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(54) **BACKLIGHT UNIT FOR LIQUID CRYSTAL DISPLAY DEVICE**

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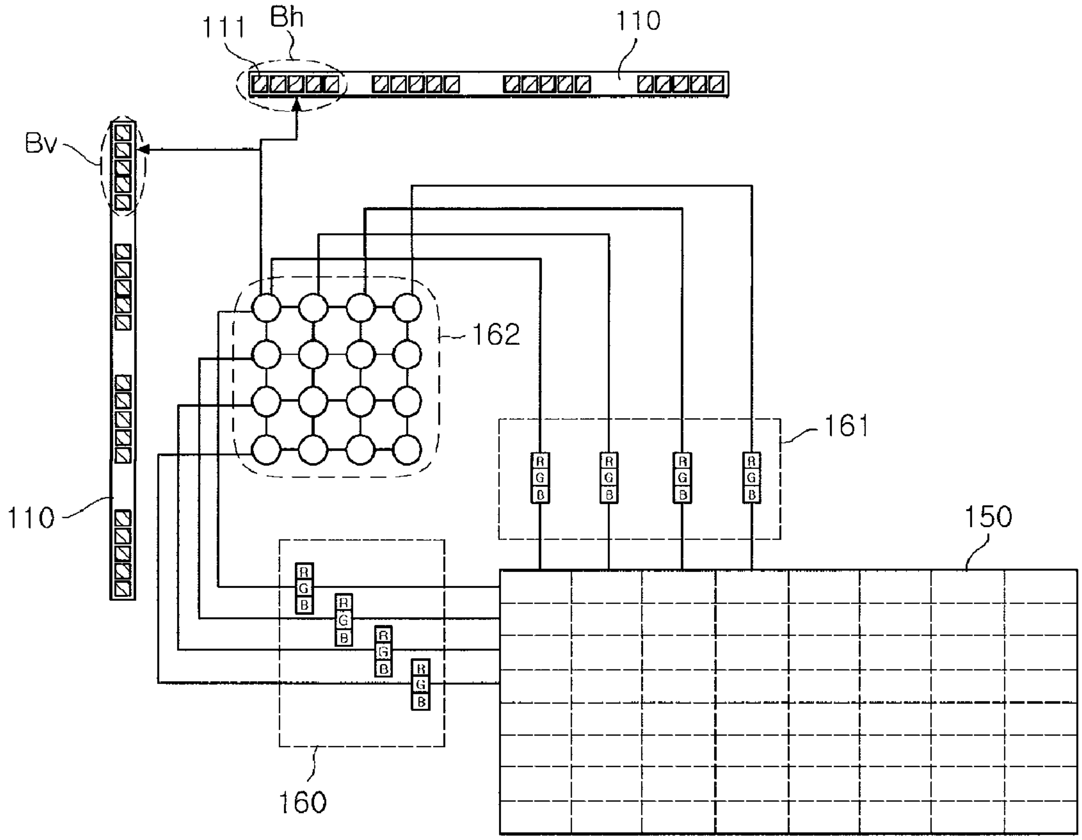
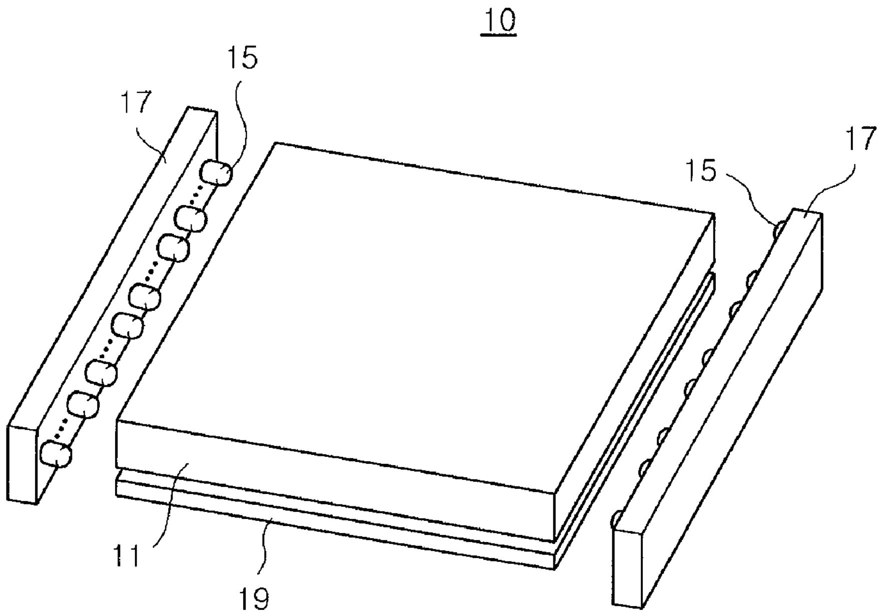
(57) **ABSTRACT**

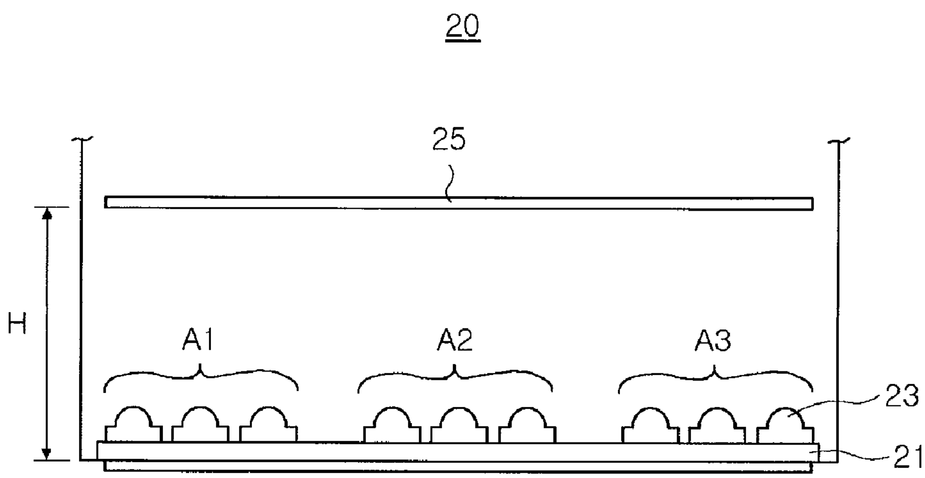
There is provided a backlight unit for an LCD device. The backlight unit, disposed under a liquid crystal panel and emitting light to a liquid crystal panel, includes a lightguide plate, a light emitting diode (LED) array disposed at an edge of the lightguide plate and including a plurality of LED blocks each including at least one LED emitting white light, and a controller controlling a current signal applied to each of the plurality of LED blocks to regulate the luminance of each LED block. Accordingly, the backlight unit can be provided, which is capable of contributing to manufacturing thinner and larger products and realizing effective local dimming by using an LED disposed at an edge of the lightguide plate.



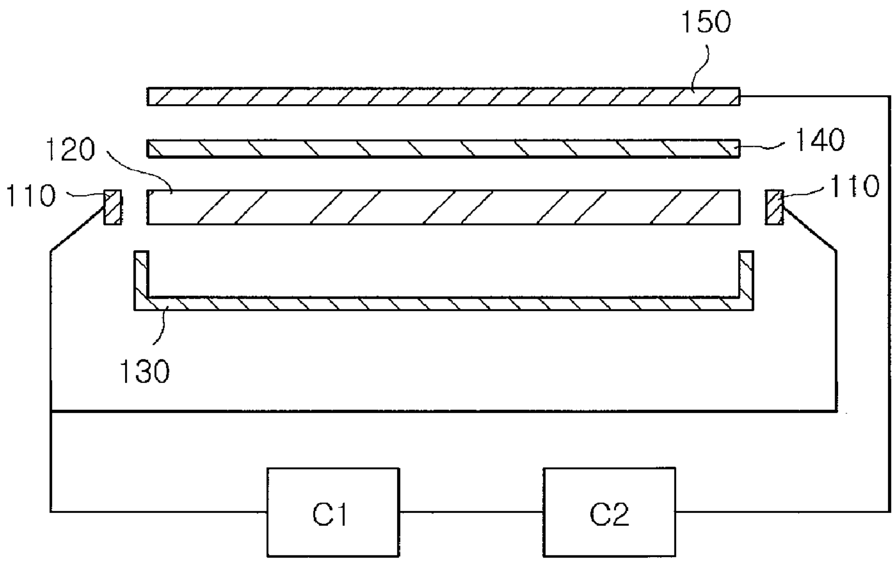
【Figure 1】



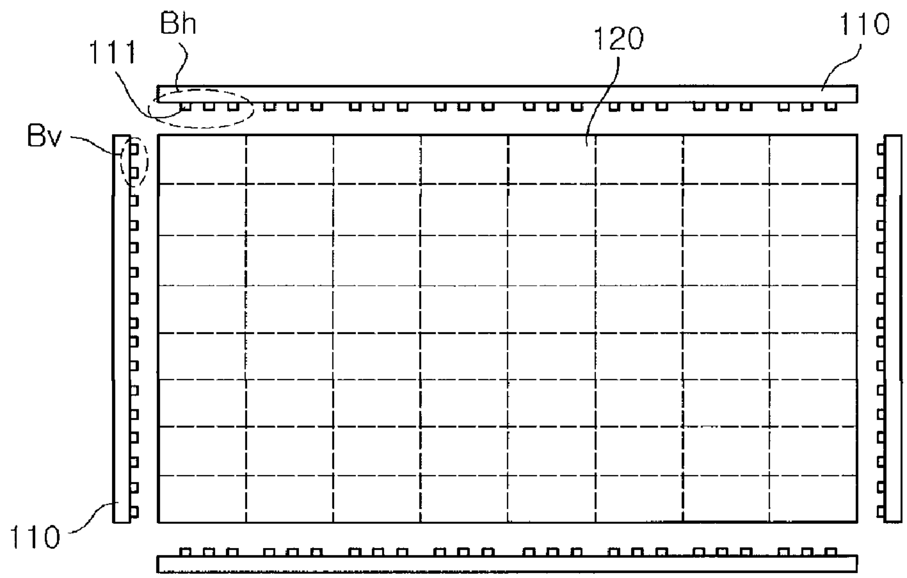
【Figure 2】



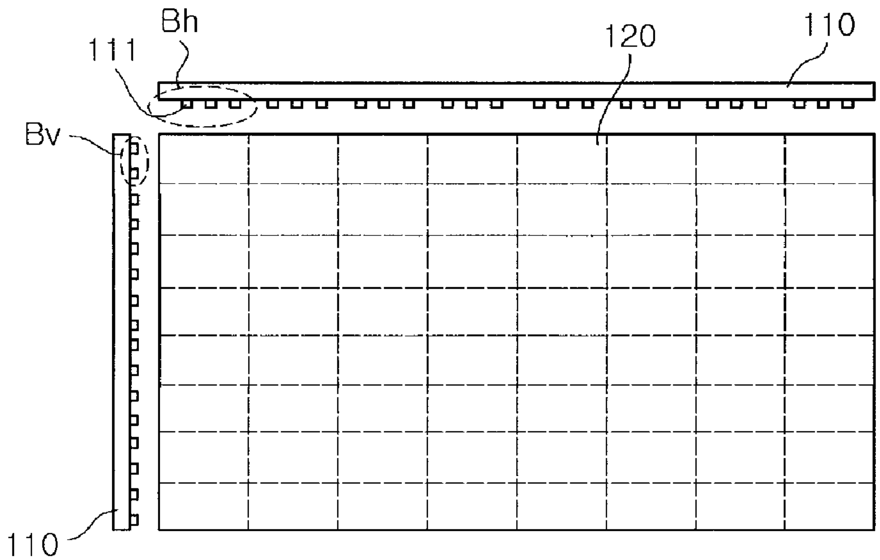
【Figure 3】



【Figure 4】



【Figure 5】



【Figure 6】

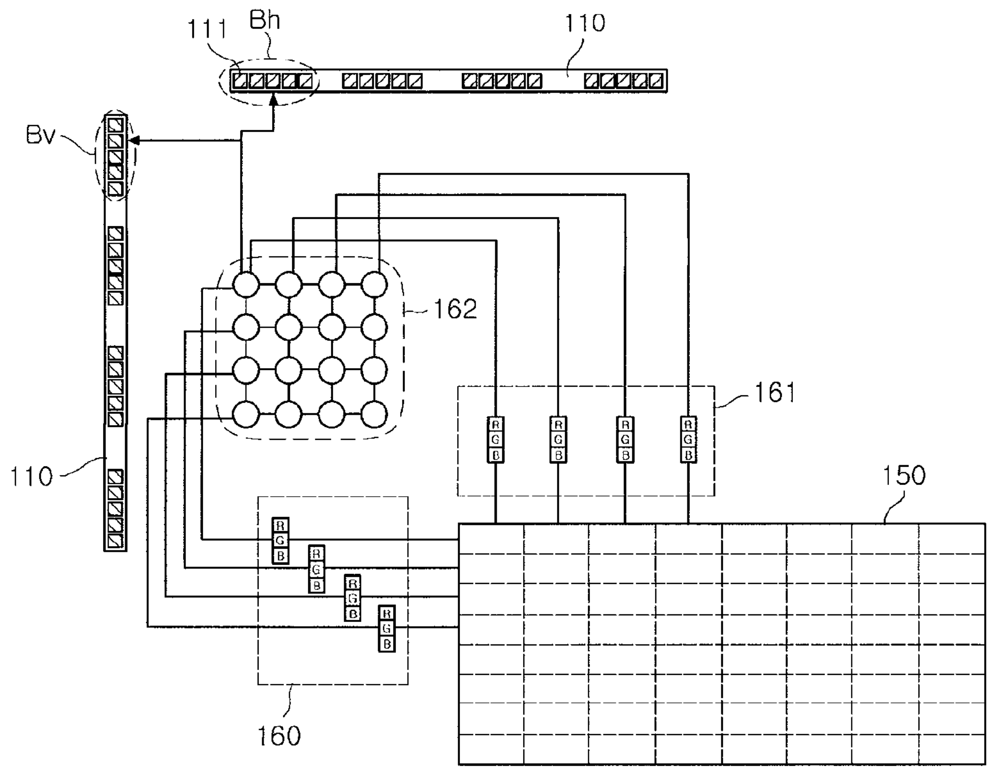
(a)

	1	0
0	1/2	0
1	1/2+1/2	1/2

(b)

	1	0	1/2	
0	1/3+1/6	1/6+1/6	1/6+1/6+1/3	1/2
1	1/3+1/3	1/3+1/6	1/3+1/6+1/3	0
1/2	1/3+1/6	1/6+1/6	1/3+1/6+1/6	0
	0	1/2	1	

【Figure 7】



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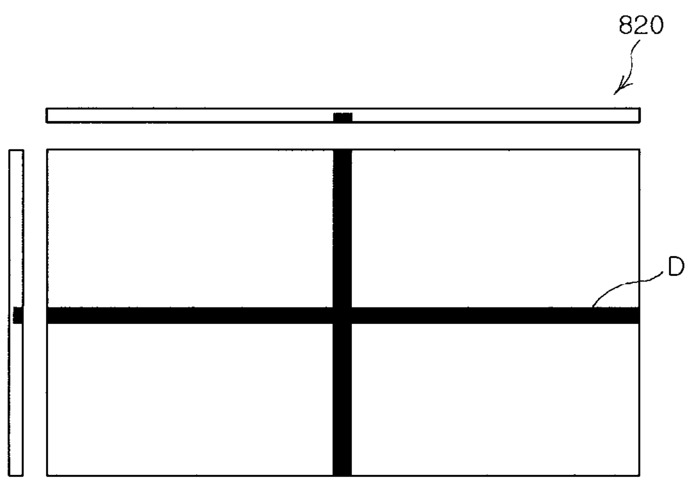

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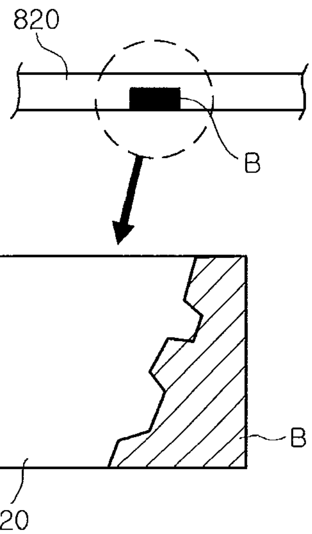

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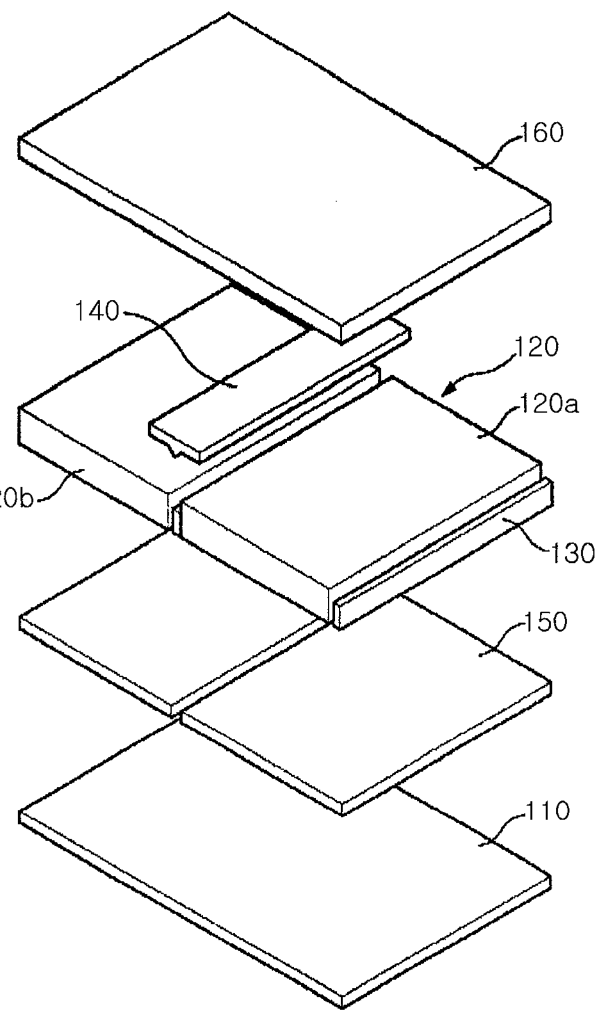

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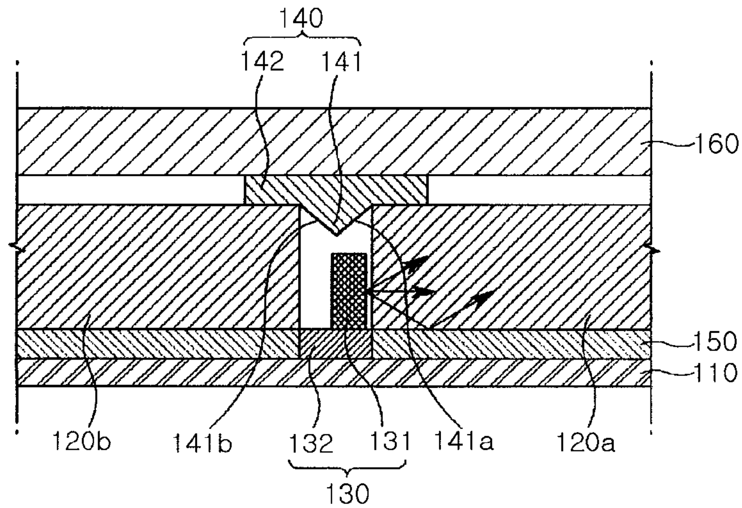

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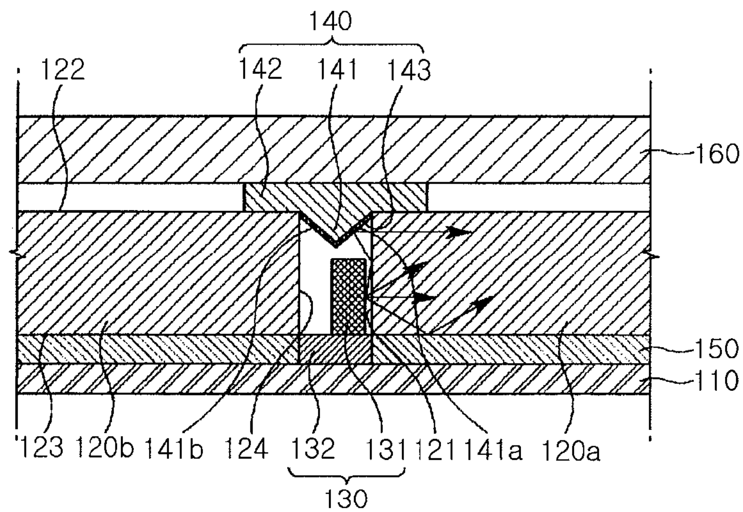

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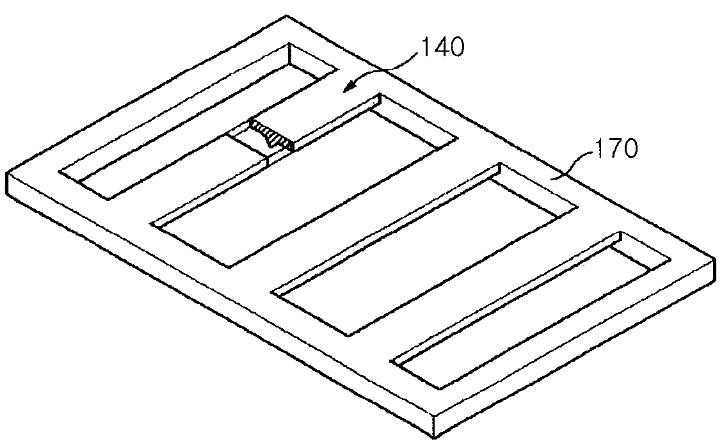

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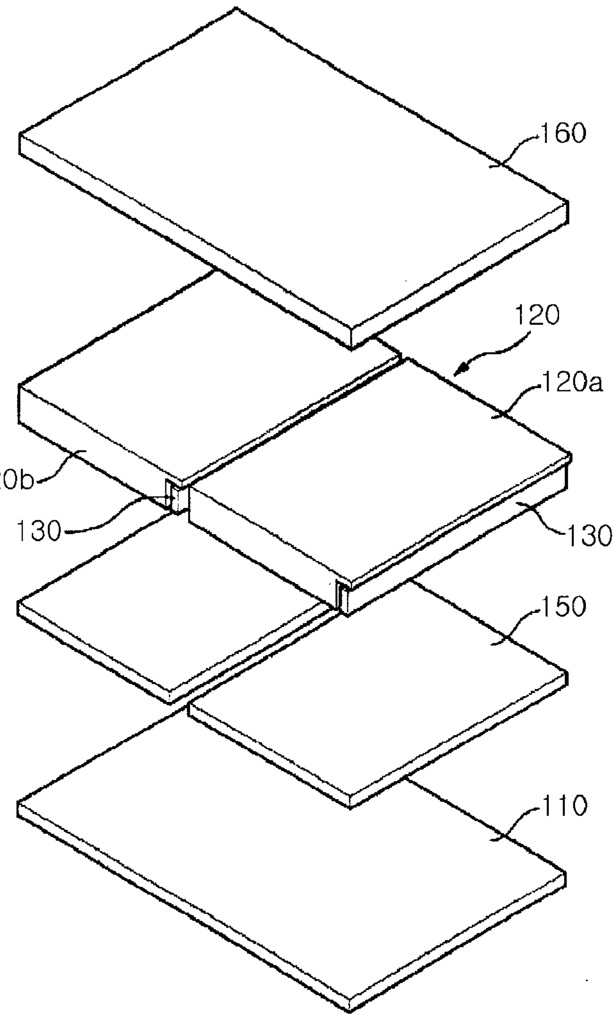

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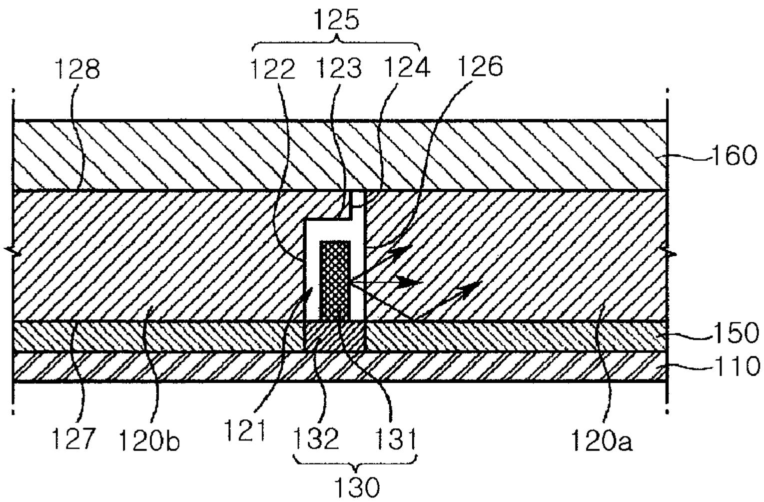

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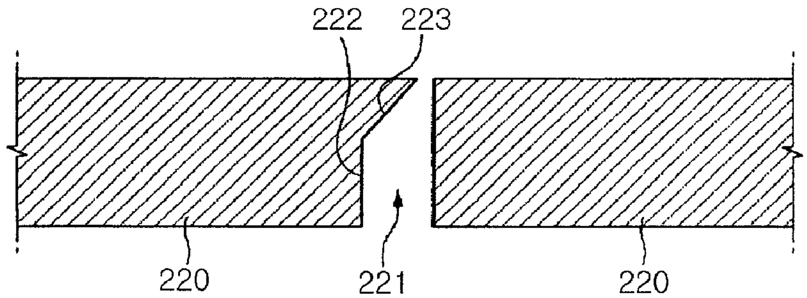

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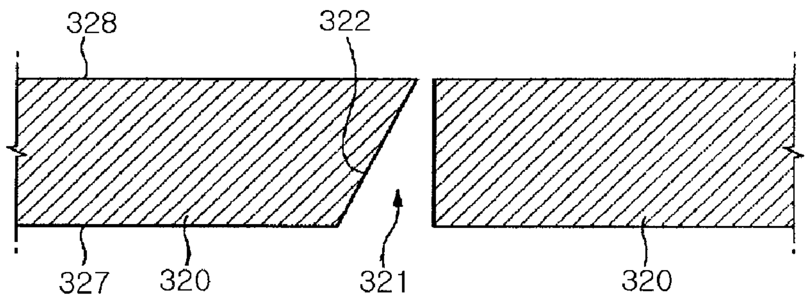

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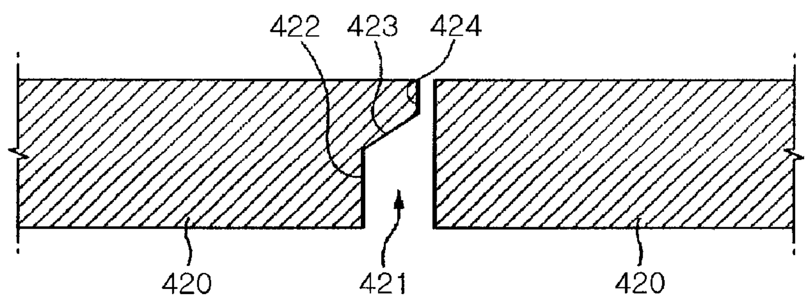

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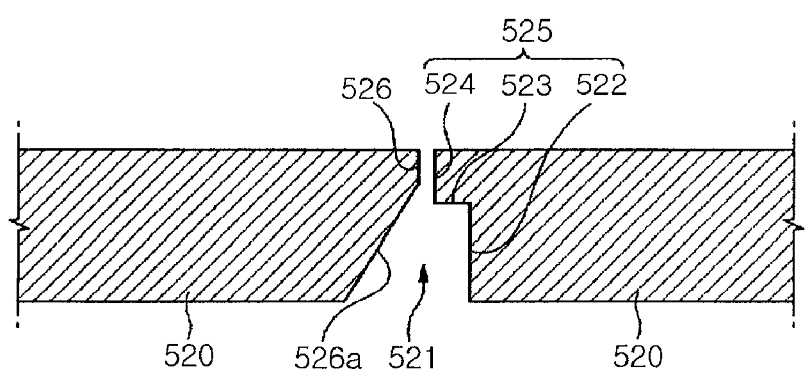

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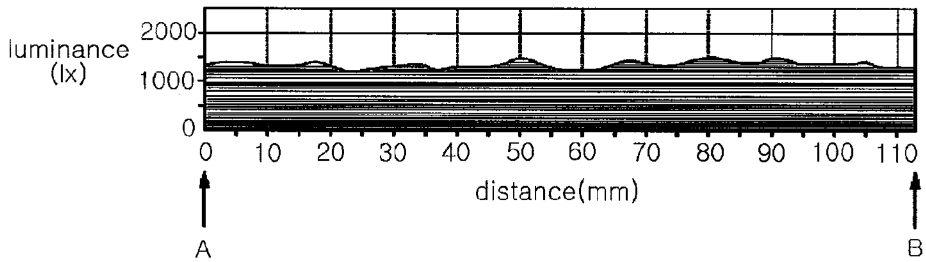

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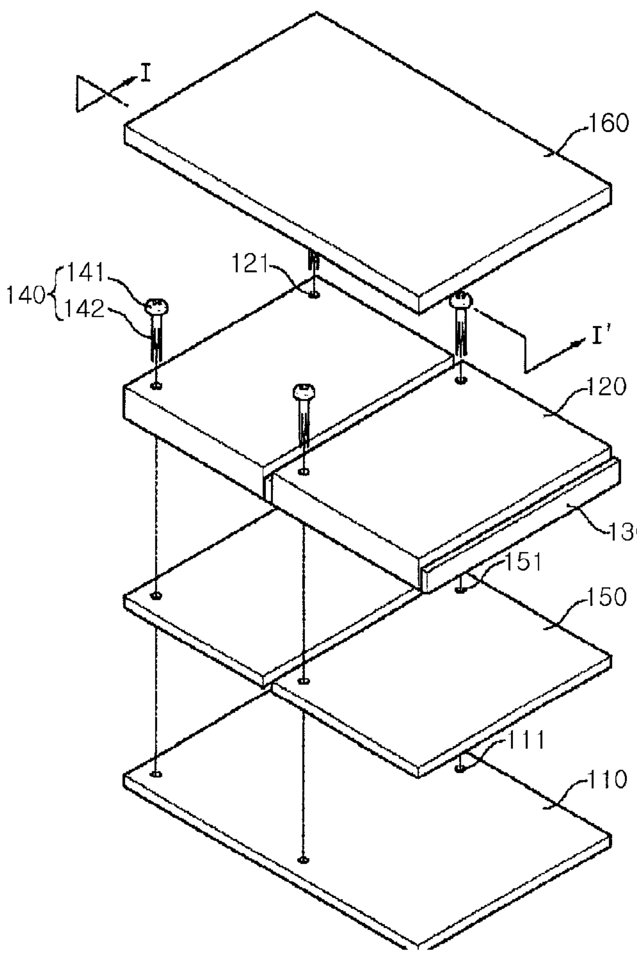

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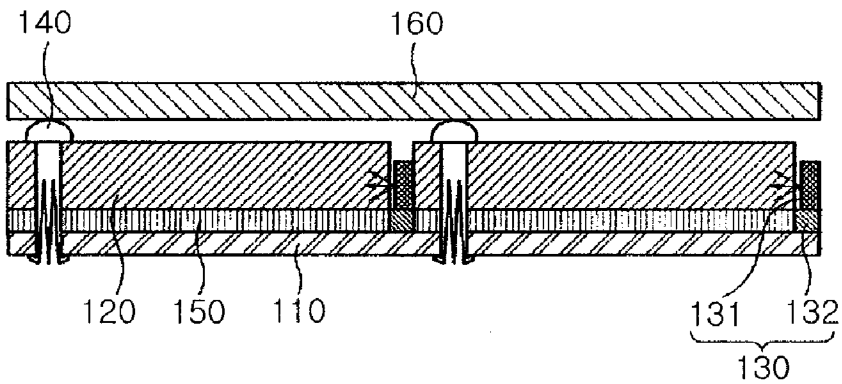

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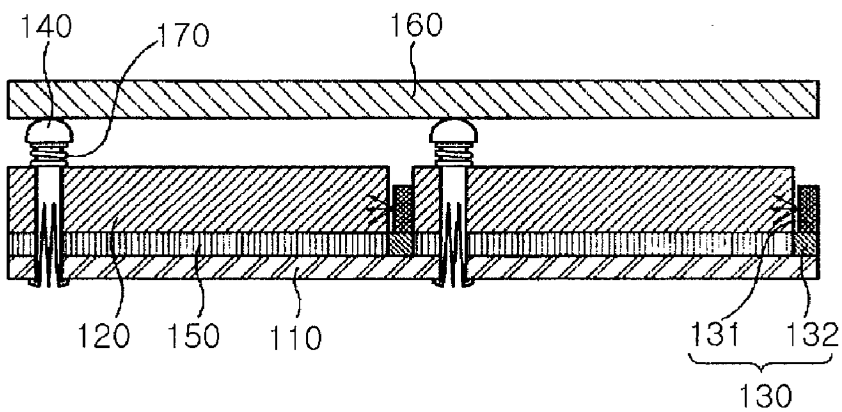

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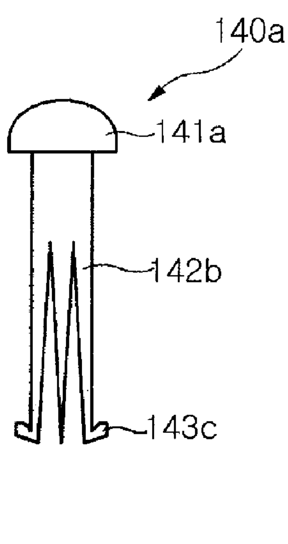

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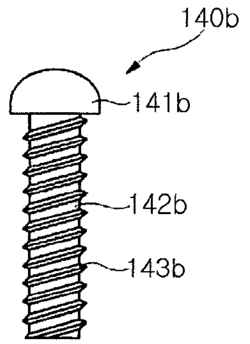

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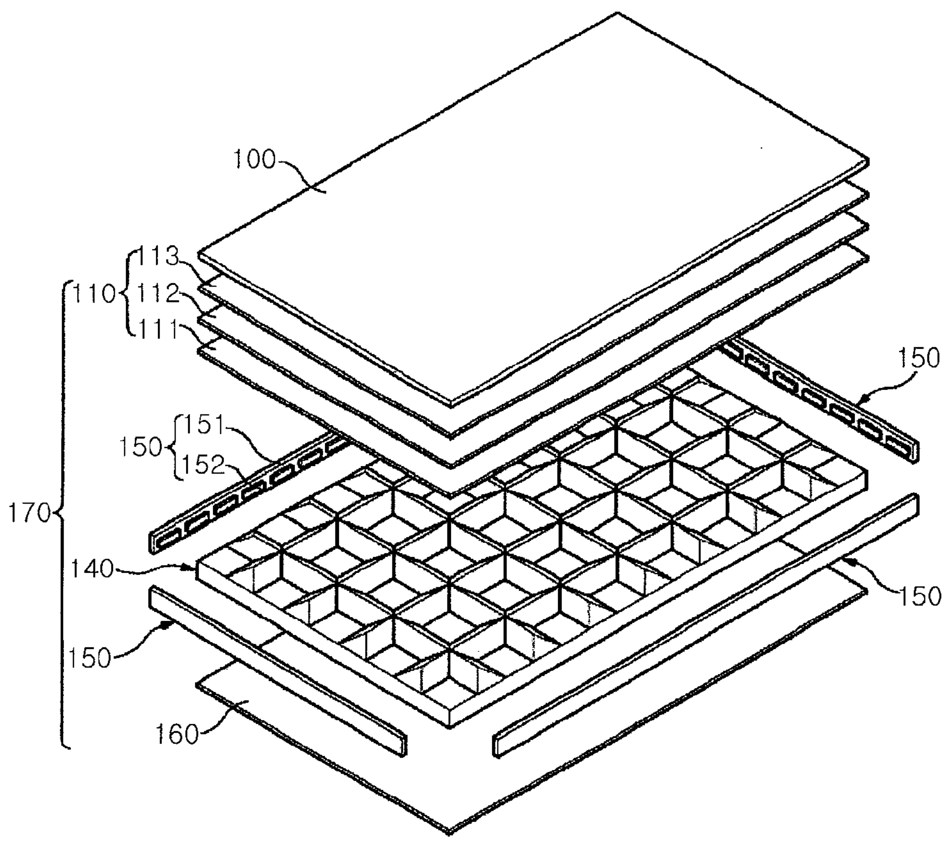

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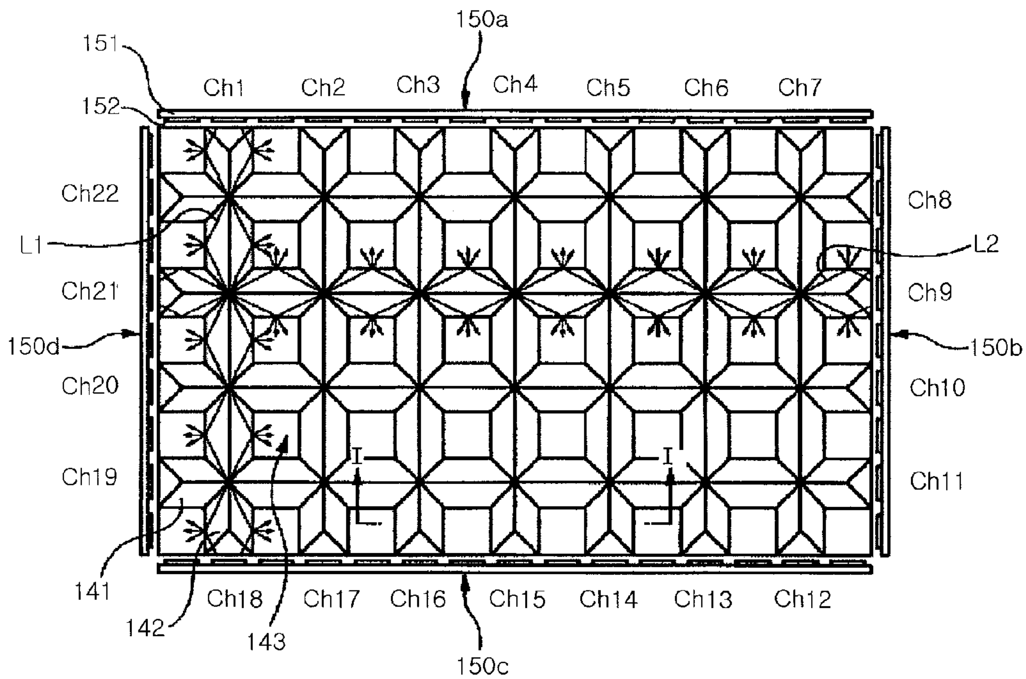

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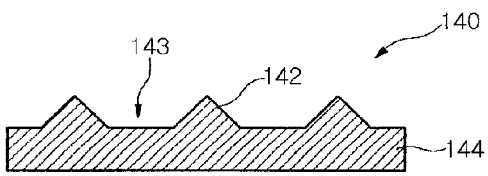
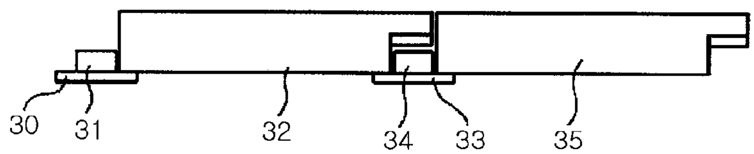
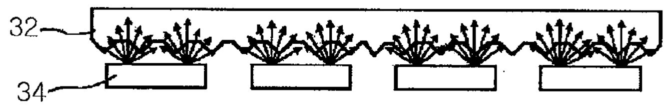


【Figure 29】

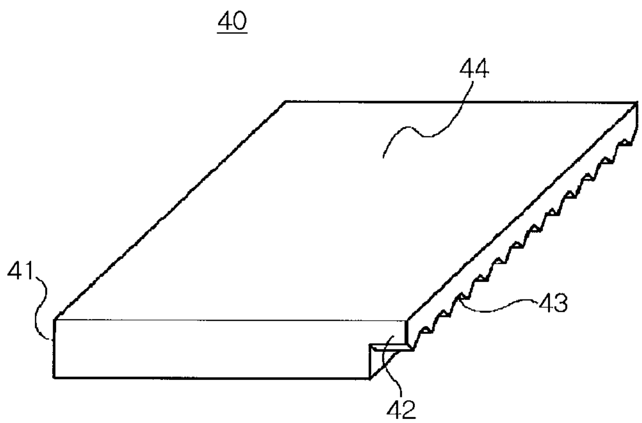
(a)



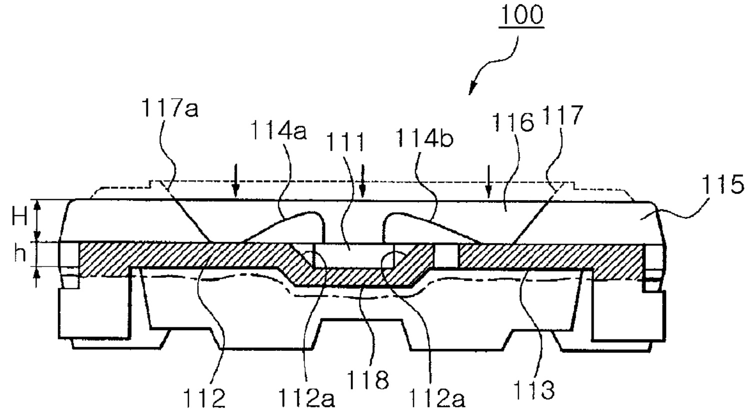
(b)



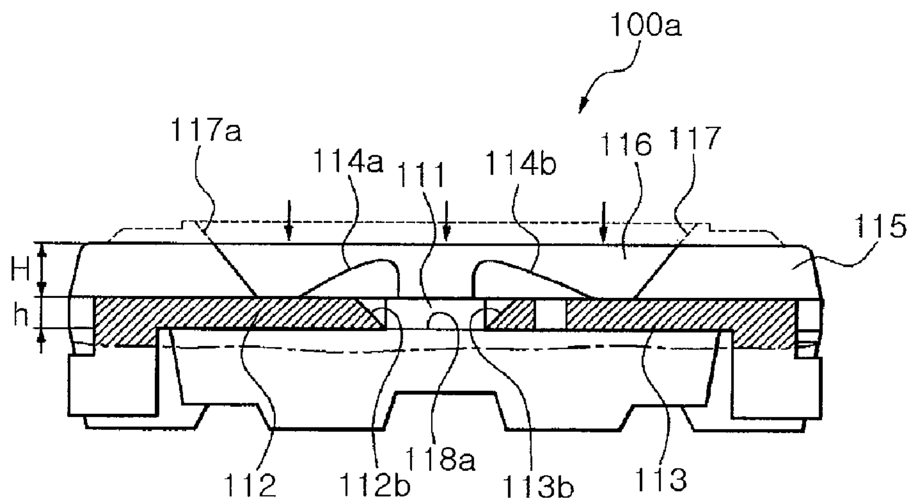
【Figure 30】



【Figure 31】

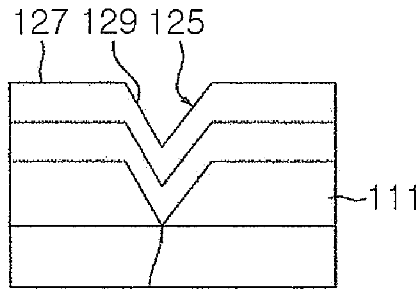


【Figure 32】

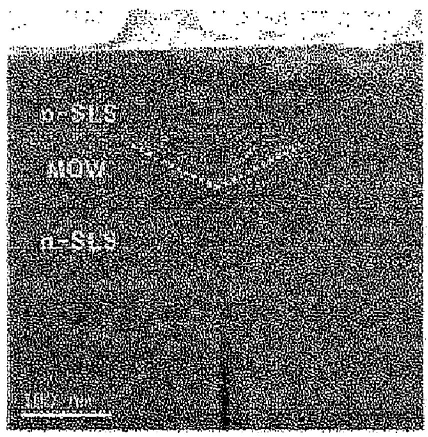


【Figure 33】

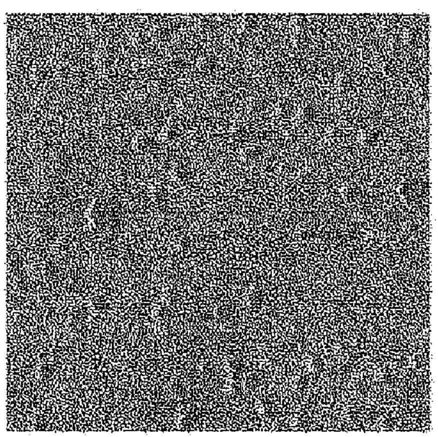
(a)



(b)

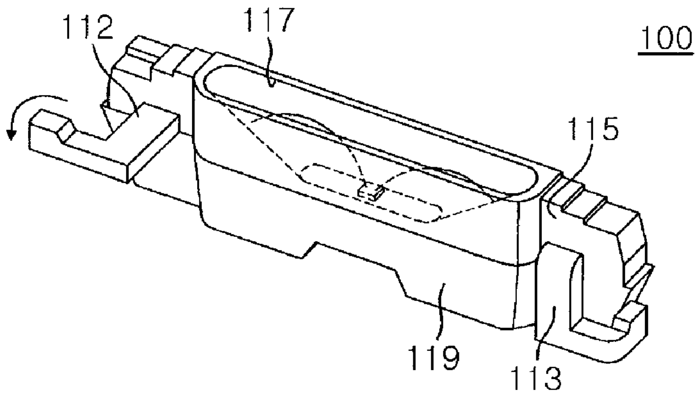


(c)

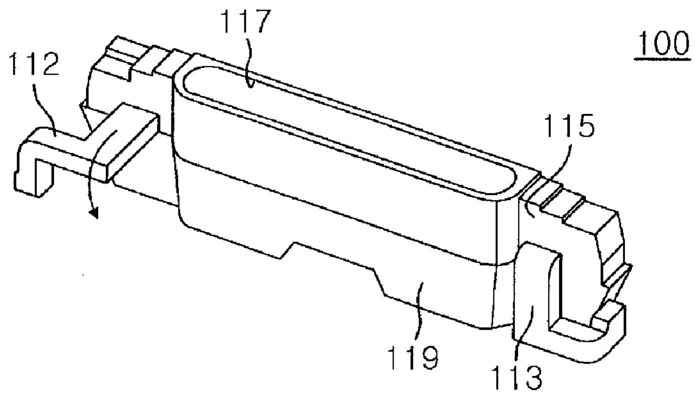


【Figure 34】

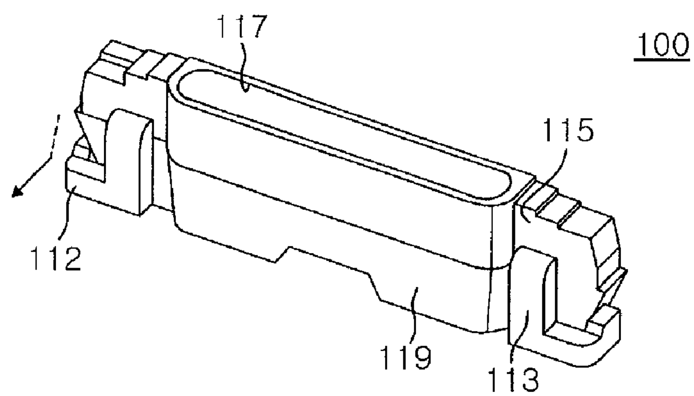
(a)



(b)



(c)



BACKLIGHT UNIT FOR LIQUID CRYSTAL DISPLAY DEVICE

TECHNICAL FIELD

[0001] The present invention relates to a backlight unit for liquid crystal display (LCD) devices, which employs a light emitting diode (LED) and a lightguide plate, and more particularly, to a backlight unit for LCD devices capable of performing local dimming in a side-view type.

BACKGROUND ART

[0002] Liquid crystal display (LCD) devices are commonly used in TVs, monitors and the like according to the recent tendency toward thinner image display devices with higher performances. A liquid crystal panel itself is unable to emit light. Therefore, the LCD needs a backlight unit. A cold cathode fluorescent lamp (CCFL), which is cheap and easy to assemble, has been mainly used as a light source of LCD backlight units.

[0003] However, in the backlight units employing CCFLs, it is difficult to implement local driving such as local dimming or impulsive driving, and they have limitations such as environmental contamination by mercury and slow response times. To overcome such limitations, a light emitting diode (LED), instead of a CCFL, is proposed as the light source of the backlight unit.

[0004] The liquid crystal panel of an LCD device is divided into a plurality of regions, and the luminance value of the light source of the backlight unit can be regulated for each divided region according to the gray level of each divided region. This type of backlight unit driving is called local dimming. That is, in local dimming, the LEDs in a region of the backlight unit corresponding to a bright part of an image may be turned ON, while the LEDs corresponding to the rest of the image may be turned ON with a low luminance level or completely turned OFF. Impulsive driving is a driving method of temporally synchronizing the backlight unit with a liquid crystal panel. According to impulsive driving, a plurality of light sources regions arranged on the backlight unit are sequentially turned ON.

[0005] Backlight units are generally categorized into direct type backlight units and edge type backlight units (i.e., a side-view type). In the edge type backlight unit, a bar-shaped light source is placed at an edge of a liquid crystal panel and emits light toward the liquid crystal panel via a lightguide plate. In contrast, in the direct type backlight unit, a planar light source placed under the liquid crystal panel emits light directly to the liquid crystal panel.

[0006] FIG. **1** is a perspective view of a related art edge type backlight unit employing LEDs. Referring to FIG. **1**, a backlight unit **10** includes a lightguide plate **11**, LED light source parts **15** and **17** disposed at edges of the lightguide plate **11**, and a reflective plate **19** disposed under the lightguide plate **11**. Each of the LED light source parts **15** and **17** includes a printed circuit board (PCB) **17** and a plurality of LEDs **15** arranged on the substrate **17**. Light incident to the lightguide plate **11** from the LEDs **15** is sent from the lightguide plate **11** to the liquid crystal panel through total internal reflection, scattering and the like.

[0007] The edge type backlight unit **10** is suitable for a backlight of a relatively small size of, e.g. 17 inches or less because it may be manufactured with a relatively small thickness. However, the edge type backlight unit **10**, when applied to a midsize and large LCD backlight light source of 40 to 70 inches or larger, does not ensure sufficient luminance of the backlight and degrades luminance uniformity. Also, the edge type backlight unit **10** is inadequate for local driving such as local dimming, and for liquid crystal panels having a relatively large area.

[0008] FIG. **2** is a perspective view of a related art direct type backlight unit employing LEDs. Referring to FIG. **2**, a backlight unit **20** includes a PCB **21**, and a plurality of LEDs **23** arranged thereon. A diffusion plate **25** for light scattering is disposed between a liquid crystal panel (not shown) and the LEDs **23**. The LEDs **23** emit light directly to the liquid crystal panel. The direct type backlight unit **20** may realize local driving such as local dimming. For the realization of local dimming, the LEDs **23** may be individually controlled to be turned ON/OFF, or the backlight unit may be divided into predetermined regions (e.g., region A**1**, region A**2**, and region A**3**) and LEDs may be driven by each region.

[0009] However, the individual driving of the LEDs **23** results in limitations such as high power consumption, costs incurred by a heat dissipation structure to cope with high temperatures, and the complexity of their circuits. Driving by each area brings about a difficulty in area segmentation, and a relatively small local-dimming effect caused by the height H of the backlight unit. Particularly, to ensure the uniformity of light, the direct type backlight unit needs to have a sufficient thickness H corresponding to the optical thickness. This makes it difficult to achieve sliminess of the backlight unit and thus of the LCD device.

DISCLOSURE

Technical Problem

[0010] An aspect of the present invention provides a backlight unit for an LCD device, which is contributive to manufacturing thinner and larger products by being configured as an edge type, and can perform local dimming effectively.

Technical Solution

[0011] According to an aspect of the present invention, there is provided a backlight unit for a liquid crystal display (LCD) device, disposed under a liquid crystal panel and emitting light to a liquid crystal panel, the backlight unit including; a lightguide plate; a light emitting diode (LED) array disposed at an edge of the lightguide plate and including a plurality of LED blocks each including at least one LED emitting white light; and a controller controlling a current signal applied to each of the plurality of LED blocks to regulate the luminance of each LED block.

[0012] The lightguide plate may have at least one separation structure controlling light propagation therein.

[0013] The separation structure may be disposed in at least one of vertical and horizontal directions with respect to the lightguide plate.

[0014] The separation structure may be at least one of an LED array structure and a reflective layer mounted on a circuit board and inserted linearly between the lightguide plates.

[0015] The separation structure may be an uneven part formed at a boundary between regions divided by the separation structure.

[0016] The LED array may include a first LED array and a second LED array that are disposed at one edge and the other edge perpendicular to the one edge of the lightguide plate, respectively.

[0017] Light emitted from the first LED may overlap light emitted from the second LED array in the lightguide plate.

[0018] The backlight unit may further include a third LED array and a fourth LED array respectively facing the first LED array and the second LED array with the lightguide plate therebetween and having the same configurations as the first and second LED arrays, respectively.

[0019] The LED array may include a first LED array and a second LED array disposed at one edge and the other edge facing the one edge of the lightguide plate, respectively.

[0020] The LED block may include a red LED, a green LED, and a blue LED to be used as a light emitting unit for an LCD TV and the like. Alternatively, the LED block may include a white LED using a blue or UV LED and a fluorescent material.

[0021] The controller may include an LED block driving a controller and a panel image signal transmitter.

[0022] The panel image signal transmitter may include a panel information transfer circuit and a panel information combination circuit.

[0023] The backlight unit may further include a reflective plate disposed under the lightguide plate.

[0024] The backlight unit may further include an optical sheet disposed on the lightguide plate.

[0025] The LED may emit white light by at least one fluorescent material.

Advantageous Effects

[0026] As described above, according to the present invention, a backlight unit for an LCD device can be provided that is contributive to manufacturing thinner and larger products and can perform effective local dimming by using LEDs disposed at an edge of a lightguide plate.

DESCRIPTION OF DRAWINGS

[0027] FIG. **1** is a perspective view of a related art edge type backlight unit.

[0028] FIG. **2** is a cross-sectional view of a related art direct type backlight unit.

[0029] FIG. **3** is an exploded cross-sectional view of a backlight unit according to an exemplary embodiment of the present invention.

[0030] FIG. **4** is a top plan view of a lightguide plate and a light emitting diode (LED) array of FIG. **3**.

[0031] FIG. **5** is a top plan view of a lightguide plate and an LED array according to a modified embodiment of the embodiment of FIG. **4**.

[0032] FIG. **6** illustrates the backlight unit of FIG. **3** to explain the principle of local dimming.

[0033] FIG. **7** is a schematic view of a controller controlling the luminance of each LED block in the backlight unit according to the embodiment of FIG. **3**.

[0034] FIG. **8** is a top plan view of a lightguide plate applicable to an exemplary embodiment of the present invention.

[0035] FIG. **9** illustrates an exemplary embodiment for the lightguide plate of FIG. **8**.

[0036] FIG. **10** is a perspective view of a portion of a backlight unit according to an exemplary embodiment of the present invention.

[0037] FIG. **11** is a cross-sectional view of the backlight unit of FIG. **10**.

[0038] FIG. **12** is a cross-sectional view of a backlight unit according to a modified embodiment of the embodiment of FIG. **10**.

[0039] FIG. **13** is a perspective view of a fixing member of a backlight unit according to a modified embodiment of the embodiment of FIG. **10**.

[0040] FIG. **14** is a perspective view of a backlight unit according to an exemplary embodiment of the present invention.

[0041] FIG. **15** is a cross-sectional view of a portion of the backlight unit of FIG. **14**.

[0042] FIGS. **16** through **19** are views illustrating a variety of shapes of a receiving groove provided in a lightguide plate according to an exemplary embodiment of the present invention.

[0043] FIG. **20** is a graph showing the luminance distribution according to a distance between two spots on a lightguide plate according to the present invention.

[0044] FIG. **21** is a perspective view of a backlight unit according to an exemplary embodiment of the present invention.

[0045] FIG. **22** is a cross-sectional view taken along line I-I? of FIG. **21**.

[0046] FIG. **23** is a cross-sectional view of a backlight unit according to a modified embodiment of the embodiment of FIG. **21**.

[0047] FIGS. **24** and **25** are cross sectional views of a fixing member according to exemplary embodiments of the present invention.

[0048] FIG. **26** is a perspective view of an LCD device according to an exemplary embodiment of the present invention.

[0049] FIG. **27** is a plan view of a backlight unit of FIG. **26**.

[0050] FIG. **28** is a cross-sectional view of FIG. **26**.

[0051] FIG. **29** is a schematic perspective view for explaining a backlight unit according to an exemplary embodiment of the present invention.

[0052] FIG. **30** is a schematic perspective view for explaining a planar lightguide plate of FIG. **29**.

[0053] FIG. **31** illustrates a white LED using a fluorescent material according to the present invention.

[0054] FIG. **32** is a cross-sectional view of an LED package according to a modified embodiment of the embodiment of FIG. **31**.

[0055] FIG. **33** illustrates a V-shaped distortion structure formed in an LED layer employed in the present invention, wherein (a) is a cross-sectional view, (b) is a sectional photographic image, and (c) is a plan photographic image.

[0056] (a) through (c) of FIG. **34** are schematic views illustrating the process of forming an external lead frame of the LED package of FIG. **32**.

Best Mode

[0057] The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art. In the drawings, the thicknesses of layers and regions are exaggerated for clarity. Like reference numerals in the drawings denote like elements, and thus their description will be omitted.

[0058] FIG. **3** is an exploded cross-sectional view of a backlight unit according to an exemplary embodiment of the present invention. FIG. **4** is a top plan view of a lightguide plate and a light emitting diode (LED) array of FIG. **3**. FIG. **5** is a top plan view of a lightguide plate and an LED array according to a modified embodiment of the embodiment of FIG. **4**.

[0059] Referring to FIG. **3**, the backlight unit according to this embodiment emits light toward a liquid crystal panel **150** disposed above the backlight unit. The backlight unit includes a plurality of LED arrays **110**, a lightguide plate **120**, a lower chassis **130**, an optical sheet **140**, and controllers C**1** and C**2**. In this case, the controllers include an LED block driving controller C**1** and a panel image signal transmitter C**2**, and this will be described in more detail with reference to FIG. **7**.

[0060] The lower chassis **130** is commonly formed of a metallic material for the purpose of heat dissipation or the like. The lower chassis **130** accommodates therein other elements constituting the backlight unit, such as a printed circuit board (PCB) where LED chips are mounted, and the lightguide plate **120**.

[0061] The light guide plate **120** is formed of a transparent material to transmit light emitted from the LED array **110**. In general, the lightguide plate **120** may have a hexahedral shape although it is not limited thereto. The lightguide plate **120** evenly scatters light emitted from its edge, thereby maintaining the uniformity of the luminance and colors of the liquid crystal panel **150**. The lightguide plate **120** also guides incident light to travel uniformly straight.

[0062] Although not essential in the present invention, an optical sheet **140** may be provided on the lightguide plate **120**. The optical sheet **140** serves to improve luminance by including a diffusion sheet or a prism sheet that is selectively stacked. Here, the diffusion sheet serves to diffuse light emitted to the liquid crystal panel **150** in multiple directions, and the prism sheet serves to concentrate light within a front viewing angle.

[0063] If necessary, a reflective plate (not shown) may be additionally disposed between the lightguide plate **120** and the lower chassis **130**.

[0064] The disposition of the lightguide plate **120** and the LED arrays **110** according to this embodiment will now be described in detail with reference to FIG. **4**. The LED arrays **110**, including a plurality of LED blocks Bh and Bv, are disposed at the four edges of the lightguide plate **120**, respectively.

[0065] In this case, light emitted from LED arrays, which are perpendicular to each other among the four LED array **110** disposed at the respective edges of the lightguide plate **120**, may overlap at the lightguide plate **120**. According to this embodiment, the LED arrays **110**, divided into LED blocks Bh and Bv, allow luminance control within each LED block. Thus, the lightguide plate may be understood as being virtually partitioned into regions corresponding to the divided blocks as indicated by dotted lines.

[0066] In more detail, each of the LED blocks Bh and By includes at least one LED chip **111**, and the luminance of each LED block included in the LED array **110** may be controlled by a different current injection signal. In the drawing of this embodiment the LED block Bh disposed horizontally at the edge of the lightguide plate **120** includes three LEDs, and the LED block By disposed vertically at another edge of the lightguide plate **120** includes two LEDs. However, the number of LEDs in each block is not limited to the illustration or description, and may be selected properly as occasion demands.

[0067] The LED chip **111** in each of the LED blocks Bh and By may emit white light for use as a light supply unit of an LCD TV or the like. Thus, the LED chip **111** may be a white LED that can emit white light in combination with a fluorescent material. Alternatively, according to embodiments, each of the LED blocks Bh and By may include a blue LED, a green LED and a red LED.

[0068] In this case, the white LED employing the fluorescent material, as shown in FIG. **31**, is formed by filling a cavity **117** with light-transmissive, transparent resin **116** containing a fluorescent material to cover a blue LED chip or an ultraviolet (UV) LED chip **111** and metal wires **114***a* and **114***b* for protection against external environments. The light-transmissive, transparent resin may be epoxy, silicon or resin, for example.

[0069] The LED chip **111** is bonded with one set of ends of the pair of metal wires **114***a* and **114***b*. Lead frames **112** and **113** are bonded with the other set of ends of the pair of metal wires **114***a* and **114***b*, respectively.

[0070] A package body **115** is a molded structure formed of a resin through injection-molding to have a cavity **17** with an open top and a closed bottom.

[0071] The cavity **117** includes an upper inclined surface inclined at a predetermined angle. A reflective member **117***a* of a metallic material having high reflectance properties, such as Al, Ag or Ni, may be provided on the upper inclined surface to reflect light generated from the LED chip **111**.

[0072] The package body **115** is molded integrally with the pair of lead frames **112** and **113** for the fixation thereof. A portion of a top surface of an end of each of the lead frames **112** and **113** is exposed to the outside through the bottom of the cavity **117**.

[0073] The other end of each of the lead frames **112** and **113** is exposed to an outer surface of the package body **115** to form a connection with external power.

[0074] A recess **118** may be formed in one **112** of the pair of lead frames **112** and **113**, on which the LED chip **111** is mounted.

[0075] FIG. **32** is a cross-sectional view of an LED package according to a modified embodiment of the embodiment of FIG. **31**.

[0076] Referring to FIG. **32**, an LED package, unlike the embodiment of FIG. **31** including the recess **118**, includes a groove **118***a* between facing ends of the pair of lead frames **112** and **113**. The groove **118***a* is formed to a predetermined depth from a bottom surface of the cavity **117** when the package body **115** is molded. Other elements are identical to those of the embodiment of FIG. **31**.

[0077] The light-transmissive, transparent resin **116** may include a fluorescent material for wavelength conversion. The fluorescent material may be one of YAG-based, TAG-based, silicate-based, sulfide-based and nitride-based fluorescent materials that can convert light generated from the LED chip into white light.

[0078] The YAG-based and TAG-based fluorescent materials may be selected from $(Y, Tb, Lu, Sc, La, Gd, Sm)_3(Al, Ga, In, Si, Fe)_5(O, S)_{12}$: Ce, and the silicate-based fluorescent material may be selected from $(Sr, Ba, Ca, Mg)_2SiO_4$: (Eu, F, Cl). The Sulfide-based fluorescent material may be selected from (Ca,Sr)S: Eu and $(Sr,Ca,Ba)(Al,Ga)_2S_4$: Eu. The nitride-based fluorescent material may be selected from (Sr, Ca, Si, Al, O)N: Eu (e.g., $CaAlSiN_4$: Eu β-SiAlON: Eu) and Ca-α SiAlON: Eu-based fluorescent materials $(Ca_x,M_y)(Si,Al)_{12}(O,N)_{16}$, where M denotes at least one of europium (Eu), terbium (Tb), ytterbium (Yb) and erbium (Er), and x and y meet the conditions of $0.05<(x+y)<0.3$, $0.02<x<0.27$ and $0.03<y<0.3$.

[0079] White light may be obtained by using a yellow (Y) fluorescent material or green (G) and red (R) fluorescent materials, or Y, G and R fluorescent materials in a blue (B) LED chip. The Y, G and R fluorescent materials are excited by the blue LED chip to emit yellow light, green light and red light, respectively. The yellow, green and red light is mixed with a portion of blue light emitted from the blue LED chip, thereby outputting white light.

[0080] The blue LED chip may employ a group-III-nitride semiconductor that is in current use. A substrate of the nitride-based semiconductor may be selected from the group consisting of sapphire, spinel (MgAl204), SiC, Si, ZnO, GaAs, and GaN substrates.

[0081] A buffer layer may be further provided on the substrate. The buffer layer may be formed of one selected from the group consisting of nitride semiconductor-based and carbide-based materials.

[0082] An n-type nitride semiconductor layer is formed on the buffer layer, and the n-type nitride semiconductor layer may include an n-type GaN-based semiconductor layer and an n-type superlattice layer. The n-type nitride semiconductor layer may include an undoped GaN layer; an n-type GaN contact layer; an n-type GaN layer on the n-type GaN contact layer; and an n-type superlattice layer on the n-type GaN layer. The n-type superlattice layer may have a multilayer structure of alternating layers of GaN/InGaN-based materials, AlGaN/GaN-based materials or AlGaN/GaN/InGaN-based materials. An n-type electrode may be further provided on the n-type GaN-based semiconductor layer. A section of the n-type GaN-based semiconductor layer may have a V-shaped distortion structure. The V-shaped distortion structure includes both a flat growth plane and an inclined growth plane.

[0083] FIG. **33** illustrates a V-shaped distortion structure formed in an LED layer employed in the present invention, wherein (a) is a cross-sectional view, (b) is a sectional photographic image, and (c) is a plan photographic image.

[0084] An LED chip **111** is an n-type nitride semiconductor layer. An active layer is formed on the n-type nitride semiconductor layer, and the active layer has at least one quantum well layer. The quantum well layer may be formed of InGaN or GaN. The active layer may further include at least one quantum barrier layer. The quantum barrier layer may be formed of InGaN, GaN or AlGaN. A band gap of the quantum barrier layer is greater than that of the quantum well layer.

[0085] A p-type nitride semiconductor layer is formed on the active layer. The p-type nitride semiconductor layer includes a p-type superlattice layer and a p-type GaN-based semiconductor layer. The p-type superlattice layer may have a multilayer structure of alternating layers of GaN/InGaN-based materials, AlGaN/GaN-based materials or AlGaN/GaN/InGaN-based materials. The p-type nitride semiconductor layer may include a p-type superlattice layer, a p-type GaN layer on the p-type superlattice layer, and a p-type GaN contact layer on the p-type GaN layer.

[0086] A transparent electrode and a bonding electrode may be further provided on the p-type nitride semiconductor layer. The transparent electrode may be an oxide conductive layer having the property of light transmission.

[0087] The V-shaped distortion structure may be formed in succession in at least one of the n-type semiconductor layer, the active layer and the p-type semiconductor layer. The V-shaped distortion structure may be formed around a threading dislocation, increasing resistance in this area. Thus, current leakage caused by a threading dislocation is prevented and damage by electrostatic discharge (ESD) can be reduced. Besides, the V-shaped distortion structure may serve to achieve luminance enhancement by forming an uneven structure at a semiconductor surface. That is, the lattice mismatch between the sapphire substrate and the GaN semiconductor formed on the sapphire substrate causes a threading dislocation. When static electricity is applied thereto, the threading dislocation concentrates the current and thus results in current leakage. For this reason, various studies have been conducted to reduce the threading dislocation causing current leakage and to therefore reduce the damage caused by ESD. According to the present invention, the V-shaped distortion structure is arbitrarily formed around the threading dislocation to increase resistance in the area of the threading dislocation. Accordingly, the current concentration in this area is prevented and ESD resistance can be enhanced. A layer with the V-shaped distortion structure may be formed at a low growth temperature of 600° C. to 900° C. or through chemical etching and regrowth. The blue LED chip completed in the aforesaid manner may be controlled to have a thickness ranging from 50 to 400 by controlling the thickness of a substrate through polishing or etching, for example.

[0088] The red fluorescent material for the output of white light may include a nitride-based fluorescent material containing N (e.g., $CaAlSiN_3$: Eu). The nitride-based red fluorescent material ensures higher reliability in external environments involving heat, moisture or the like, and less chance of discoloration than a sulfide-based fluorescent material. Particularly, high excitation efficiency of the fluorescent material is realized in the dominant wavelength of the blue LED chip defined within the specific range of 430 nm to 465 nm to obtain high color reproducibility. Other nitride-based fluorescent materials such as $Ca_2Si_5N_8$: Eu or sulfide-based fluorescent materials may be used as the red fluorescent material. As for the green fluorescent material, a nitride-based fluorescent materials such as β-SiAlON: Eu or a silicate-based fluorescent material such as $(Ba_x,Sr_y,Mg_z)SiO_4$: Eu^{2+}, F, Cl ($0<x$, $y\leqq 2$, $0\leqq z\leqq 2$, 0 ppm<F, Cl<5000000 ppm) may be used. The nitride-based and silicate-based fluorescent materials have high excitation efficiency within the dominant wavelength range of 430 nm to 465 nm.

[0089] Preferably, the full width at half maximum (FWHM) of the blue LED chip ranges from 10 nm to 50 nm, the FWHM of the green fluorescent material ranges from 30 nm to 150 nm, and the FWHM of the red fluorescent material ranges from about 50 nm to 200 nm. As each light source has the FWHM ranges as above, white light with higher color uniformity and color quality is obtained. Particularly, by limiting the dominant wavelength and the FWHM of the blue LED chip to 430 to 465 nm and 10 to 50 nm respectively, the efficiency of the $CaAlSiN_3$: Eu-based red fluorescent material and the efficiency of the β-SiAlON: Eu-based or $(Ba_x,Sr_y,Mg_z)SiO_4$: Eu , F, Cl ($0<x$, $y\leqq 2$, $0\leqq z\leqq 2$, 0 ppm≦F, Cl≦5000000 ppm)-based green fluorescent material can be

significantly enhanced. The blue LED chip may be replaced with an UV LED chip having a dominant wavelength in the range of 380 nm to 430 nm. In this case, to output white light, the light-transmissive, transparent resin **116** may include, at the least, blue, green and red fluorescent materials. The blue fluorescent material may be selected from the group consisting of (Ba, Sr, Ca)$_5$(PO$_4$)$_3$Cl: (Eu^{2+}, Mn^{2+}) and Y_2O_3: (Bi^{3+}, Eu^{2+}), and the green and red fluorescent materials may be selected from the group consisting of the YAG-based, TAG-based, silicate-based, sulfide-based and nitride-based fluorescent materials.

[0090] A white LED for emitting white light may be obtained without using a fluorescent material. For example, a second quantum well layer emitting light with a different wavelength (e.g., yellow light) from that of blue light may be further provided on and/or under a first quantum well layer of a nitride-based InGaN and/or GaN emitting blue light to obtain an LED chip emitting white light through combination with blue light. The quantum well layer may have a multi-quantum well structure, and the first and second quantum well layers may be formed by controlling the amount of In in the InGaN forming the well layers. If the first quantum well layer emits UV light of the wavelength ranging from 380 nm to 430 nm, the amount of In in the active layer may be controlled such that the second quantum well layer emits blue light and a third quantum well layer emits yellow light.

[0091] The recess **118** is the recessed top surface of the lead frame **112** and **113** exposed in the bottom of the cavity **117** and has a predetermined depth.

[0092] The recess **118** is provided as a downwardly curved portion in one end portion of the lead frame **112** on which at least one LED chip **111** is mounted. The curved portion includes a mounting surface on which the LED chip **111** is mounted, and a pair of lower inclined surfaces **112***a* and **112***a* respectively extending upwardly from both sides of the mounting surface, inclined at a predetermined angle and facing outer surfaces of the LED chip **111**.

[0093] A reflective member may be provided at the lower inclined surfaces **112***a* and **112***a* to reflect light generated when the LED chip **111** emits light.

[0094] The adequate depth H of the recess **118** or the groove **118***a* ranges from 50 μm to 400 μm in due consideration of the height h of the LED chip **111** mounted therein. Accordingly, the height H of the cavity of the package body can be lowered to between 150 μm and 500 μm, and the amount of light-transmissive, transparent resin filling the cavity is decreased, thereby saving on manufacturing costs, enhancing light luminance and contributing to the miniaturization of a product.

[0095] Respective end portions of the lead frames **112** and **113** facing outer surfaces of the LED chip **111** mounted in the groove **118***a* may include lower inclined surfaces **112***b* and **113***b* on which reflective members are respectively provided to reflect the light generated when the LED chip **111** emits light.

[0096] In the LED packages **100** and **100***a* having the above configurations, the top surface of the LED chip **111** located at the very center of the cavity **117** may be roughly flush with the top surfaces of the lead frames **112** and **113** because the LED chip **111** is mounted on the mounting surface of the downwardly curved portion of the lead frame **112** or in the groove **118***a* between facing end portions of the lead frames **112** and **113**. Here, the top surface of the LED chip **11** is wire-bonded with the lead frames **112** and **113** through metal wires **114***a* and **114***b*, respectively.

[0097] In this case, the maximum heights of the metal wires **114***a* and **114***b* used for the wire bonding with the LED chip **111** can be decreased by the lowered mounting height of the LED chip **111**.

[0098] Accordingly, the amount of light-transmissive, transparent resin **116** filling the cavity **117** to protect the LED chip **111** and the metal wires **114***a* and **114***b* can be reduced, while the height H to which the light-transmissive, transparent resin is filled can be lowered by the lowered mounting height of the LED chip **111**. Consequently, the luminance of light from the LED chip can be relatively increased as compared to the related art.

[0099] As the height H of the light-transmissive, transparent resin **116** in the cavity **117** is lowered, the height of the package body **115** is lowered by the lowered height H of the light-transmissive, transparent resin **116**. Accordingly, the entire package size can be minimized.

[0100] (a) through (c) of FIG. **34** are schematic views illustrating the process of forming an external lead frame in the LED package of FIG. **32**.

[0101] Referring to (a) through (c) of FIG. **34**, cathode and anode lead frames **112** and **113** each are integrally fixed to the package body **115** and have an end portion exposed to an outer surface of the package body **115** to be connected to external power (see (a) of FIG. **6**).

[0102] The lead frames **112** and **113** exposed on the downwards part of the package body **115** are each bent along a side surface and/or a lower surface of the package, thus being bent in an opposite direction to the light emitting side where the cavity **117** is formed.

[0103] In the package **100** of the present invention, the lead frames **112** and **113**, downwardly exposed to the outside of the package, are each bent to a side portion and/or a back portion (rear or lower portion) of a mounting surface **119** (i.e., the bottom) of the package.

[0104] In the forming process, an end portion of the lead frame **112** exposed to the bottom of the package is bent first to correspond to the shape of the side surface of the package **100** (see (b) of FIG. **34**), and then bent backwardly of the bottom **119** of the package, thereby completing the entire shape of the lead frame **122** (see (c) of FIG. **34**).

[0105] As described above, light emitted from the horizontal LED block Bh overlaps light emitted from the vertical LED block Bv. In this case, the light can travel uniformly straight. Because of the overlap of light emitted from the horizontal and vertical LED blocks Bh and By, the backlight unit according to this embodiment can realize local dimming even as the edge type.

[0106] This will now be described with reference to FIG. **6**. FIG. **6** is a view for explaining the principle of local dimming in the backlight unit according to the embodiment of FIG. **3**.

[0107] FIG. **6**(*a*) illustrates the case that two LED arrays are disposed horizontally and vertically at edges of a lightguide plate, respectively, and each LED array has two LED blocks. The lightguide plate, as shown in FIG. **6**(*a*), may be divided into four regions for luminance control, assuming that, regardless of the number of LED chips of each LED block, each LED block has two operation modes of a mode (0) where no light is substantially emitted (hereinafter, referred to as light non-emission mode (0)? and light emission mode (1), and light from the LED blocks travels uniformly straight.

[0108] For example, if one of the two horizontal LED blocks and one of the two vertical LED blocks are made to emit light, the relative luminance values of the four regions of the lightguide plate may be 1/2, 0, 1(1/2+1/2) and 1/2.

[0109] This will now be described with reference to FIG. **6**B in more detail.

[0110] FIG. **6**B illustrates the case that four LED arrays are disposed at the edges of the lightguide plate respectively, i.e., two in a horizontal direction and two in a vertical direction. The two LED arrays disposed in each direction face each other across the lightguide plate. Each of the LED arrays has three LED blocks. Unlike FIG. **6**A, each of the LED blocks may operate in three operational modes: a light non-emission mode (0), a light emission mode (1), and an intermediate light emission mode (1/2).

[0111] Accordingly, if the four LED arrays have the operational modes shown in FIG. **6**(*b*), the lightguide plate is divided into nine driving regions. The relative luminance values of the respective nine driving regions correspond to 1/2(1/3+1/6), 1/3(1/6+1/6), 2/3(1/6+1/6+1/3), 2/3(1/3+1/3), 1/2(1/3+1/6), 5/6(1/3+1/6+1/3), 2/3(1/3+1/6), 1/3(1/6+1/6), and 2/3(1/3+1/6+1/6).

[0112] The backlight unit according to this embodiment can regulate the luminance of the individual LED blocks included in the LED arrays disposed at the edges of the lightguide plate, thereby enabling local dimming. Particularly, the number of regions driven separately is determined according to the LED blocks. Luminance levels can be variously regulated according to the number of cases of operational modes involving light emissions, and the number of LED arrays (two or four LED arrays). Local dimming can be more finely regulated with greater numbers of operational modes and LED arrays.

[0113] Accordingly, besides the configuration illustrated in FIG. **4**, the configuration as shown in FIG. **5** may also be allowed in which only two LED arrays **110** are perpendicularly disposed at the edges of the lightguide plate **120**.

[0114] As in this embodiment, the number of regions that are individually driven for local dimming may be the same in both horizontal and vertical directions (a square) or different in horizontal and vertical directions (a rectangle).

[0115] Although varied according to embodiments, a 40 inch liquid crystal panel divided into as many as 64 (8×8) individually driven regions, a 46 inch liquid crystal panel divided into as many as 80 (10×8) regions and a liquid crystal panel of 52 inches divided into as many as 96 (12×8) regions may be driven.

[0116] As described above, the backlight unit according to this embodiment is characterized in that the luminance value is regulated by each LED block. This may be executed by regulating the magnitude of a current signal injected into the LED block. This will now be described with reference to FIG. **7**.

[0117] FIG. **7** is a schematic view illustrating a controller for regulating the luminance of each LED block in the backlight unit according to the embodiment of FIG. **3**.

[0118] A panel image signal transmitter (indicated by C**2** in FIG. **3**) includes panel information transfer circuits **160** and **161**, and a panel information combination circuit **162**. The panel information transfer circuits **160** and **161** receive image signals for each of the individually driven regions of the liquid crystal panel **150**. In this case, the panel image signal transmitter includes a vertical control unit **160** and a horizontal control unit **161**. The image signals received correspond to R, G and B color driving signals and an aperture ratio of a panel (i.e., a variation in the slope of a liquid crystal) according to an electrical signal applied to the liquid crystal panel.

[0119] The image signals are collected at the panel information combination circuit **162** in a matrix in vertical columns and horizontal rows. From the collected image signals, the output power of each of the LED blocks Bh and Bv, as indicated by arrows in FIG. **7** (only one LED block in each of vertical and horizontal directions is indicated), is determined via the LED block driving controller (indicated by C**1** in FIG. **3**).

[0120] In this case, the detailed circuit configuration of the panel image signal transmitter and the LED block driving controller constituting the controllers may employ a known circuit configuration that connects the LED with the liquid crystal panel.

[0121] FIG. **7** illustrates, for convenience of description, 4-by-4 individually driven regions, that is, 16 LED blocks Bh and Bv are controlled. However, corresponding numbers of transfer circuits and combination circuits are needed to control all the individually driven regions.

[0122] FIG. **8** is a top plan view of a lightguide plate applicable to an exemplary embodiment of the present invention. FIG. **9** illustrates a lightguide plate applicable to the embodiment of FIG. **8**, according to an exemplary embodiment of the present invention.

[0123] As shown in FIG. **8**, a lightguide plate **820** according to this embodiment has four optically distinguishable regions, which are different from the virtual individually driven regions of the lightguide plate of the embodiment of FIG. **3**. The optically distinguishable regions of the lightguide plate of this embodiment correspond to regions that are physically (i.e., optically) divided regions.

[0124] The lightguide plate **820** is divided into four regions by a separation structure D, which is arranged horizontally and vertically in the lightguide plate to thereby block light propagation. Thus, the respective regions of the lightguide plate **820** divided by the separation structure D can be individually driven without interference therebetween. As this lightguide plate **820** is combined with the individual control by each LED block described above, local dimming can be more effectively performed.

[0125] In different embodiments, the separation structure may be configured as a reflective structure of a material with high light reflectivity, or as an uneven structure B formed by indenting a boundary of each separated region as shown in FIG. **9**. The lightguide plate **820** itself may have a separated structure.

[0126] As described above, the backlight unit according to the exemplary embodiments of the present invention does not have to be thick (i.e., light is sent to the liquid crystal panel via the lightguide plate in the present invention). Thus, the backlight unit of the present invention may have a thin thickness while enabling local driving. Accordingly, the effects of local driving (e.g., a high contrast ratio and high image quality) can be sufficiently realized, and a slim product can be obtained.

[0127] Hereinafter, various exemplary embodiments according to different aspects of the present invention will now be described. Although not illustrated, backlight units according to the following embodiments may be used together with the structures used in the edge type backlight unit capable of local dimming according to the embodiments of FIGS. **3** through **9**.

[0128] FIG. **10** is a perspective view illustrating a portion of a backlight unit according to an exemplary embodiment of the present invention. FIG. **11** is a cross-sectional view of the backlight unit of FIG. **10**. The backlight unit according to an exemplary embodiment of the present invention includes a plurality of separate lightguide plates, but only first and second lightguide plates are illustrated for convenience of description.

[0129] Referring to FIGS. **10** and **11**, the backlight unit includes a bottom case **110**, a lightguide plate **120**, a light source unit **130**, and a fixing member **140**.

[0130] The bottom case **110** has a receiving space. For example, the receiving space may be formed by the bottom surface of the bottom case **110**, and a sidewall bent from the edge of the bottom surface.

[0131] The lightguide plate **120** includes a plurality of separate lightguide plates **120**. The plurality of separate lightguide plates **120** are disposed in parallel within the receiving space of the bottom case **110**.

[0132] In the drawing, the lightguide plate **120** is in a quadrangular form. However, the light guide plat **120** is not limited to the shape described in the drawings, and may have a variety of shapes such as a triangle or a hexagon.

[0133] The light source unit **130** providing light to the lightguide plate **120** is disposed at one edge of each lightguide plate **120**. Each light source unit **130** may include a light source **131** providing light, and a printed circuit board **132** including a plurality of circuit patterns for applying a driving voltage to the light source **131**.

[0134] An example of the light source **131** may include a light emitting diode (LED) that emits light when a current is applied thereto. The LED may have a variety of configurations. For example, the LED may include a plurality of sub-LEDs respectively implementing green, blue and red colors. White light can be realized by mixing blue, green and red light emitted from the sub-LEDs. Alternatively, the LED may include at least one of blue and UV LEDs or a fluorescent material that converts a portion of blue light emitted from the LED into yellow light. In this case, white light can be implemented as the blue and yellow light is mixed. White light may be also realized by mixing blue and green light, yellow and red light, or blue and yellow light. Alternatively, white light may be realized by converting UV light into blue, green, yellow and red light, or blue, green and red light. As to the construction for white light, the light-transmissive, transparent resin **116** may include, as described above, a fluorescent material, one wave conversion material among YAG-based, TAG-based, silicate-based, and nitride-based materials that can convert light generated from the LED chip into white light.

[0135] The FWHM of a blue LED chip ranges from about 10 nm to 50 nm, the FWHM of a blue fluorescent material ranges from about 30 nm to 150 nm, and the FWHM of a red fluorescent material ranges from about 50 nm to 200 nm. As each light source has the above FWHM, white light with better color uniformity and color quality is obtained. Particularly, the dominant wavelength and the FWHM of the blue LED chip are limited to 430 nm to 465 nm and to 10 nm to 50 nm, respectively, thereby significantly improving the efficiency of a $CaAlSiN_3$: Eu-based red florescent material, and the efficiency of a β-SiAlON: Eu-based or $(Ba_x,Sr_y,Mg_z)SiO_4$: Eu^{2+}, F, Cl ($0<x$, $y\leqq 2$, $0\leqq x\leqq 2$, 0 ppm$\leqq$F, Cl$\leqq$5000000 ppm)-based green fluorescent material. The blue LED chip may be substituted with a UV LED chip having a dominant wavelength ranging from 380 nm to 430 nm. In this case, to output white light, the light-transmissive, transparent resin **116** may include at least blue, green and red fluorescent materials. The blue fluorescent material may be selected from $(Ba, Sr, Ca)_5(PO_4)_3Cl$: (Eu^{2+}, Mn^{2+}) and Y_2O_3: (Bi^{3+}, Eu^{2+}) materials. The green and red fluorescent materials may be selected from the YAG-based, TAG-based, silicate-based, sulfide-based and nitride-based materials.

[0136] Light from the light source unit **130** is made incident onto the edge of the lightguide plate **120**, and then emitted upwardly by total internal reflection in the lightguide plate **120**.

[0137] The fixing member **140** is disposed between the separate lightguide plates **120** to prevent the separate lightguide plates **120** from moving.

[0138] The fixing member **140** includes an insertion portion **141** and a head portion **142** connected with the insertion portion **141**.

[0139] The insertion portion **141** is inserted between the separate lightguide plates **120**, thereby preventing the separate lightguide plates **120** from moving from side to side. That is, the insertion portion **141** is inserted between neighboring first and second lightguide plates **120***a* and **120***b* among the separate lightguide plates **120**. The insertion portion **141** has first and second inclined surfaces **141***a* and **141***b* extending from its end toward both sides and connected with the head portion **142**. That is, the section of the insertion portion **141** may have a triangular shape. Thus, the insertion portion **141** may be easily inserted between the separate lightguide plates **120**.

[0140] The head portion **142** has a larger area than the insertion portion **141**. The head portion **142** has a width greater than an interval between the neighboring lightguide plates. The head portion **142** is disposed at top edges of the separate lightguide plates **120**. That is, the head portion **142** is placed over the top edges of the facing lightguide plates **120** with the insertion portion **141** interposed between, thereby preventing the fixing member **140** from slipping out from between the separate lightguide plates **120**. Also, the head portion **142** presses downwards on the separate lightguide plates **120**, thereby preventing the separate lightguide plates **120** from moving up and down.

[0141] The fixing member including the insertion portion **141** and the head portion **142** is disposed between the separate lightguide plates **120**, thereby preventing the separate lightguide plates **120** from moving up and down or side to side.

[0142] The fixing member **140** may have a stripe shape crossing the bottom case **110** or a lattice shape surrounding an edge of each lightguide plate **120**.

[0143] The fixing member **140** may be formed of a light transmissive material, for example, transparent plastic, in order to minimize the influence on image quality. The fixing member **140** may contain a reflective material, e.g., TiO_2, for guide light leaking between the lightguide plates **120** toward a corresponding one of the lightguide plates **120**.

[0144] A reflective member **150** may be further disposed under each of the lightguide plates **120**. The reflective member **150** reflects light traveling downwardly of the lightguide plate **120** back towards the lightguide plate **120**, so that the optical efficiency of the backlight unit is improved.

[0145] The backlight unit may further include an optical member **160** supported by the fixing member **140** and disposed on the lightguide plate **120**. Examples of the optical member **160** may include a diffusion plate, a diffusion sheet, a prism sheet, and a protective sheet disposed on the lightguide plate **140**. The optical member **160** is spaced apart from the lightguide plate **120** at a predetermined interval by the fixing member **140**. Thus, the lightguide plate **120** can provide light uniformly to the optical member **160**.

[0146] In the backlight unit including the plurality of separate lightguide plates for local dimming according to the embodiment of the present invention, the fixing member for preventing the separate lightguide plate from moving can prevent defects caused by the movement of the lightguide plate from occurring.

[0147] FIG. **12** is a cross-sectional view of a backlight unit according to a modified embodiment of the embodiment of FIG. **10**.

[0148] The configuration of this embodiment is identical to the backlight unit of FIG. **10**, except for a reflective layer. Thus, in this embodiment, the identical reference numerals are used for the same elements as in the embodiment of FIG. **10**, and a repetition of the description will be omitted.

[0149] Referring to FIG. **12**, the backlight unit according to this embodiment of the present invention includes a bottom case **110**, a plurality of separate lightguide plates **120**, a light source unit **130** and a fixing member **140**.

[0150] Each lightguide plate **120** may include a first side **121** receiving light, a second side **122** curved at a top edge of the first side **121** and emitting light, a third side **123** facing the second side **122** and reflecting light to the second side **122**, and a fourth side **124** facing the first side **123** and connected with the second and third sides **122** and **123**. The separate lightguide plates **120** are arranged with their respective first side **121** and fourth side **124** facing each other. For example, in the adjacent first and second lightguide plates **120***a* and **120***b* among the separate lightguide plates **120**, the first side **121** of the first lightguide plate **120***a* faces the fourth side **124** of the second lightguide plate **120***b*.

[0151] The fixing member **140** includes an insertion portion **141** inserted between the separate lightguide plates **120**, e.g., between the first and second lightguide plates **120***a* and **120***b;* and a head portion **142** connected with the insertion portion **141** and disposed extending to top edges of the first and second lightguide plates **120***a* and **120***b*.

[0152] The insertion portion **141** may include first and second inclined surfaces **141***a* and **141***b* respectively extending from its end toward both sides and connected with the head portion **142**. A section of the insertion portion **141** may be a triangle.

[0153] One of the first and second inclined surfaces **141***a* and **141***b* may be inclined toward the first side **121** of the lightguide plate **120** on which light is incident from the light source unit **130**. For example, in the adjacent first and second lightguide plates **120***a* and **120***b* among the separate lightguide plates **120**, the first side **121** of the first lightguide plate **120***a* may face the first inclined surface **141***a,* and the fourth side **124** of the second lightguide plate **120***b* may face the second inclined surface **141***b*. The first inclined surface extends toward a top portion of the first side **121**, and the second inclined surface **141***b* extends toward a top portion of the fourth side **124**.

[0154] A reflective layer **143** is provided on an outer surface of the insertion portion **141**, i.e., on the first and second inclined surfaces **141***a* and **141***b*.

[0155] The reflective layer **143** guides at least a portion of light directed at the first side **121** of the first lightguide plate **120***a* but leaking toward the fourth side **124** of the second lightguide plate **120***b* to the first lightguide plate **120***a,* thereby preventing hot spots from occurring due to light leakage between the separate lightguide plates **120**. Here, the hot spot refers to a defect involving a bright point caused when part of a screen has a higher level of luminance than its surroundings.

[0156] The reflective layer **143** may extend toward the top of the first side **121**, inclined by the first inclined surface **141***a*. Thus, the reflective layer **143** can efficiently reflect light to the first side **121**. To prevent hot spots, the reflectivity of the reflective layer **143** and the slops of the first and second inclined surfaces **141***a* and **14***b* are controlled according to the luminance characteristics of the light source unit **130** and the material of the lightguide plate **120**.

[0157] Accordingly, the backlight unit of this embodiment can prevent hot spots as well as the movement of the separate lightguide plates by including the reflective layer, which reflects at least a portion of light leaking between the separate lightguide plates, onto the fixing member.

[0158] FIG. **13** is a perspective view of a fixing member provided in a backlight unit according to a modified embodiment of the embodiment of FIG. **10**.

[0159] The backlight unit of the embodiment of FIG. **13** has the same configuration as the backlight unit of the embodiment of FIG. **10**, except for a fixing frame. Thus, the same reference numerals are used for the same elements as in the embodiment of FIG. **12**, and the repetition of the description will be omitted.

[0160] Referring to FIG. **13**, the backlight unit according to this embodiment includes a bottom case **110**, a plurality of separate lightguide plates **120**, a light source unit **130**, a fixing member **140**, and a fixing frame **170**.

[0161] The fixing frame **170** connects a plurality of fixing members **140**. Specifically, the fixing frame **170** has a shape of a quadrangular frame with an open interior. The fixing member **140** is disposed in an opening of the fixing frame **170**. As shown in the drawing, the fixing member **140** may have a stripe shape. However, the shape of the fixing member **140** is not limited, and it may have a lattice shape.

[0162] The fixing member **140** and the fixing frame **170** may be integrally manufactured through molding. Alternatively, the fixing member **140** and the fixing frame **170** may be coupled together by means of a coupling unit, e.g., an adhesive agent or a coupling element.

[0163] Accordingly, the plurality of fixing members **140** can be assembled into the separate lightguide plates **120** at once by the fixing frame **170**. Therefore, productivity can be improved as compared to the case that they are individually assembled.

[0164] The fixing frame **170** may be coupled to the bottom case **110** of FIG. **1**. Thus, the plurality of fixing members **140** may be fixed to the bottom case **110** in order to more effectively fix the separate lightguide plates **120**.

[0165] Accordingly, as the backlight unit according to this embodiment of the present invention includes the fixing frame connecting a plurality of fixing members, the assembly productivity and fixing properties can be further enhanced.

[0166] FIG. **14** is a perspective view of a backlight unit according to another exemplary embodiment of the present invention, and FIG. **15** is a cross-sectional view of a portion of the backlight unit of FIG. **14**. The backlight unit may include a plurality of lightguide plates, but in the drawings, just two lightguide plates are illustrated for convenience of description.

[0167] Referring to FIGS. **14** and **15**, the backlight unit includes a bottom case **110**, a plurality of lightguide plates **120** disposed in parallel in the bottom case **110**, and a light source unit **130** disposed at one side of each of the lightguide plates.

[0168] Specifically, the bottom case **110** has a receiving space for accommodating the plurality of lightguide plates **120** and the light source unit **130**. For example, the receiving space may be formed by a bottom surface of the bottom case **110** and a sidewall bent upwardly from the edge of the bottom surface.

[0169] As the light source unit **130** is disposed at the edge of each of the lightguide plates **120**, the edge type backlight unit can perform a local dimming function. That is, the light source unit **130** provides light having a regulated luminance value to a corresponding lightguide plate **120**, and the corresponding lightguide plate **120** can provide light having a regulated luminance value to a selected region of the liquid crystal panel.

[0170] The plurality of lightguide plates **120** each have one side **125** having a receiving groove **121**, the other side **126** opposing the one side, a bottom side **127** bent and extending from the edge of the one side **125**, and a top side **128** opposing the bottom side **127**. The other side **126** may serve as an incident side, receiving light from the light source unit **130**. The bottom side **127** may serve as a reflective side for total reflection of light in an upward direction. Although not shown, a plurality of optical patterns may be disposed at the bottom side **127**. Also, the top side **128** may serve as an emission surface from which the light is emitted to the outside.

[0171] The plurality of lightguide plates **120** may be disposed such that one side **125** and the other side **126** of respective adjacent lightguide plates face each other. For example, the plurality of lightguide plates **120** may include adjacent first and second lightguide plates **120***a* and **120***b*. Here, one side **125** of the first lightguide plate **120***a* faces the other side **126** of the second lightguide plate **120***b*.

[0172] The light source unit **130** is disposed between the neighboring lightguide plates, e.g., the one side of the first lightguide plate **120***a* and the other side of the second lightguide plate **120***b*. The light source unit **130** is received in the receiving groove **121** formed in the one side **125**. Accordingly, there is no need to put a space of a predetermined distance between the plurality of lightguide plates **120** for the installation of the light source unit **130** between each set of neighboring lightguide plates **120**. This is contributive to forming a compact backlight unit. Also, the intervals between the lightguide plates **120** can be narrowed, thereby preventing light leakage between the plurality of lightguide plates **120**.

[0173] The receiving groove **121** may be formed by a first side **122** extending bent upwardly from the edge of the bottom side **127**, and a second side **123** extending bent outwardly from the edge of the first side **122**. In the case that the light source unit **130** emits light to the other side **126** of the second lightguide plate **120**, the first side **122** faces the back of the light source unit **13**, and the second side **123** faces the side surface of the light source unit **130**.

[0174] By regulating the optical characteristics of the receiving groove **121**, particularly, of the second side **123**, light leaking between the plurality of lightguide plates **120** is prevented from causing hot spots. For example, the first side **122** may be configured as one of a diffusion surface, a reflective surface and an optical polished surface. The first side **122** reflects a portion of leaked light to the other side **126**, and absorbs or transmits the remaining leaked light to the outside. The second side **123** may be configured as a diffusion surface. The second side may have a reflectivity ranging from 40% to 70%. If the reflectivity of the second side **123** is less than 40%, hot spots are caused, resulting in brighter boundaries between the lightguide plates **120** than on the top side **128** of the lightguide plate **120**. In contrast, the reflectivity of the second side **123** exceeding 70% may cause dark spots, resulting in darker boundaries between the lightguide plates **120** than on the top side of the lightguide plate **120**.

[0175] The one side **125** may further include a third side **124** extending to the receiving groove **121**, i.e., extending bent upwardly from the edge of the second side **123**. The third side **124** may face the other side **126** of the adjacent lightguide plate **120** parallel thereto. The third side **124** may be configured as one of a diffusion surface, a reflective surface and an optical polished surface.

[0176] In other words, the second side **123** of the receiving groove **121** needs to be configured as a diffusion surface, and the optical characteristics of the first side **122** and the third side **124** do not significantly affect hot spots. However, if a side with a larger area among the first side **122** and the third side **124** is configured as an optical polished surface, the amount of light being transmitted increases, causing hot spots. Therefore, a larger side of the first side **122** and the third side **124** needs to be configured as a diffusion surface or a reflective surface, not an optical polished surface.

[0177] For example, if the third side **124** has a larger area than the first side **122**, the first side **122** may be configured as one of an optical polished surface, a reflective surface and a diffusion surface. However, the third side **124** may be configured as one of a reflective surface and a diffusion surface. In contrast, if the third side **124** has a smaller area than the first side **122**, the third side **124** may be configured as one of an optical polished surface, a reflective surface and a diffusion surface, and the first side **122** may be configured as a reflective surface or a diffusion surface.

[0178] The optical characteristics of the first, second and third sides, particularly, the optical characteristic of the second side may be regulated by changing the concentration of white ink applied thereon.

[0179] Although illustrated and described as a quadrangular shape, the receiving groove in the lightguide plate is not limited thereto.

[0180] Referring to FIGS. **16** through **19**, a variety of shapes of the receiving groove provided in the lightguide plate according to the embodiment of the present invention will now be described in detail.

[0181] As shown in FIG. **16**, a receiving groove **221** of a lightguide plate **220** may have a sectional shape of a trapezoid formed by a first side **222** and a second side **223** inclined upwardly from the first side **222**.

[0182] As shown in FIG. **17**, a receiving groove **321** of a lightguide plate **320** may have a triangular sectional shape formed by a first side **322** extending inclined from the edge of a bottom side **327** to the edge of a top side **328**.

[0183] As shown in FIG. **18**, a receiving groove **421** of a lightguide plate **420** may have a sectional shape of a trapezoid formed by a first side **422** and a second side **423** inclined upwardly from the first side **422**. The lightguide plate **420** may include a third side **424** extending bent upwardly from the second side **423** of the receiving groove **421**.

[0184] As shown in FIG. **19**, a receiving groove **521** of a lightguide plate **520** may be formed by a first side **522**, and a second side **523** bent upwardly from the first side **522**. One side **525** in which the receiving groove **521** is formed may serve as an incident side receiving light. That is, the receiving groove **521** for accommodating the light source unit may be provided in the incident side. The other side **526** facing the one side **525** of the lightguide plate **520** may have an inclined surface **526***a* extending upwardly. The inclined surface **526***a* serves more efficiently to prevent hot spots by efficiently reflecting light leaking from the back of a neighboring light source unit.

[0185] Referring to FIGS. **14** and **15** again, since each of the lightguide plates **120** has a flat bottom side **127**, the respective bottom sides **127** of the plurality of lightguide plates **120** may be disposed to be flush with one another. Accordingly, the plurality of lightguide plates **120** are easy to assemble, and the assembly property of the backlight unit can be improved. Furthermore, when the backlight unit is used for a large display device, the flat bottom surfaces **127** contribute to achieving uniform flatness between the plurality of lightguide plates **120**. Also, the flat bottom surfaces **127** of the lightguide plates **120** can facilitate a cutting process and an optical polishing process of the lightguide plates **120**.

[0186] The light source **130** may include a light source **131** forming light, and a printed circuit board **132** applying a driving voltage to the light source **131**. A plurality of light sources **131** may be mounted on the printed circuit board **132**.

[0187] An example of the light source **131** may include an LED that emits light when a current is applied thereto. The LED may have various configurations. For example, the LED may include sub-LEDs respectively realizing blue, green and red colors. The sub-LEDs realizing the blue, green and red colors emit blue light, green light and red light, respectively, and blue, green and red light is mixed to realize white light. Alternatively, the LED may include a fluorescent material that converts a portion of blue light emitted from a blue LED into yellow light. In this case, white light is realized by the mixture of blue and yellow light.

[0188] According to this embodiment of the present invention, the light source unit is described as a light source including an LCD. However, the present invention is not limited thereto. For example, the light source of the light source unit may be a cold cathode fluorescent lamp (CCFL), or an external electrode fluorescent lamp.

[0189] Furthermore, a reflective member **150** may be disposed under each of the lightguide plates **120**. The reflective member **150** reflects light emitted downwardly of the lightguide plate **120** back towards the lightguide plate **120**, thereby improving the optical efficiency of the backlight unit.

[0190] According to this embodiment of the present invention, the reflective member **150** includes a plurality of separate reflective members being disposed under the lightguide plates **120**, respectively. However, the present invention is not limited thereto. That is, the reflective member **150** may be disposed under the plurality of lightguide plates as a single unit.

[0191] The reflective member **150** can be easily placed since the bottom sides of the plurality of lightguide plates are fush with one another.

[0192] The backlight unit may further include an optical member **160** disposed on the lightguide plates **120**. The optical member **160** may include a diffusion plate, a diffusion sheet, a prism sheet and a protective sheet on the lightguide plates **140**, for example.

[0193] Hereinafter, the luminance characteristic of the backlight unit according to an embodiment of the present invention will be described. Here, a plurality of lightguide plates of the backlight unit each include a receiving groove formed by a first side and a second side, and a third side extending from the receiving groove. The first side and the second side are configured as diffusion surfaces, and the third side is configured as a reflective surface. The diffusion surface has a reflectivity of 45%, and the reflective surface has a reflectivity of 90%.

[0194] FIG. **20** is a diagram showing the luminance distribution over the distance between two spots of lightguide plates according to the present invention. As shown in FIG. **20**, the luminance has a uniform distribution over two spots, spot A (0 mm) of one lightguide plate and spot B (110 mm) of another lightguide plate.

[0195] The same result was obtained when the first side and the third side were configured as reflective surfaces and the second side were configured as a diffusion surface. Thus, the description of the above case will be omitted.

[0196] In the backlight unit including the plurality of lightguide plates, the luminance was uniform over top portions of the plurality of lightguide plates and over boundaries between the plurality of lightguide plates when the second side of the receiving groove for receiving a light source unit for each lightguide plate is configured as a diffusion surface.

[0197] According to the embodiment of the present invention, the backlight unit includes a plurality of separate lightguide plates and a light source unit disposed at the edge of each of the lightguide plates. Thus, the effect of local dimming by local driving can be achieved as well as the effect of the backlight unit.

[0198] Also, the receiving groove for receiving the light source unit at the edge of each lightguide plate allows the formation of a compact backlight unit.

[0199] The optical characteristics of one edge of each lightguide plate including the receiving groove are regulated, thereby preventing optical defects such as a hot spot. Consequently, the quality of the backlight unit can be improved.

[0200] FIG. **21** is a perspective view of a backlight unit according to an exemplary embodiment of the present invention, and FIG. **22** is a cross-sectional view taken along line I-I of FIG. **21**. The backlight unit may include a plurality of lightguide plates, but just two lightguide plates are illustrated for convenience of description.

[0201] Referring to FIGS. **21** and **22**, the backlight unit includes a bottom case **110**, a lightguide plate **120**, a light source unit **130** and a fixing member **140**.

[0202] The bottom case **110** has a receiving space. For example, the receiving space may be formed by a bottom surface of the bottom case **110** and a sidewall bent from the edge of the bottom surface.

[0203] The bottom case **110** may include a coupling portion **111** to which the fixing member **140** (to be described later) is coupled. The coupling portion **111** may be an opening which the fixing member **140** (to be described later) passes through or a groove which the fixing member is inserted into.

[0204] The lightguide plate **120** includes a plurality of separate lightguide plates. The plurality of separate lightguide plates **120** need to be disposed in parallel in the receiving space of the bottom case **110**.

[0205] Each of the lightguide plates **120** includes a through hole **121** penetrating its body. The through hole **121** is disposed at the edge of the lightguide plate. However, the embodiment of the present invention does not limit the location and number of through holes. The through hole **121** is disposed corresponding to the coupling portion **111**.

[0206] The shape of the lightguide plate **120** is illustrated as a quadrangular shape, but the present invention is not limited thereto. The lightguide plate **120** may have various shapes such as triangular and hexagonal shapes.

[0207] Each of a plurality of light source units **130** is disposed at one edge of a corresponding one of the lightguide plates **120**. The light source units **130** may each include a light source **131** forming light, and a printed circuit board **132** including a plurality of circuit patterns for applying a driving voltage to the light source **131**.

[0208] The light source **131** may be, for example, an LED emitting light when current is applied thereto. The LED may have various configurations. For example, the LED may include sub-LEDs respectively realizing blue, green and red colors. Blue light, green light and red light emitted from the sub LEDs respectively realizing the blue, green and red colors are mixed to realize white light. Alternatively, the LED may include a blue LED and a fluorescent material that converts a portion of blue light emitted from the blue LED into yellow light. The blue light is mixed with the yellow light to realize white light.

[0209] Light formed at the light source unit **130** is incident to the edge of the lightguide plate **120**, and is emitted upwardly by total internal reflection in the lightguide plate **120**.

[0210] The fixing member **140** serves to fix the lightguide plate **120** to the bottom case **110**, thereby preventing the movement of the lightguide plate **120**. The fixing member **140** is inserted in the through hole **121** of the lightguide plate **120** and fixes the lightguide plate **120** to the bottom case **110**. Furthermore, the fixing member **140** may be coupled with the coupling portion **111** of the lightguide plate **120** through the through hole **121** of the lightguide plate **120**. For example, the fixing member **140** may pass through the opening or be inserted in the insertion groove.

[0211] The fixing member **140** includes a body portion **142**, and a head portion **141** extending from the body portion **142**.

[0212] The body portion **142** is coupled with the coupling portion **111**, passing through the through hole of the lightguide plate **120**. That is, the body portion **142** serves to fix the lightguide plate **120** on the bottom case **110** by coupling the lightguide plate **120** with the bottom case **110**.

[0213] The head portion **142** having a wider width than the body portion **142** prevents the fixing member **140** from completely slipping out of the through hole **121** of the lightguide plate **121**.

[0214] The head portion **141** may have various shapes. For example, the head portion **141** may have a sectional shape of a semicircle, a semi-oval, a quadrangle or a triangle. When the head portion **141** has a triangular sectional shape, the contact between the fixing member **140** and an optical member (to be described later) can be minimized, thereby minimizing the generation of dark spots caused by the fixing member **140**.

[0215] The lightguide plate **120** and the optical member **160** have a predetermined distance therebetween. Thus, light emitted from the lightguide plate **120** can be uniformly provided onto the optical member **160**. The head portion **141** supporting the optical member **160** serves to maintain the distance between the lightguide plate **120** and the optical member **160** (to be described later). The distance between the lightguide plate **120** and the optical member **160** can be adjusted by controlling the height of the head portion **141**.

[0216] The fixing member **140** may be formed of a material that transmits light, e.g., transparent plastic in order to minimize its influence on image quality.

[0217] The fixing member **140** may have a variety of configurations. Various embodiments of the fixing member will be described afterwards.

[0218] Furthermore, a reflective member **150** may be disposed under each of the lightguide plates **120**. The reflective member **150** reflects light emitted downwardly of the lightguide plate **120** back to the lightguide plate **120**, thereby improving the optical efficiency of the backlight unit.

[0219] The reflective member **150** may include a through portion **151** corresponding to the through hole **121** and the coupling portion **111**. The fixing member **140** passes through the through hole **121** and the through portion **151** to be coupled with the coupling portion **111**. Accordingly, the reflective member **150**, when provided with a plurality of separate reflective members like the lightguide plates **120**, can be fixed on the bottom case **110** by the fixing member **140**.

[0220] The backlight unit may further include an optical member **160** disposed on the lightguide plates **120**. The optical member **160** may include, for example, a diffusion plate, a diffusion sheet, a prism sheet and a protective sheet disposed on the lightguide plates **120**.

[0221] Accordingly, the backlight unit according to the embodiment of the present invention includes a plurality of separate lightguide plates, so that the effect of local dimming by local driving can be further improved.

[0222] The plurality of separate lightguide plates are fixed to the bottom case by means of the fixing member, thereby preventing defects caused by the movement of the lightguide plates.

[0223] Also, the fixing member can maintain the uniform distance between the lightguide plates and the optical member, so that light can be uniformly provided to a liquid crystal panel.

[0224] FIG. **23** is a cross-sectional view of a backlight unit according to a modified embodiment of the embodiment of FIG. **21**.

[0225] The backlight unit according to this embodiment has the same configuration as in the embodiment of FIG. **21**, except for a support member. Therefore, the same reference numerals are used for the same elements as in the embodiment of FIG. **21**, and repetition of the description will be omitted.

[0226] Referring to FIG. **23**, the backlight unit according to this embodiment of the present invention includes a bottom case **110** including a coupling portion **111**, a plurality of lightguide plates **120** disposed in parallel on the bottom case **110** and each including a through hole **121** corresponding to the coupling portion **111**, light source units **130** respectively disposed at one set of edges of the lightguide plates **120**, and a fixing member **140** passing through the through hole **121** and coupled to the coupling portion **111** to fix the plurality of lightguide plates **120** to the bottom case **110**. The backlight unit further includes an optical member disposed on the lightguide plate **120**.

[0227] The fixing member **140** includes a body portion **142** coupling the lightguide plate **120** with the bottom case **110** to fix the lightguide plate **120**, and a head portion **141** extending from the body portion **12**. The head portion **141** prevents the fixing member **140** from slipping out, and maintains the distance between an optical member **160** and the lightguide plate **120**.

[0228] However, the distance between the lightguide plate **120** and the optical member **160** needs to be adjusted according to the model of an LCD device or the characteristics of elements of the backlight unit. The height of the head portion **141** with reference to the top surface of the lightguide plate **120** may be selectively controlled by adjusting the length of the body of the fixing member **140** inserted into the through hole. If the head portion **141** is spaced apart from the lightguide plate **120** at a predetermined distance, the fixing member **140** may move downwardly without being fixed in the through hole **121**, changing the height of the head portion **141**. Therefore, a support member **170** is provided between the lightguide plate **120** and the fixing member **140**, thereby preventing the movement of the fixing member **140**. The support member **170** may be a spring for example. The spring, decreasing in volume under a predetermined force, prevents the fixing member **140** from moving downwardly by decreasing its volume according to the coupled length of the fixing member **140**. Thus, the support member **170** serves to prevent the movement of the fixing member **140**.

[0229] The support member **170** can disperse the pressure that the head portion **141** of the fixing member **140** applies directly on the lightguide plate **120**. Accordingly, damage to the lightguide plate **120** can be prevented from occurring due to the coupling of the fixing member **140**.

[0230] According to this embodiment of the present invention, the support member is described as limited to the support member. However, the present invention is not limited thereto, and the support member may be an elastic pad that can control its volume according to the coupling force.

[0231] In the backlight unit including the support member according to this embodiment of the present invention, the fixing member is supported and fixed after the height of the head portion of the fixing member is selectively controlled. Accordingly, a uniform distance can be maintained between the light guide and the optical member.

[0232] Also, the support member can minimize the damage to the lightguide plate and allow the fixing member to be coupled with the lightguide plate.

[0233] Various configurations of the fixing member will now be described with reference to the accompanying drawings.

[0234] FIG. **24** is a cross-sectional view of a fixing member according to an exemplary embodiment of the present invention.

[0235] Referring to FIG. **24**, a fixing member **140*a*** according to this embodiment includes a head portion **141*a***, a body portion **142*b***, and a stopping portion **143*c***. The body portion **142*b*** has one end separated into at least two parts. Thus, when the fixing member **140*a*** is inserted into the through hole **121** of the lightguide plate **120**, the end of the body portion **142*b*** decreases in diameter, thereby facilitating the insertion thereof. Also, the stopping portion **143*c*** is disposed at the end of the diverging body portion **142*b***, thereby preventing the fixing member **140*a*** from slipping out of the through hole.

[0236] FIG. **25** is a cross-sectional view of a fixing member according to an exemplary embodiment of the present invention.

[0237] Referring to FIG. **25**, a fixing member **140*b*** according to this embodiment includes a head portion **141*b*** and a body portion **142*b***. The body portion **142*b*** has a screw protrusion **143*b*** around its outer surface. Thus, the body portion **142*b*** passes through the lightguide plate **120** by the rotation of the fixing member **140**, and can be easily coupled with the coupling portion **111**.

[0238] FIG. **26** is a perspective view of an LCD device according to an exemplary embodiment of the present invention.

[0239] Referring to FIG. **26**, the LCD device includes a liquid crystal panel **100** displaying an image, and a backlight unit **170**. Although not shown, the liquid crystal panel includes first and second substrates facing each other, and a liquid crystal layer interposed between the first and second substrates. The first substrate includes a plurality of pixels disposed in the matrix. Each of the pixels may include a thin film transistor and a pixel electrode electrically connected to the thin film transistor. Also, the first substrate further includes a plurality of lines, e.g., gate lines and data lines, to apply an electrical signal to each pixel. The second substrate includes a color lifter layer and a common electrode disposed on the color filter. The common electrode forms a liquid crystal driving voltage for driving the liquid crystals of the liquid crystal layer together with the pixel electrode in response to the electrical signal. The liquid crystal displays an image by controlling the transmittance of light transmitting from the liquid crystal.

[0240] According to this embodiment of the present invention, a twisted nematic (TN) liquid crystal panel is described. However, the present invention is not limited thereto, and various modes, e.g., in-plane switching (IPS) and vertically aligned (VA) liquid crystal panels may be applied to the present invention.

[0241] The backlight unit **170** includes a light source module **150** forming light, and a lightguide plate **140** guiding the light to the liquid crystal panel **100**.

[0242] The light source module **150** includes a light source **152** forming light, and a light source circuit board **151** including a plurality of circuit patterns for applying a driving voltage to the light source **152**.

[0243] The lightguide plate **140** is disposed under the liquid crystal panel **100**, the light source module **150** may be disposed at each edge of the liquid crystal panel **140**. That is, the light source module **150** is disposed at the edge of the LCD panel **100**. Accordingly, the backlight unit **170** may be manufactured with a thin thickness.

[0244] The lightguide plate **140** includes an incident side facing the optical module **150**, an exit side bent from the incident side and facing the liquid crystal panel **100**, a light collecting pattern disposed at the exit side, and a back side facing the exit side. A plurality of patterns (not shown) may be disposed at the back side in order to guide light incident on the incident side toward the exit side.

[0245] In the lightguide plate **140**, the light collecting pattern can enhance the effect involving local dimming driving, i.e., the effect of a contrast ratio or the like.

[0246] The backlight unit **170** may further include an optical member **110** disposed on the lightguide plate **140**. The optical member **110** may include, e.g., a diffusion sheet **111**, a prism sheet **112** and a protective sheet disposed on the lightguide plate **140**.

[0247] A reflective plate **160** may be provided under the lightguide plate **140**. The reflective plate **160** reflects light leaking downwardly of the lightguide plate **140** to guide the light back to the lightguide plate **140**, thereby improving the optical efficiency of the backlight unit **170**.

[0248] Although not shown, the backlight unit **170** may further include a bottom case receiving the light source unit **150**, the lightguide plate **140** and the like. The backlight unit **170** and the liquid crystal panel **100** may be fixed together by a bottom case and a top case (not shown) coupled with the bottom case.

[0249] FIG. **27** is a plan view of the backlight unit of FIG. **26**, and FIG. **28** is a cross-sectional view of FIG. **26**.

[0250] Referring to FIGS. **27** and **28**, the backlight unit **170** includes the optical module **150** and the lightguide plate **140**.

[0251] The optical module **150** may include first, second, third and fourth optical modules **150***a*, **150***b*, **150***c* and **150***d* disposed at four edges of the lightguide plate **140**, respectively. However, the embodiment of the present invention does not limit the number of optical modules.

[0252] The light source **152** may include an LED device, which is a semiconductor device that emits light when a current is applied thereto. For example, the LED device includes an LED and a fluorescent material to realize white light. The LED may realize blue light. The fluorescent material absorbs and excites a portion of the blue light to realize yellow light for the realization of white light through combination with the blue light. Also, the LED device may include sub-LEDs respectively emitting red light, green light and blue light. The light provided from the sub-LEDs may be mixed to realize white light.

[0253] However, the light source of this embodiment of the present invention is not limited to the LED device. For example, a lamp may be used as the light source.

[0254] The plurality of light sources **152** are mounted on the light source circuit board **150**. The light source circuit board **150** includes a circuit line providing a light source driving voltage sent from a light source driver (not shown) to the light source. The circuit line may be electrically connected with each of the light sources **152** or with each group of light sources **152**. Thus, the plurality of light sources **152** may be driven individually or by group. For example, the first optical module **150***a* may include a first channel to a seventh channel (Ch**1** to Ch**7**) respectively configured as separate circuits. Each channel may include one or more light sources electrically connected to each other. Likewise, the second optical module **150***b* may include an eighth channel to an eleventh channel (Ch**8** to Ch**11**), the third optical module **150***c* may include a twelfth channel to an eighteenth channel (Ch**12** to Ch**18**), and the fourth optical module **150***d* may include a nineteenth channel to a twenty second channel (Ch**19** to Ch**22**).

[0255] However, the embodiment of the present invention does not limit the number of channels of each module. A first region of a liquid crystal panel that needs to display a brighter image than its periphery can be provided with light with a higher luminance than its peripheral by regulating the luminance of a light source disposed at a channel corresponding to the first region. In contrast, a second region of the liquid crystal panel that needs to display a darker image can be provided with light with a lower luminance than its periphery by regulating the luminance of a light source disposed at a channel corresponding to the second region. Since the light source module **150** includes a plurality of channels that can drive independently, light with a selectively regulated luminance value can be provided to a predetermined region of the liquid crystal panel.

[0256] The lightguide plate **140** includes a first light collecting pattern **141** disposed at an exit side to collect light in a first direction, and a second light collecting pattern **142** collecting light in a second direction intersecting the first direction. The first and third light source modules **150***a* and **150***c* facing each other may be disposed at both ends of the first light collecting pattern **141**. Also, the second and fourth light source modules **150***b* and **150***d* may be disposed at both ends of the second light collecting pattern **142**, facing each other.

[0257] The first and second light collecting patterns **141** and **142** each may have constant patterns protruding from the body of the lightguide plate **140**. For example, each of the first and second light collecting patterns **141** and **142** may be in the shape of a prism pattern. That is, the first light collecting pattern **141** may be disposed across the top of the lightguide plate **140** in the first direction. The second light collecting pattern **142** may be disposed across the top of the lightguide plate **140** in the second direction. The sectional shape of each of the first and second light collecting patterns **141** and **142** may be a hemispherical or triangular shape to collect light.

[0258] The lightguide plate **140** further includes diffusion parts **143** that diffuse light emitted by the first and second light collecting patterns **141** and **142**. The diffusion parts **143** may be disposed at the right and left sides of the first light collecting pattern **141**, respectively. The diffusion parts **143** may be disposed at the top and bottom of the second light collecting pattern **142**, respectively. The diffusion part **143** diffuses light collected by the first and second light collecting patterns **141** and **142**. That is, the diffusion portions **143** can allow light having the regulated luminance value to be uniformly provided to a selective region of the liquid crystal panel, and an image of the liquid crystal panel can be more smoothly displayed.

[0259] Light paths formed by the first and second light collecting patterns **141** and **142** will now be described. Light sources disposed at both ends of the first light collecting pattern **141**, e.g., the light sources **152** disposed at the first channel Ch**1** are turned on. First light L**1** formed at the first channel Ch**1** exits linearly in the first direction due to the first light collecting pattern **141**. At this time, the first light is diffused by the diffusion portions **143** disposed at the right and left sides of the first light collecting pattern **141**. Meanwhile, light sources disposed at both ends of the second light collecting pattern **142**, e.g., light sources disposed at the ninth channel Ch**9** are turned on. Second light L**2** formed at the ninth channel Ch**9** exits linearly in the second direction by the second light collecting pattern **142**. At this time, the second light L**2** is diffused by the diffusion portions disposed at the top and bottom of the second light collecting pattern **142**. When the light sources **152** of the first channel Ch**1** and the ninth channel Ch**9** are simultaneously turned on as described above, the first and second light sources L**1** and L**2** overlap at the intersection of the first and second light collecting patterns **141** and **142** so that light can exit with higher luminance than from other regions.

[0260] Although in the embodiment of the present invention, light sources of the first and fourth light source modules are driven, the present invention is not limited thereto, and corresponding light source modules can be driven together according to the required light quantity. For example, when the light sources disposed at the ninth channel Ch**9** are turned on, light sources disposed at the twenty first channel Ch**21** corresponding to the ninth channel Ch**9** may be turned on at the same time. Likewise, when the light sources disposed at the first channel Ch1 are turned on, light sources disposed at the eighteenth channel Ch18 corresponding to the first channel Ch1 may be turned on at the same time. Thus, light with more improved luminance can be provided to a selected region of the liquid crystal panel. That is, the degree of luminance of an image can be controlled through selecting the channel location and controlling ON/OFF of the light sources disposed at the channel.

[0261] Accordingly, the backlight unit including the first and second light collecting patterns **142** can improve the contrast ratio by the effect of local dimming since light with a regulated luminance value is collected to a selected region without being diffused to the entire area of the liquid crystal panel.

[0262] FIGS. **29**A and **29**B are schematic perspective views for describing a backlight unit according to another aspect of the present invention. As shown in FIG. **29**A, the backlight unit according to this embodiment is a planar light source device having a flat lightguide plate, and corresponds to a tandem planar light source device. The backlight unit of FIG. **29**A includes an n number of LED light sources and an n number of flat lightguide plates.

[0263] The LED light sources each include a plurality of LED packages **31** arranged in a row on a board **30**, and are arranged parallel to one another. Each of the flat lightguide plates **32** and **35** are arranged at one side of a corresponding one of the n number of LED light sources.

[0264] The planar light source device having the flat lightguide plate includes a reflective member (not shown) disposed under the LED packages **31** and **34** and under the flat lightguide plates **32** and **35** and reflecting light emitted from the LED light sources. Also, an optical sheet is provided on the flat lightguide plates. The optical sheet may include, for example, a diffusion sheet diffusing light, which is emitted toward a liquid crystal panel after being reflected by the reflective member and refracted by the flat lightguide plate, in different directions, and a prism sheet serving to concentrate light having passed through the diffusion sheet within a frontal viewing angle.

[0265] Specifically, the LED light source includes the plurality of LED packages each including a top-view LED. The lightguide plates **32** and **35** are flat and, and are disposed in the direction that light is emitted, and formed of a transparent material that can transmit light. The flat lightguide plate is simple in shape and easy to mass-produce, and facilitates the positioning thereof on the LED light source, as compared to the edge type lightguide plate.

[0266] The flat lightguide plates **32** and **35** each include a light incident part on which light emitted from the LED light source is incident, an emission surface from which light incident from the LED source travels toward the liquid crystal panel as lighting, and a front end part opposing the light incident part and having a thickness smaller than that of the light incident part. The front end portion of the flat lightguide plate **32** overlaps the LED package **34**. That is, an n+1th LED light source is placed under the front end part of an nth flat lightguide plate. A bottom surface of the front end part of the flat lightguide plate **32** has a prism shape.

[0267] As shown in FIG. **29**B, light from the LED package **34** is not emitted directly to the lightguide plate **32**, but is scattered and dispersed by the prism shape provided on the bottom surface of the front end part of the flat lightguide plate **32**. Thus, hot spots on the lightguide plate on the LED light source can be removed.

[0268] FIG. **30** is a schematic perspective view for describing the flat lightguide plate of FIG. **29**. As shown in FIG. **30**, the flat lightguide plate **40** includes a light incident part onto which light from the LED light source is made incident, an emission surface **44** emitting light incident through the light incident part **41** toward the liquid crystal panel as lighting, and a front end part **42** opposing the light incident part **41** and having a section with a smaller thickness than that of an incident sectional surface of the light incident part **41**.

[0269] The front end part **42** includes a prism shape **43** dispersing a portion of light from an LED package disposed under the front end part **42**. The prism shape **43** may be at least one of triangular, conic, and hemispherical prisms that can disperse and scatter incident light.

[0270] The prism shape of the front end part **42** may be formed over the entire front end part **42**, or partially formed only above the LED package. The prism shape allows the removal of hot spots on the lightguide plate on the LED package.

[0271] In the flat lightguide plate according to the present invention, the prism shape processed on the bottom surface of the front end part makes it unnecessary to process separate diffusion and prism sheets between the LED package and the lightguide plate to disperse hot spots generated on the lightguide plate on the LED package by a portion of light emitted from the LED package.

[0272] While the present invention has been shown and described in connection with the exemplary embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

INDUSTRIAL APPLICABILITY

[0273] An aspect of the present invention may provide a backlight unit for an LCD device capable of contributing to manufacturing thinner and larger products and realizing effective local dimming by using an LED disposed at an edge of a lightguide plate.

1. A backlight unit for a liquid crystal display (LCD) device, disposed under a liquid crystal panel and emitting light to a liquid crystal panel, the backlight unit comprising;
- a lightguide plate;
- an light emitting diode (LED) array disposed at an edge of the lightguide plate and including a plurality of LED blocks each including at least one LED emitting white light; and
- a controller controlling a current signal applied to each of the plurality of LED blocks to regulate the luminance of each LED block.

2. The backlight unit of claim **1**, wherein the lightguide plate has at least one separation structure controlling light propagation therein.

3. The backlight unit of claim **2**, wherein the separation structure is disposed in at least one of vertical and horizontal directions with respect to the lightguide plate.

4. The backlight unit of claim **2**, wherein the separation structure is at least one of an LED array structure and a reflective layer mounted on a circuit board and inserted linearly between the lightguide plates.

5. The backlight unit of claim **2**, wherein the separation structure is an uneven part formed at a boundary between regions divided by the separation structure.

6. The backlight unit of claim **1**, wherein the LED array comprises a first LED array and a second LED array that are disposed at one edge and the other edge perpendicular to the one edge of the lightguide plate, respectively.

7. The backlight unit of claim **6**, wherein light emitted from the first LED overlaps light emitted from the second LED array in the lightguide plate.

8. The backlight unit of claim **6**, further comprising a third LED array and a fourth LED array respectively facing the first LED array and the second LED array with the lightguide plate therebetween and having the same configurations as the first and second LED arrays, respectively.

9. The backlight unit of claim **1**, wherein the LED array comprises a first LED array and a second LED array disposed at one edge and the other edge facing the one edge of the lightguide plate, respectively.

10. The backlight unit of claim **1**, wherein the LED block comprises a red LED, a green LED, and a blue LED.

11. The backlight unit of claim **1**, wherein the controller comprises an LED block driving a controller and a panel image signal transmitter.

12. The backlight unit of claim **11**, wherein the panel image signal transmitter comprises a panel information transfer circuit and a panel information combination circuit.

13. The backlight unit of claim **1**, further comprising a reflective plate disposed under the lightguide plate.

14. The backlight unit of claim **1**, further comprising an optical sheet disposed on the lightguide plate.

15. The backlight unit of claim **1**, wherein the LED emits white light by at least one fluorescent material.

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