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(54) LIQUID CRYSTAL DISPLAY DEVICE HAVING THIN POLARIZING FILM AND THIN PHASE RETARDATION FILM

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(57) **ABSTRACT**

A LCD device having a thin phase retardation film is disclosed, which is achieved using a thin film polarizing film formed by accurately processing a thin aluminum film, a polarizing film of a nano imprint lithography method that uses polymer, and a polarizing film and a liquid crystal material that form a polarizing nano material thin film by uniformly coating a polarizing nano material (TCF).

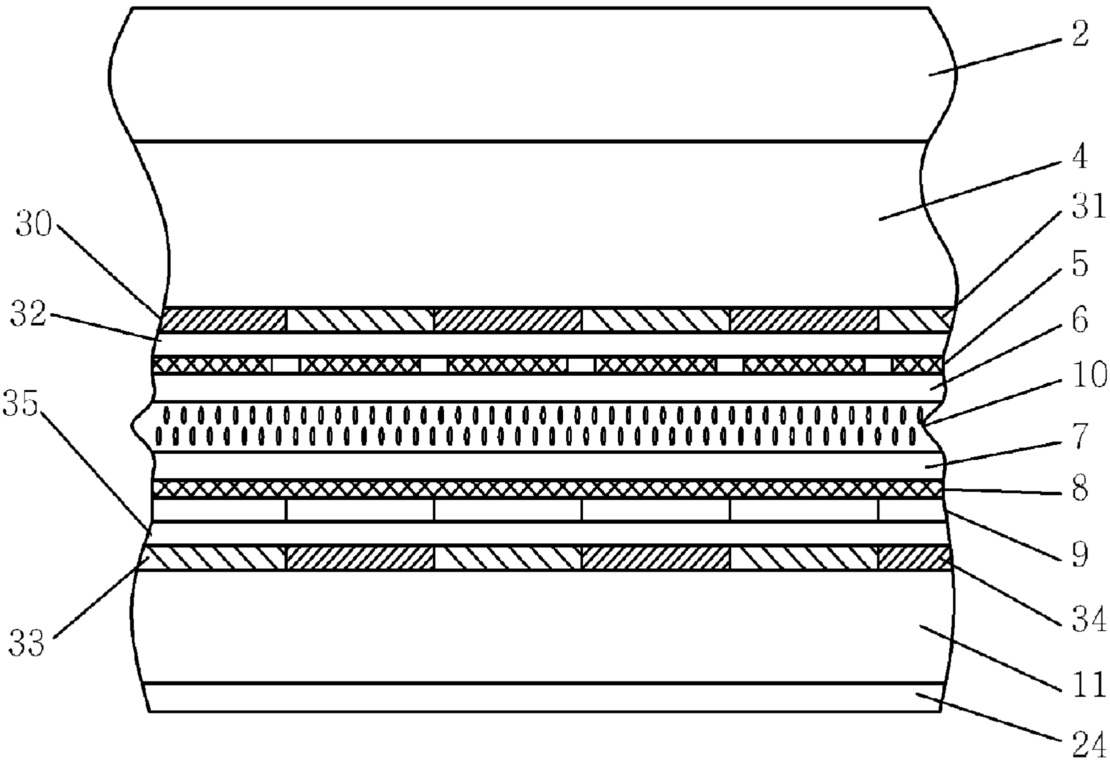


FIG. 1

Prior Art

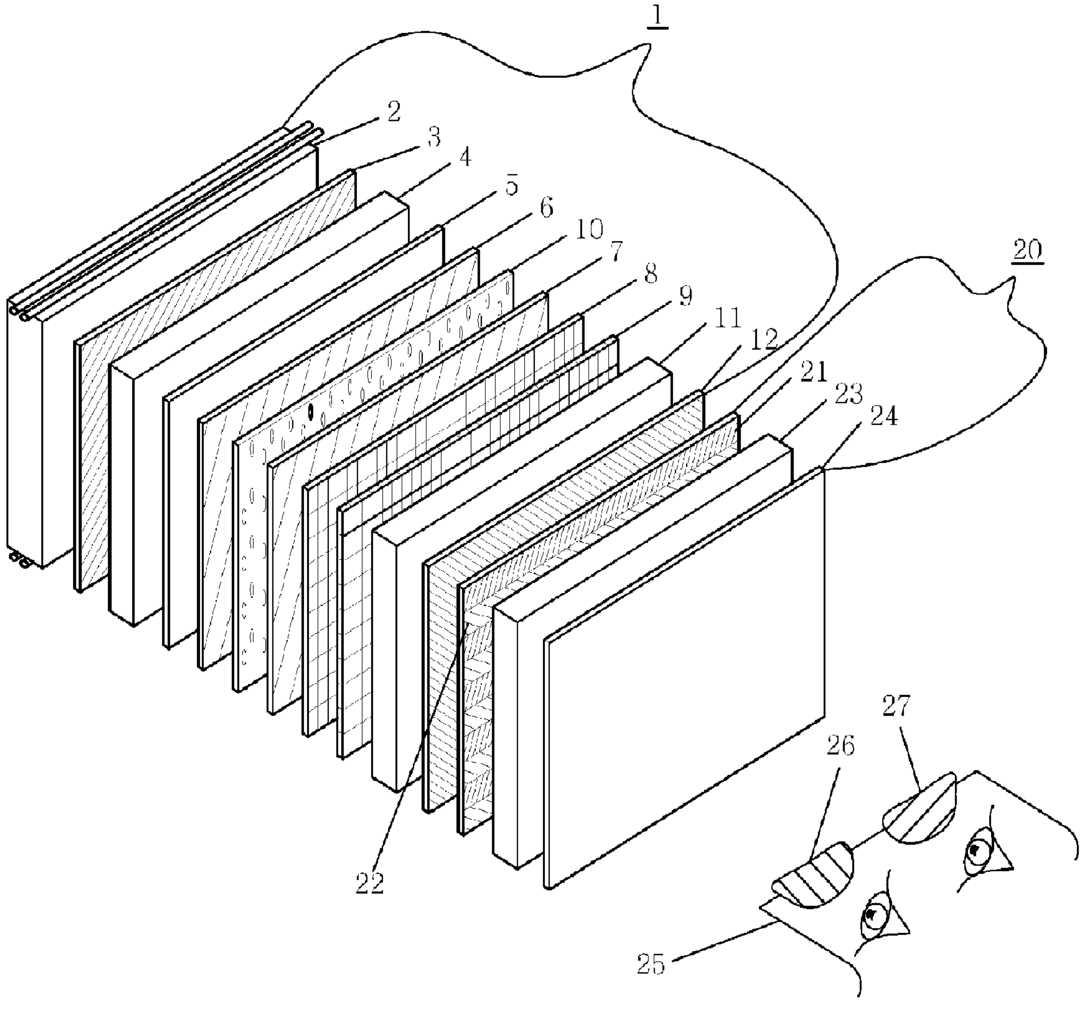


FIG. 2

Prior Art

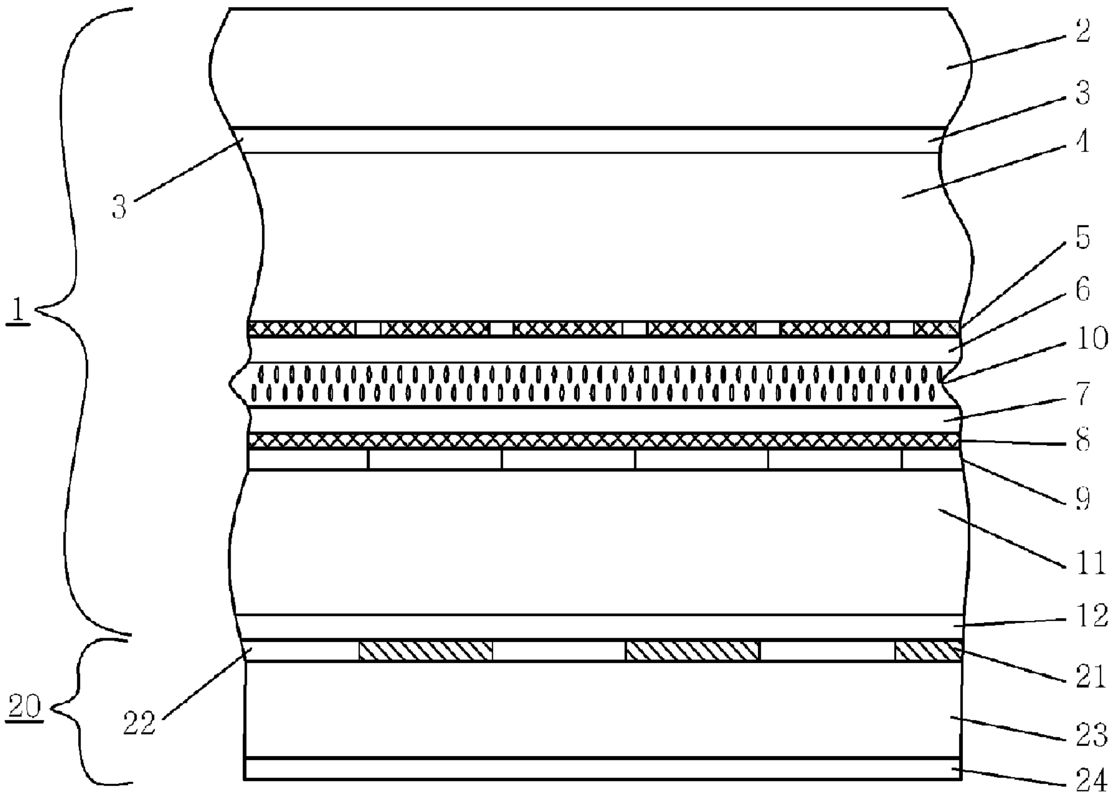


FIG. 3

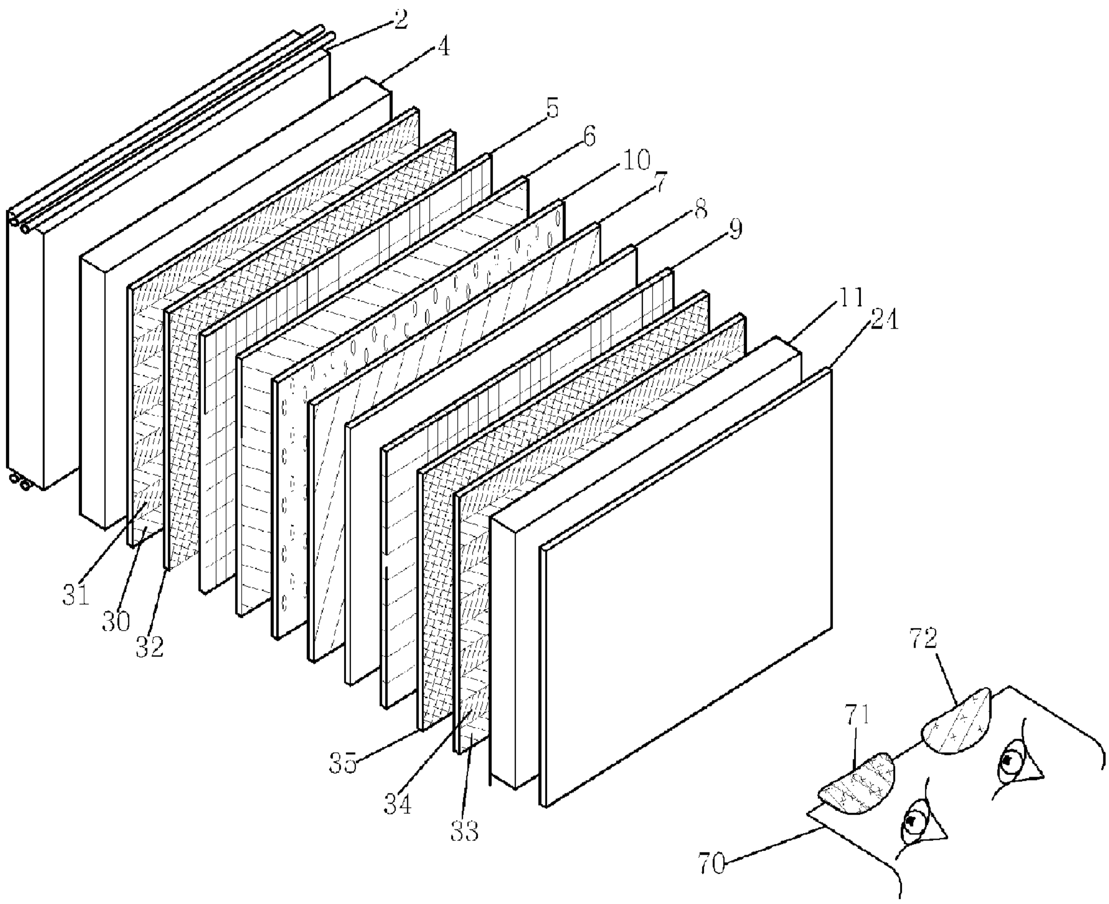


FIG. 4

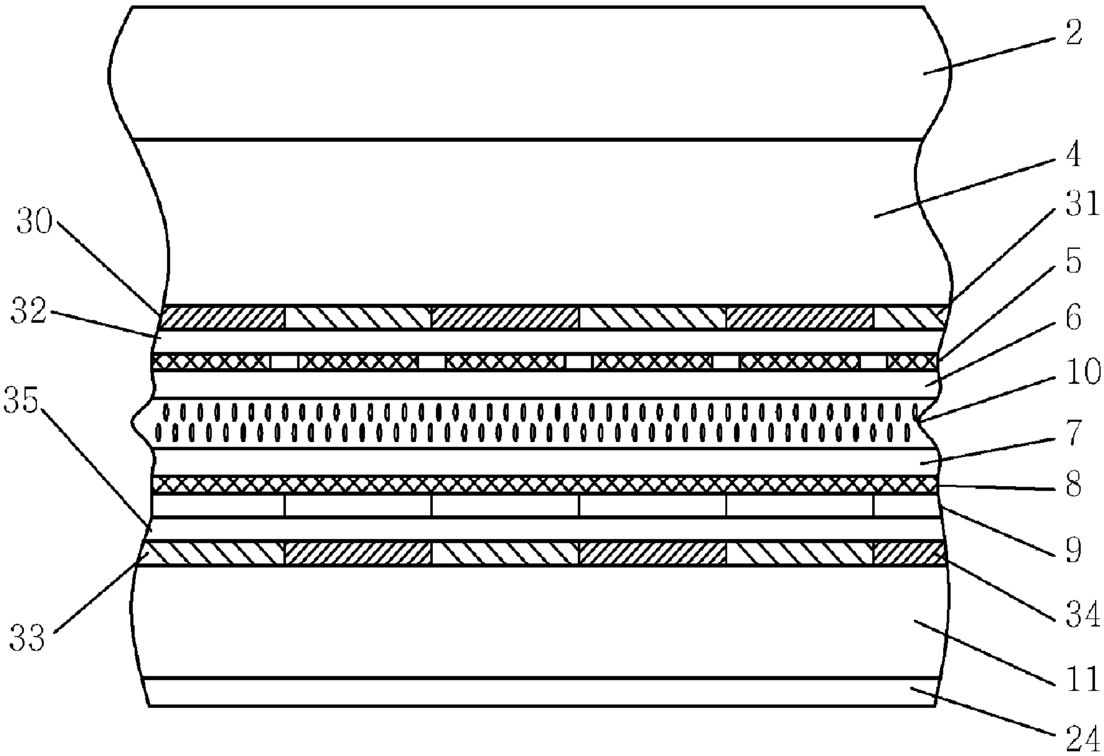


FIG. 5

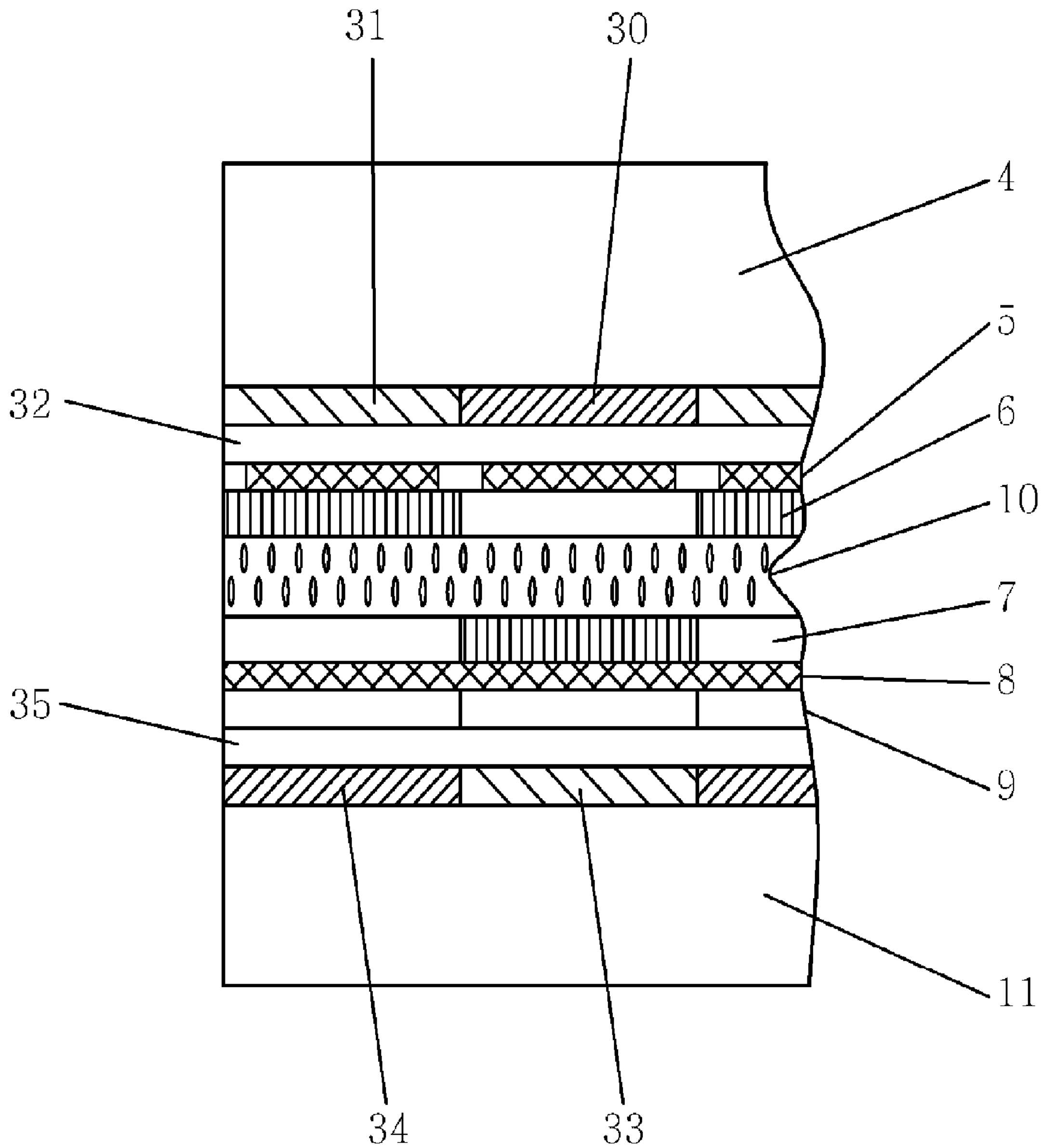


FIG. 6

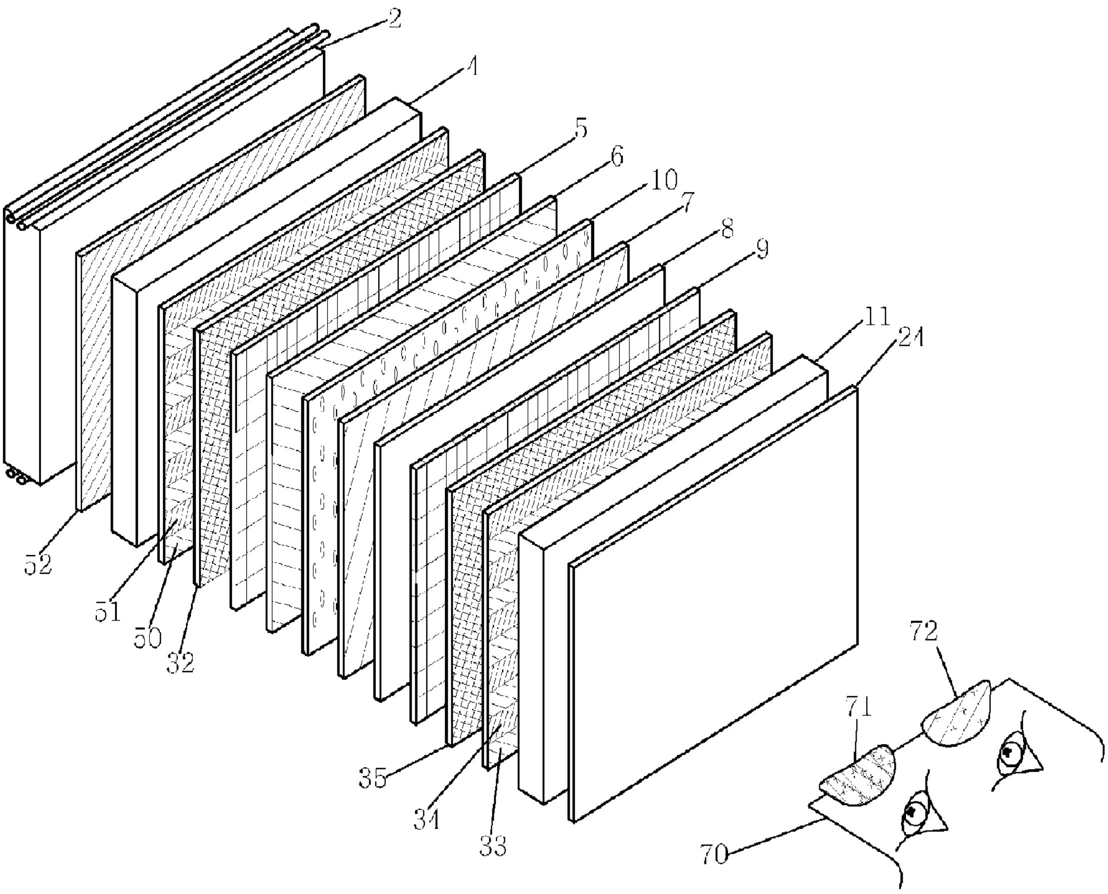


FIG. 7

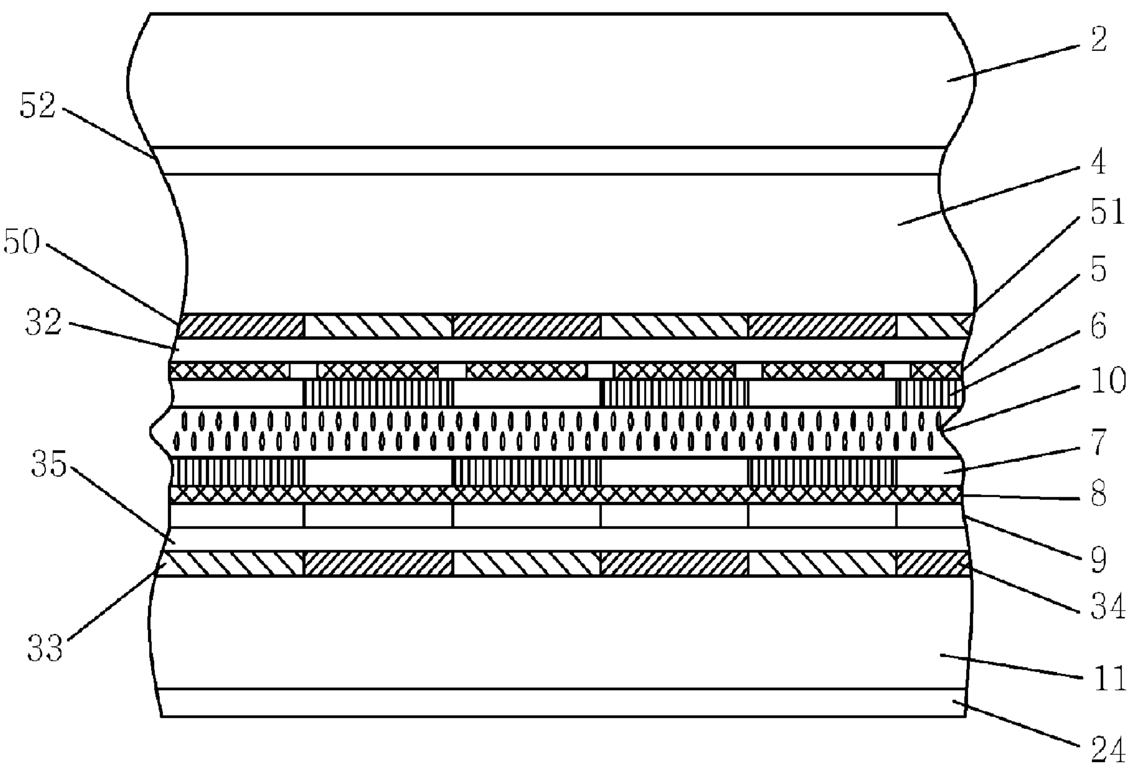


FIG. 8

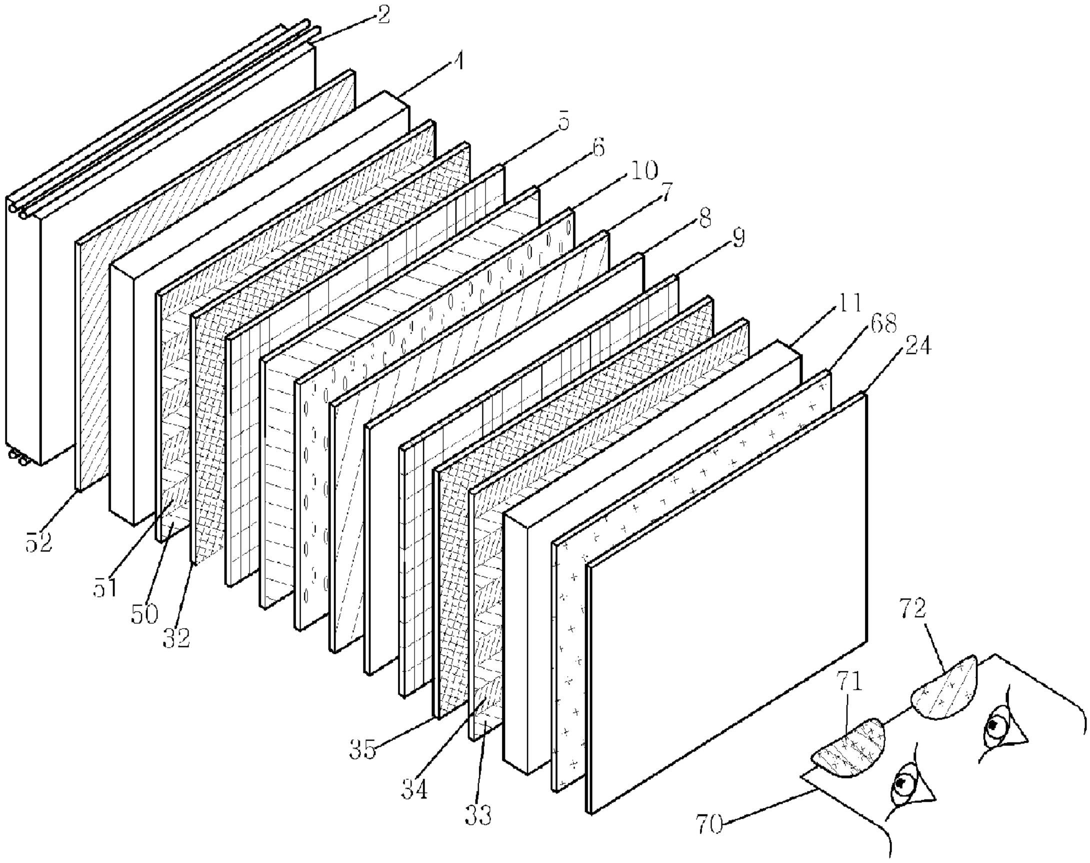


FIG. 9

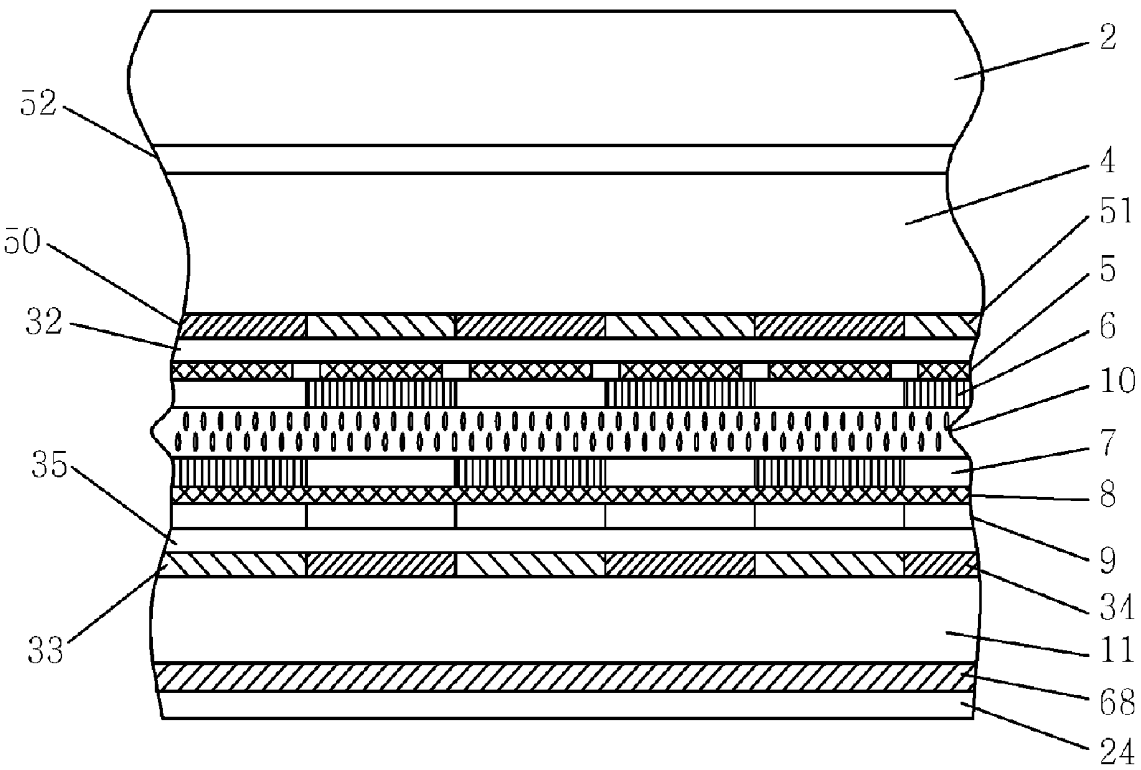


FIG. 10

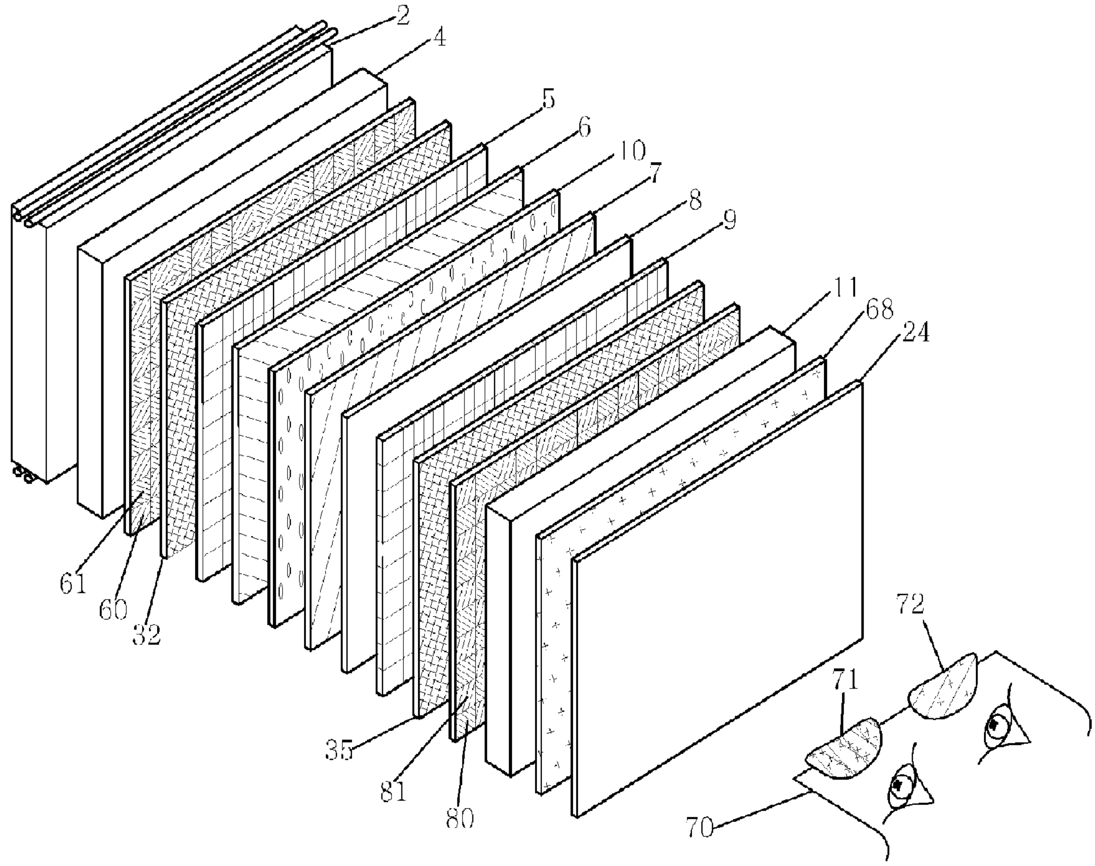


FIG. 11

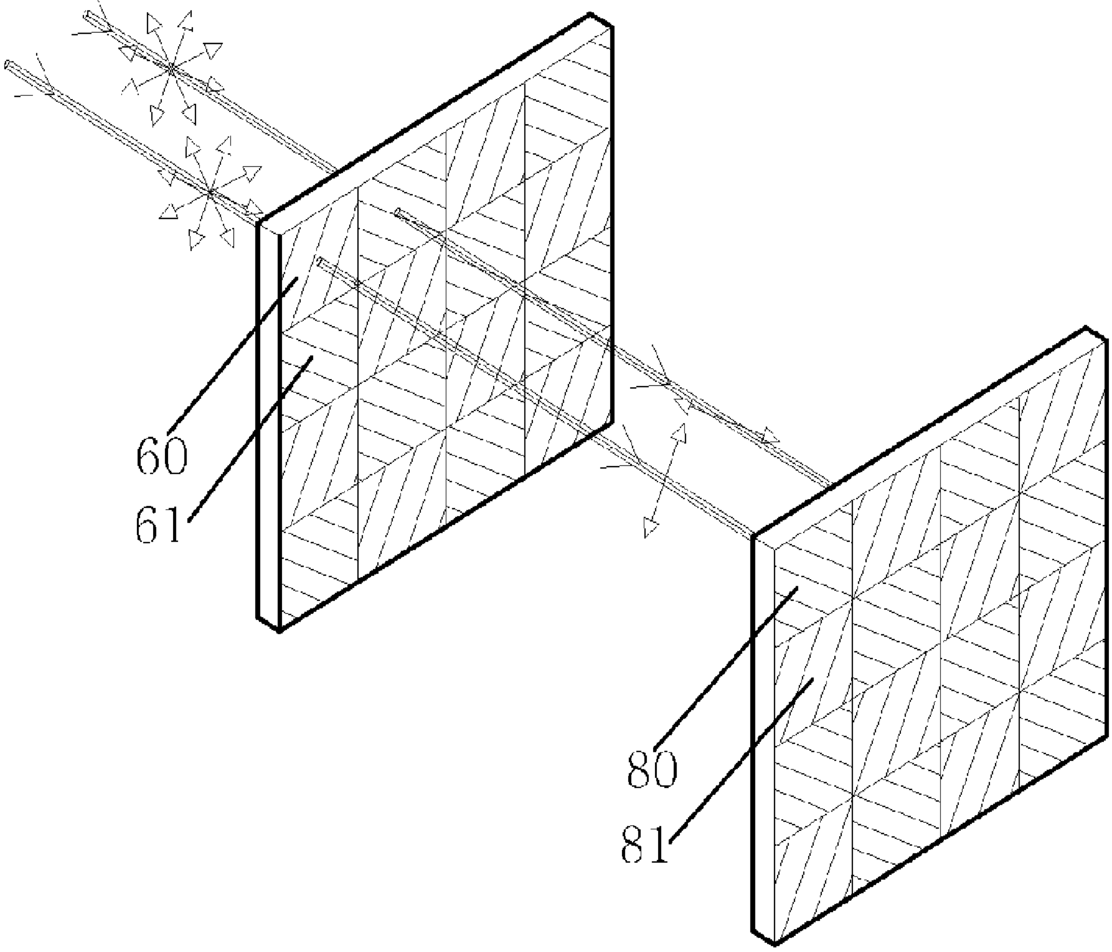


FIG. 12

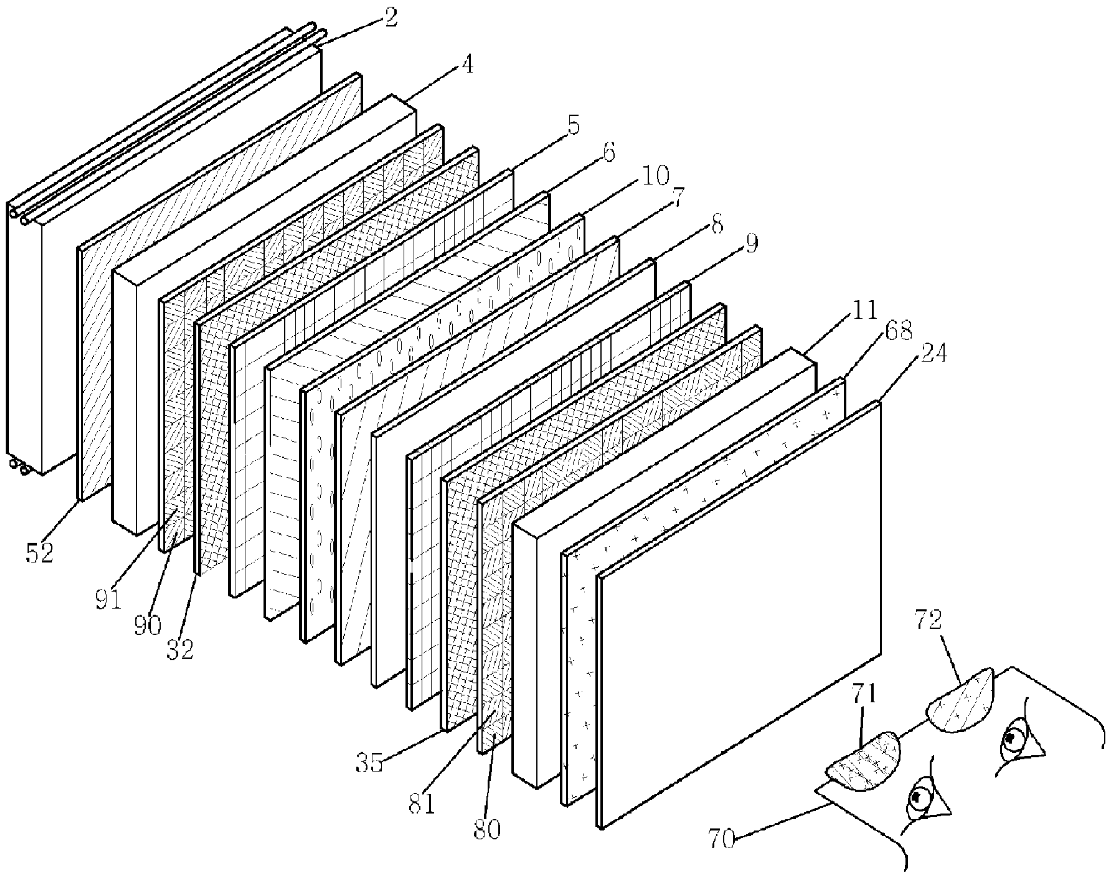


FIG. 13

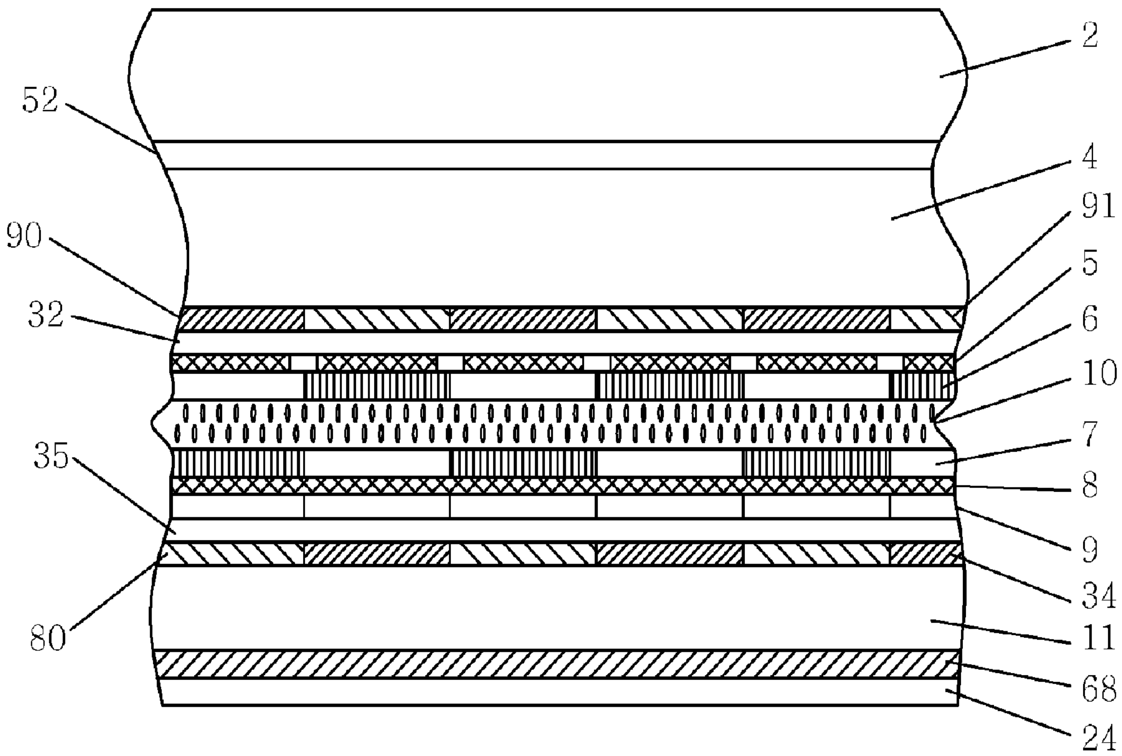


FIG. 14

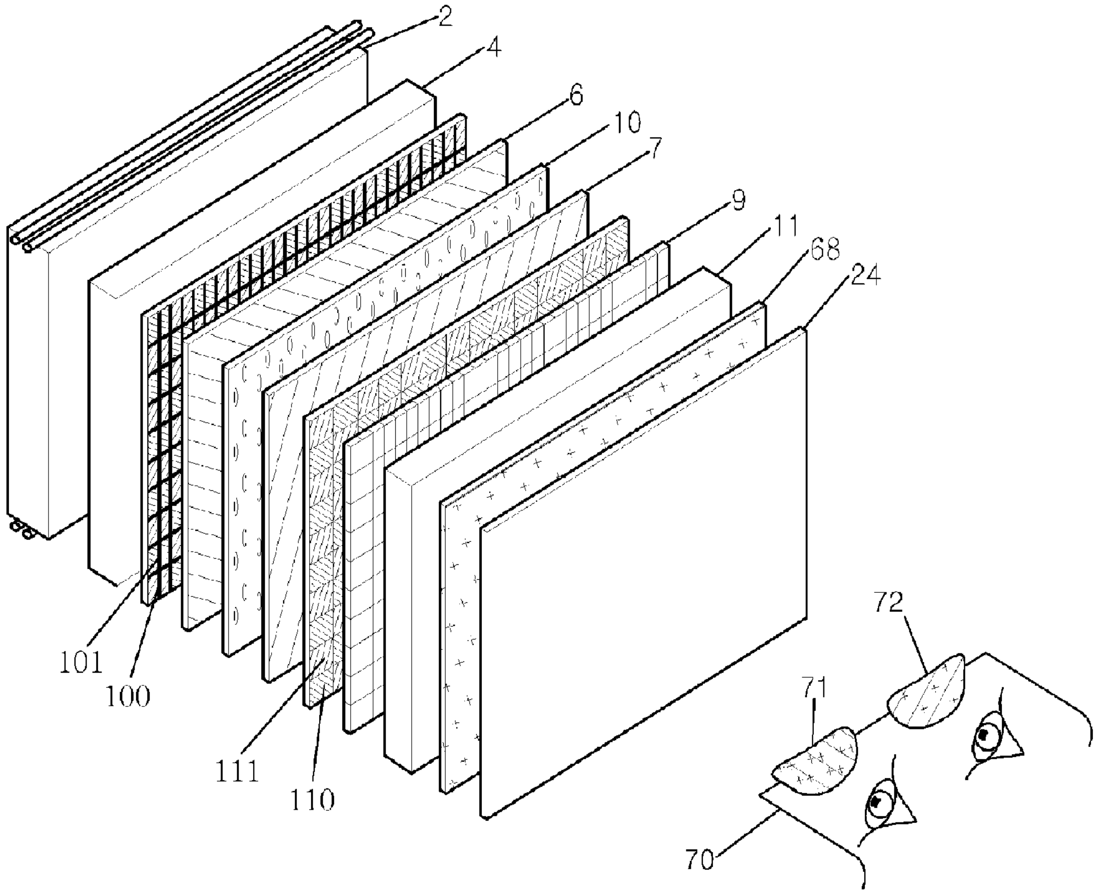


FIG. 15

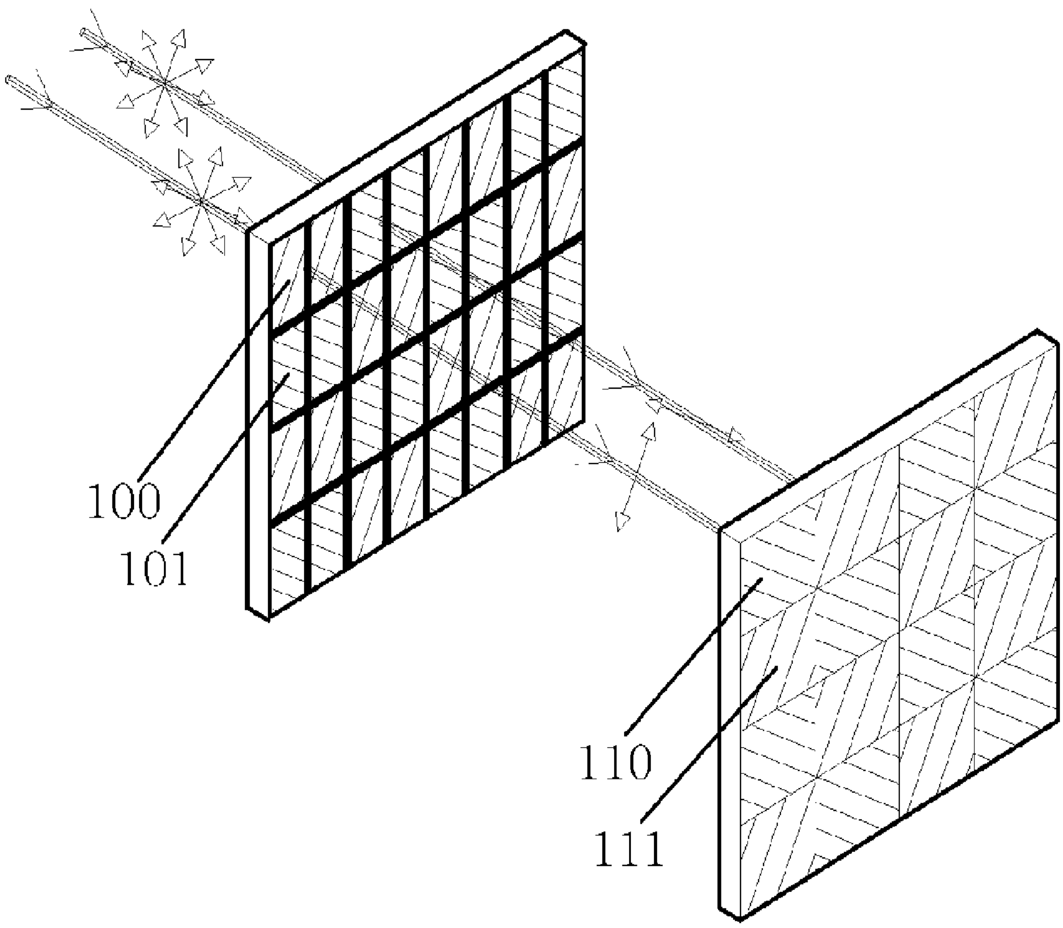
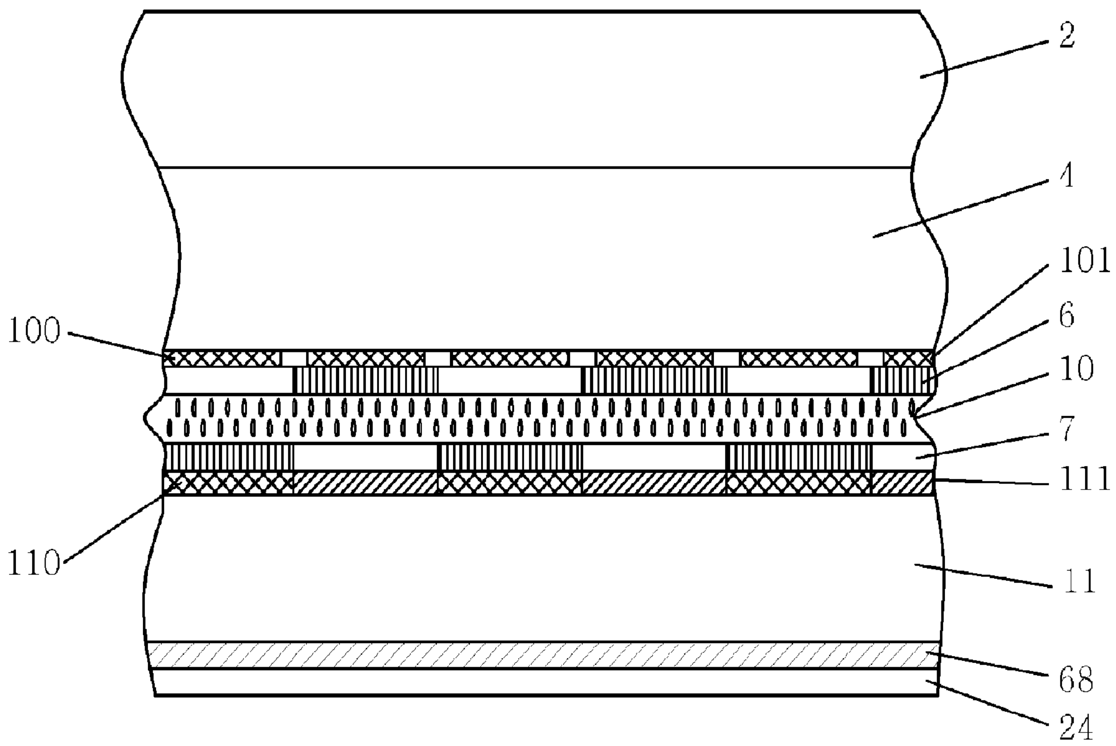


FIG. 16



LIQUID CRYSTAL DISPLAY DEVICE HAVING THIN POLARIZING FILM AND THIN PHASE RETARDATION FILM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a LCD (Liquid Crystal Display) device having a thin polarizing film and a thin phase retardation film, and in particular to a LCD device having a thin polarizing film and a thin phase retardation film capable of displaying a 2D (dimension) image and a 3D (dimension) image.

[0003] 2. Description of the Background Art

[0004] The Korean patent gazette No. 2992-41382 (laid-open date: Jun. 1, 2002) entitled "Liquid crystal shutter for 3D display device" discloses a technique capable of removing Moire interference phenomenon fin a display device that is designed to implement a 3D based on a parallax barrier.

[0005] The U.S. Pat. No. 6,122,103 of US Moxtek Inc. discloses a thin polarizing film manufactured using a thin aluminum film.

[0006] The U.S. Pat. No. 6,813,077 of Corning Inc. discloses a technique of fabricating a thin film of a wire grid with an imprint method. In addition, the U.S. Pat. Nos. 5,772,905 and 6,900,126 discloses a nano imprint lithography that uses polymer. The U.S. Pat. No. 6,174,394 of Optiva Ltd. Discloses a polarizing nano material (TCF) fabricated by a technique related with a polarizing nano material thin film. Some companies including Germany Merck company sell liquid crystal material (Reactive Mesogen) related to fabrication of phase retardation film. The U.S. Pat. No. 5,91 **7,562** (issue date: Jun. 29, 999) entitled "Autostereocopic display and spatial light modulator" that is one of the prior art of the present invention discloses an automatic 3D display apparatus capable of improving an image contrast between a left eye and a right eye.

[0007] **FIG. 1** is a view illustrating a conventional 3D display structure, and **FIG. 2** is a cross sectional view of **FIG. 1**. In the LCD device capable of displaying a 2D image and a 3D image, a first polarizing film **3** is installed at a front side of a backlight unit **2**. A first transparent substrate **4** is disposed at a front surface of the first polarizing film **3**, and a crystal liquid layer **10** filled with a liquid crystal material is disposed between a first transparent substrate **4** and a second transparent substrate **11**.

[0008] The second polarizing film **12** having an orthogonal 90° polarizing direction with respect to the first polarizing film **3** is installed at a front surface of the crystal liquid layer **10**. A first ½ phase retardation film **21** is installed at a front surface of the second polarizing film **3**. When a user wears polarizing glasses **25** for left and right eyes having a 90° polarizing direction difference, the user can see a 3D image.

[0009] In the conventional LCD device capable of displaying a 3D image of **FIG. 1**, the first ½ phase retardation film **21** is installed at a front surface of a 2D image panel. When a user wears polarizing glasses **25** and sees a 3D image, a viewing angle is limited, and a viewing distance is limited. Since the 3D viewing angle is generally less than 16°, it is impossible to view 3D images clearly.

[0010] Therefore, a development of a 2D and 3D image display device capable of displaying 2D and 3D images and achieving a simple structure is urgently needed in the industry.

SUMMARY OF THE INVENTION

[0011] Accordingly, it is an object of the present invention to overcome the above-described problems encountered in the conventional art.

[0012] It is another object of the present invention to provide a LCD device having a thin polarizing film and a thin phase retardation film capable of displaying a 2D image and a 3D image with a simple structure in such a manner that polarizing films having different polarizing directions are disposed on the same plane, and a simple structure is achieved using a thin phase retardation film.

[0013] It is another object of the present invention to provide a LCD device having a thin phase retardation film that is achieved using a thin film polarizing film formed by accurately processing a thin aluminum film, a polarizing film of a nano imprint lithography method that uses polymer, and a polarizing film and a liquid crystal material that form a polarizing nano material thin film by uniformly coating a polarizing nano material (TCF).

[0014] To achieve the above objects, in a LCD (Liquid Crystal Display) device in which a first transparent substrate is disposed at a front surface of a backlight unit, and a first polarizing region having a polarizing direction angle of 0° or 45° and a second polarizing region having a polarizing direction angle of 90° or 135° are formed on a surface of the first transparent substrate in an orthogonal structure on the same plane, and a liquid crystal layer is disposed between a first alignment film and a second alignment film, and a second transparent electrode and a color filter are disposed at a front surface of the second alignment film, there is provided a LCD device having a thin polarizing film and a tin phase retardation film characterized in that a first polarizing region having a polarizing direction of 0° or 45° and a second polarizing region having a polarizing direction of 90° or 135° formed on a surface of the first transparent substrate are orthogonal from each other and are aligned on the same plane, and a first insulation layer is stacked on the front surfaces of the first polarizing region and the second polarizing region, and next to that, the first transparent electrode and a first alignment film are disposed at a front surface of the first insulation layer, and a liquid crystal later filled with liquid crystal is aligned between the first and second alignment films, and a second transparent electrode, a color filter and a second insulation layer are sequentially disposed at a front surface of the second alignment film, and a third polarizing region and a fourth polarizing region are formed on the same plane in a structure in which the first polarizing region and the second polarizing region are orthogonal in their polarizing directions at 90°, and next to that the second transparent substrate is disposed, and a non-reflection coating layer is disposed at the front most surface.

[0015] In the first embodiment of the present invention, a polarizing film according to the present invention is integrally formed in a first polarizing region and a second polarizing region on a surface of a first transparent substrate of a conventional LCD panel. A liquid crystal layer is disposed between a third polarizing region and a fourth polarizing region integrally formed at a back surface of the second transparent substrate.

[0016] Namely, the first polarizing region and the second polarizing region are alternately formed at a surface of the first transparent substrate, and the third polarizing region and the fourth polarizing region are alternately formed at a back surface of the second transparent substrate, and the polarizing region formed at a portion corresponding to the first transparent substrate and the second transparent substrate are arranged to have different polarizing directions.

[0017] Here, the first polarizing region has a polarizing direction of 0° or 45°, and the third polarizing region has a polarizing direction of 90° or 135°. The polarizing direction between the first polarizing region and the third polarizing region has an orthogonal angle of 90°. In addition, the polarizing direction between the second polarizing region and the fourth polarizing region has an orthogonal angle of 90°.

[0018] In the second embodiment of the present invention, a third polarizing film is formed of a straight line polarizing film on the whole front surfaces of the backlight unit. A second ½ phase retardation film and a transparent unit are aligned at a surface of the first transparent substrate with a certain width and distance. Next, a first insulation layer is disposed. A first transparent electrode and a first alignment film are sequentially aligned at a front surface of the same. In addition, a liquid crystal layer, a second alignment film, a second transparent electrode, a color filter and a second insulation layer are sequentially aligned. A transparent substrate integrally formed of a third polarizing region and a fourth polarizing region are aligned at a front surface of the same. A non-reflection coating layer is disposed at a front most surface.

[0019] In the third embodiment of the present invention, a ¼ phase retardation film is disposed for converting an incident light into a circular polarizing light in the structure of the second embodiment of the present invention.

[0020] In the fourth embodiment of the present invention, the whole construction is similar with the first embodiment of the present invention. The structure of the polarizing region is aligned in a lattice shape, and a ¼ phase retardation film is further provided.

[0021] In the fifth embodiment of the present invention, the whole construction is similar with the third embodiment of the present invention. Here, the structure of the phase retardation film and the structure of the polarizing region are aligned in a lattice shape.

[0022] In the sixth embodiment of the present invention, the polarizing region is formed of a conductive metal differently from the structure of the fourth embodiment of the present invention. In this embodiment, since the polarizing film function and the electrode function are concurrently provided, two transparent electrodes and two insulation layers are not needed before and after the liquid crystal layer differently from the fourth embodiment of the present invention. Therefore, the fabrication process of the LCD device can be decreased, and the fabrication cost is also decreased.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein;

[0024] **FIG. 1** is a view illustrating a construction of a conventional 3D display;

[0025] **FIG. 2** is a cross sectional view of **FIG. 1**;

[0026] **FIG. 3** is view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a first embodiment of the present invention;

[0027] **FIG. 4** is a cross sectional view of **FIG. 3**;

[0028] **FIG. 5** is a detailed view illustrating a polarizing region and an alignment direction used in the present invention;

[0029] **FIG. 6** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a second embodiment of the present invention;

[0030] **FIG. 7** is a cross sectional view of **FIG. 6**;

[0031] **FIG. 8** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a third embodiment of the present invention;

[0032] **FIG. 9** is a cross sectional view of **FIG. 8**;

[0033] **FIG. 10** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a fourth embodiment of the present invention;

[0034] **FIG. 11** is a view illustrating a structure of a polarizing film of **FIG. 10**;

[0035] **FIG. 12** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a fifth embodiment of the present invention;

[0036] **FIG. 13** is a cross sectional view of **FIG. 12**;

[0037] **FIG. 14** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a sixth embodiment of the present invention;

[0038] **FIG. 15** is a view illustrating a structure of a conductive polarizing film of **FIG. 14**; and

[0039] **FIG. 16** is a cross sectional view of **FIG. 14**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] The preferred embodiments of the present invention will be described with reference to the accompanying drawings.

[0041] **FIG. 3** is view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a first embodiment of the present invention, **FIG. 4** is a cross sectional view of **FIG. 3**, **FIG. 5** is a detailed view illustrating a polarizing region and an alignment direction used in the present invention, **FIG. 6** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a second embodiment of the present invention, **FIG. 7** is a cross sectional view of **FIG. 6**, **FIG. 8** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a third embodiment of the present invention, and **FIG. 9** is a cross sectional view of **FIG. 8**.

[**0042**] In addition, **FIG. 10** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a fourth embodiment of the present invention, **FIG. 11** is a view illustrating a structure of a polarizing film of **FIG. 10**, **FIG. 12** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a fifth embodiment of the present invention, **FIG. 13** is a cross sectional view of **FIG. 12**, **FIG. 14** is a view illustrating a LCD device having a thin polarizing film and a thin phase retardation film according to a sixth embodiment of the present invention, **FIG. 15** is a view illustrating a structure of a conductive polarizing film of **FIG. 14**, and **FIG. 16** is a cross sectional view of **FIG. 14**.

First Embodiment

[**0043**] The 2D and 3D LCD device according to a first embodiment of the present invention will be described with reference to **FIGS. 3 and 4**. Polarizing regions are given reference numerals of **30**, **31**, **33**, **34**, **60**, **61**, **80** and **81** in order to recognize the regions from a polarizing film because the polarizing directions are orthogonal at 90° in a lattice shape on one plane.

[**0044**] As shown in **FIGS. 3 and 4**, in the liquid crystal device capable of displaying a 2D image and a 3D image according to the first embodiment of the present invention, a first polarizing region **30** having a polarizing direction of 0° or 45° formed on a plane of the first transparent substrate aligned on a front surface of the backlight unit **2** and a second polarizing region **31** that has a polarizing direction of 90° or 135° are aligned in an orthogonal structure. A first insulation layer **32** is aligned at a front surface of the first polarizing region **30** and the second polarizing region **31**. A first transparent electrode **5** and a first alignment film **6** are disposed at the front surface of the same. A liquid crystal layer **10** filled with a liquid crystal is disposed between the first alignment film **6** and the second alignment film **7**. Here, the alignment directions of the first alignment film **6** and the second alignment film **7** may be different based on the kinds of liquid crystal.

[**0045**] As shown in **FIG. 5**, it is preferred that the alignment directions of the first alignment film **6** and the second alignment film **7** are vertical at the portions corresponding to the first polarizing region **30** and the second polarizing region **31**, but the alignments may be in the same direction depending of the kinds of the liquid crystal. When electromagnetic field is applied to the liquid crystal layer **10**, it is moved based on the characteristic of the liquid crystal. Therefore, it is needed to retard transmitting light.

[**0046**] Next, a second transparent electrode **8**, a color filter **9** and a second insulation layer **35** are disposed at a front surface of the second alignment film **7**. A third polarizing region **33** and a fourth polarizing region **34** are integrally formed at the next front surface in a structure that the polarizing direction is orthogonal at **900** with respect to the first polarizing region **30** and the second polarizing region **31**. A non-reflection coating layer **24** is disposed at the front most side.

[**0047**] In the conventional liquid crystal display panel, the polarizing films before and after the liquid crystal layer have the same polarizing direction, and the polarizing directions have 90° difference. In this embodiment of the present invention, the polarizing films are formed like a structure that fine stripes are orthogonal from each other with the polarizing directions being 90° fine stripes are orthogonal on one plane. Namely, the first polarizing region **30** and the second polarizing region **31** are on the front surface of the first transparent substrate **4**, and the third polarizing region **33** and the fourth polarizing region **34** are integrally formed at the back side of the second transparent substrate **11**. The liquid crystal layer **10** is disposed therebetween.

[**0048**] As shown in **FIG. 5**, the first polarizing region **30** and the second polarizing region **31** are alternately formed on the front surface of the first transparent substrate **4**. The third polarizing region **33** and the fourth polarizing region **34** are alternately formed on the backside of the second transparent substrate **11**. The polarizing regions formed at the portions corresponding to the first transparent substrate **4** and the second transparent substrate **11** have different polarizing directions.

[**0049**] Here, the first polarizing region **30** has a polarizing direction of 0° or 45°, and the third polarizing region **33** has a polarizing direction of 90° or 135°. The polarizing direction is orthogonal at 90° between the first polarizing region **30** and the third polarizing region **33**. The polarizing direction is orthogonal at 90° between the second polarizing region **31** and the fourth polarizing region **34**.

[**0050**] The operation of the LCD device according to the first embodiment of the present invention will be described. First, when light transmits the first polarizing region **30** formed at the front surface of the first transparent substrate **40** through the backlight unit **2**, the light becomes a straight line polarizing light polarized at 0° or 45°. Since the light becomes a straight line polarizing state having 90° rotated polarizing direction after the light transmitted the liquid crystal layer **10**, so that a viewer can view the image transmitted the third polarizing region **33** having a polarizing direction of 90° or 135°.

[**0051**] When the light from the backlight unit **2** transmits the second polarizing region **31** formed at the front surface of the first transparent substrate **4**, the light is changed to a straight line polarizing light polarized at an angle of 90° or 135° and is changed to a 90° rotated straight line polarizing light while transmitting the liquid crystal layer **10**. Therefore, as the light transmits the fourth polarizing region **34** having a polarizing direction of 0° or 45°, the viewer can view the images.

[**0052**] Therefore, the first polarizing region **30** and the third polarizing region **33** are matched with the pitches of the pixels at the liquid crystal display panel, and the right eye image is displayed at the odd number row at the LCD panel, and the left eye image is displayed on the even number row, so that the right eye image transmits the fourth polarizing region **34**, and the left eye image transmits polarizing glasses **25**, so that the viewer can see a 3D image.

Second Embodiment

[**0053**] The 2D and 3D liquid crystal display device according to the second embodiment of the present invention will be described. **FIG. 6** is a view of the second embodiment, and **FIG. 7** is a cross sectional view of **FIG. 6**.

[0054] As shown in **FIG. 6**, a part of the LCD device capable of displaying 2D and 3D images according to the second embodiment of the present invention is changed as compared with the first embodiment of the present invention. The above changes will be described in detail.

[0055] As shown in **FIG. 6**, in the LCD device capable of displaying 2D and 3D images according to the second embodiment of the present invention, a third polarizing film **52** formed of straight line polarizing films on its entire surface is disposed at the front surface of the backlight unit **2**. The second **1/2** phase retardation film **50** and the transparent unit **51** are disposed at the front surface of the first transparent substrate **4** with a certain width and distance. Next, the first insulation layer **32** is disposed, and the first transparent electrode **5** and the first alignment film **6** are formed at the front surface of the same. A liquid crystal layer **10** filled with liquid crystal is disposed between the first alignment **6** and the second alignment film **7**. When an electromagnetic field is applied to the liquid crystal layer **10**, it is moved based on the characteristic of the liquid crystal, so that it is possible to retard the transmitting light.

[0056] Next, the second transparent electrode **8**, the color filter **9** and the second insulation layer **35** are sequentially disposed at the front surface of the second alignment film **7**. The second transparent substrate **11** integrally formed of the third polarizing region **33** and the fourth polarizing region **34** is disposed at the next front surface. A non-reflection coating layer **24** is disposed at the front most surface.

[0057] In the conventional LCD panel, the polarizing films before and after the liquid crystal have the same polarizing directions with 90° differences in their polarizing directions. In the first embodiment of the present invention, new polarizing films are alternately orthogonal before and after the liquid crystal in fine stripe shapes having different polarizing directions of 90° at one plane. In the second embodiment of the present invention, the second ½ phase retardation film **50**, the liquid crystal layer **10**, the third polarizing region **33** and the fourth polarizing region **34** are sequentially engaged, and the polarizing films are integral with the above structure.

[0058] The operation according to the second embodiment of the present invention will be described. When light from the backlight unit **2** is changed to straight line polarizing light having a 90° polarizing direction while transmitting the third polarizing film **52** formed of straight line polarizing films. Next, the light transmitted the transparent unit **51** disposed at the front surface of the first transparent substrate **4** transmits the liquid crystal layer **10** and is changed to straight line polarizing light having a 90° rotated polarizing direction. The light transmits the fourth polarizing region **34** having a 0° or 45° polarizing direction, so that the viewer can view the image.

[0059] In addition, the light that transmitted the third polarizing film **52** and polarized at 90° or 135° transmits the second ½ phase retardation film **50** and has a 180° difference between incident light and the phase, so that the light is changed to straight line polarizing light having a 90° rotated polarizing direction, and the polarizing direction becomes 0°. The light becomes straight line polarizing light having a 90° rotated polarizing direction while transmitting the liquid crystal layer **10**. Therefore, as the light transmits the third polarizing region **33** having a 90° or 135° polarizing direction, the viewer can view the image.

[0060] In the LCD panel, the transparent unit **51** and the fourth polarizing region **31** are matched with the pitches of the pixels, and the second ½ phase retardation film **50** and the third polarizing region **33** are matched with the pitches of the pixels. In the LCD panel, the right eye image is displayed at the odd number row, and the left eye image is displayed at the even number row. The right eye image transmits the fourth polarizing region **34**, and the left eye image transmits the third polarizing region **33**. Therefore, the viewer can view the 3D image using the polarizing glasses **25**.

Third Embodiment

[0061] **FIG. 8** is a view of the third embodiment of the present invention, and **FIG. 9** is a cross sectional view of **FIG. 8**. As shown in **FIG. 8**, the construction of the third embodiment of the present invention is similar with the second embodiment of the present invention except for a ¼ phase retardation film **68** that is additionally provided in this embodiment. In more detail, the light from the backlight unit **2** is changed to straight line polarizing light having 90° or 135° polarizing direction while transmitting the third polarizing film **52** formed of straight line polarizing films.

[0062] The light transmitted the transparent unit **51** disposed at the front surface of the first transparent substrate **4** is changed to straight line polarizing light having a 90° rotated polarizing direction while transmitting the liquid crystal layer **10**. Thereafter, the light transmits the fourth polarizing region **34** having a 0° or 45° polarizing direction. Next, the polarized light transmits the ¼ phase retardation film **68** and becomes a circular polarizing light. The viewer can view the image using the right eye polarizing glasses **72** of the circular polarizing glasses **70**.

[0063] The light transmitted the third polarizing film **52** and polarized in straight line with 90° or 135° has a 180° angle difference between the incident light and the phase, so that the light is changed to the straight line light having a 90° rotated polarizing direction. The light is changed to have a straight line polarizing light state having a 90° rotated polarizing direction, while transmitting the liquid crystal layer **10**. The light transmits the third polarizing region **33** having a 90° or 135° polarizing direction and then transmits the ¼ phase retardation film **68** and becomes a circular polarizing state. Therefore, the viewer can view the image using the left eye circular polarizing glasses **71** of the circular polarizing glasses **70**.

[0064] The transparent unit **51** and the fourth polarizing region **34** are matched with the pitches of the pixels at the LCD panel, and the second ½ phase retardation film **50** and the third polarizing region **33** are matched with the pitches of the pixels. The right eye image is displayed on the odd number row at the LCD panel, and the left eye image is displayed on the even number row, so that the right eye image transmits the fourth polarizing region **34**, and the left eye image transmits the third polarizing region **33**. Therefore, the viewer can view the 3D images using the circular polarizing glasses **70**. In the present invention, the viewer can view the 3D images using the circular polarizing glasses **70** even if the viewer's head is tilted in the left or right direction.

Fourth Embodiment

[0065] **FIGS. 10 and 11** shows the fourth embodiment of the present invention. The basic construction is similar with the construction of the first embodiment of the present invention. The first, second, third and fourth polarizing regions are formed in a lattice structure like the fifth, sixth, seventh, and eighth polarizing regions. In this embodiment of the present invention, a ¼ phase retardation film **68** is further disposed. The same construction as the first embodiment will be omitted. Namely, only the fifth, sixth, seventh and eighth polarizing regions and the ¼ phase retardation film **68** will be described.

[0066] **FIG. 11** is a view illustrating an optical characteristic of the polarizing region. The light outputted from the backlight transmits the fifth polarizing region **60** and is changed to a 45° rotated straight line light. When the light reaches at the seventh polarizing region **80**, the light does not transmit the seventh polarizing region **80**. In addition, the light transmitted the sixth polarizing region **61** is changed to a 135° rotated straight line light. When the light reaches at the eighth polarizing region **81**, the light does not transmit the same.

[0067] When the above construction and principle are adapted in the construction of **FIG. 10**, the first transparent electrode **5** and the second transparent electrode **8** are disposed between the sixth polarizing region **61** and the eighth polarizing region **81**. The liquid crystal layer **10** reacts with respect to electromagnetic field applied thereto for thereby retarding light, so that the viewer can view the 3D images. Here, the fifth polarizing region **60**, the sixth polarizing region **61**, the seventh polarizing region **80**, and the eighth polarizing region **81** have polarizing direction angle difference of 90° at the corresponding portions. In addition, the ¼ phase retardation film **68** is additionally provided. In this case, the straight line polarizing light **25** of the first embodiment of the present invention is substituted with the circular polarizing glasses **70**. Therefore, the viewer can view the 3D images even when the viewer's head is tilted in the left or right direction.

Fifth Embodiment

[0068] The fifth embodiment of the present invention is shown in **FIG. 12**. **FIG. 13** is a cross sectional view of **FIG. 12**. The construction is basically similar with the third embodiment of the present invention. In this embodiment, the ½ phase retardation film and the transparent unit and the polarizing regions are formed in a lattice shape.

[0069] As shown in **FIG. 12**, the light from the backlight unit **2** transmits the third polarizing film **52** formed of straight line polarizing films and is changed to straight line polarizing light having 90° or 135° polarizing directions.

[0070] Next, the light transmitted the transparent unit **91** disposed at the front surface of the first transparent substrate **4** transmits the liquid crystal layer **10** and is changed to straight line polarizing light having 90° rotated polarizing direction. The light transmits the eighth polarizing region **81** having a polarizing direction of 0° or 45°. The polarized light transmits the ¼ phase retardation film **68** and is changed to a circular polarizing state. Therefore, the viewer can see the image through the right circular polarizing glasses **72** of the circular polarizing light glasses **70**.

[0071] In addition, the light polarized at an angle of 90° or 135° and transmitted the third polarizing film **52** transmits the third ½ phase retardation film **90** and has 180° difference between the incident light and the phase. Therefore, the light is changed into straight line polarizing light having a 90° rotated polarizing direction. This light transmits the liquid crystal layer **10** and is changed to straight line polarizing light having a 90° rotated polarizing direction. Therefore, the light can be changed to circular polarizing light while transmitting the seventh polarizing region **80** having a 135° polarizing direction and the ¼ phase retardation film **68**. Therefore, the viewer can view the images using the left eye circular polarizing glasses **71** of the circular polarizing light glasses **70**.

[0072] Therefore, in the LCD panel, the transparent unit **91** and the eighth polarizing region **81** are matched with the pitches of the pixels, and the third ½ phase retardation film **90** and the seventh polarizing region **80** are matched with the pitches of the pixels. The right eye image is displayed at the portions of the transparent unit **91** and the eighth polarizing region **81** in the LCD panel, and the left eye image is displayed at the portions of the third ½ phase retardation film **90** and the seventh polarizing region **80**. The right eye image transmits the eighth polarizing region **81**, and the left eye image transmits the seventh polarizing region **80**. Therefore, the viewer can view the 3D images using the circular polarizing light glasses **70**. In addition, even when the viewer's head is tilted in the left or right direction, it is possible to view the 3D images using the circular polarizing light glasses **70**.

Sixth Embodiment

[0073] The construction of the six embodiment of the present invention will be described with reference to **FIG. 14**.

[0074] In the sixth embodiment of the present invention, as shown in **FIG. 14**, the fifth polarizing region **60**, the seventh polarizing region **80**, and the eighth polarizing region **81** are all formed of a conductive metal. Here, the conductive metal represents an electrically conductive metal. Preferably, the conductive metal is aluminum. In the sixth embodiment of the present invention, since a conductive polarizing film is used, two transparent electrodes and two insulation layers are not needed before and after the liquid crystal layer.

[0075] The sixth embodiment of the present invention will be described in detail. **FIG. 14** is a view illustrating a structure of the present invention, and **FIG. 15** is a view illustrating an optical characteristic when the polarizing region is formed of a conductive metal, and **FIG. 16** is a cross sectional view of **FIG. 14**.

[0076] The construction that the conductive metal, a major feature of the sixth embodiment of the present invention, is used for the polarizing region will be described.

[0077] As shown in **FIG. 15**, the polarizing regions are divided into a sub pixel shape of the display like the first conductive polarizing film **100** and the second conductive polarizing film **101**. In addition, the third conductive polarizing film **110** and the fourth conductive polarizing film **111** are formed of common electrodes. Here, the polarizing directions of the third conductive polarizing film **10** and the fourth conductive polarizing film **111** are orthogonal at 90°, which correspond to the first conductive polarizing film **100** and the second conductive polarizing film **101**.

[0078] When the above principle is adapted to the embodiment of **FIG. 14**, the first conductive polarizing film **100** and the second conductive polarizing film **101** formed on the plane of the first transparent substrate **4** disposed at a front surface of the backlight unit **2** are orthogonal with a 90° polarizing direction difference for thereby achieving a polarizing film function and a conventional transparent electrode function. Next to that, the first alignment film **6** is disposed, and the liquid crystal layer **10** filled with liquid crystal is disposed between the first alignment film **6** and the second alignment film **7**. Here, the aligning directions of the first and second alignment films **6** and **7** may be changed depending on the kinds of the liquid crystal used. When an electromagnetic field is applied to the conductive polarizing film, the liquid crystal layer **10** is moved based on the characteristic of the liquid crystal for thereby retarding the transmitting light.

[0079] Next, the third conductive polarizing film **110** and the fourth conductive polarizing film **111** are disposed at the front surface of the second alignment film **7** with both polarizing film function and transparent electrode function. Next to that, the color filter **9** and the second transparent substrate **11** are disposed. Next, the ¼ phase retardation film **68** is disposed, and the non-reflection coating layer **24** is disposed at the front most surface.

[0080] In this embodiment of the present invention, when the thin polarizing film is formed using a conductive metal, since there are provided both polarizing film function and electrode function, two transparent electrodes and two insulation layers are not needed before and after the liquid crystal layer as compared to the conventional LCD device, so that the fabrication process of the LCD device is simplified, and the fabrication unit cost is decreased.

[0081] As described above, in the present invention, it is possible to implement an optical structure capable of viewing 2D and 3D images without providing additional parts for 2D and 3D images.

[0082] In the optical structure of the present invention, polarizing films are disposed very near the LCD device, so that a viewing angle is not limited in upper and lower directions wherein the limited viewing angle has been a big problem in the conventional art. In addition, a viewing distance is not limited in forward and backward directions. Multiple people can concurrently view 3D images irrespective of the viewing angle or distance.

[0083] In addition, the fabrication process of the LCD device can be decreased, and the fabrication cost of the 2D and 3D LCD device can be decreased.

[0084] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described examples are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalences of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. In a LCD (Liquid Crystal Display) device in which a first polarizing region and a second polarizing region are integrally formed at a surface of a first transparent substrate disposed at a front surface of a backlight unit, and a liquid crystal layer filled with liquid crystal is disposed between a first alignment film and a second alignment film, and a second transparent electrode and a color filter are disposed at a front surface of the second alignment film, a LCD device having a thin polarizing film and a tin phase retardation film characterized in that a first polarizing region having a polarizing direction of 0° or 45° and a second polarizing region having a polarizing direction of 90° or 135° formed on a surface of the first transparent substrate are orthogonal from each other and are aligned on the same plane, and a first insulation layer is stacked on the front surfaces of the first polarizing region and the second polarizing region, and next to that, the first transparent electrode and a first alignment film are disposed, and a liquid crystal layer, a second alignment film, a second transparent electrode, a color filter and a second insulation layer are sequentially disposed, and a third polarizing region and a fourth polarizing region are disposed on the same plane in a structure that the polarizing directions of the same are orthogonal 90° with respect to the first polarizing region and the second polarizing region on the front surface, and next to that a second transparent substrate is disposed, and a non-reflection coating layer is disposed at the front most surface.

2. The device of either claim 1, wherein a ¼ phase retardation film is disposed at a front surface of the second transparent substrate for thereby converting an incident light into a circular polarizing light.

3. The device of either claim 1, wherein the aligning directions of the first alignment film and the second alignment film are either vertical or in the same direction at the portions corresponding to the first polarizing region and the second polarizing region.

4. The device of either claim 1, wherein said thin film polarizing film is formed of an aluminum thin film or a polymer or a polarizing nano material (TCF) in a wire grid structure, and said phase retardation film is formed of a liquid crystal material.

5. In a LCD device in which a backlight unit is disposed, and a liquid crystal layer filled with liquid crystal is disposed between a first alignment film and a second alignment film, and next to that a second transparent electrode and a color filter are disposed at a front surface of the second alignment film, a LCD device having a thin polarizing film and a thin phase retardation film characterized in that a third polarizing film formed of straight line polarizing films over its entire portions is disposed at a front surface of the backlight unit, and next to that a second ½ phase retardation film and a transparent unit are disposed at a front surface of the first transparent substrate with a certain width and distance on the same plane, and next to that a first insulation layer is disposed, and a first transparent electrode and a first alignment film are sequentially disposed at a front surface of the first insulation layer, and then a crystal layer, a second alignment film, a second transparent thin film, a color filter, and a second insulation layer are sequentially disposed, and next to that a third polarizing region and a fourth polarizing region are disposed on the same plane, and next to that a second transparent substrate is disposed, and a non-reflection coating layer is disposed at a front most surface.

6. The device of either claim 5, wherein a ¼ phase retardation film is disposed at a front surface of the second transparent substrate for thereby converting an incident light into a circular polarizing light.

7. The device of either claim 5, wherein the aligning directions of the first alignment film and the second alignment film are either vertical or in the same direction at the portions corresponding to the first polarizing region and the second polarizing region.

8. The device of either claim 5, wherein said thin film polarizing film is formed of an aluminum thin film or a polymer or a polarizing nano material (TCF) in a wire grid structure, and said phase retardation film is formed of a liquid crystal material.

9. In a LCD device in which a first transparent substrate is disposed at a front surface of a backlight unit, and a fifth polarizing region having a 0° or 45° polarizing direction and a sixth polarizing region **61** having a 90° or 135° polarizing direction are integrally formed on a surface of the first transparent substrate in an orthogonal structure on the same plane, and a first insulation layer is stacked at the front surfaces of the fifth polarizing region and the sixth polarizing region, and a liquid crystal layer is disposed between the first and second alignment films, and a second transparent electrode and a color filter are disposed at a front surface of the second alignment film, and next to that a second insulation layer, a seventh polarizing region, an eighth polarizing region and a second transparent substrate are sequentially disposed, and a non-reflection coating layer is disposed at the front most surface, a LCD device characterized in that a first polarizing region and a second polarizing region are integrally formed in a lattice shape, and a third polarizing region and a fourth polarizing region are disposed on the same plane in a lattice shape in a structure that the polarizing directions of the first polarizing region and the second polarizing region are orthogonal at 90°, and next to that a second transparent substrate is disposed, and a ¼ phase retardation film is disposed following the second transparent substrate.

10. The device of claim 9, wherein the polarizing films of said fifth polarizing region, said sixth polarizing region, said seventh polarizing region and said eighth polarizing region are formed of conductive polarizing films.

11. In a LCD device in which a backlight unit is disposed, and a third polarizing film formed of straight line polarizing films is disposed at a front surface of the backlight unit over its entire portions, and next to that a third ½ phase retardation film and a transparent unit are aligned at a front surface of the first transparent substrate, and next to that a first insulation layer is provided, and a first transparent electrode and a first alignment film are sequentially aligned at a front surface of the first insulation layer, and a liquid crystal layer is disposed between the first alignment film and the second alignment film, and a second transparent electrode, a color filter and a second insulation layer are sequentially disposed at a front surface of the second alignment film, and next to that a seventh polarizing region, an eighth polarizing region and a second transparent substrate are sequentially disposed, and a non-reflection coating layer is disposed at a front most surface, a LCD device having a thin polarizing film and a thin phase retardation film characterized in that the third ½ phase retardation film and the transparent unit are aligned in a lattice shape on the same plane, and the seventh polarizing region and the eighth polarizing region are integrally formed in a lattice shape on the same plane, and next to that a second transparent substrate is disposed, and a ¼ phase retardation film is disposed next to the second transparent substrate for converting an incident light into a circular polarizing light.

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摘要(译)

公开了一种具有薄相位延迟膜的LCD装置，其使用通过精确加工薄铝膜形成的薄膜偏振膜，使用聚合物的纳米压印光刻方法的偏振膜，以及偏振膜和液体来实现。通过均匀涂覆偏振纳米材料（TCF）形成偏振纳米材料薄膜的晶体材料。