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(54) **Back-light "Light-recycling" System for an Area-Division Type Transflective Liquid Crystal Display**

System zur Wiederverwendung des Lichts einer Rückbeleuchtung in einer transflektiven Flüssigkristallanzeige, deren Reflektor in Zonen geteilt ist

Système de rétroéclairage réutilisant la lumière dans un dispositif d'affichage à cristaux liquides de type transflectif à division de zones

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EP 1 826 603 B1

Description

BACKGROUND OF THE INVENTION

Field of Invention

[0001] The present invention relates to a liquid crystal display. More particularly, the present invention relates to a transflective LCD.

Description of Related Art

[0002] To match the life style of modem people, video or imaging equipment is becoming lighter and slimmer. Although the conventional cathode ray tube (CRT) has many advantages, the design of the electron gun renders it heavy and bulky. Moreover, there is always some risk of hurting viewer's eyes due to the production of some harmful radiation. With big leaps in the techniques in manufacturing semiconductor devices and opto-electronic devices, flat panel displays such as liquid crystal displays (LCD), organic light-emitting displays (OLED) and plasma display panels (PDP) has gradually become the mainstream display products. According to the light source used, a liquid crystal display can be classified into three types: reflective LCD, transmissive LCD and transflective LCD. Taking a transflective LCD as an example, the transflective LCD mainly includes a transflective liquid crystal panel and a backlight unit The transflective LCD panel includes a thin film transistor array, a color filter and a liquid crystal layer sandwiched therebetween. The backlight unit provides a surface light source to illuminate the transflective LCD panel for displaying images. More specifically, the thin film transistor array includes a plurality of pixels, each pixel has a transmissive region and a reflective region respectively, and wherein the thickness of liquid crystal layer located above the transmissive region is often different from the thickness of liquid crystal layer located above the reflective region.

[0003] FIG. 1 schematically illustrates a cross-sectional view of a conventional liquid crystal display. Referring to FIG 1, the conventional LCD 10 includes a transflective LCD panel 100, a backlight unit 102 disposed under the transflective LCD panel 100, a polarizer 104a disposed between the transflective LCD panel 100 and the backlight unit 102, a polarizer 104b disposed above the transflective LCD panel 100, and a quarter wave plate 106 disposed between the transflective LCD panel 100 and the polarizer 104a. The light is polarized to the desired phase by the polarizer 104a implemented between the backlight unit 102 and the transflective LCD panel 100.

[0004] As shown in FIG. 1, the conventional transflective LCD panel 100 includes a thin film transistor array substrate (TFT array substrate) 110, a color filter substrate 120 disposed above the TFT array substrate 110, and a liquid crystal layer 130 filled between the TFT array substrate 110 and the color filter substrate 120. As shown in FIG 1, the TFT array substrate 110 includes a transparent substrate 112, a plurality of thin film transistors (TFT) 114, a plurality of scan lines (not shown), a plurality of data lines 116, and a plurality of pixel electrodes 118. The TFT 114, the scan lines, the data lines 116, and the pixel electrodes 118 are all arranged over the transparent substrate 112. The layout of the TFT 114, the scan lines, the data lines 116, and the pixel electrodes 118 should be known by the ordinary skilled artisans, and are not described in detail. Each TFT 114 includes a gate electrode 114G electrically connected to the corresponding scan line, a source electrode 114S electrically connected to the corresponding data line 116, a drain electrode 114D electrically connected to the corresponding pixel electrode 118, and a channel layer 114C capable of turning on or off by a bias (e.g. V_{gh} or V_{gl}) that is applied to the gate electrode 114G.

[0005] As shown in FIG 1, the pixel electrodes 118 includes a transparent electrode 118T and a reflective electrode 118R electrically connected to each other such that a plurality of transmissive regions T and reflective regions R of the transflective LCD panel 100 are defined. In detail, the transparent electrodes 118T permit light emitted from the backlight unit 102 passing through, and the reflective electrodes 118R reflect ambient light. Generally, the transparent electrodes 118T are made of indium tin oxide (ITO), indium zinc oxide (IZO), or other transparent conductive materials; the reflective electrodes 118R are made of metals or other reflective conductive materials.

[0006] Still referring to FIG 1, the color filter substrate 120 includes a transparent substrate 122, a plurality of color filters 124R, 124G, and 124B, and a common electrode 126, wherein the color filters 124R, 124G, and 124B are disposed over the substrate 122, and the common electrode 126 are disposed above the color filters 124R, 124G, and 124B. Usually, the common electrode 126 is made of ITO, IZO, or other transparent conductive materials.

[0007] In the conventional LCD 10 described above, a portion of light provided by the backlight unit 102 is reflected back by the reflective electrodes 118R on the TFT array substrate 110; the other portion of light provided by the backlight unit 102 passes through the transparent electrodes 118T. In detail, the light reflected back by the reflective electrodes 118R is cut by the quarter wave plate 106 above the backlight unit 102. Therefore, the light reflected back by the reflective electrodes 118R can not be recycled. In addition, the manufacturing time and costs can not be reduced significantly because the polarizer 104a, the analyzer 104b and the quarter wave plate 106 are necessary for image displaying.

[0008] US 2005/0179840 describes a colour filer panel that includes a first substrate, a light reflecting member, a colour filter, and a light polarizing layer. The light reflecting member is formed on the first substrate. The light reflecting member reflects at least a portion of an external light.

[0009] WO 2005/101106 describes a transflective LCD incorporating a partial mirror as a transflector. In the

transmissive display mode, light from a backlight system passes apertures in the transflector. A patterned polarizer extends over apertures in the partial mirror.

[0010] US 2004/0004681 describes a liquid crystal display device that comprises an upper polarizing plate that is provided on the outer surface of an upper substrate, and a lower polarizing plate that is provided on the outer surface of a lower substrate. A retardation layer having a phase shift of a quarter wavelength, and a protective layer are provided in turn only on reflective display regions of the inner surface of the lower substrate so that with no voltage applied, the phase shifts of a liquid crystal layer in transmissive display regions and the reflective display regions are set to a half wavelength and a quarter wavelength, respectively.

SUMMARY OF THE INVENTION

[0011] The present invention is directed to a transflective LCD, a flat panel display, and an electronic apparatus.

[0012] The present invention is directed to a liquid crystal panel having an internal reflective surface that is provided on a panel substrate that is different from the panel substrate on which the pixel switching device matrix (e.g., a TFT array) is provided, to enhance the image quality of the liquid crystal panel. The internal reflective surface is placed on the same substrate that supports the color filters. The internal reflective surface is placed on the substrate that is positioned adjacent a backlight unit. The liquid crystal panel is of the transflective type.

[0013] An optical film is provided internal within the liquid crystal panel to enhance the image quality of the liquid crystal panel. The internal optical film may be, for example, a polarizer, or an optical compensator. The internal optical film is supported by the substrate that supports an internal reflective surface.

[0014] As embodied and broadly described herein, the present invention provides a liquid crystal display having an internal reflective surface, e.g., a transflective LCD. The transflective LCD includes a backlight unit for providing a light, a liquid crystal panel comprising a pixel switching device matrix substrate such as an active matrix substrate structure, an opposite substrate structure comprising a second substrate, with an internal reflector disposed between the active matrix substrate structure and the backlight unit, an optical film such as internal polarizer or optical compensator supported on the second substrate and a liquid crystal layer filled between the active matrix substrate structure and the optical film. In the transflective LCD of the present invention, a portion of the light provided by the backlight unit is reflected back by the internal reflector such that the light provided by the backlight unit can be recycled.

[0015] As embodied and broadly described herein, the present invention also provides a flat panel display device. The flat panel display device includes the transflective LCD mentioned above, and a driving circuit electrically connected to the transflective LCD.

[0016] As embodied and broadly described herein, the present invention further provides an electronic apparatus. The electronic apparatus includes a flat panel display device mentioned above, a user interface, and a control circuit electrically connected to the flat panel display device and the user interface.

[0017] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG 1 schematically illustrates a cross-sectional view of a conventional liquid crystal display.

FIG 2 schematically illustrates a cross-sectional view of a liquid crystal display according to the first embodiment of the present invention.

FIG 3 schematically illustrates a cross-sectional view of a liquid crystal display according to the second embodiment of the present invention.

FIG 4 schematically illustrates cross-sectional views of a liquid crystal display according to another embodiments of the present invention.

FIG 5 schematically illustrates a block diagram of a flat panel display device according to the various embodiments of the present invention.

FIG 6 schematically illustrates a block diagram of a flat panel display device according to the various embodiments of the present invention.

FIG 7 schematically illustrates a block diagram of a general electronic apparatus according to the various embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] In the present invention, a liquid crystal display panel is proposed. By way of example and not limitation, an inventive transflective LCD is proposed. In the transflective LCD of the present invention, an opposite substrate structure with an internal reflector is disposed between an active matrix substrate structure and a backlight unit such that the light provided by the backlight unit can be reflected back by the internal reflector for further recycling. In addition, a quarter wave plate used in FIG 1 is not necessary in the transflective LCD of the present invention because an optical film is supported on a substrate in the opposite substrate structure and between the active matrix substrate structure and the second substrate of the opposite substrate structure. As a result, the

light reflected back by the internal reflector can be reused without cutting by the quarter wave plate.

[0020] FIG 2 schematically illustrates a cross-sectional view of a liquid crystal display according to the first embodiment of the present invention. Referring to FIG 2, the transflective LCD 20 according to the first embodiment of the present invention is provided. The transflective LCD 20 includes a backlight unit 260 for providing a light L_0, and an LCD panel 200. The LCD panel 200 comprises a substrate on which an array of pixel switching matrix is disposed, e.g., an array of TFTs for an active matrix substrate structure, hereafter referred to as an active matrix substrate 210, an opposite substrate structure, hereafter referred to as an opposite substrate 220 with an internal reflector 201, an internal polarizer 230 disposed on the opposite substrate 220, and a liquid crystal layer 240. As shown in FIG. 2, the liquid crystal layer 240 is filled between the active matrix substrate 210 and the internal polarizer 230. The internal polarizer 230 can adjust the phase of an ambient light L1 and image quality of the reflective region R can be improved. It should be noted that, the opposite substrate 220 is disposed between the active matrix substrate 210 and the backlight unit 260 and a portion of the light L_0 provided by the backlight unit 260 is reflected back by the internal reflector 201. The architecture of the transflective LCD 20 is quite different from the conventional transflective LCD10 (shown in FIG 1). Specifically, the arrangement of the backlight unit 260, the active matrix substrate 210, and the opposite substrate 220 is different.

[0021] The detail structures of backlight unit 260, the active matrix substrate 210 and the opposite substrate 220 are discussed below. Referring to FIG 2, the backlight unit 260 of the present embodiment may be an edge-lighting type backlight module, a direct type backlight module, cathode fluorescence flat lamp (CCFFL), or organic electro-luminescence device (OEL device). In either the edge-lighting type backlight module or the direct type backlight module, the light source may be light emitting diode array (LED array), cold cathode fluorescence lamp (CCFL), or other light source.

[0022] Still referring to FIG 2, the active matrix substrate 210 includes a first substrate 212 (e.g., a transparent substrate such as a glass substrate), a plurality of control lines 214 disposed on the first substrate 212, a plurality of thin film transistor 216, and a plurality of storage capacitance Cst disposed on the first substrate 212 and arranged in array, wherein each of the thin film transistor 216 is electrically connected to the corresponding control lines 214. In the active matrix substrate 210, the control lines 214 disposed on the first substrate 212 maybe scan lines and data lines. In the present embodiment, the active matrix substrate 210 may be fabricated by low temperature poly-silicon (LTPS) technology or other array processes. Moreover, the storage capacitance Cst includes a first electrode 213a, a second electrode 213b, and a dielectric layer 213c disposed between the first electrode 213a and the second electrode 213b.

[0023] It should be noted that the first electrodes 213a and the second electrodes 213b may be made of ITO, IZO, or other transparent conductive materials such that the light provided from the backlight unit 260 can pass through the storage capacitance Cst. As a result, the transmittance of the active matrix substrate 210 can achieve about 85%~90%. However, the material of the first electrodes and the second electrodes is not limited to be transparent; i.e. the first electrodes 213a and/or the second electrodes 213b may be opaque electrode. For example, the first electrodes 213a may be made of polysilicon and the second electrodes 213b may be made of opaque metal.

[0024] Although the thin film transistors 216 illustrated in FIG 2 are top-gate transistors and the material of the channel layers C is low temperature poly-silicon fabricated by excimer laser anneal (ELA) process, the structure of the thin film transistors 216 and the material of the channel layers C are only illustrated for elaboration and not limited by FIG 2. In other words, the thin film transistors T of the present invention may be bottom gate transistors, also, the material of the channel layers C may be amorphous silicon fabricated by chemical vapor deposition.

[0025] In the conventional transflective LCD 10 (shown in FIG. 1), the transmissive regions T and the reflective regions R are defined respectively by the transparent electrodes 118T and the reflective electrodes 118R the same side of the LCD panel 100 on the TFT array substrate 110. On the contrary, in the transflective LCD 20 of the present invention, the transmissive regions T and the reflective regions R are defined on the opposite side of the LCD panel 200, on the side of the opposite substrate 220 instead of the active matrix substrate 210 in the illustrated embodiment.

[0026] Referring to FIG 2, the opposite substrate 220 includes a second substrate 202 (e.g., a transparent substrate such as a glass substrate), a polymer layer 203, a plurality of color filters 204R, 204G, 204B, an over-coating 205, and a common electrode 206. The internal reflector 201 is disposed on the polymer layer 203. The polymer layer 203 is disposed on the second substrate 202. The color filters 204R, 204G, 204B are disposed on the polymer layer 203 and the internal reflector 201 such that a portion of the internal reflector 201 is covered by the color filters 204R, 204G, 204B. The over-coating 205 is disposed on the color filters 204R, 204G, 204B and the internal reflector 201 that is not covered by the color filters 204R, 204G, 204B. In addition, the common electrode 206 is disposed on the over-coating 205 and the internal polarizer 230 is disposed on the common electrode 206.

[0027] As shown in FIG 2, the internal reflector 201 includes a plurality of first reflective patterns 201a for reflecting the light L_0 provided by the backlight unit 260 and a plurality of second reflective patterns 201b for defining a plurality of reflective regions R on the opposite substrate 220, i.e. ambient light L_1 can be reflected by

the second reflective patterns 201b. (While the illustrated embodiment shows the internal reflector 201 having a discontinuous structure comprising separate sections 201a and 201b, it is contemplated that for certain applications dependent on the image quality desired, the internal reflector may have a continuous structure across the planar area.) Specifically, regions that are not occupied by the internal reflector 201 are defined as transmissive regions T. It is noted that, the first reflective patterns 201a facilitate recycling of the light L_0 so as to improve the display quality of the transmissive regions T. The reflective patterns 201a have a smooth undersurface towards the backlight unit 260. The reflective patterns 201a are covered by the color filters, but does not need to be.

[0028] In a embodiment of the present invention, a portion surface of the polymer layer 203 covered by the second reflective patterns 201b is bumpy and the second reflective patterns 201b is conformal with the covered (bumpy) surface of the polymer layer 203. The bumpy surface of the polymer layer 203 can facilitate reflectivity of the second reflective patterns 201b so as to improve the display quality of the reflective regions R.

[0029] FIG. 3 schematically illustrates a cross-sectional view of a liquid crystal display according to the second embodiment of the present invention. Referring to FIG 3, the transflective LCD 20a of the present embodiment is similar with the transflective LCD 20 of the first embodiment except that the position of the common electrode 206 and the internal polarizer 230. In the present embodiment, the internal polarizer 230 is disposed on the overcoating 205 and the common electrode 206 is disposed on the internal polarizer 230. It should be noted that, position of the internal polarizer 230 is not limited by FIG 2 and FIG 3, the internal polarizer also can be a discontinuous structure, wherein the discontinuous internal polarizer comprises separate sections, each section is disposed between any two laminated layers and located above the second reflective patterns 201b.

[0030] FIG 4 schematically illustrates cross-sectional views of a liquid crystal display according to another embodiments of the present invention. Referring to FIG. 4, the transflective LCD 20b of the present embodiment is similar with the transflective LCD 20 of the first embodiment except for the disposition of the optical compensators 250 instead of an internal polarizer. In the present embodiment, the optical compensators 250 are disposed on the common electrode 206 and located above the second reflective patterns 201b such that the phase of the ambient light L_1 can be compensated by the optical compensators 250. Image quality of the reflective region R can be improved.

[0031] Referring to FIG 5, the transflective LCD 20c of the present embodiment is similar with the transflective LCD 20a of the second embodiment except for the disposition of the optical compensators 250 instead of an internal polarizer. In the present embodiment, the optical compensators 250 are disposed on the second reflective patterns 201b such that the phase of the ambient light L_1 can be compensated by the optical compensators 250. Image quality of the reflective region R can be improved. It should be noted that, position of the optical compensators 250 is not limited by FIG 4 and FIG 5, the optical compensators 250 may be disposed between any two laminated layers located above the second reflective patterns 201b.

[0032] In general, the LCD of the present invention as described above can be applied to a flat panel display device, which may be further implemented into an electronic apparatus. FIG 6 schematically illustrates a block diagram of a flat panel display device according to the various embodiments of the present invention. In FIG 6, the flat panel display device 300, in general, can include a driving unit 302 and a transflective LCD 304 of the present invention as described above. The driving unit 302 includes source driver, gate driver, and control board electrically connected to the transflective LCD 304 through the source driver and gate driver. Generally, the driving unit 302 may be fabricated by chip-on-glass technology (COG technology), chip-on-board technology (COB technology), tape automated bonding technology (TAB technology), or chip-on-film technology (COF technology).

[0033] FIG 7 schematically illustrates a block diagram of a general electronic apparatus according to the various embodiments of the present invention. In FIG 7, the electronic apparatus 400, such as a mobile phone, an LCD television set, a computer system, a game player, or a device with a display region, and so on, includes a user interface 402, a circuit unit 404, and a flat panel display 300 shown in FIG 6.

[0034] The circuit unit 404 is electrically connected to the user interface 402 and the display 300, so that the user can use the electronic apparatus 400, and the information is display on the flat panel display 300. In other words, the flat panel display 300 of the present invention can be implemented into any electronic apparatus to serving as the display unit.

[0035] According to foregoing descriptions of the present invention, the internal reflector is formed on the opposite substrate to define reflective regions and transmissive regions of the transflective LCD panel. Because the opposite substrate is arranged between the backlight unit and the active matrix substrate, the light primarily traveling along the direction toward the LCD panel can be reflected by the reflector back to the backlight unit for recycling use. As a result, the aperture ratio of the LCD panel of the present invention can be effectively improved. In addition, the optical film (e.g., an internal polarizer or an optical compensator) is disposed at the inner surface of the opposite substrate and no quarter wave plate is required to attach on the outer surface of the opposite substrate. In this way, the light reflected by the internal reflector can be re-used effectively.

[0036] While the illustrated embodiments show the optical film supported on the opposite substrate, the optical

film (e.g., a polarizer or optical compensator) may be supported on the matrix substrate. While the optical film is shown deployed in connection with an internal reflector, the internal optical film may be used independent of an internal reflector. While the pixel switching device substrate is shown to be an active matrix substrate, other types of pixel switching device may be supported on the matrix substrate. The internal reflector aspect and/or the internal optical film aspect may be deployed in connection with transmissive type and/or reflective type LCD, in addition to the illustrated transflective type LCD.

[0037] The foregoing description of the embodiment of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form or to exemplary embodiments disclosed. Accordingly, the foregoing description should be regarded as illustrative rather than restrictive. Many modifications and variations will be apparent to practitioners skilled in this art. The embodiments are chosen and described in order to best explain the principles of the invention and its best mode practical application, thereby to enable persons skilled in the art to understand the invention for various embodiments and with various modifications as are suited to the particular use or implementation contemplated. It is intended that the scope of the invention be defined by the appended claims. It should be appreciated that variations may be made in the embodiments described by persons skilled in the art without departing from the scope of the present invention as defined by the following claims.

Claims

1. A transflective liquid crystal display panel (200), comprising:

   an active matrix substrate structure (210) comprising a first substrate (212);
   a liquid crystal layer (240);
   an opposite substrate structure (220) comprising a second substrate (202), an internal reflector (201) and a plurality of colour filters (204) supported on the second substrate (202), wherein a portion of the internal reflector (201) is covered by the colour filters (204) the opposite substrate (220) structure being arranged on the opposite side of the liquid crystal layer (240) to the active matrix substrate structure (210), the opposite substrate structure (220) having an outer face facing away from the liquid crystal layer (240) for receiving light from a backlight (260);
   an optical film (230; 250) supported on the second substrate (202) between the second substrate (202) and the liquid crystal layer(240);
   characterised in that the internal reflector (201) comprises:

   a plurality of first reflective patterns (201a), for reflecting light provided by a backlight (260) incident through the outer face of the opposite substrate structure (220), whose surfaces (201a) that face away from the liquid crystal layer (240) are smooth and wherein at least part of the first reflective patterns (201a) is covered by the colour filters (204); and
   a plurality of second reflective patterns (201b), for reflecting light that is incident on the opposite substrate structure (220) from the liquid crystal layer (240) back towards the liquid crystal layer (240), the plurality of second reflective patterns (201b) defining a plurality of reflective regions in the opposite substrate structure (220), wherein the surface of the plurality of second reflective patterns (201b) that face the liquid crystal layer (240) are bumpy.

2. The liquid crystal display panel (200) of claim 1, wherein the active matrix substrate structure (210) comprises an array of pixel switching devices (216) supported on the first substrate (212).

3. The liquid crystal display panel (200) of claim 2, wherein the pixel switching devices (216) comprise thin film transistors.

4. The liquid crystal display panel (200) of claim 1, wherein the optical film (230; 250) comprises at least one of an internal polarizer (230) or an optical compensator (250).

5. The liquid crystal display panel (200) of claim 4, wherein the optical film is an internal polarizer (230) which comprises separate sections, each section associated with and positioned in relation to a second reflective pattern (201b).

6. The liquid crystal display panel (200) of claim 4, wherein the optical film is an optical compensator which (250) comprises separate compensator sections, each compensator section associated with and positioned in relation to a second reflective pattern (201b).

7. The liquid crystal display panel of claim 1, wherein the first reflective patterns (201a) and the second reflective patterns (201b) are discontinuous.

8. The liquid crystal display panel (200) of claim 1, wherein the opposite substrate structure (220) further comprises a polymer layer (203) supported on the second substrate (202), wherein the polymer lay-

er (203) supports the internal reflector (201), and wherein the surface of the polymer layer (203) adjacent to the second reflective patterns (201b) is bumpy and the second reflective patterns (201b) are conformal with the bumpy surface of the polymer layer (203).

9. The liquid crystal display panel (200) as in claim 1, wherein a polymer layer (203) is provided between the colour filters (204) and the second substrate (202).

10. The liquid crystal display panel (200) of claim 9, further comprising an over-coating (205) disposed on the colour filters (204) and a portion of the internal reflector (201) not covered by the colour filters (204).

11. The liquid crystal display panel (200) as in claim 10, wherein the optical film (230; 250) is disposed on the over-coating; the panel (200) further comprising:

a common electrode (206) disposed on the optical film (230; 250).

12. A liquid crystal display (304), comprising:

a liquid crystal display panel (200) as in claim 1;
a backlight module (260) located adjacent to the opposite substrate structure (220).

13. A flat panel display device (300), comprising:

a liquid crystal display (304) as recited in claim 12; and
a driving circuit (302), operatively coupled to the liquid crystal display (304).

14. An electronic apparatus (400), comprising:

a flat panel display device (300) as recited in claim 13;
a user interface (402); and
a control circuit (404), operatively coupled to the flat panel display device (300) and the user interface (402).

Patentansprüche

1. Teilreflektierende Flüssigkristall-Anzeigetafel (200), umfassend:

eine aktive Matrix-Trägerstruktur (210) mit einem ersten Träger (212);
eine Flüssigkristallschicht (240);
eine gegenüberliegende Trägerstruktur (220) mit einem zweiten Träger (202), einen Innenreflektor (201) und einer Vielzahl von Farbfiltern (204), die auf dem zweiten Träger (202) liegen, wobei ein Teil des Innenreflektors (201) von den Farbfiltern (204) bedeckt wird, wobei die gegenüberliegende Trägerstruktur (220) auf der gegenüberliegenden Seite der Flüssigkristallschicht (240) auf der aktiven Matrix-Trägerstruktur (210) angeordnet ist, wobei die gegenüberliegende Trägerstruktur (220) eine Außenfläche aufweist, die von der Flüssigkristallschicht (240) abgewandt ist, um von der Hintergrundbeleuchtung (260) Licht zu empfangen;
einen auf dem zweiten Träger (202) zwischen dem zweiten Träger (202) und der Flüssigkristallschicht (240) angebrachten optischen Film (230; 250);
dadurch gekennzeichnet ist, dass der Innenreflektor (201) umfasst:

eine Vielzahl von ersten reflektierenden Mustern (201a), um das von der Hintergrundbeleuchtung (260) bereitgestellte Licht zu reflektieren, das durch die Außenfläche der gegenüberliegenden Trägerstruktur (220) einfällt, deren der Flüssigkristallschicht (240) abgewandte Oberfläche (201a) glatt ist und wobei mindestens ein Teil des ersten reflektierenden Musters (201a) von den Farbfiltern (204) bedeckt wird; und
eine Vielzahl von zweiten reflektierenden Mustern (201b) zum Reflektieren des Lichts, das von der Flüssigkristallschicht (240) in Richtung der Flüssigkristallschicht (240) zurückgeworfen wird und auf die gegenüberliegende Trägerstruktur (220) einfällt, wobei die Vielzahl von zweiten reflektierenden Mustern (201b) eine Vielzahl von reflektierenden Bereichen auf der gegenüberliegenden Trägerstruktur (220) definiert, wobei die Oberflächen der vielen der Flüssigkristallschicht (240) zugewandten zweiten reflektierenden Muster (201b) uneben sind.

2. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 1, wobei die aktive Matrix-Trägerstruktur (210) eine Gruppe von Pixelschaltvorrichtungen (216) umfasst, die auf dem ersten Träger (212) angebracht sind.

3. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 2, wobei die Pixelschaltvorrichtungen (216) Dünnfilmtransistoren (TFT) umfassen.

4. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 1, wobei der optische Film (230; 250) mindestens einen internen Polarisator (230) oder einen optischen Drehkompensator (250) aufweist.

5. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 4, wobei der optische Film ein interner Polarisator (230) mit separaten Abschnitten ist, wobei jeder Abschnitt mit einem zweiten reflektierenden Muster (201b) verbunden und dementsprechend positioniert ist.

6. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 4, wobei der optische Film ein optischer Drehkompensator (250) mit separaten Drehkompensator-Abschnitten ist, wobei jeder Drehkompensator-Abschnitt mit einem zweiten reflektierenden Muster (201b) verbunden und dementsprechend positioniert ist.

7. Flüssigkristall-Anzeigetafel gemäß Anspruch 1, wobei die ersten reflektierenden Muster (201a) und die zweiten reflektierenden Muster (201b) unterbrochen sind.

8. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 1, wobei die gegenüberliegende Trägerstruktur (220) ferner eine auf dem zweiten Träger (202) aufgebrachte Polymerschicht (203) umfasst, wobei die Polymerschicht (203) den Innenreflektor (201) trägt und wobei die Oberfläche der Polymerschicht (203) neben dem zweiten reflektierenden Mustern (201b) uneben ist und die zweiten reflektierenden Muster (201b) mit der unebenen Oberfläche der Polymerschicht (203) konturgetreu sind.

9. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 1, wobei zwischen den Farbfiltern (204) und dem zweiten Träger (202) eine Polymerschicht (203) vorgesehen ist.

10. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 9, ferner umfassend eine auf den Farbfiltern (204) angeordnete Beschichtung (205) und einen Abschnitt des Innenreflektors (201), der von den Farbfiltern (204) nicht bedeckt wird.

11. Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 10, wobei der optische Film (230; 250) auf der Beschichtung angeordnet ist; wobei die Flüssigkristall-Anzeigetafel (200) ferner aufweist:

eine übliche Elektrode (206), die auf dem optischen Film (230; 250) angeordnet ist.

12. Flüssigkristallanzeige (304), umfassend:

eine Flüssigkristall-Anzeigetafel (200) gemäß Anspruch 1;
ein Gegenlichtmodul (260), das neben der gegenüberliegenden Trägerstruktur (220) angeordnet ist.

13. Flachbildschirm (300), umfassend:

eine Flüssigkristallanzeige (304) gemäß Anspruch 12; und
eine Ansteuerelektronik (302), die mit der Flüssigkristallanzeige (304) funktionsfähig gekoppelt ist.

14. Elektronisches Gerät (400), umfassend:

einen Flachbildschirm (300) gemäß Anspruch 13;
eine Benutzerschnittstelle (402); und
einen Steuerstromkreis (404), der mit der dem Flachbildschirm (300) und der Benutzerschnittstelle (402) funktionsfähig gekoppelt ist.

Revendications

1. Un afficheur à cristaux liquides transflectif (200), comprenant :

Une structure de substrat à matrice active (210) comprenant un premier substrat (212) ;
Une couche de cristaux liquides (240) ;
une structure de substrat opposée (220) comprenant un deuxième substrat (202), un réflecteur interne (201) et une pluralité de filtres couleur (204) soutenus sur le deuxième substrat (202), dans laquelle une portion du réflecteur interne (201) est couverte par les filtres de couleur (204), la structure de substrat opposée (220) placée du côté opposé de la couche de cristaux liquides (240) vers la structure de substrat à matrice active (210), la structure de substrat opposée (220) ayant une face extérieure opposée à la couche de cristaux liquides (240) pour recevoir la lumière d'un contre-jour (260) ;
un film optique (230, 250) soutenu sur le deuxième substrat (202) entre le deuxième substrat (202) et la couche de cristaux liquides (240) ;
caractérisé en ce que le réflecteur interne (201) comprend :

une pluralité de premiers modèles réfléchissants (201a), pour refléter la lumière fournie par un contre-jour incident (260) à travers la face extérieure de la structure de substrat opposée (220) dont les surfaces (201a) du côté opposé de la couche de cristaux liquides (240) sont lisses et dans laquelle une partie au moins des premiers modèles réfléchissants (201a) est couverte par les filtres de couleur (204), et
une pluralité de deuxièmes modèles réfléchissants (201b) pour refléter une lumière qui est incidente sur la structure de substrat

opposée (220) à partir de la couche de cristaux liquides (240) vers l'arrière de la couche de cristaux liquides (240), la pluralité des deuxièmes modèles réfléchissants (201b) définissant une pluralité de zones réfléchissantes dans la structure de substrat opposée (220), dans laquelle la surface de la pluralité des deuxièmes modèles réfléchissants (201b) qui font face à la couche de cristaux liquides (240) sont cahoteux.

2. L'afficheur à cristaux liquides (200) selon la revendication 1, dans lequel la structure du substrat à matrice active (210) comprend une gamme de dispositifs de commutation à pixels (216) soutenus sur le premier substrat (212).

3. L'afficheur à cristaux liquides (200) selon la revendication 2, dans lequel les dispositifs de commutation à pixels (216) comprennent des transistors à film fin.

4. L'afficheur à cristaux liquides (200) selon la revendication 1, dans lequel le film optique (230, 250) comprend au moins un polariseur interne (230) ou un compensateur optique (250).

5. L'afficheur à cristaux liquides (200) selon la revendication 4, dans lequel un film optique est un polariseur interne (230) qui comprend des sections distinctes, chaque section associée à et positionnée par rapport au deuxième modèle réfléchissant (201b).

6. L'afficheur à cristaux liquides (200) selon la revendication 4, dans lequel le film optique est un compensateur optique (250) qui comprend des sections de compensateur distinctes, chaque section de compensateur associée à et positionnée par rapport au deuxième modèle réfléchissant (201b).

7. L'afficheur à cristaux liquides selon la revendication 1, dans lequel les premiers modèles réfléchissants (201a) et les deuxièmes modèles réfléchissants (201b) sont discontinus.

8. L'afficheur à cristaux liquides (200) selon la revendication 1, dans lequel la structure de substrat opposée (220) comprend par ailleurs une couche polymère (203) soutenue sur le deuxième substrat (202), dans lequel la couche polymère (203) soutient le réflecteur interne (201), et dans lequel la surface de la couche polymère (203) adjacente aux deuxièmes modèles réfléchissants (201b) est cahoteuse et les deuxièmes modèles réfléchissants (201b) sont conformes à la surface cahoteuse de la couche polymère (203).

9. L'afficheur à cristaux liquides (200) selon la revendication 1, dans lequel une couche polymère (203) est fournie entre les filtres couleur (204) et le deuxième substrat (202).

10. L'afficheur à cristaux liquides (200) selon la revendication 9, comprenant par ailleurs une couche épaisse (205) placée sur les filtres couleur (204) et une portion du réflecteur interne (201) qui n'est pas couvert par les filtres couleur (204).

11. L'afficheur à cristaux liquides (200) selon la revendication 10, dans lequel le film optique (230, 250) est placé sur la couche épaisse ; l'afficheur (200) comprenant par ailleurs une électrode commun (206) placé sur le film optique (230, 250).

12. Un affichage à cristaux liquides (304) comprenant :

un afficheur à cristaux liquides (200) selon la revendication 1 ;
un module de contre-jour (260) adjacent à la structure de substrat opposée (220).

13. Un dispositif d'affichage à panneau plat (300), comprenant :

un affichage à cristaux liquides (304) tel que décrit à la revendication 12 ; et
un circuit de commande (302), accouplé de façon opérationnelle à l'affichage à cristaux liquides (304).

14. Un appareil électronique (400), comprenant :

un dispositif d'affichage à panneau plat (300) tel que décrit à la revendication 13,
une interface utilisateur (402) ; et
un circuit de commande (404), accouplé de façon opérationnelle au dispositif d'affichage à panneau plat (300) et à l'interface utilisateur (402).

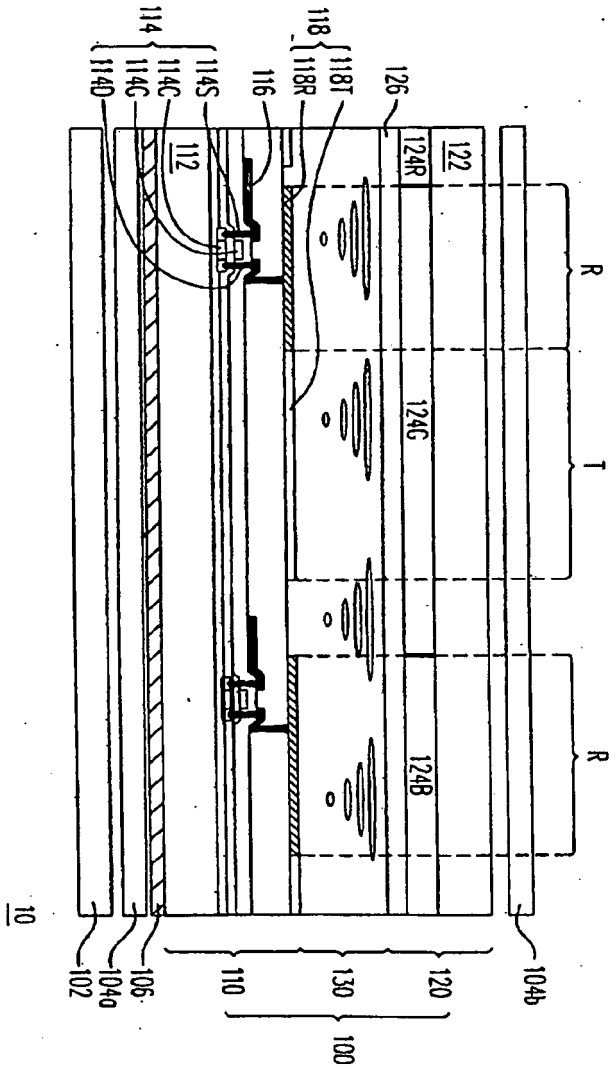

FIG. 1 (PRIOR ART)

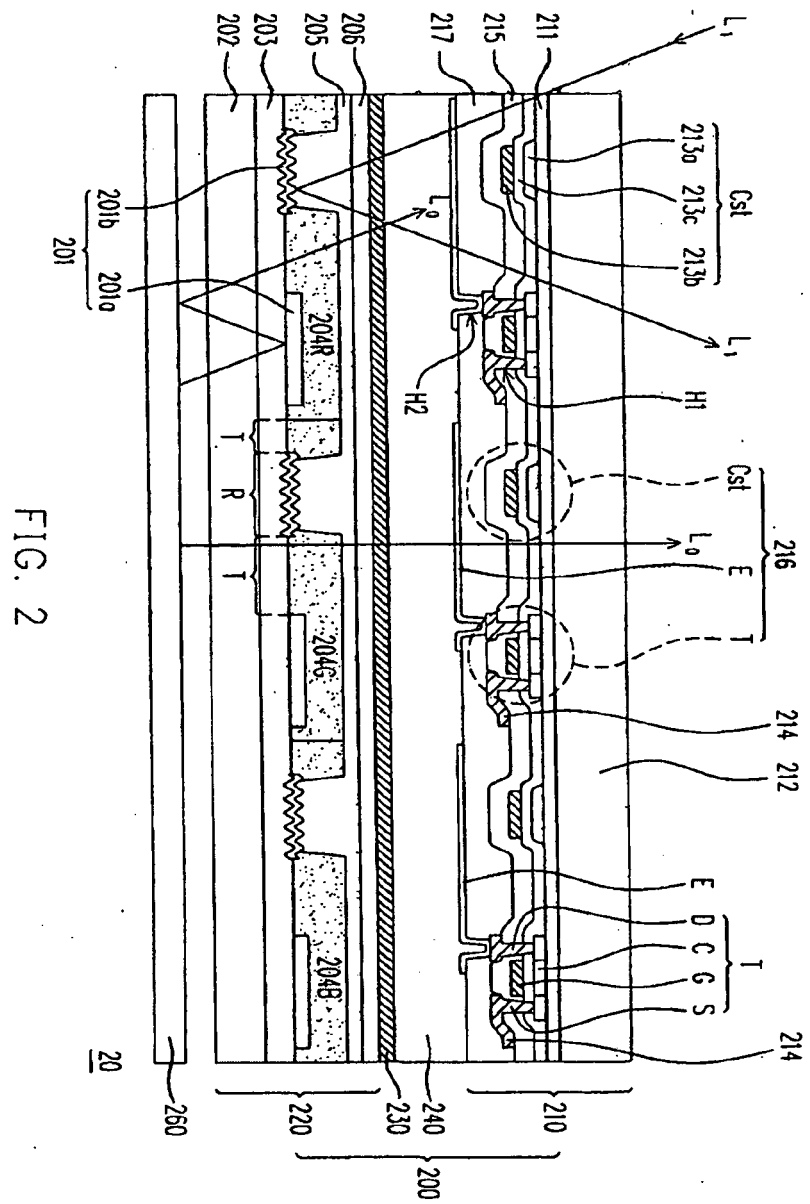
L1
211
215
217
206
205
203
202
213a
213c
213b
Cst
201b
201a
201
204R
204G
204B
H2
H1
Lo
216
E
T
214
212
D
C
G
S
R
260
220
230
240
210
200
20

FIG. 2

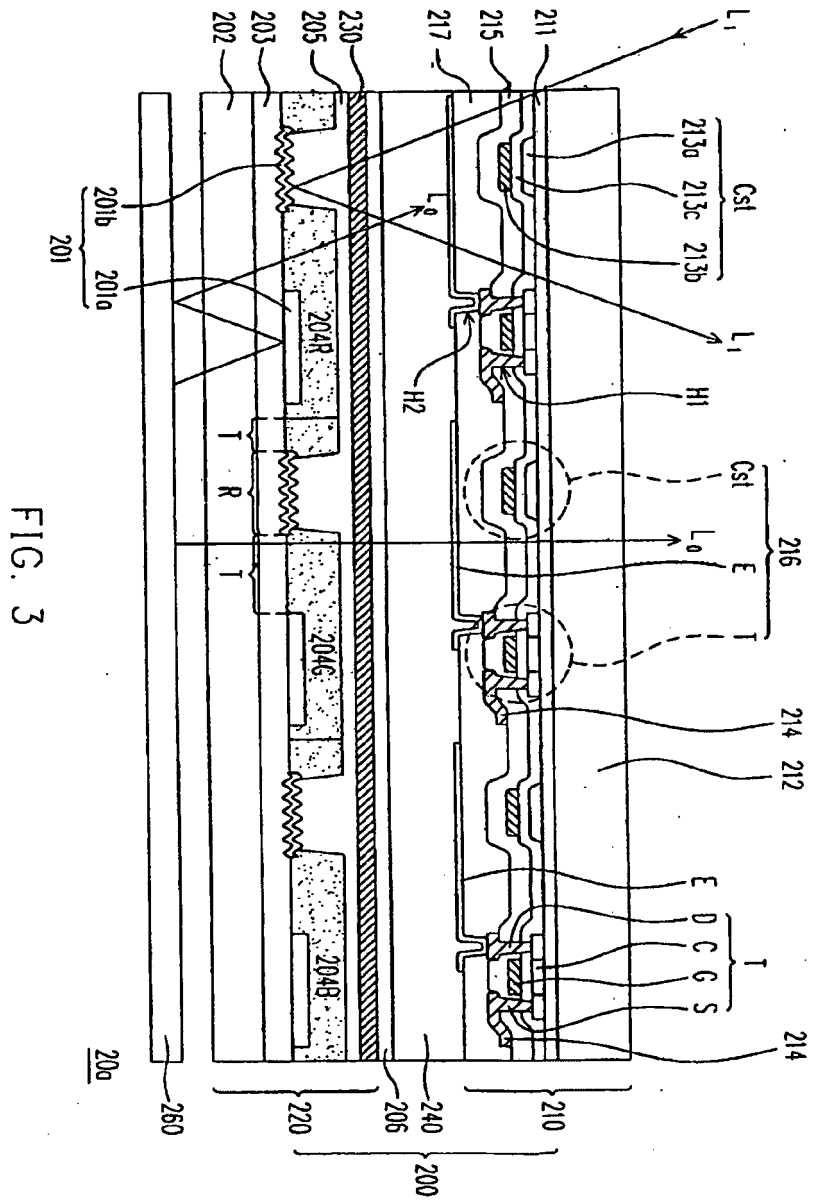
L1
211
215
217
230
205
203
202
213a
213c
213b
Cst
201b
201a
201
Lo
H2
H1
204R
204G
204B
T
R
G
B
216
E
T
214
212
D
C
S
20a
260
240
206
220
210
200

FIG. 3

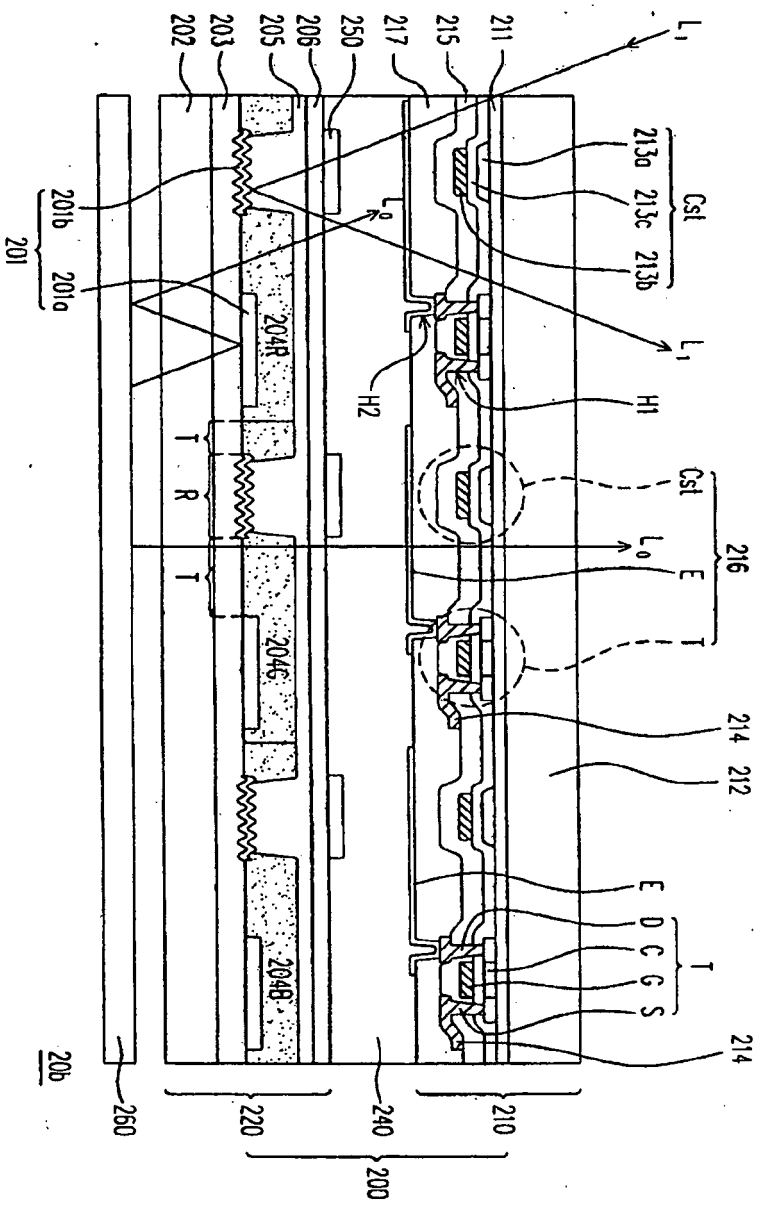
L1
211
215
217
250
206
205
203
202
213a
213c
213b
Cst
201b
201a
201
Lo
H2
H1
204R
204G
204B
T
R
T
Cst
Lo
E
T
216
214
212
E
D
C
G
S
T
214
20b
260
220
240
210
200

FIG. 4

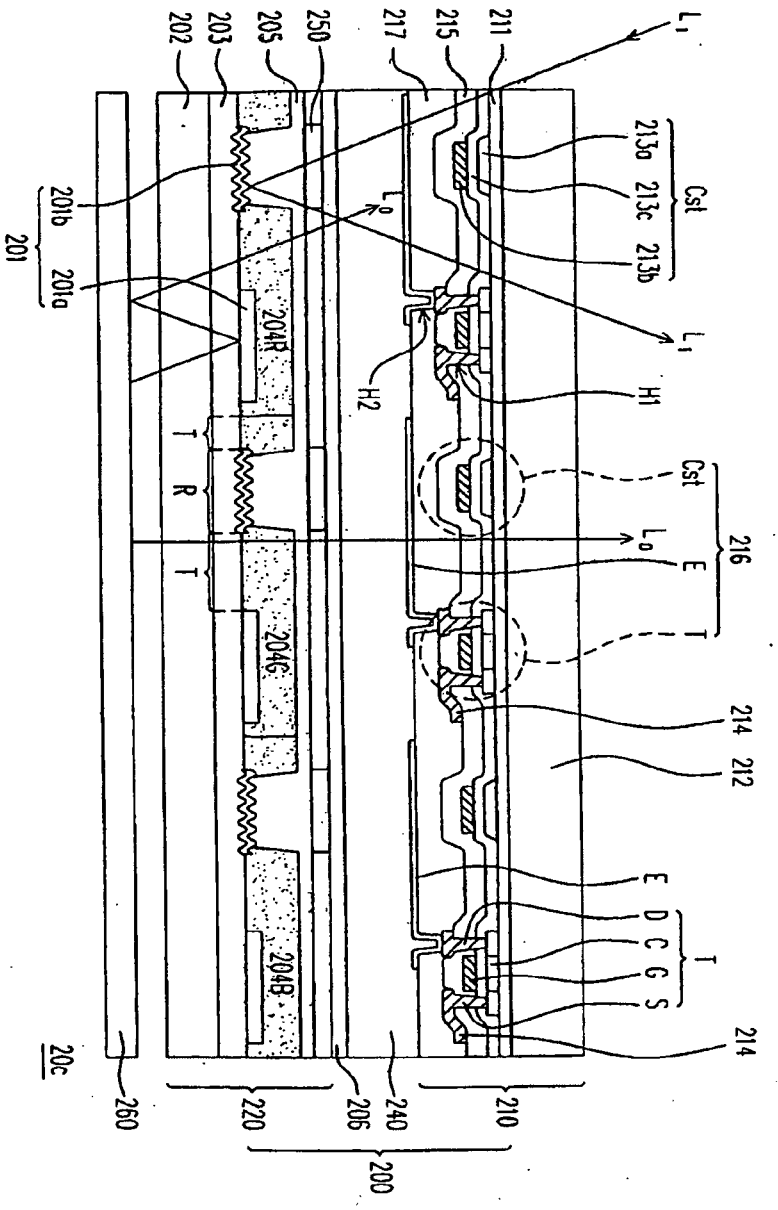
L1
211
215
217
250
205
203
202
213a
213c
213b
Cst
201b
201a
201
L0
H2
H1
204R
204G
204B
T
R
G
B
E
D
C
S
216
214
212
220
206
240
210
200
260
20c

FIG. 5

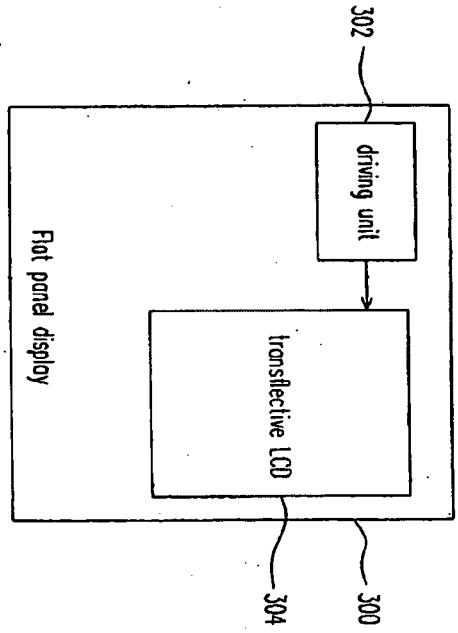
302
driving unit
transflective LCD
Flat panel display
304
300

FIG. 6

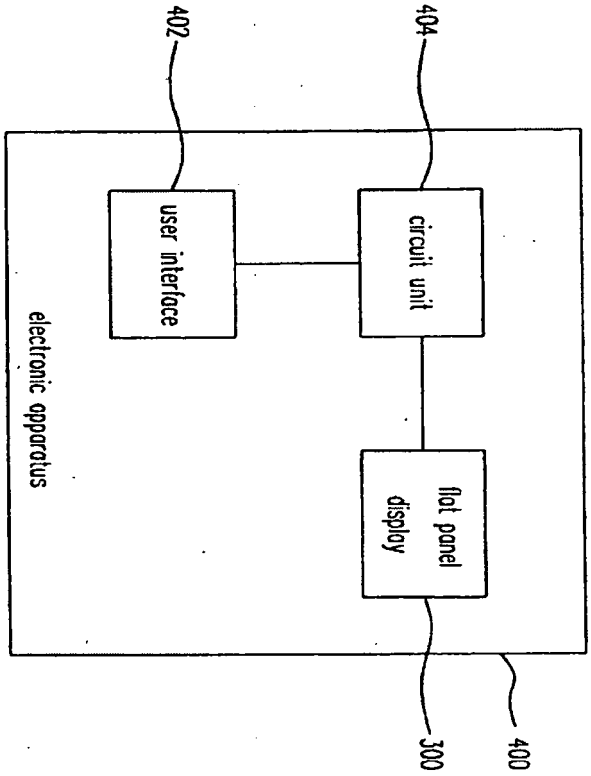
402
404
user interface
circuit unit
electronic apparatus
flat panel display
300
400

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20050179840 A **[0008]**
- WO 2005101106 A **[0009]**
- US 20040004681 A **[0010]**

专利名称(译)	区域型透反液晶显示器的背光“光回收”系统		
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申请号	EP2006251958	申请日	2006-04-06
[标]申请(专利权)人(译)	统宝光电股份有限公司		
申请(专利权)人(译)	统宝光电股份有限公司.		
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发明人	CHANG, WEI-CHIH CHANG, YU-CHI OKU, NORIO 6F, NO. 66, LANE 405, SEC. 6		
IPC分类号	G02F1/1335 G02F1/13363 G02F1/1362		
CPC分类号	G02F1/133553 G02F1/133555 G02F2001/13356		
优先权	11/360794 2006-02-22 US		
其他公开文献	EP1826603A1		
外部链接	Espacenet		

摘要(译)

区域分割型半透半反式有源矩阵液晶显示器（LCD）（20）。在LCD单元（200）中，薄膜晶体管（TFT）（216）位于面向观察者的上基板（212）上，而面向背光（BL）（260）的下基板（202）具有结构化反射器（ 201）。反射器由每个像素中的两种类型的反射元件组成：具有不平坦表面的第一元件（201b）和具有光滑表面（201a）的第二元件。在反射模式中，外部光（L1）从第一元件（201b）反射，并且在透射模式中，来自BL（260）的未在反射元件之间通过的光（L0）从光滑反射回BL。第二个要素的下面（201a，图2）。以这种方式，来自BL（260）的光被更有效地利用（光再循环）。在BL（102）和下基板之间没有偏振器（104a）或四分之一波片（106）（112）如在传统器件中那样（通常具有位于下基板上的有源元件（TFT））（图1中的10）。相反，内部偏振器（230）布置在下基板（202）上的单元内。这种布置省略了四分之一波片（106）并允许光循环。滤色器层（204R，G，B）设置在第二反射元件（201a）上，但不设置在第一反射元件（204b）上。第一反射元件（204b）的不平坦表面符合下面的聚合物层（203）上的不规则性。内部偏振器（230）或者光学补偿层（250）布置在覆盖CF（204R，G，B）的外涂层（205）上。公共电极（206）位于偏振（230）或补偿层（250）的下方或上方。补偿层（250）被构造并布置在第一反射元件（201b）上方。该装置可用于平板显示器系统。