as would be known to one of the ordinary skill in the art. The liquid crystal display apparatus **100** may not have the third retardation film **410**, the fourth retardation film **420** and the second polarizer **480**.

FIG. **3** is a schematic view showing the liquid crystal display apparatus of FIG. **2** when a touch screen is pressed down, and FIG. **4** is an enlarged view of a portion 'A' of FIG. **2**.

Referring to FIGS. **3** and **4**, the first and second transparent electrodes **350** and **360** of the liquid crystal display apparatus **100** make electrical contact with each other by an object such as a finger of a user.

The first polarizer **380** is pressed down by the user's finger when the user inputs information through the touch panel.

The first and second transparent electrodes **350** and **360** are comprised of a transparent conductive material having resistive property. The first and second transparent electrodes **350** and **360** have linear voltage distribution when current is applied to the first and second transparent electrodes **350** and **360**.

Accordingly, when the first and second transparent electrodes **350** and **360** make contact with each other by the finger of the user, the voltage of the contact point between the first and second transparent electrodes **350** and **360** is measured, so that the position of an object that touches an outer surface of the touch panel can be detected.

A plurality of spacers **330** is formed on the first transparent electrode **350**. A height of each of the spacers **330** is smaller than the distance between the first and second transparent electrodes **350** and **360**.

The spacers **330** have a dot shape. Although the above embodiments discuss a spacer having a dot shape, a spacer having circular cylinder, elliptic cylinder shape or any other shapes known to one of the ordinary skill in the art may also be utilized in place of or in conjunction with the spacer having a dot shape.

A width of the lower face of the spacer **330** may be wider a width of the upper face of the spacer **330**. For example, the width of the lower face of the spacer **330** may be between about 10 μm and about 80 μm, and the height of the spacer **330** may be between about 2 μm and about 20 μm.

The spacers **330** absorb the impact on the first and second transparent electrodes **350** and **360** when the second transparent electrode **360** is pressed and makes contact with the first transparent electrode **350**. In addition, the spacers **330** provide the second transparent electrode **360** with restoring forces so that the second transparent electrode **360** is separated from the first transparent electrode **350** when the user takes off (or withdraws) his finger from the touch panel **300**.

FIG. **5** is a schematic view showing an arrangement among a first polarizing film, a first retardation film and a second retardation film.

Referring to FIG. **5**, the first retardation film **310**, the second retardation film **320** and the first polarizer **380** are arranged so as to enhance the optical characteristic of the light from the liquid crystal display panel **200**.

An X-axis is referred to as a polarizing axis of the first polarizer **380**, an I-axis is referred to as a retardation axis of the second retardation film **320**, and an II-axis is referred to as a retardation axis of the first retardation film **310**.

The second retardation film **320** is disposed under the first polarizer **380** so that the I-axis forms an angle between about 45° and about 135° with respect to the II-axis. In addition, the first retardation film **310** is disposed under the second retardation film **320** so that the II-axis forms an angle between about 90° and about 180° with respect to the X-axis.

The third retardation film **410**, the fourth retardation film **420** and the second polarizer **480** of FIG. **2** are arranged in the same manner as the first retardation film **310**, the second retardation film **320** and the first polarizer **380**.

FIG. **6** is a cross sectional view showing a liquid crystal display apparatus that further includes a hard coated film and a reflection protection film in addition to the liquid crystal display apparatus of FIG. **2**.

Referring to FIG. **6**, the hard coated film **510** and the reflection protection film **530** is disposed sequentially on the first polarizer **380**.

A portion of the surface of the first polarizer **380** in the touch panel **300** may be pressed down by the object or the finger of the user many times until the liquid crystal display apparatus may reach the expected life span thereof.

Accordingly, the surface of the first polarizer **380** may be easily damaged by the repeated pressing actions. The hard coated film **510** is formed on the first polarizer **380** so that the first polarizer **380** should not be damaged. The hard coated film **510** may be comprised of polyacryl resin.

The reflection protection film **530** is formed on the hard coated film **510**, and prevents light from being reflected from the surface of the hard coated film **510**.

Although only the hard coated film **510** is formed on the first polarizer **380**, the hard coated film may prevent the light incident thereonto from being reflected therefrom because the hard coated film **510** absorbs external light incident thereonto.

In addition, only the reflection protection film **530** without the hard coated film **510** may protect the surface of the first polarizer **380** when the reflection protection film **530** has Mohs hardness of about 3 or more.

FIG. **7** is a schematic view showing the reflection protection film;

Referring to FIG. **7**, a first light I**1** is incident onto the reflection protection film **530** from a first medium B in an incident angle θ. A portion of the first light I**1** is reflected from the reflection protection film **530** in the angle θ to be a second light I**2**. A remaining portion of the first light I**1** is refracted toward the reflection protection film **530** as a third light I**3**.

The third light I**3** advances into the reflection protection film **530**, a portion of the third light I**3** is reflected from an interface between the reflection protection film **530** and a second medium C to be a fourth light I**4**. A remaining portion of the third light I**3** is refracted toward the second medium C to be a fifth light I**5**.

The fourth light I**4** exits toward the first medium and is refracted as a sixth light I**6**.

The phase of the reflected light is not varied when the light advancing from a medium having high refractivity toward a medium having a low refractivity is reflected from the interface between the two mediums. The phase of the reflected light is varied by 180° when the light advancing from a medium having low refractivity toward a medium having a high refractivity is reflected from the interface between the two mediums. However, the phase of the transmitted light is not varied.

The thickness d of the reflection protection film **530** is determined in view of the refractivity n_a of the reflection protection film **530**, the refractivities n_b and n_c of the first and second medium B and C so that the second light I**2** and the sixth light I**6** are interfered with each other to disappear by a destructive interference on the surface of the reflection protection film **530**.

Accordingly, reflection phenomenon on the surface of the reflection protection film **530** may be prevented.

FIGS. **8**A, **8**B and **8**C are cross sectional views showing a method of manufacturing the liquid crystal display apparatus according to the first exemplary embodiment of the present invention.

Referring to FIG. **8**A, first, a liquid crystal display panel **200** is formed. The liquid crystal display panel **200** has a TFT substrate **230**, a color filter substrate **260** facing the TFT

substrate **230** and a liquid crystal layer **270** interposed between the TFT substrate **230** and the color filter substrate **260**.

The TFT substrate **230** includes a plurality of switching devices (not shown) and a plurality of pixel electrodes, each of the pixel electrodes being electrically connected with each of the switching devices. The switching devices are formed on a first transparent substrate **210**. The color filter substrate **260** includes color filters (not shown) and a common electrode **250** formed on the color filters. The color filters are formed on a second transparent substrate **240**.

Referring to FIG. **8**B, a third retardation film **410**, a fourth retardation film **420** and a second polarizer **480** are formed on a lower surface of the liquid crystal display panel **200**.

In detail, the third and fourth retardation films **410** and **420** are formed successively on the second polarizer **480**. Then, the second polarizer **480** having the third and fourth retardation films **410** and **420** is attached to the lower surface of the liquid crystal display panel **200**. The first transparent substrate **210** makes contact with the third retardation film **410**.

Referring to FIG. **8**C, a second retardation film **320** is formed on the first polarizer **380**. Then, a transparent conductive material such as ITO or IZO is deposited on the second retardation film **320**, thereby forming a second transparent electrode **360**.

A first transparent electrode **350** is formed on the first retardation film **310**. A transparent conductive material such as ITO or IZO is deposited on the first retardation film **310**, thereby forming a first transparent electrode **350**.

Then, a plurality of spacers **330** is formed on the first transparent electrode **350**, an adhesive (not shown) comprised of insulating material is formed at the boundary portion of the first transparent electrode **350**.

The first transparent electrode **350** faces the second transparent electrode **360**. The second transparent electrode **360** is attached to the first transparent electrode **350** by means of the adhesive formed on the boundary portion of the first transparent electrode **350**. The first and second transparent electrodes **350** and **360** are separated from each other by the thickness of the adhesive.

Then, the first retardation film **310** is combined with the second transparent electrode **240** of the color filter substrate **260** of FIG. **2**, thereby completing the liquid crystal display apparatus **100** of FIG. **2**

The step illustrated in FIG. **8**C may be performed prior to the step illustrated in FIG. **8**B.

FIGS. **9**A, **9**B, **9**C and **9**D are cross sectional views showing a method of forming the spacer of FIG. **4**.

Referring to FIG. **9**A, the first transparent electrode **350** comprised of a transparent conductive material such as ITO or IZO is formed on the first retardation film **310**.

Then, as shown in FIG. **9**B, a photosensitive organic layer **340** is deposited in a uniform thickness on the first retardation film **310**.

Referring to FIG. **9**C, a mask **500** is aligned over the photosensitive organic layer **340**. The mask **500** has a transmitting layer for transmitting light therethrough and the blocking layer for blocking the light. Then, an exposure process is performed by means of the mask **500**. In detail, ultra violet is applied onto the photosensitive organic layer **340** through the mask **500**.

The photosensitive organic layer **340** deposited on the first transparent electrode **350** may be a negative photoresist, and the exposed area of the photosensitive organic layer **340** onto which UV light is supplied is polymerized. Accordingly, an unexposed area that is not polymerized is etched away by a developer solution, thereby forming the spacers **330** of FIG. **9**D. A baking process may be further performed so as to cure the spacers **330**.

FIG. **10** is a cross sectional view showing a liquid crystal display apparatus according to a second exemplary embodiment of the present invention.

Referring to FIG. **10**, the liquid crystal display apparatus **600** according to the second exemplary embodiment of the present invention includes a liquid crystal display panel **700**, a touch panel **800** and a plurality of optical plates **930**, **940** and **950**. The liquid crystal display panel **700** displays an image, and the touch panel **800** detects the position of the object that touches an outer surface of the touch panel **800**. The optical plates **930**, **940** and **950** are disposed on the lower surface of the liquid crystal display panel **700**.

The liquid crystal display panel **700** includes a TFT substrate **730**, a color filter substrate **760** facing the TFT substrate **730**, and a liquid crystal layer **770** interposed between the TFT substrate **730** and the color filter substrate **760**.

The TFT substrate **730** includes a plurality of switching devices (not shown) and a plurality of pixel electrodes each of which is electrically connected with each of the switching devices. The switching devices are formed on the first transparent substrate **710**. The color filter substrate **760** includes color filters (not shown) and a common electrode **750** formed on the color filters. The color filters are formed on the second transparent substrate **740**.

The touch panel **800** includes a first retardation film **810**, a second retardation film **820**, first and second retardation films **830** and **840** disposed on an upper surface of the second transparent electrode **820**, and a first polarizer **850** disposed on the second retardation film **840**. The first transparent electrode **810** is disposed on an upper surface of the color filter substrate **760**, and the second transparent electrode **760** is separated from the first transparent electrode **850** by a predetermined distance.

The first retardation film **810** is a $\lambda/4$ retardation film, and the second retardation film **840** is a $\lambda/2$ retardation film. The first and second transparent electrodes **810** and **820** are comprised of a transparent conductive material such as indium tin oxide (ITO) or indium zinc oxide (IZO).

An adhesive (not shown) comprised of an insulating material is interposed between the first and second transparent electrodes **810** and **820**. The adhesive combines the first and second transparent electrodes **810** and **820** with each other. The first transparent electrode **810** is separated from the second transparent electrode **820** by the thickness of the adhesive interposed between the first and second transparent electrodes **810** and **820**.

A plurality of spacers **870** is formed on the first transparent electrode **810**. The spacers **870** may be formed on the second transparent electrode **820**.

A detailed description about the spacer **870** will be omitted because the spacer **870** is the same as the spacer **330** of FIG. **4**.

A third retardation film **930**, a fourth retardation film **940** and a second polarizer **950** may be disposed on a lower surface of the liquid crystal display panel **700**.

The third retardation film **930** is disposed on the lower surface of the liquid crystal display panel **700**, the fourth retardation film **940** is disposed on a lower surface of the third retardation film **930**, and the second polarizer **950** is disposed on a lower surface of the fourth retardation film **940**. The third retardation film **930** is a $\lambda/4$ retardation film, and the fourth retardation film **940** is a $\lambda/2$ retardation film.

The first, second, third and fourth retardation films **830**, **840**, **930** and **940** are comprised of polyarylate or polyether sulfone resin.

The first retardation film **830**, the second retardation film **840** and the first polarizer **850** are arranged so as to enhance the optical characteristic of the light from the liquid crystal display panel **700**.

The second retardation film **840** is disposed under the first polarizer **850** so that the a polarizing axis of the first polarizer **850** forms an angle between about 45° and about 135° with respect to a retardation axis of the second retardation film **840**. In addition, the first retardation film **830** is disposed under the second retardation film **840** so that a polarizing axis of the first polarizer **850** forms an angle between about 90° and about 180° with respect to a retardation axis of the first retardation film **830**.

A third retardation film **930**, a fourth retardation film **940** and a second polarizer **950** are arranged in the same manner as the first retardation film **830**, the second retardation film **840** and the first polarizer **850**.

In addition, the hard coated film and the reflection protection film illustrated in FIG. **6** may be further formed on the first polarizer **530**.

The first retardation film **310** on which the first transparent electrode **350** is formed is supported by the second transparent substrate **240** or the color filter substrate.

The first transparent electrode **810** is supported by the second transparent substrate **740** of the color filter substrate **760**. The second transparent electrode **820** is supported by the first polarizer **850**. Accordingly, an unnecessary substrate that causes the increase of the thickness of the liquid crystal display apparatus may be removed, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

Although the above embodiments discuss a reflective and transmissive type liquid crystal display panel, a reflective liquid crystal display panel could be utilized to display an image, as would be known to one of the ordinary skill in the art. The liquid crystal display apparatus **600** may not have the third retardation film **930**, the fourth retardation film **940** and the second polarizer **950**.

FIG. **11** is a cross sectional view showing a liquid crystal display apparatus according to a third exemplary embodiment of the present invention.

Referring to FIG. **11**, the liquid crystal display apparatus **1000** according to the third exemplary embodiment of the present invention includes a liquid crystal display panel **1100**, a touch panel **1200** and a second polarizer **1350**. The liquid crystal display panel **1100** displays an image, and the touch panel **1200** detects the position of the object that touches an outer surface of the touch panel **1200**. The second polarizer **1350** is disposed on a lower surface of the liquid crystal display panel **1100**.

The liquid crystal display panel **1100** includes a TFT substrate **1130**, a color filter substrate **1160** facing the TFT substrate **1130**, and a liquid crystal layer **1170** interposed between the TFT substrate **1130** and the color filter substrate **1160**.

The TFT substrate **1130** includes a plurality of switching devices (not shown) and a plurality of pixel electrodes **1120** each of which is electrically connected with each of the switching devices. The switching devices are formed on the first transparent substrate **1110**. The color filter substrate **1160** includes color filters (not shown) and a common electrode **1150** formed on the color filters. The color filters are formed on the second transparent substrate **1140**.

The touch panel **1200** includes a first transparent electrode **1210**, a second transparent electrode **1220**, an optical film **1230** and a first retardation film **1250**. The first transparent electrode **1210** is disposed on an upper surface of the color filter substrate **1160**, and the second transparent electrode **1220** is separated from the first transparent electrode **1210** by a predetermined distance. The optical film **1230** is disposed on an upper surface of the second transparent electrode **1220**, and the first polarizer **1250** is disposed on an upper surface of the optical film **1230**.

The optical film **1230** is comprised of a material having an isotropic refractivity such as polycarbonate.

An adhesive **1280** comprised of an insulating material is interposed between the first and second transparent electrodes **1210** and **1220**. The adhesive **1280** combines the first and second transparent electrodes **1210** and **1220** with each other. The first transparent electrode **1210** is separated from the second transparent electrode **1220** by the thickness of the adhesive interposed between the first and second transparent electrodes **1210** and **1220**.

A plurality of spacers **1270** is formed on the first transparent electrode **1210**. The spacers **1270** may be formed on the second transparent electrode **1220**.

A detailed description about the spacer **1270** will be omitted because the spacer **1270** is the same as the spacer **330** of FIG. **4**.

A second polarizer **1350** may be disposed on a lower surface of the liquid crystal display panel **1100**.

In addition, the hard coated film and the reflection protection film illustrated in FIG. **6** may be further formed on the first polarizer **1250**.

The first transparent electrode **1210** is supported by the second transparent substrate **1140** of the color filter substrate **1160**. The second transparent electrode **1220** is supported by the first polarizer **1250**. Accordingly, an unnecessary substrate that causes the increase of the thickness of the liquid crystal display apparatus may be removed, the entire thickness of the liquid crystal display apparatus may be decreased, and the manufacturing cost of the liquid crystal display apparatus may be reduced.

Although the above embodiment discuss a reflective and transmissive type liquid crystal display panel, a reflective liquid crystal display panel could be utilized to display an image, as would be known to one of the ordinary skill in the art. The liquid crystal display apparatus **1000** may not have the second polarizer **1350**.

This invention has been described with reference to the exemplary embodiments. It is evident, however, that many alternative modifications and variations will be apparent to those having skill in the art in light of the foregoing description. Accordingly, the present invention embraces all such alternative modifications and variations as fall within the spirit and scope of the appended claims.

The invention claimed is:

1. A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image; and

a touch panel including

i) a first retardation member being disposed on an upper surface of the liquid crystal display panel,

ii) a first transparent electrode disposed directly on the first retardation member

iii) a second transparent electrode separated from the first transparent electrode by a predetermined distance,

iv) a second retardation member disposed on the second transparent electrode, and

v) a first polarizing member disposed on the second retardation member, and the touch panel detecting a point where the first transparent electrode is electrically connected to the second transparent electrode to detect a position of an object that touches an outer surface of the touch panel.

2. The liquid crystal display apparatus of claim **1**, wherein the first retardation member is a λ/4 retardation film, and the second retardation member is a λ/2 retardation film.

3. The liquid crystal display apparatus of claim **2**, wherein a first retardation axis of the first retardation member forms a first angle between about 90° and about 180° with respect to a polarizing axis of the first polarizing member, and a second retardation axis of the second retardation member forms a second angle between about 45° and about 135° with respect to the polarizing axis of the first polarizing member.

4. The liquid crystal display apparatus of claim **1**, wherein the touch panel further includes a spacer disposed between the first and second transparent electrodes, the spacer having a diameter from about 10 μm to about 80 μm and a height from about 2 μm to about 10 μm.

5. The liquid crystal display apparatus of claim **1**, wherein the liquid crystal display panel further includes a hard coated film, disposed on the first polarizing member, for protecting the first polarizing member.

6. The liquid crystal display apparatus of claim **1**, wherein the liquid crystal display panel further includes a reflection protection film, disposed on the first polarizing member, for preventing a light from being reflected from a surface of the first polarizing member.

7. The liquid crystal display apparatus of claim **6**, wherein the reflection protection film has a Mohs hardness of no less than about 3.

8. The liquid crystal display apparatus of claim **1**, wherein the touch panel further includes:

a hard coated film, disposed on the first polarizing member, for protecting the first polarizing member; and

a reflection protection film, disposed on the hard coated film, for removing a light reflected from a surface of the hard coated film.

9. The liquid crystal display apparatus of claim **1**, wherein the liquid crystal display apparatus further includes:

a third retardation member disposed on a lower surface of the liquid crystal display panel;

a fourth retardation member disposed on a lower surface of the third retardation member; and

a second polarizing member disposed on a lower surface of the fourth retardation member.

10. The liquid crystal display apparatus of claim **9**, wherein the first and third retardation members are λ/4 retardation films, and the second and fourth retardation members are λ/2 retardation films.

11. The liquid crystal display apparatus of claim **9**, wherein the first, second, third and fourth retardation members comprise polyarylate.

12. The liquid crystal display apparatus of claim **2**, wherein the first and third retardation members comprise polyether sulfone.

13. A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image; and

a touch panel including

i) a first transparent electrode disposed on an upper surface of the liquid crystal display panel,

ii) a second transparent electrode separated from the first transparent electrode by a predetermined distance,

iii) a first retardation member disposed directly on the second transparent electrode,

iv) a second retardation member disposed on the first retardation member, and

v) a first polarizing member disposed on the second retardation member, and the touch panel detecting a point at which the first transparent electrode is electrically connected to the second transparent electrode to detect a position of an object that touches an outer surface of the touch panel.

14. The liquid crystal display apparatus of claim **13**, wherein the first retardation member is a λ/2 retardation film, and the second retardation member is a λ/4 retardation film.

15. The liquid crystal display apparatus of claim **14**, wherein a first retardation axis of the first retardation member forms a first angle between about 90° and about 180° with respect to a polarizing axis of the first polarizing member, and a second retardation axis of the second retardation member forms a second angle between about 45° and about 135° with respect to the polarizing axis of the first polarizing member.

16. The liquid crystal display apparatus of claim **13**, wherein the liquid crystal display apparatus further includes:

a third retardation member disposed on a lower surface of the liquid crystal display panel;

a fourth retardation member disposed on a lower surface of the third retardation member; and

a second polarizing member disposed on a lower surface of the fourth retardation member.

17. The liquid crystal display-apparatus of claim **13**, wherein the first and third retardation members are λ/4 retardation films, and the second and fourth retardation members are λ/2 retardation films.

* * * * *

专利名称(译)	导光板和具有该导光板的液晶显示器		
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IPC分类号	G02F1/1335 G02F1/133 G02F1/13363 G06F3/033 G06F3/041 G06F3/045		
CPC分类号	G02F1/13338 G06F3/045 G06F3/0412 G02F1/133502 G02F1/13363 G02F2201/50 G02F2001/133638		
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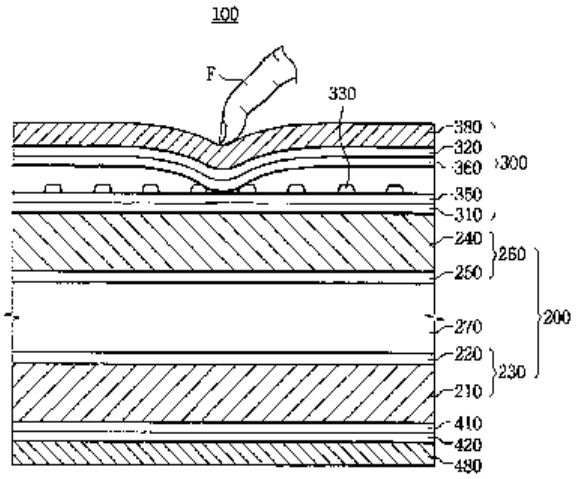
其他公开文献	US20060146207A1		
外部链接	Espacenet USPTO		

摘要(译)

本发明公开了一种液晶显示装置（100），包括液晶显示面板（2009和触控面板（300））。第一透明电极（350）设置于液晶显示面板（200）的上表面，用于显示第二透明电极（360）设置在延迟构件（320）的下表面上，第二透明电极（360）与第一透明电极（350）相对。因此，液体的整个厚度可以减少晶体显示装置，并且可以降低液晶显示装置的制造成本。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