US 20050140872A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0140872 A1

Kang (43) Pub. Date: Jun. 30, 2005

(54) TRANSFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR MANUFACTRUING THE SAME

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(21) Appl. No.: 10/973,358

(22) Filed: Oct. 26, 2004

(30) Foreign Application Priority Data

Dec. 30, 2003 (KR) 2003-100692

Publication Classification

(51) Int. Cl.^{7} G02F 1/1335

(52) U.S. Cl. 349/114

(57) ABSTRACT

A liquid crystal display device includes a first substrate, a second substrate facing the first substrate, a liquid crystal layer made of liquid crystals injected between the first and the second substrates, and a backlight assembly arranged on an outer surface of the first substrate. The first substrate has a light guiding pattern containing a periodic structure formed from a medium whose refractive index is different from the refractive index of the first substrate.

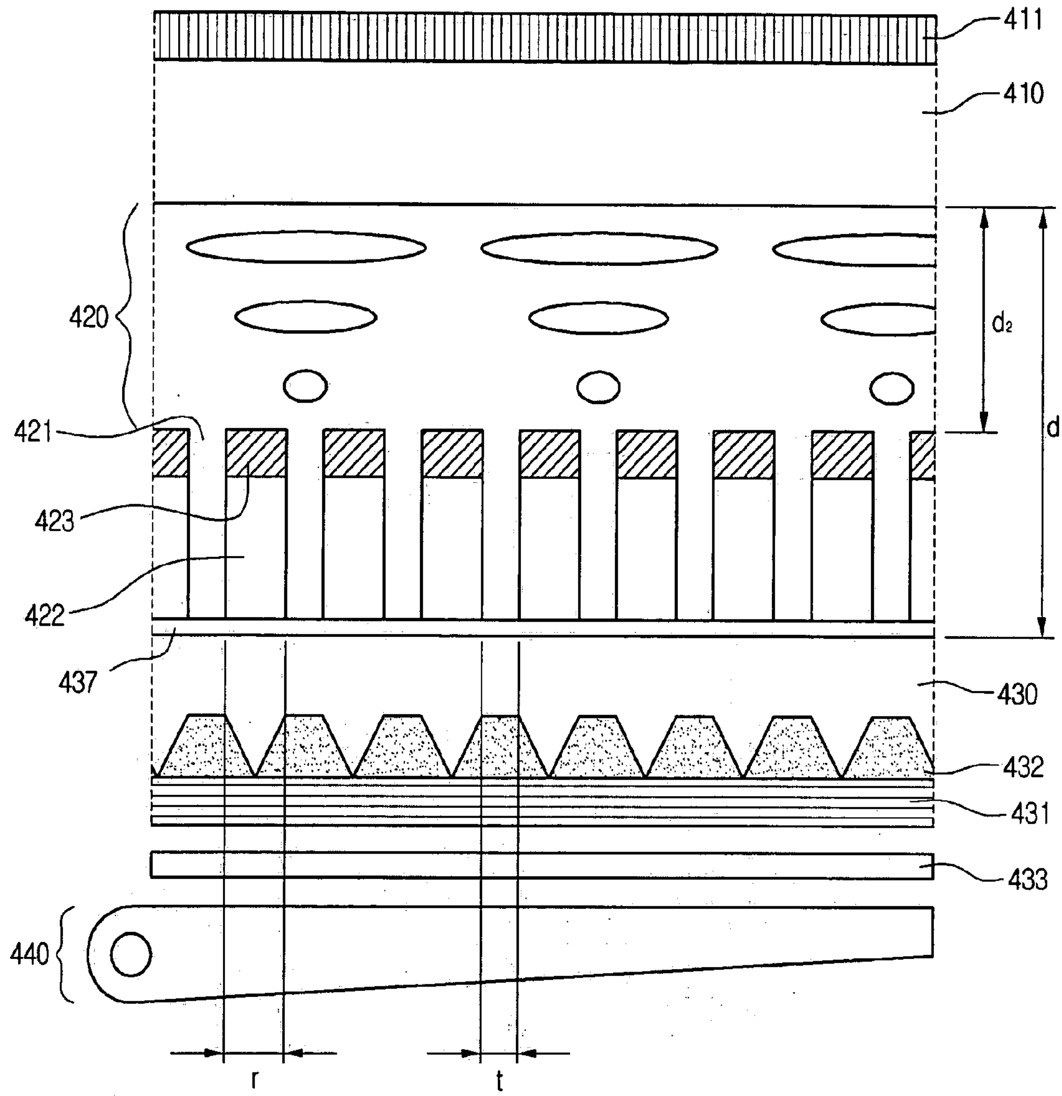


Fig.1
Related Art

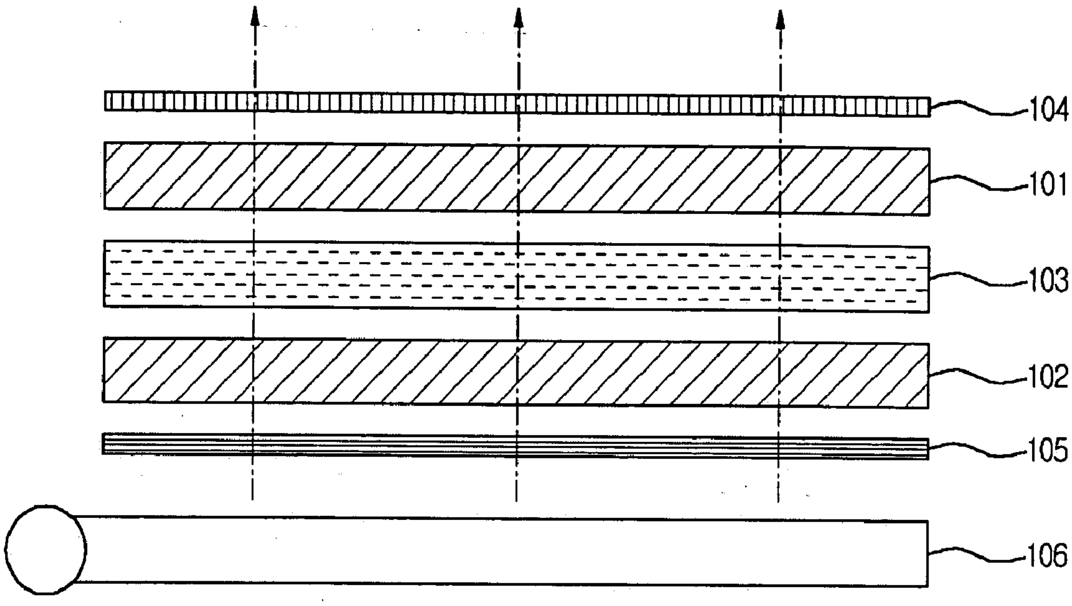


Fig.2
Related Art

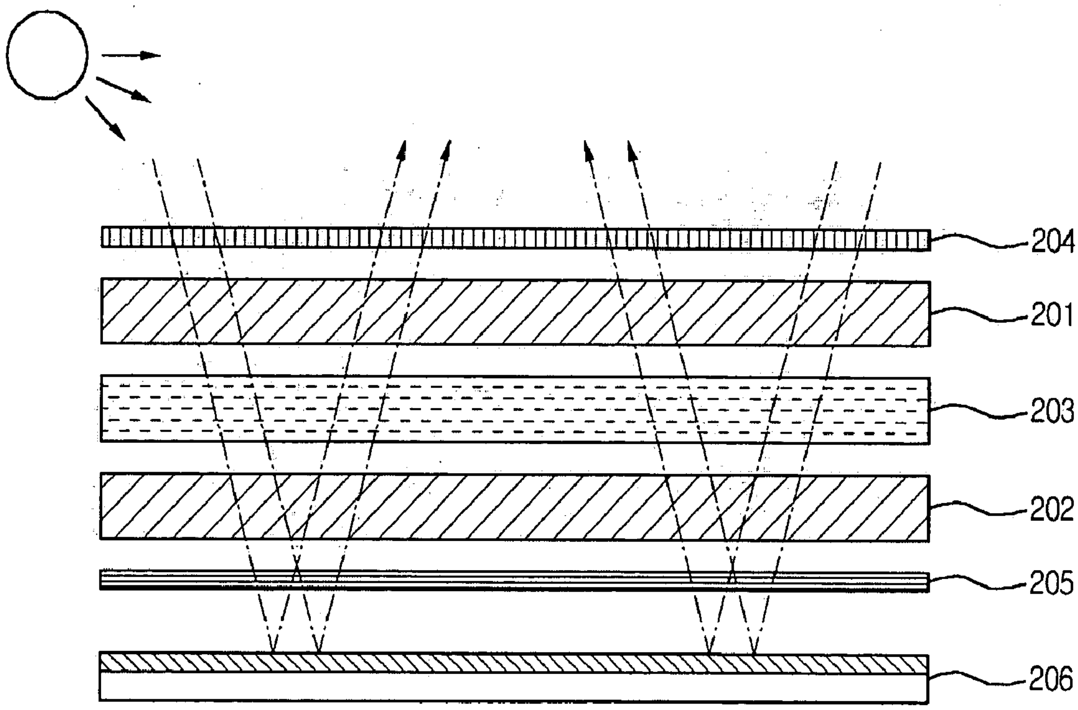


Fig.3
Related Art

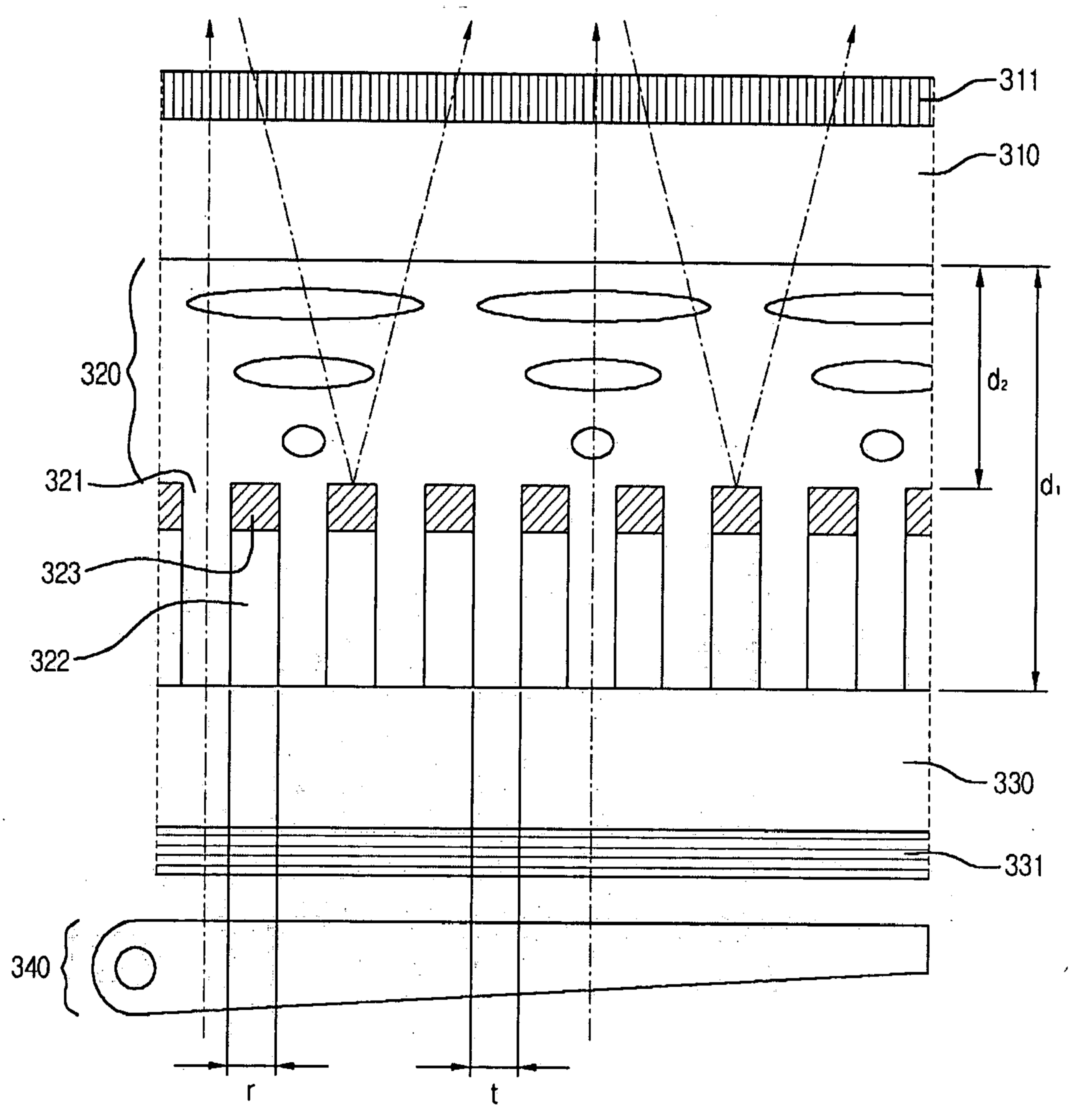


Fig.4

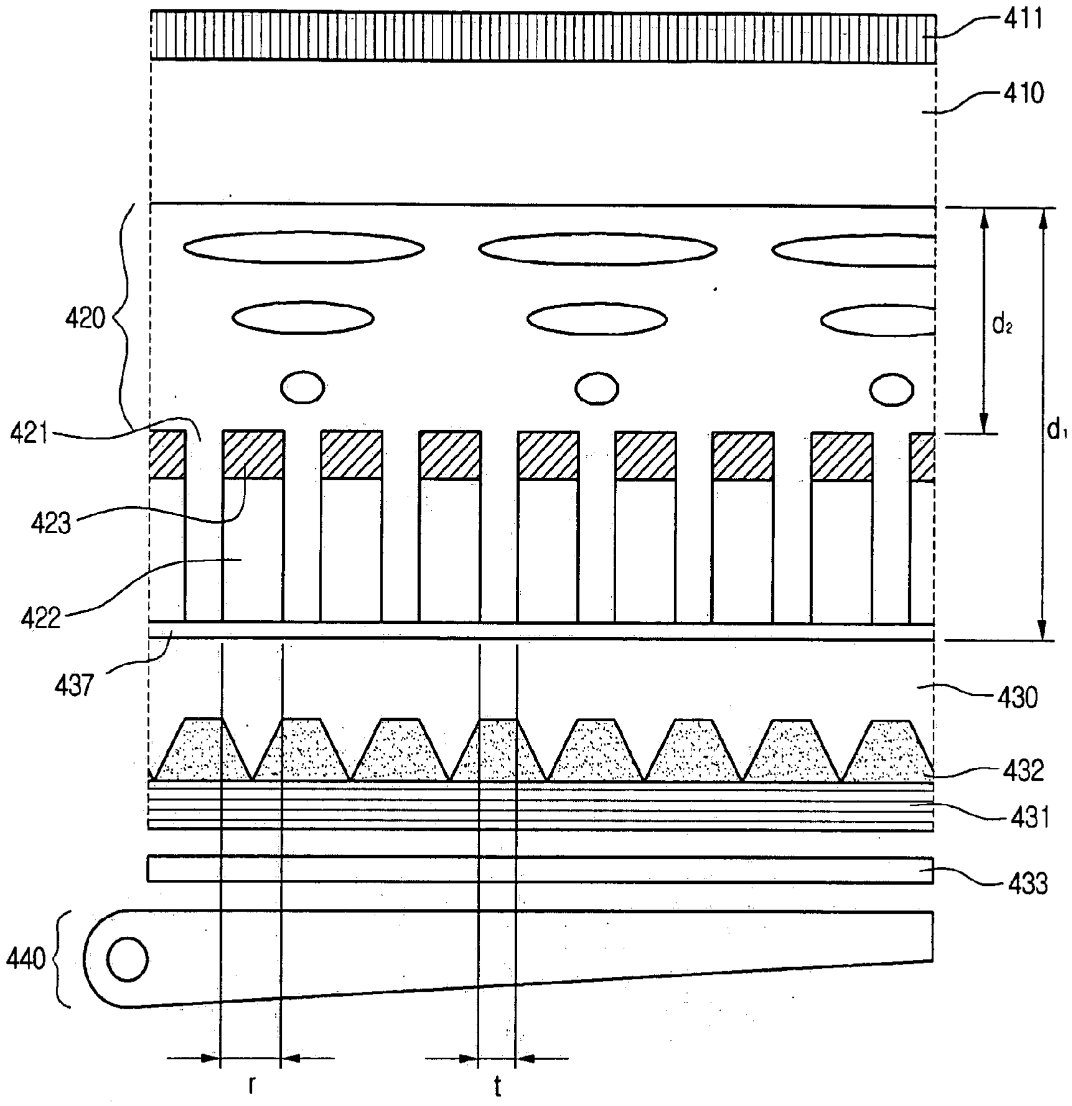


Fig.5

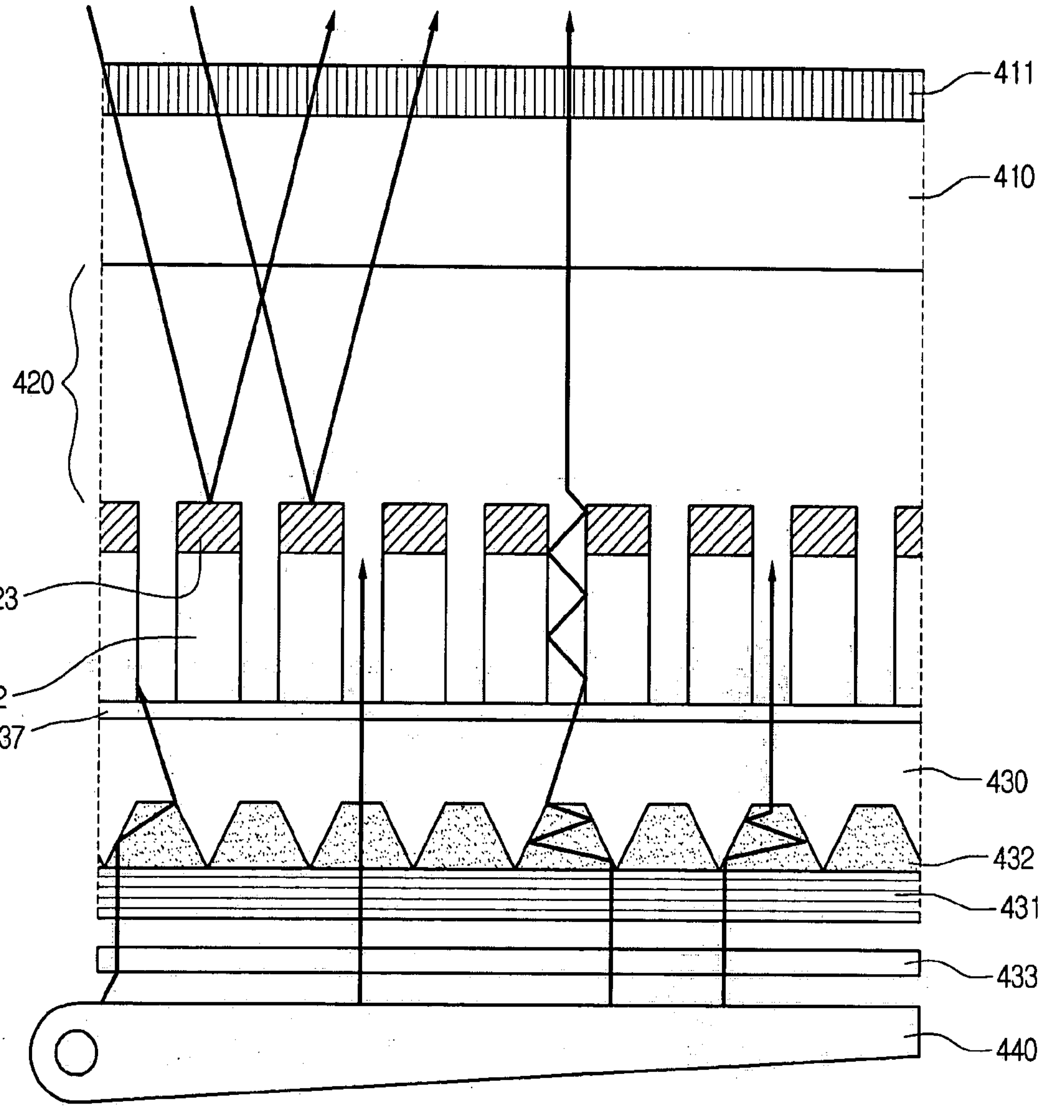


Fig.6A

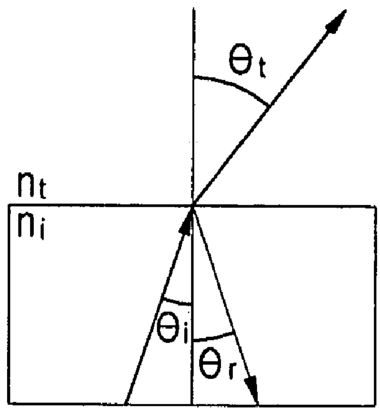


Fig.6B

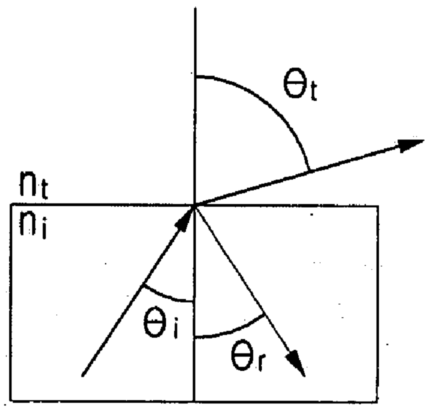


Fig.6C

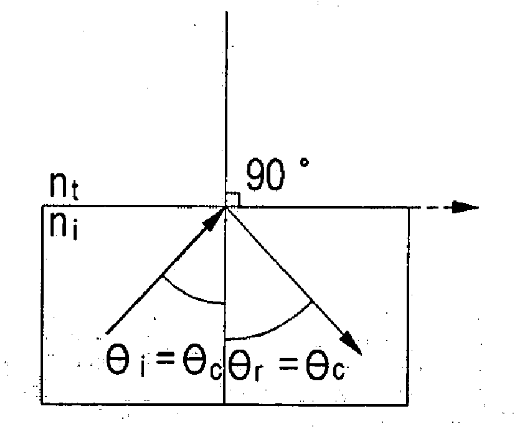


Fig.6D

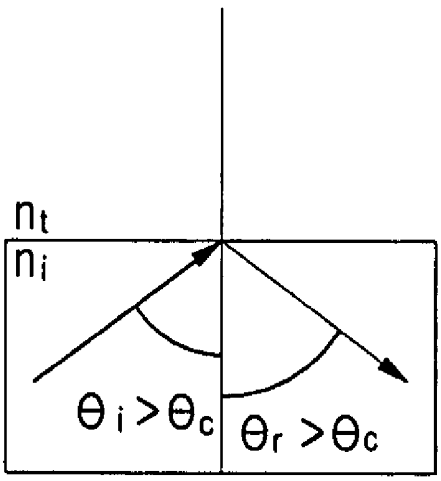


Fig.7

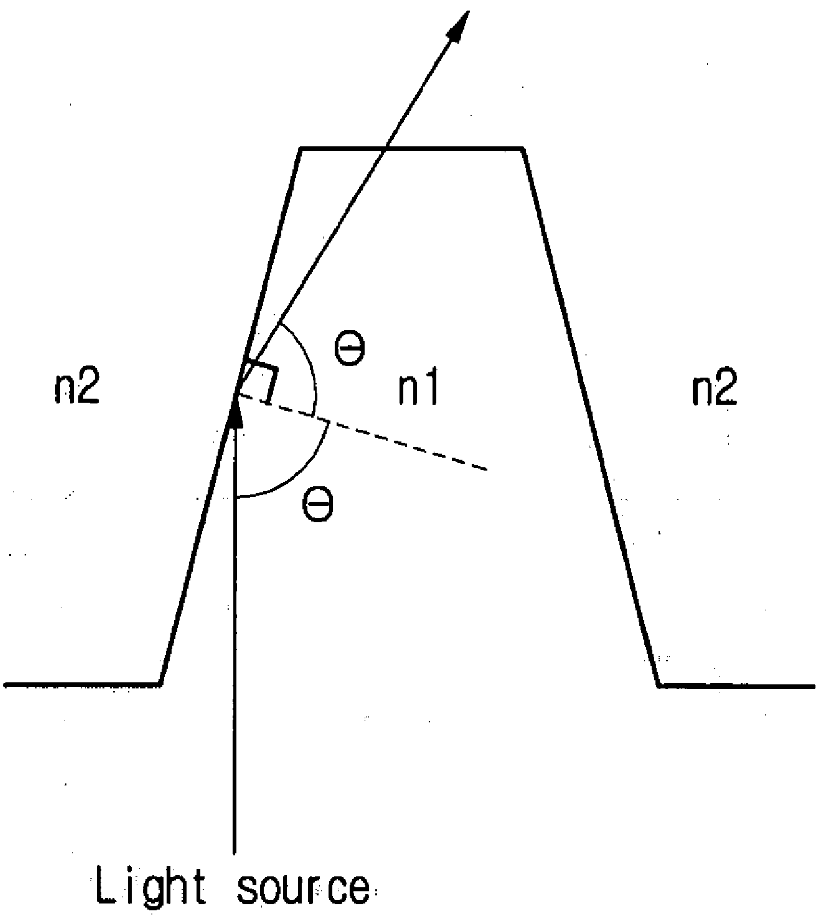


Fig.8A

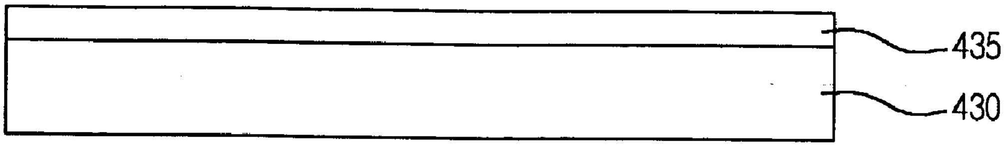


Fig.8B

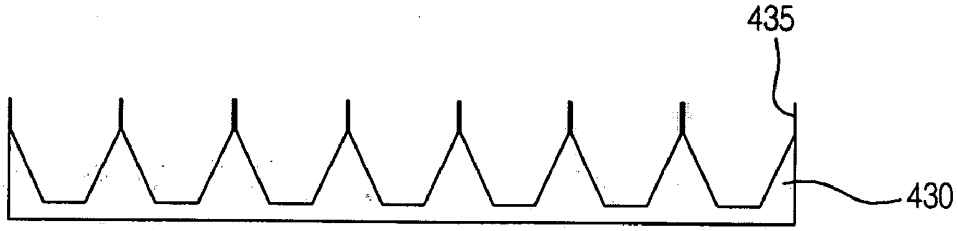


Fig.8C

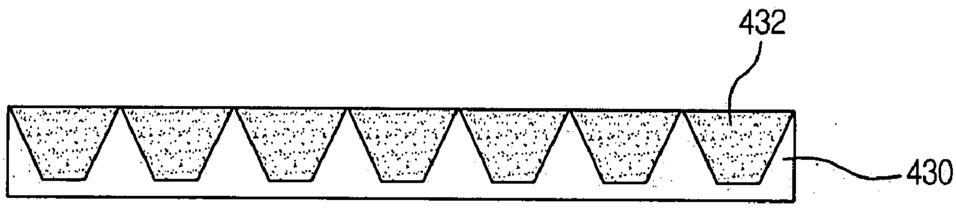
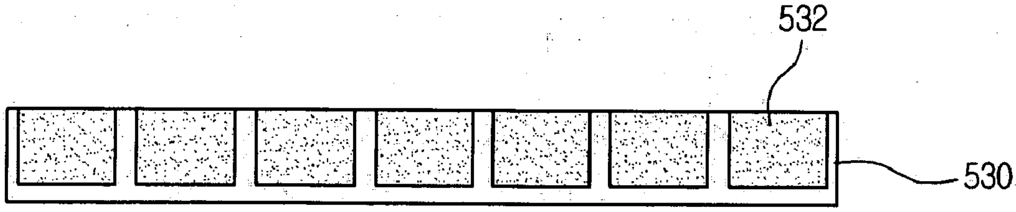


Fig.9



TRANSFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR MANUFACTRUING THE SAME

BACKGROUND

[0001] 1. Field

[0002] The present invention relates to a transflective type liquid crystal display device, and more particularly, to a transflective type liquid crystal display device and method for manufacturing the same, capable of optimizing optical efficiency.

[0003] 2. Description of the Related Art

[0004] Generally, liquid crystal display (LCD) devices have advantages such as being lightweight, having a slim profile, and low power consumption, and are widely used for portable computers, office automation equipment, and audio/video apparatuses.

[0005] The LCD device includes two substrates and a liquid crystal layer interposed between the two substrates, and displaces liquid crystal molecules using an electric field generated upon application of a voltage. Hence, an image is displayed by manipulating the transmission of light through the liquid crystal.

[0006] Since the LCD device does not generate light by itself, it uses ambient light or a backlight assembly for generating light. Generally, the LCD device can be classified into two different categories: a transmission type LCD device or a reflection type LCD device.

[0007] **FIG. 1** is a cross-sectional view schematically showing a structure of the transmission type LCD device according to the related art. In **FIG. 1**, the transmission type LCD device includes: a first substrate **102** on which a thin film transistor (TFT) functioning as a switching element is formed on each of intersection points between a plurality of gate lines and data lines; a second substrate **101** which faces the first substrate **102** and on which a black matrix (BM) layer, a color filter layer, and a common electrode are formed; a liquid crystal layer **103** including liquid crystals interposed between the first and the second substrates **102** and **101**; first and the second polarizing plates **105** and **104** arranged on an outer surface of each of the first and the second substrates **102** and **101**; and a backlight assembly **106** disposed outside the first polarizing plate **105**.

[0008] An optical transmission axis of the first polarizing plate **105** has an angle of 90° to that of the second polarizing plate **104**. The backlight assembly **106** generates light and provides the light toward the first substrate **102**.

[0009] In the related art LCD device having the foregoing construction, when the TFTs are turned on by a scanning signal applied to the plurality of gate lines and a data voltage applied to the plurality of data lines, the data voltage is applied to pixel electrodes through the turned-on TFTs. At this time, a common voltage is supplied to the common electrode of the second substrate **101**. Accordingly, the liquid crystal molecules are controlled by the electric field generated between the pixel electrodes and the common electrode to transmit or block light provided from the backlight assembly **106**, so that a predetermined image is displayed.

[0010] However, in the transmission type LCD device of the related art, it is difficult to realize slimness and lightweight of the LCD device due to a large volume and a heavy weight of the backlight assembly **106**. Also, the power consumption of the backlight assembly **106** increases the overall power consumption of the device by a significant amount.

[0011] Therefore, research into reflection type LCD devices using ambient light instead of the backlight assembly **106** is actively performed. Such a reflection type LCD device is widely used as a portable display device such as an electronic organizer and a PDA (Personal Digital Assistant) thanks to low power consumption.

[0012] **FIG. 2** is a cross-sectional view schematically showing a structure of the reflection type LCD device according to the related art. In **FIG. 2**, the reflection type LCD device includes: a first substrate **202** on which a thin film transistor (TFT) functioning as a switching element is formed on each of crossing points between a plurality of gate lines and data lines; a second substrate **201** which faces the first substrate **202** and on which a black matrix (BM) layer, a color filter layer, and a common electrode are formed; a liquid crystal layer **203** including liquid crystals interposed between the first and the second substrates **202** and **201**; a first and a second polarizing plates **205** and **204** arranged on an outer surface of each of the first and the second substrates **202** and **201**; and a reflector **206** disposed outside the first polarizing plate **205**.

[0013] An optical transmission axis of the first polarizing plate **205** has an angle of 90° to that of the second polarizing plate **204**. The reflector **206** reflects light provided from the outside and provides the light toward the first substrate **202**.

[0014] In the LCD device having the foregoing construction, when a plurality of TFTs are turned on by a scanning signal applied to a plurality of gate lines and a data signal applied to a plurality of data lines, the data signal is applied to pixel electrodes through the turned-on TFTs. At this time, a common voltage is supplied to the common electrode of the second substrate **201**. Accordingly, the liquid crystals are controlled by the electric field generated between the pixel electrodes and the common electrode to transmit or block light provided and reflected from the outside, whereby a predetermined image is displayed.

[0015] However, in the related art reflection type LCD device, when ambient light does not have a sufficient intensity (for example, the surrounding environment is dim), the brightness level of the display image is lowered and displayed information is not readable, which is problematic.

[0016] To resolve the above problems, a transflective type LCD device, which combines the reflection type LCD device and the transmission type LCD device, has been suggested.

[0017] **FIG. 3** is a cross-sectional view schematically showing a construction of the transflective type LCD device according to the related art. In **FIG. 3**, the transflective type LCD device includes: a first substrate **330** on which a thin film transistor (TFT) functioning as a switching element is formed on each of crossing points between a plurality of gate lines and data lines; a second substrate **310**, which faces the first substrate **330** and on which a black matrix (BM) layer, a color filter layer, and a common electrode are formed; a liquid crystal layer **320** including liquid crystals interposed between the first and the second substrates **330** and **310**; a first and a second polarizing plates **331** and **311** arranged on a lower surface of the first substrate **330** and an upper surface of the second substrates **310**, respectively; and a backlight assembly **340** disposed outside the first polarizing plate **331**.

[**0018**] An optical transmission axis of the first polarizing plate **331** has an angle of 90° to that of the second polarizing plate **311**.

[**0019**] On the first substrate **330**, a pixel electrode is connected to each TFT. On the pixel electrodes, a passivation layer **322** having a transmission hole **321** exposing a portion (transmission region) of each of the pixel electrodes and a reflector **323** are sequentially formed.

[**0020**] It is assumed that a region corresponding to the reflector **323** is a reflection region 'r' and a region corresponding to the portion of the pixel electrode, exposed by the transmission hole **321**, is a transmission region 't'. The reflection region 'r' is the region for reflecting light provided from ambient light in a reflection mode, and the transmission region 't' is the region for transmitting light provided from the backlight assembly **340** in a transmission mode.

[**0021**] At this time, to reduce the difference in the distance that the light travels between the transmission region 't' and the reflection region 'r', the cell gap d**1** of the transmission region 't' is about twice that of the cell gap d**2** of the reflection region 'r'.

[**0022**] Generally, a phase difference δ of a liquid crystal is obtained by the following formula:

$$\delta = \Delta n \cdot d$$

[**0023**] where δ is the phase difference of a liquid crystal, Δn is the refractive index of a liquid crystal, and d is the cell gap.

[**0024**] Therefore, a difference in optical efficiency is generated between the reflection mode and the transmission mode. To reduce this difference in optical efficiency, the cell gap d**1** of the transmission region 't' should be greater than the cell gap d**2** of the reflection region 'r' such that the phase difference value of the liquid crystal layer **320** is constant.

[**0025**] However, even though the difference in optical efficiency is reduced by making the cell gap d**1** of the transmission region t different from the cell gap d**2** of the reflection region r, it is difficult to optimize the transmission region and the reflection region. Therefore, it is difficult to obtain optimized optical efficiency. For example, in the transmission mode, not all of the light provided from the backlight assembly is transmitted through the transmission region, and some of the light impinges on the reflection region and is not transmitted, whereby optical loss occurs. Also, in the reflection mode, not all the ambient light is reflected by the reflector, and some of the ambient light impinges on the backlight assembly through the transmission region, whereby optical loss occurs.

SUMMARY

[**0026**] By way of introduction only, a transflective type LCD device of a first embodiment includes: a first substrate having a light guiding pattern containing a medium whose refractive index is different from a refractive index of the first substrate; a second substrate facing the first substrate; a liquid crystal layer disposed between the first and the second substrates; and a backlight assembly arranged on an outer surface of the first substrate.

[**0027**] A reflector may be formed on a pixel electrode formed on the first substrate such that a reflection region and a transmission region are provided. In this case, the reflector is formed in the reflection region and is not formed in the transmission region.

[**0028**] The reflection region may have a larger width than the transmission region. The light guiding pattern may be formed at the position that corresponds to the transmission region. Also, the refractive index of the light guiding pattern may be at least greater than that of the first substrate. The light guiding pattern may be tapered towards an inside thereof.

[**0029**] According to a second embodiment, a method for manufacturing a transflective type liquid crystal display includes: forming a predetermined pattern on a lower side of the substrate adjacent to a backlight assembly; and forming, in the pattern, a light guiding pattern made of medium whose refractive index is different from the refractive index of the substrate.

[**0030**] In another embodiment, the display device contains a light provider and a substrate having a periodic light guiding pattern formed therein. The light guiding pattern and substrate have different refractive indices that are different enough such that light from the light provider entering the light guiding pattern is directed by total internal reflection towards a front surface of the display device.

[**0031**] In another embodiment, the display device contains a light supplier, a reflector to reflect light from a light source external to the device towards the front surface, and means for redirecting light from the light supplier through total internal reflection towards the front surface.

[**0032**] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0033**] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[**0034**] **FIG. 1** is a cross-sectional view schematically showing a structure of a transmission type LCD device of the related art;

[**0035**] **FIG. 2** is a cross-sectional view schematically showing a structure of a reflection type LCD device of the related art;

[**0036**] **FIG. 3** is a cross-sectional view schematically showing a structure of a transflective type LCD device of the related art;

[**0037**] **FIG. 4** is a cross-sectional view schematically showing a structure of a transflective type LCD device according to the first embodiment of the present invention;

[0038] **FIG. 5** is a drawing showing a status in which light progresses by a light guiding pattern of the present invention in transmission mode;

[0039] **FIGS. 6A, 6B, 6**C and **6**D show the condition under which the total internal reflection occurs generally;

[0040] **FIG. 7** is a drawing showing a total internal reflection path of light by a light guiding pattern of the present invention;

[0041] **FIGS. 8A, 8B** and **8**C are sectional views illustrating a method for forming a light guiding pattern on a first substrate of a transflective type LCD device; and

[0042] **FIG. 9** illustrates a light guiding pattern formed in a rectangular pattern.

DETAILED DESCRIPTION

[0043] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0044] **FIG. 4** is a cross-sectional view schematically showing a structure of a transflective type LCD device according to a first embodiment of the present invention. In **FIG. 4**, the transflective type LCD device includes: a first substrate **430** on which a thin film transistor (TFT) functioning as a switching element is formed on each of crossing points between a plurality of gate lines and data lines and a pixel electrode **437** is formed; a second substrate **410** facing the first substrate **430** and on which a black matrix (BM) layer, a color filter layer, and a common electrode are formed; a liquid crystal layer **420** including liquid crystals interposed between the first and the second substrates **430** and **410**; first and second polarizing plates **431** and **411** arranged on a lower surface of the first substrate **430** and an upper surface of the second substrates **410**, respectively; and a backlight assembly **440** disposed on an outer surface of the first polarizing plate **431**.

[0045] An optical transmission axis of the first polarizing plate **431** has an angle of 90° to that of the second polarizing plate **411**.

[0046] The transflective type LCD device further includes a collimator **433** disposed between the first polarizing plate **431** and the backlight assembly **440**. The collimator **433** modulates an incident angle of light provided from the backlight assembly **440** such that parallel light is incident into the first substrate **430**.

[0047] Though not shown in **FIG. 4**, each thin film transistor is connected to a gate line and a data line, and each pixel electrode is connected to the drain electrode of the TFT. Accordingly, the pixel region may include the TFT and the pixel electrode.

[0048] The pixel region can be divided into a reflection region 'r' and a transmission region 't'. Namely, a transmission hole **421** exposing a portion of the pixel electrode **437**, and a passivation layer **422** and a reflector **423** thereon are alternately arranged on the pixel electrode **437**. The region corresponding to the transmission hole **421** exposed by the pixel electrode **437** is the transmission region 't' and the region corresponding to the reflector **423** is the reflection region 'r'. The reflection region 'r' is the region that reflects light provided from ambient light in the reflection mode and the transmission region 't' is the region that transmits light provided from the backlight assembly **440** in the transmission mode.

[0049] To reduce the difference between distances traveled by light through the transmission region t and the reflection region r, the cell gap d**1** of the transmission region t is about twice that of the cell gap d**2** of the reflection region r.

[0050] In the embodiment shown, the ratio of the width of the reflection region r to that of the transmission region t is 3:2. Namely, by making the width of the reflection region r greater than the width of the transmission region t, more ambient light can be reflected in the reflection mode, whereby the brightness can be increased. Therefore, optical loss is reduced and optical efficiency is improved, compared to the related art.

[0051] However, if the width of the reflection region r is greater than that of the transmission region, the width of the transmission region t is relatively small, so that the amount of light provided from the backlight assembly **440** through the transmission region t is reduced. The light guiding pattern **432** helps to mitigate this problem.

[0052] **FIG. 5** shows how light is affected by the light guiding pattern in the transmission mode. As shown in **FIG. 5**, in the transmission mode, light generated from the backlight assembly **440** is modulated into parallel light by the collimator **433** and provided to the first substrate **430** by way of the first polarizing plate **431**.

[0053] A light guiding pattern **432** capable of guiding light is formed on the first substrate **430**. The light guiding pattern **432** transmits incident light to be provided without any optical loss, to the transmission region t, through total internal reflection of the incident light. The light guiding pattern **432** is formed at the position that corresponds to the transmission region, which permits light that has traveled through using total internal reflection by the light guiding pattern **432** can be directly provided to the corresponding transmission region t.

[0054] Namely, light provided to the light guiding pattern **432** of the first substrate **430** is subject to total internal reflection inside the light guiding pattern **432** and is provided to the transmission region t. Therefore, since light generated from the backlight assembly **440** is provided to the transmission region t without any optical loss, the brightness is increased and the optical efficiency can be improved.

[0055] **FIG. 6** is a schematic view showing a condition under which the total internal reflection occurs generally. As shown in **FIG. 6A**, the relation between light transmitted and provided to and from media having different refractive indexes n_i and n_t, is given by the following formula:

$$\sin\theta_i = n_t/n_i \sin\theta_t$$

[0056] Here, θ_i represents an incident angle, θ_t represents a transmission angle, n_i represents a refractive index of a medium through which light is provided, and n_t represents a refractive index of a medium to which light is transmitted.

[0057] As revealed by the above formula, if the refractive index n_i of the medium through which light is provided is greater than the refractive index n_t of the medium to which light is transmitted, the transmission angle θ_t is greater than the incident angle θ_i.

[0058] As shown in **FIG. 6B**, as the incident angle θ_i increases the transmission angle θ_t also increases. Accordingly, the transmitted light approaches the boundary between the two media and the amount of transmitted light is greater than in the amount of reflected light.

[0059] Eventually, as shown in **FIG. 6C**, when the transmission angle θ_t becomes 90°, the incident light is neither transmitted nor reflected. The incident angle θ_i when the transmission angle θ_t becomes 90°, is called a critical angle θ_c. As shown in **FIG. 6D**, light provided at an angle greater than the critical angle θ_c is completely reflected by total internal reflection.

[0060] **FIG. 7** is a drawing showing a total internal reflection path of light by the light guiding pattern. As shown in **FIG. 7**, to meet the total internal reflection condition, n_1 is greater than n_2 ($n_1>n_2$). Here, n, represents the refractive index of the light guiding pattern **432** and n_2 represents the refractive index of the first substrate **430**.

[0061] Also, the incident angle θ is greater than the critical angle ($\theta_c=\arcsin(n_2/n_1)$). Therefore, light that satisfies the above two conditions is not transmitted but completely reflected by total internal reflection. Here, θ represents an incident angle of the light guiding pattern **432** and θ_c represents the critical angle. At this time, it should be noted that the reflective angle equals the incident angle.

[0062] Therefore, the refractive index n_1 of the light guiding pattern **432** is at least greater than the refractive index n_2 of the first substrate **430**. Generally, since the refractive index n_2 of the first substrate **430** is about 1.5, the refractive index n_1 of the light guiding pattern **432** is at least greater than 1.5.

[0063] Also, to get the incident light to be provided in the direction of the first substrate **430** by total internal reflection, the light guiding pattern **432** is tapered from a lower part thereof to an upper part. By tapering the width of the upper part compared to that of the lower part, incident light is repeatedly reflected inside the light guiding pattern **432** by total internal reflection and provided to the first substrate **430**.

[0064] Therefore, the transflective type LCD device of the present invention can improve the optical efficiency through increase in optical transmittance by forming a light guiding pattern **432** for guiding light in the direction of the first substrate **430** and providing the light from the backlight assembly **440** completely to the transmission region t of the first substrate **430** without any optical loss.

[0065] Also, the transflective type LCD device having the foregoing construction improves reflection efficiency by making the reflection region r having a larger width than that of the transmission region t so that a greater amount of incident ambient light is reflected upon the reflection mode, and improves optical transmittance by forming the light guiding pattern **432** so that light provided from the backlight assembly **440** is completely guided to the transmission region t by total internal reflection. As described above, the transflective type LCD device of the present invention can maximize the optical efficiency in both the reflection mode and the transmission mode.

[0066] In the meantime, **FIGS. 8A through 8C** are drawings explaining a manufacturing process for forming the light guiding pattern on the first substrate of the transflective type LCD device.

[0067] As shown in **FIG. 8A**, a V-shaped pattern is formed on one side of the first substrate **430** by etching. For example, if the first substrate **430** is etched using photolithography, a positive or negative type photoresist is coated on the first substrate **430** so that a photoresist layer **435** is formed.

[0068] Subsequently, as shown in **FIG. 8B**, an exposure mask (not shown) is positioned above the photoresist layer **435** and a specific portion of the photoresist layer **435** is exposed to exposure light of a particular wavelength. Thereafter, the exposed photoresist layer **435** is developed so that a predetermined pattern is formed. Etching is then performed using the patterned photoresist layer **435** as a mask.

[0069] More specifically, etchant partially passes through the patterned photoresist layer **435** and reacts with the first substrate **430**. Subsequently, by removing the patterned photoresist layer **435**, a V-shaped pattern is formed on the first substrate **430**. The V-shaped pattern is tapered such that the surface of the pattern has a larger width than the end of the V-shaped pattern inside the first substrate **430**.

[0070] As shown in **FIG. 8C**, the light guiding pattern **432** made of a medium having the refractive index different from the first substrate **430** is formed on the V-shaped pattern. The light guiding pattern **432** has a refractive index greater than the refractive index of the first substrate **430** so that total internal reflection may occur.

[0071] Alternatively, as shown in **FIG. 9**, the light guiding pattern **532** may be formed on a first substrate **530** in rectangular shape.

[0072] As is apparent from the foregoing, the optical transmittance is increased by forming a light guiding pattern on a first substrate so that light provided from a backlight assembly is guided in the transmission mode. Also, the optical reflectance is increased by increasing the width of the reflection region formed on the first substrate so that more ambient light is reflected in the reflection mode. Thus, the optical efficiency is increased by increasing the optical reflectance and transmittance in the transflective type LCD device having a reflection mode and a transmission mode.

[0073] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A transflective type liquid crystal display device comprising:

a first substrate having a light guiding pattern containing a medium whose refractive index is different from a refractive index of the first substrate;

a second substrate facing the first substrate;

a liquid crystal layer containing liquid crystals injected between the first and the second substrates; and

a backlight assembly arranged on an outer surface of the first substrate.

2. The transflective type liquid crystal display device according to claim 1, further comprising a reflector disposed on an opposing side of the first substrate as the light guiding pattern, the reflector defining a reflection region and a transmission region such that the reflector is present in the reflection region and the reflector is not present in the transmission region.

3. The transflective type liquid crystal display device according to claim 2, wherein a cell gap in the transmission region is twice a cell gap in the reflection region.

4. The transflective type liquid crystal display device according to claim 2, wherein the reflection region has a greater width than the transmission region.

5. The transflective type liquid crystal display device according to claim 1, further comprising first and second polarizing plates, whose optical transmission axes are perpendicular each other, arranged on outer surfaces of the first and the second substrates, respectively.

6. The transflective type liquid crystal display device according to claim 1, further comprising a collimator arranged between the first substrate and the backlight assembly, the collimator for modulating light provided from the backlight assembly into parallel light.

7. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern is formed in a position that corresponds to a transmission region.

8. The transflective type liquid crystal display device according to claim 7, wherein a majority of the light guiding pattern is formed in a position that corresponds to the transmission region.

9. The transflective type liquid crystal display device according to claim 1, wherein a refractive index of the light guiding pattern is greater than a refractive index of the first substrate.

10. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern is tapered such that a width of the light guiding pattern decreases with decreasing distance to the liquid crystal layer.

11. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern guides light to a transmission region by reflecting light provided from the backlight assembly inside the light guiding pattern using total internal reflection.

12. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern is a V-shaped pattern.

13. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern is a rectangular shaped pattern.

14. The transflective type liquid crystal display device according to claim 2, further comprising a passivation layer on which the reflector is disposed.

15. The transflective type liquid crystal display device according to claim 14, wherein the passivation layer is disposed only in the reflection region.

16. The transflective type liquid crystal display device according to claim 14, further comprising a pixel electrode on which the passivation layer is disposed.

17. The transflective type liquid crystal display device according to claim 2, wherein each element of the light guiding pattern corresponds with a portion of the transmission region, and a width of each element of the light guiding pattern is greater than a width of the corresponding portion of the transmission region.

18. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern is a periodic structure.

19. The transflective type liquid crystal display device according to claim 1, wherein the light guiding pattern extends from the outer surface of the first substrate towards the liquid crystal layer.

20. The transflective type liquid crystal display device according to claim 19, wherein the light guiding pattern terminates before reaching an inner surface of the first substrate opposing the outer surface of the first substrate.

21. The transflective type liquid crystal display device according to claim 19, wherein the light guiding pattern at the outer surface of the first substrate covers substantially all of the outer surface of the first substrate.

22. A method for manufacturing a transflective type liquid crystal display device having first and second substrates, a liquid crystal layer interposed between the first and the second substrates, and a backlight assembly arranged outside the first substrate, the method comprising:

forming a predetermined pattern on a lower side of the first substrate to be adjacent to the backlight assembly; and

depositing a medium in the predetermined pattern to form a light guiding pattern, the medium having refractive index different from a refractive index of the first substrate.

23. The method according to claim 22, wherein the light guiding pattern is tapered such that a width of the light guiding pattern decreases from the lower side of the first substrate.

24. The method according to claim 22, wherein the light guiding pattern is formed by etching.

25. The method according to claim 22, further comprising assembling the device such that the light guiding pattern is disposed at a position that corresponds to a transmission region.

26. The method according to claim 25, wherein a majority of the light guiding pattern is disposed at the position that corresponds to the transmission region.

27. The method according to claim 22, further comprising arranging the first substrate such that the light guiding pattern guides light to a transmission region by reflecting light provided from the backlight assembly inside the light guiding pattern using total internal reflection.

28. The method according to claim 22, wherein a refractive index of the light guiding pattern is greater than that of the first substrate.

29. The method according to claim 22, further comprising forming a reflector on an opposing side of the first substrate as the light guiding pattern, the reflector defining a reflection region and a transmission region such that the reflector is present in the reflection region and the reflector is not present in the transmission region.

30. The method according to claim 29, wherein a cell gap in the transmission region is twice a cell gap in the reflection region.

31. The method according to claim 22, further comprising forming the reflector on a passivation layer.

32. The method according to claim 31, further comprising removing a portion of the reflector and the underlying passivation layer such that the passivation layer is disposed only in the reflection region.

33. The method according to claim 31, further comprising forming the passivation layer on a pixel electrode.

34. The method according to claim 29, wherein each element of the light guiding pattern corresponds with a portion of the transmission region, and a width of each element of the light guiding pattern is greater than a width of the corresponding portion of the transmission region.

35. The method according to claim 22, wherein the light guiding pattern is a periodic structure.

36. The method according to claim 22, wherein the light guiding pattern extends from the outer surface of the first substrate towards the liquid crystal layer.

37. The method according to claim 36, wherein the light guiding pattern terminates before reaching an inner surface of the first substrate opposing the outer surface of the first substrate.

38. The method according to claim 36, wherein the light guiding pattern at the outer surface of the first substrate covers substantially all of the outer surface of the first substrate.

39. A display device comprising:

a light provider; and

a substrate having a periodic light guiding pattern formed therein, the light guiding pattern and substrate having different refractive indices that are different enough such that light from the light provider entering the light guiding pattern is directed by total internal reflection towards a front surface of the display device.

40. The display device according to claim 39, further comprising a reflector disposed on a reflecting region of an opposing side of the substrate as the light guiding pattern, a transmission region of the opposing side of the substrate devoid of the reflector.

41. The display device according to claim 40, wherein a cell gap in the transmission region is twice a cell gap in the reflection region.

42. The display device according to claim 40, wherein the reflection region has a greater width than the transmission region.

43. The display device according to claim 39, wherein the light guiding pattern is tapered such that a width of the light guiding pattern decreases with increasing distance from the light provider.

44. The display device according to claim 40, further comprising a passivation layer on which the reflector is disposed, the passivation layer disposed only in the reflection region.

45. The display device according to claim 44, further comprising a transparent electrode disposed on the substrate and on which the passivation layer is disposed.

46. The display device according to claim 40, wherein each element of the light guiding pattern corresponds with a portion of the transmission region, and a width of each element of the light guiding pattern is greater than a width of the corresponding portion of the transmission region.

47. The display device according to claim 39, wherein the light guiding pattern extends from a surface of the substrate facing the light provider and terminates before reaching an opposing surface.

48. A display device having a front surface viewed by a viewer, the display device comprising:

a light provider;

a reflector to reflect light from a light source external to the device towards the front surface; and

means for redirecting light from the light supplier through total internal reflection towards the front surface.

49. The display device according to claim 48, wherein reflector has holes disposed therein and the means for redirecting directs the light through the holes.

50. The display device according to claim 49, wherein an area of the holes is smaller than an area of the reflector.

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专利名称(译)	半透射型液晶显示装置及其制造方法		
公开(公告)号	US20050140872A1	公开(公告)日	2005-06-30
申请号	US10/973358	申请日	2004-10-26
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG飞利浦LCD CO.，LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
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发明人	KANG, HOON		
IPC分类号	G02F1/133 G02F1/1333 G02F1/1335 H01L21/00		
CPC分类号	G02F1/133371 G02F1/133555 G02F1/133524		
优先权	1020030100692 2003-12-30 KR		
其他公开文献	US7365814		
外部链接	Espacenet USPTO		

摘要(译)

一种液晶显示装置，包括第一基板，面向第一基板的第二基板，由注入第一基板和第二基板之间的液晶制成的液晶层，以及布置在第一基板的外表面上的背光组件。第一基板具有导光图案，该导光图案包含由折射率与第一基板的折射率不同的介质形成的周期结构。