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(54) **Surface light source using white light emitting diodes and liquid crystal display backlight unit having the same**

Oberflächenlichtquelle mit Weißlicht emittierenden Dioden und Rückbeleuchtungseinheit einer Flüssigkristallanzeige damit

Source lumineuse de surface utilisant des diodes luminescentes blanches et unité de rétroéclairage à cristaux liquides dotée de celles-ci

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priorities of Korean Patent Application No. 2007-86197 filed-on August 27, 2007, and Korean Patent Application No. 2008-22437 filed on March 11, 2008, in the Korean Intellectual Property Office.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a surface light source using white light emitting diodes (LEDs) and a liquid crystal display (LCD) backlight unit having the same, and more particularly, to a surface light source capable of producing uniform white light overall using white light emitting diodes, and an LCD backlight unit having the same.

Description of the Related Art

[0003] A cold cathode fluorescent lamp (CCFL) used as a light source of a conventional liquid crystal display (LCD) employs mercury gas, which may trigger environmental pollution Besides, the CCFL is slow in response rate, low in color reproducibility and inappropipriate for a smaller-sized and lighter-weight LCD panel.

[0004] In contrast, a light emitting diode (LED) is environment-friendly, and exhibits a high response rate of the order of several nano seconds. Thus the LED is effective for a video signal stream and may be driven by impulse signals. Moreover, the LED is capable of fully reproducing colours and varying brightness and color temperature by adjusting the light output of red, green and blue LEDs. Also, the LED advantageously is suitable for a smaller-sized and lighter-weight LCD panel. Therefore, of late, the LED has been actively employed as a backlight source of the LCD panel.

[0005] LCD backlights including LEDs may be classified as edge-type backlights and direct-type backlights according to the location of a light source. In the former, a light source of an elongated bar shape is disposed at an edge of the LCD panel to irradiate light onto the LCD panel using a light guide plate. In the latter, a surface light source with a substantially identical area to the LCD panel is disposed below the LCD panel to directly irradiate light onto the LCD panel.

[0006] FIGS. 1 and 2 illustrate arrangement of red (R), green (G) and blue (B) LEDs of a conventional surface light source.

[0007] The surface light source 10 for use in a conventional direct-type LCD panel emits white light by combining the red (R), green (G) and blue (B) light together. Thus, as shown in FIG. 1, a plurality of LED units (U) are arranged to define a square shape. In each of the LED units U, the red, green and blue LEDs 11, 12 and 13 are disposed within a proximity to respective vertices of a triangle. Alternatively, as shown in FIG. 2, a plurality of LED units U are arranged to define a triangular shape. However, when the LED units U are arranged to define a square shape as shown in FIG. 1, the red LEDs 11 are located with such density that a red line appears in the display.

[0008] Meanwhile, when the LED units U are arranged to define a triangular shape as shown in FIG. 2, the red, green and blue LEDs are relatively evenly disposed. However, a light source including the red, green and blue LEDs 11, 12, and 13 in each of the LED units U is arranged such that the LED unit U can produce white light. Thus, to ensure the light source maintains appropriate brightness levels with respect to the other light sources adjacent thereto in the triangular shape, the LED units U should be balanced with one another and the light sources of each of the LED units should be balanced with one another in an overall backlight unit. This accordingly renders it hard to manufacture the backlight unit or degrades the quality thereof. EP 1 717 633 A discloses such a bach light having the features of the preamble of claim 1.

[0009] Also, a difference in the light amount of the red, green and blue LEDs may adversely affect uniformity, or degrade contrast uniformity despite good color uniformity.

[0010] That is, the LED units are shown partially red or partially blue. Also, with higher temperature, each color is darkened more. This hardly ensures a properly functional white surface light source.

[0011] Therefore, in the conventional surface light source 10 and the LCD backlight unit having the same, colours are added together with limitation, thereby not realizing uniformly-distributed white light.

SUMMARY OF THE INVENTION

[0012] An aspect of the present invention provides a surface light source capable of producing uniform white light using white light emitting diodes (LEDs) and a liquid crystal display (LCD) backlight unit having the same.

[0013] Another aspect of the present invention provides an LCD backlight unit having a surface light source capable of producing overall uniform white light using white light emitting diodes.

[0014] According to the invention, there is provided a surface light source using white light emitting diodes comprising:

a plurality of white light emitting diodes arranged at a predetermined distance from one another, wherein the white light emitting diodes are arranged such that a light emitting diode unit defined by each of the white light emitting diodes and corresponding ones of the white light emitting diodes disposed at a closest distance from each white light emitting diode has a central light amount ranging from 80% to 120% with respect to an average light amount of the white light emitting diodes, and the white light emitting diode comprises a blue light emitting diode chip having a dominant wavelength of 430 to 456nm, a red phosphor emitting red light and a green phosphor emitting green light, wherein the red light emitted from the red phosphor has a color coordinate falling within a space defined by four coordinate points (0.6448, 0.4544), (0.8079, 0.2920), (0.6427, 0.2905) and (0.4794, 0.4633) based on the CIE 1931 chromaticity diagram, and the green light emitted from the green phosphor has a color coordinate falling within a space defined by four coordinate points (0.1270, 0.8037), (0.4117, 0.5861), (0.4197, 0.5316) and (0.2555, 0.5030) based on the CIE 1931 chromaticity diagram; and wherein the red phosphor is represented by $CaAlSiN_3$:Eu and the green phosphor is represented by at least one of $(Ba_x,Sr_y,Mg_z)SiO_4:Eu^{2+}$, F, Cl, where 0<x, y≤s2, 0≤z≤2, 0ppm≤F, Cl≤5000000ppm and β-SiAlON.

[0015] An emission spectrum of the blue light emitting diode chip may have a full width at half-maximum of 10 to 30nm, the green phosphor may have a full width at half-maximum of 30 to 100nm and the red phosphor may have a full width at half-maximum of 50 to 200nm.

[0016] The white light emitting diodes may be arranged in a matrix of columns and rows having a spacing of 8.2 to 70mm from one another, respectively. The white light emitting diodes may be arranged by adjusting at least one of spacing of columns, spacing of rows, and arrangement angles thereof.

[0017] The light emitting diode unit may have a shape selected from one of a polygon, a circle and a combination thereof.

[0018] According to another aspect of the present invention, there is provided a a liquid crystal display backlight unit including: a board; a reflective plate disposed on the board; a surface light source in accordance with the invention as defined herein disposed on the reflective plate, a diffusing sheet disposed on the surface light source to diffuse light incident from the surface light source uniformly; and a light collecting sheet disposed on the diffusing sheet to collect the light diffused by the diffusing sheet.

[0019] The liquid crystal display backlight unit may further include a protective sheet disposed on the light collecting sheet.

[0020] There now follows a description of preferred embodiments of the invention, by way of non-limiting example, with reference being made to the accompanying drawings in which:

[0021] FIGS. 1 and 2 illustrate arrangement of red (R), green (G) and blue (B) LEDs of a conventional surface light source;

[0022] FIGS. 3 and 4 illustrate are arrangement of a surface light source according to an exemplary embodiment of the invention;

[0023] FIG. 5 is an exploded side sectional view illustrating an LCD backlight unit having a surface light source using white light emitting diodes (LEDs) according to an exemplary embodiment of the invention;

[0024] FIG. 6A illustrates a simulation test result of light amount uniformity when an average light amount of white LEDs is 80% to 120%, and FIG. 6B illustrates a simulation test result of light amount uniformity when an average light amount of white LEDs is in excess of 20%;

[0025] FIG. 7 illustrates an arrangement of light sources in a separately driven liquid crystal display (LCD) backlight unit according to an exemplary embodiment of the invention;

[0026] FIG. 8 is a view for explaining a circuit configuration for separate driving in a separately driven LCD backlight unit shown in FIG. 7; and

[0027] FIG. 9 illustrates a color coordinate range obtained when white LED light sources are employed in an LCD backlight unit.

<u>Surface light source using white LEDs</u>

[0028] First, a surface light source using white light emitting diodes (LEDs) according to an exemplary of the invention will be described in detail with reference to FIGS. 3 and 4.

[0029] FIGS. 3 and 4 illustrate an arrangement of white W LEDs of a surface light source according to the present embodiment.

[0030] As shown in FIGS. 3 and 4, the surface light source 100 using the white LED according to an embodiment of the invention includes a plurality of white W LEDs 110 arranged at a predetermined distance from one another.

[0031] Although not illustrated, each of the white LEDs 110 is formed of a blue LED chip, a red phosphor and a green phosphor. The red phosphor utilizes $CaAlSiN_3$:Eu which is a nitride composition. Also, the green phosphor comprises $(Ba_x,Sr_y,Mg_z)SiO_4:Eu^{2+}$, F, Cl (0<x, y≤2, 0≤z≤2, 0ppm≤F, Cl≤5000000ppm), which is a silicate composition, or β-SiAlON which is a nitride composition.

[0032] As described, when the white light is produced using the white LEDs 110, only one chip is utilized to ensure easier manufacture of the backlight unit and simpler configuration of a circuit than the conventional method in which white light is obtained using red, green and blue LEDs 11,12, and 13.

[0033] Particularly, in the present embodiment, the plurality of white LEDs are arranged by adjusting, e.g., the spacing D_1 of rows Lc, the spacing D_2 of columns Lr of the white LEDs 110 or arrangement angles (θ) thereof. The white light emitting diodes are arranged such that a light emitting diode unit U defined by each of the white LEDs 110 and the white LEDs disposed most closely adjacent thereto has a light amount in a center C ranging from 80% to 120% with respect to an average light amount of the white LEDs 110. Here, the average light amount of the white LEDs 110 is derived by dividing a total light amount by the number of the white LEDs 110.

[0034] Here, the LED unit U may have a triangular shape as shown in FIG. 3. Alternatively, the LED unit U may have a square shape as shown in FIG. 4. Therefore, the center C of the LED unit U may be the centre of mass of the arrangement of three white LEDs 110 in the triangular shape (see FIG. 3), or the centre of mass of the arrangement of four white LEDs 110 in the square shape (see FIG. 4).

[0035] Unlike the conventional configuration, the white light sources are arranged as in FIGS. 3 and 4 to define a polygon including a triangle. Here, the LED unit defined by the each light source and the corresponding ones of the light sources disposed most closely adjacent thereto i.e., LEDs surrounding the center C as shown in FIGS. 3 and 4, has a central light amount, i.e., a light amount measured in the center C, ranging from 80 to 120% with respect to an average light amount. This ensures optimal uniformity as shown in FIG. 6A.

[0036] The LED unit U has a shape not limited to the aforesaid ones but may be variously shaped as one of a polygon including a triangle, a circle and a combination thereof within the scope of the present invention.

[0037] When all measurements are based on the center of the LED unit, in FIG. 3, the dimension a may be 20 to 140 mm, and dimensions b and e may be adjusted in a range of 15 and 90 mm, respectively. That is, the values of b and e, when equal, assure optimal uniformity and b+e should be greater than a. Also, θ denotes an angle subtended by one of the white LEDs located on a row line connecting an array of the white LEDs with respect to an adjacent one of the white LEDs located on another row line connecting an array of the white LEDs. For example, θ denotes an angle of b or e with respect to the line L connecting the array of the white LEDs. Referring to FIG. 3, θ ranging from 70 to 110° ensures optimal arrangement of the white LEDs. D_1, and D_2, when ranging from 8.2 to 70 mm, ensure optical uniformity.

[0038] In a similar manner, as shown in FIG. 4, even when θ is substantially 90°, D_1 and D_2 range from 8.2 to 70mm, respectively to ensure optimal arrangement.

[0039] The arrangement described above may employ light sources satisfying following conditions. Such arrangement is expected to result in superior color reproducibility and improved brightness.

[0040] The white LED light source of the preferred embodiment includes a blue chip having a dominant wavelength of 430 to 456nm, a red phosphor disposed around the blue LED chip and excited by the blue LED chip to emit red light and a green phosphor disposed around the blue LED chip and excited by the blue LED chip to emit green light.

[0041] The red phosphor has a color coordinate falling within a space defined by four coordinate points (0.6448, 0.4544), (0.8079, 0.2920), (0.6427, 0.2905) and (0.4794, 0.4633) based on the CIE 1931 chromaticity diagram. The green phosphor has a color coordinate falling within a space defined by four coordinate points (0.1270, 0.8037), (0.4117, 0.5861), (0.4197, 0.5316) and (0.2555, 0.5030) based on the CIE 1931 chromaticity diagram.

[0042] The LCD backlight unit employing the white LED light source exhibits high color reproducibility as represented by a color coordinate space corresponding to an s-RGB area on the CIE 1976 chromaticity diagram (see FIG. 9). This high color reproducibility cannot be achieved by virtue of a CCFL BLU, a combination of red, blue and green LEDs. i.e., RGB LED BLU and a conventional combination of a blue LED chip, and red and green phosphors.

[0043] Furthermore, an emission spectrum of the blue LED chip has a full width at half-maximum (FWHM) of 10 to 30nm, the green phosphor 105 may have an FWEM of 30 to 100nm and the red phosphor may have an FWHM of 50 to 200nm. Each of the light sources has an FWHM ranging as described above, thereby producing white light with better color uniformity and color quality. Such FWHM conditions may be beneficially employed to enhancer performance of the white LED light source. This FWHM range may be more beneficially applied in combination with other conditions such as the dominant wavelength of the blue LED chip and color coordinates of the red phosphor and green phosphor as described above.

[0044] Particularly, the blue LED chip has a dominant wavelength set to a range of 430 and 456nm and an FWHM set to a range of 10 to 30nm. This significantly enhances efficiency of a $CaAlSiN_3$:Eu red phosphor and efficiency of a $(Ba_x,Sr_y,Mg_z)SiO_4:Eu^{2+}$, F, Cl ($0<x$, $y\leq 2$, $0\leq z\leq 2$, $0ppm\leq F$, $Cl\leq 5000000ppm$) green phosphor.

[0045] That is, according to the present embodiment, the white LEDs 110 employed can be arranged with much less limitation than the conventional surface light source using the red, green and blue LEDs.

[0046] Moreover, according to the embodiment as described above, the LED unit U has a light amount in the center C ranging from 80% to 120% with respect to an average light amount of the white LEDs 110, thereby ensuring a uniform light amount, and stable production and quality.

[0047] Here, in a case where the LED unit U has a light amount in the center C smaller than 80% of an average light amount of the white LEDs 110, the white LEDs 110 are degraded in power efficiency in a manner that increases temperature and consumption power, thereby undermining uniformity. In a case where the LED unit U has a light amount in the center C greater than 120%, brightness can be increased but the white LEDs 110 employed in a great number result in higher costs, posing difficulty to manufacture of the backlight unit.

[0048] Therefore, in the present embodiment, the white LEDs 110 are arranged such that the LED unit U has a light amount in the center C set to the aforesaid range, thereby obtaining optimal uniformity.

LCD backlight unit having a surface light source using white LEDs

[0049] The surface light source as described above may be employed in an LCD backlight unit backlighting an LCD panel in an LCD.

[0050] Hereinafter, the LCD backlight unit having a surface light source using white LEDs will be described with reference to FIG. 5.

[0051] FIG. 5 is an exploded side sectional view illustrating an LCD backlight unit having a surface light source using white LEDs.

[0052] As shown in FIG. 5, according to the present embodiment, the LCD backlight unit 200 disposed behind an LCD panel 270 includes a board 210, a reflective plate 220 disposed on the board 210 and a surface light source including white LEDs 110. The reflective plate 220 reflects light emitted from the white LEDs 110 upwards.

[0053] The surface light source is disposed on the reflective plate 220. As described with reference to FIGS. 3 and 4, the plurality of white LEDs 110 are arranged at a predetermined distance from one another. The white LEDs 110 are arranged by adjusting the spacing D_1 of columns, the spacing D_2 of rows D_2 or arrangement angles θ thereof. Here, the white LEDs 110 are arranged such that a light emitting diode unit U defined by each of the white LEDs 110 and corresponding ones of the white LEDs disposed at a closest distance from the each white light emitting diode has a central light amount ranging from 80% to 120% with respect to an average light amount of the white LEDs.

[0054] A side wall 230 is formed at an edge of the reflective plate 220 to surround the white LEDs 110. The side wall 230 has an inclination surface 235. Here, the inclination surface 235 of the side wall 230 may be additionally applied with a reflective material to ensure light emitted sideways from the white LEDs 110 is directed upward.

[0055] A diffusing sheet 240 is provided on the surface light source to uniformly diffuse light incident from the surface light source, thereby preventing light from being concentrated locally.

[0056] A light collecting sheet 250 is disposed on the diffusing sheet 240 to collect the light diffused from the diffusing sheet 240 in a direction perpendicular to the LCD panel 270.

[0057] Here, a protective sheet 260 may be further disposed on the light collecting sheet 250 to protect an underlying optical structure. The protective sheet 260 serves to protect a surface of the light collecting sheet 250 while contributing to uniform distribution of light.

[0058] An LCD panel 270 is disposed on the protective sheet 260. The LCD backlight unit 200 of the present embodiment irradiates uniform white light onto the LCD panel by virtue of the surface light source using the white LEDs 110, thereby ensuring a clear LCD image.

Separately driven LCD backlight unit

[0059] The arrangement of the white LEDs described above is applicable to a separately driven LCD backlight unit.

[0060] In the present embodiment, the board 210 may be a conductive board where at least one first connector and a plurality of second connectors are formed to enable flow of positive and negative currents. The separately driven LCD backlight unit includes a plurality of white LED modules mounted on the conductive board to be arranged in a matrix having m rows and n columns, where m and n are positive integers of at least two. The mxn number of LED light sources are defined into a plurality of blocks. The plurality of blocks are connected to the first and second connectors to independently drive the white LED chips based on each of the blocks.

[0061] In the connector configuration for separate driving, the blocks are commonly connected to the first connector and the second connectors are identical in number to the blocks of each of the modules. The plurality of blocks are connected to the second connectors, respectively.

[0062] In the separately driven LCD backlight of the present embodiment, the number of LED modules, the number of blocks of the LED module and/or the number of the white LED chips in each block may be adequately adjusted to ensure an appropriate number of LED chips and arrangement for attaining the light amount necessary for the separately driven LCD backlight unit.

[0063] The number of the LED modules may be 2 to 28, the number of the blocks may be 1 to 28 for each module and the number of the white LEDs may be 2 to 240 for each block.

[0064] Particularly, in a case where the LCD backlight unit is utilized in a 40-inch LCD, the LED module may include 1 to 14 blocks. In a case where the LCD backlight unit is used in a 46-inch LCD, the LED module may include 1 to 15 blocks. Given the assumption that an active area of the 46-inch LCD TV is 1020x580mm, when the number of the LEDs for the each block is 2 to 240, a total 4 to 100800 of LEDs will be employed.

[0065] Meanwhile, in a larger-sized backlight unit, the number of modules may be increased to employ a necessary number of LED chips easily. Specifically, the LED module may include 1 to 28 blocks and 2 to 240 white LEDs may be arranged in the each block of the LED modules.

[0066] Notably, in a case where the LCD backlight unit is utilized in a 52 inch LCD, the number of the LED modules may be 4 to 12. Also, in a case where the LCD backlight unit is adopted in a 57 inch LCD, the number of the LED modules may be 6 to 20.

[0067] As shown in FIG. 7, an LCD backlight unit 300 according to an exemplary embodiment of the present invention includes four LED modules 320. Each of the LED modules 320 includes a conductive board 311, and a plurality of LED chips 310 mounted on the conductive board 311. The LED chips 310 are white LEDs arranged in a matrix having four rows and nine columns.

[0068] The LED module 320 may be defined as six blocks B1 to B6. In the present embodiment, the blocks B1 to B6 constituting the LED module 320 serve as respective units which can be driven independently.

[0069] In a preferred embodiment, the LED chips 310 in each of the blocks B1 to B6 may be connected in series with one another. Here, each block B1 to B6 as a circuit has at least one end connected to an individual connector so that the LED chips 310 can be separately driven based on the respective units.

[0070] To ensure connection for this separate driving, the conductive board 311 of the LED module 320 is illustrated to include two first connectors 312 and six second connectors 314a, 314b, and 314c. The first and second connectors 312, and 314a, 314b, 314c are connected to different polarities from each other to provide an external voltage to the LED chips 310.

[0071] FIG. 8 illustrates a circuit configuration for separate driving in the separately driven LCD backlight of FIG. 7.

[0072] Referring to FIG. 8, an LED module 320 includes a conductive board 311 and a plurality of LED chips 310 arranged on the conductive board 311 in a matrix having four rows and nine columns.

[0073] In the LED module 320, the LED chips 310 are defined as six blocks B1 to B6 as described in FIG. 8.

[0074] In the present embodiment, six white LED chips 310 in the first and second rows and corresponding three columns of the nine columns define first to third blocks B1 to B3, respectively. In a similar manner, six white LED chips 310 in the third and fourth rows and corresponding three columns of the nine columns define fourth to sixth blocks B4 to B6, respectively.

[0075] The LED chips 310 of each of the blocks are connected in series with one another. In a circuit configuration where the first to third blocks B1, B2, and B3 are connected in series with one another, a plus (+) terminal is commonly connected to a first connector P1 and a minus (-) terminal is divided based on the each block to connect to respective three second connectors P21,P22, and P23.

[0076] Likewise, in a circuit configuration where the fourth to sixth blocks B4, B5, and B6 are connected in series with one another, a plus (+) terminal is commonly connected to a first connector and a minus (-) terminal is divided based on the each block to connect to respective three second connectors. Here, reference numerals P1, and P21, P22, P23 of FIG. 8 are construed to correspond to the first and second connectors, respectively shown in FIG. 7.

[0077] As described above, the separately driven LCD backlight unit of the present invention realizes a structure necessary for separate driving using the unit of blocks. The separately driven LCD backlight unit can be defined largely as three blocks, and the necessary number of LEDs may be adjusted.

[0078] More specifically, in the separately driven LCD backlight unit, the white LEDs are arranged in a matrix having a plurality of rows and columns to ensure uniform density overall. Also, the white LEDs can be arranged by adjusting the number of the LED modules, the number of the blocks for enabling separate driving in the LED module and the number of the LED chips in the each block, thereby assuring an appropriate number of the LED chips according to area. As a result, the white LEDs can be arranged easily in a necessary number to have adequate density. This consequently improves a local dimming effect and overall color uniformity in a medium or large-sized display.

[0079] Hereinafter, a description will be given of a suitable number of LEDs and numbers of respective units such as the LED modules, blocks and chips for each block according to size of the backlight unit (BLU).

[0080] Here, the BLUs are applied to displays with representative sizes of 40 inch, 46 inch, 52 inch and 57 inch.

[0081] First, a total required light amount (unit: lumens) for the BLUs of each size can be set to 7000, 8000, 93000, and 13000, respectively. The number of LED chips satisfying such a total required light amount can be determined by a light amount of the unit LED chip as shown in Table 1.

[0082] A necessary number of the LED chips with 4, 8, 10, and 15 lumens, respectively for general use can be noted as in Table

Table 1

BLU size (inch)	40	46	52	57
Total required light amount (lumens)	7000	8000	9300	13000

(continued)

Number of LEDs according to unit LED light amount	4 lumens LED	1750	2000	2325	3250
	8 lumens LED	875	1000	1162	1625
	10 lumens LED	700	800	930	1300
	15 lumens LED	466	533	622	866

[0083] As shewn in Table 1, a necessary number of the LED chips may be slightly varied according to a unit light amount of the LED chips used. A great number of the LED chips need to be arranged suitably to ensure optimum density considering color uniformity and brightness.

[0084] To ensure that this arrangement allows for various areas and numbers more easily, according to the present embodiment, the number of LED modules, the number of blocks for each module, the number of LED chips for each block should be adequately selected to obtain optimum brightness and color uniformity.

[0085] To satisfy conditions shown in Table 1, the number of LED modules, the number of blocks for each module, and the number of LED chips for each block can be selected in the BLU of each size, as noted in Table 2.

Table 2

BLU size (inch)	40	46	52	57
Number of LED chips	466-1750	533-2000	622-2325	866-3250
Number of modules	6-12	6-12	6-12	6-20
Number of blocks	4-14	5-15	6-28	6-28
Number of LED chips for each block	6-24	6-24	6-24	6-24

[0086] In a case where the BLU is utilized in LCDs of a medium size such as 40 inch, and 46 inch, the number of the LED modules and the number of the LED chips for the each block may be selected identically. In a case where the LCD BLU is employed in a 40-inch LCD, each of the LED modules is defined into 4 to 14 blocks. Also, in a case where the LCD BLU is used in a 46-inch LCD, the LED module may include 5 to 15 blocks. Of course, the number of the modules and the number of the chips for the each block can be varied appropriately in a range shown in Table 2.

[0087] Moreover, in a case where the LCD BLU is utilized in LCDs with a relatively big size of 52 inch and 57 inch, the number of the blocks for each LED module may be selected to range from 6 to 28, and the number of the LED chips for each block may be selected to range from 6 to 24. In a case where the LCD BLU is utilized in a 52 inch LCD, the number of the modules may be 6 to 12. Also, in a case where the LCD BLU is used in a 57 inch LCD, the number of LED modules may be 6 to 20.

[0088] Of course, the white LEDs for use in the separately driven LCD backlight unit may be any type of the white LED light sources described above (see "Surface light source using white LEDs").

[0089] As set forth above, according to exemplary embodiments of the invention, in a surface light source using white LEDs and an LCD backlight unit having the same, white LEDs can be arranged appropriately to produce uniform white light overall. Also, unlike a conventional surface light source including a combination of red, green and blue LEDs, only one-chip, i.e., white LEDs are employed to allow the LEDs to be arranged with less limitation. This also ensures easier manufacture of the backlight unit and simpler configuration of circuits.

[0090] In addition, uniform white light can be irradiated onto an LCD panel to assure a clearer LCD image.

[0091] 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 scope of the invention as defined by the appended claims.

Claims

1. A surface light source (100) using white light emitting diodes (110) comprising:

a plurality of white light emitting diodes (110) arranged at a predetermined distance from one another, wherein the white light emitting diodes (110) are arranged such that a light emitting diode unit defined by each of the white light emitting diodes (110) and corresponding ones of the white light emitting diodes (110) disposed at a closest distance from each white light emitting diode has a central light amount ranging from 80% to 120%

with respect to an average light amount of the white light emitting diodes (110), **characterised in that** the white light emitting diode comprises a blue light emitting diode chip having a dominant wavelength of 430 to 456nm, a red phosphor emitting red light and a green phosphor emitting green light, and
wherein the red light emitted from the red phosphor has a color coordinate falling within a space defined by four coordinate points (0.6448, 0.4544), (0.8079, 0.2920), (0.6427, 0.2905) and (0.4794, 0.4633) based on the CIE 1931 chromaticity diagram, and
the green light emitted from the green phosphor has a color coordinate falling within a space defined by four coordinate points (0.1270, 0.8037), (0.4117, 0.5861), (0.4197, 0.5316) and (0.2555, 0.5030) based on the CIE 1931 chromaticity diagram; and
wherein the red phosphor is represented by $CaAlSiN_3$:Eu and the green phosphor is represented by at least one of $(Ba_x,Sr_y,Mg_z)SiO_4:Eu^{2+}$, F, Cl, where 0<x, y≤2, 0≤z≤2, 0ppm≤F, Cl≤5000000ppm and β-SiAlON.

2. The surface light source of Claim 1, wherein an emission spectrum of the blue light emitting diode chip has a full width at half-maximum of 10 to 30nm, the green phosphor has a full width at half-maximum of 30 to 100nm and the red phosphor has a full width at half-maximum of 50 to 200nm.

3. The surface light source of Claim 1 or Claim 2, wherein the white light emitting diodes (110) are arranged in a matrix of columns and rows having a spacing of 8.2 to 70 mm from one another, respectively.

4. The surface light source of any of Claims 1 to 3, wherein the white light emitting diodes (110) are arranged by adjusting at least one of spacing of columns, spacing of rows and arrangement angles thereof.

5. A liquid crystal display backlight unit comprising:

a board (210);
a reflective plate (220) disposed on the board;
a surface light source according to any of Claims 1 to 4 disposed on the reflective plate;
a diffusing sheet (240) disposed on the surface light source to diffuse light incident from the surface light source uniformly; and
a light collecting sheet (250) disposed on the diffusing sheet to collect the light diffused by the diffusing sheet.

6. The liquid crystal display backlight unit of Claim 5, further comprising a protective sheet (260) disposed on the light collecting sheet.

Patentansprüche

1. Oberflächenlichtquelle (100), die weiße Leuchtdioden (110) verwendet, umfassend:

mehrere weiße Leuchtdioden (110), die in einem vorbestimmten Abstand voneinander angeordnet sind,
wobei die weißen Leuchtdioden (110) so angeordnet sind, dass eine Leuchtdiodeneinheit, die durch jede der weißen Leuchtdioden (110) und entsprechende der weißen Leuchtdioden (110), die in einem nächsten Abstand von jeder weißen Leuchtdiode angeordnet sind, definiert wird, eine zentrale Lichtmenge aufweiset, die im Bereich von 80 % bis 120 % relativ zu einer durchschnittlichen Lichtmenge der weißen Leuchtdioden (110) liegt, **dadurch gekennzeichnet, dass**
die weiße Leuchtdiode einen blauen Leuchtdiodenchip, der eine dominierende Wellenlänge von 430 bis 456 nm hat, einen roten Leuchtstoff, der rotes Licht aussendet, und einen grünen Leuchtstoff, der grünes Licht aussendet, umfasst, und
wobei das rote Licht, das von dem roten Leuchtstoff ausgesendet wird, eine Farbkoordinate hat, die in einen Raum fällt, der durch vier Koordinatenpunkte (0,6448, 0,4544), (0,8079, 0,2920), (0,6427, 0,2905) und (0,4794, 0,4633), basierend auf der CIE 1931-Farbtafel (Normfarbtafel), definiert wird, und
das grüne Licht, das von dem grünen Leuchtstoff ausgesendet wird, eine Farbkoordinate hat, die in einen Raum fällt, der durch vier Koordinatenpunkte (0,1270, 0,8037), (0,4117, 0,5861), (0,4197, 0,5316) und (0,2555, 0,5030), basierend auf der CIE 1931-Farbtafel, definiert wird; und
wobei der rote Leuchtstoff durch $CaAlSiN_3$:Eu repräsentiert wird und der grüne Leuchtstoff durch $(Ba_x,Sr_y,Mg_z)SiO_4:Eu^{2+}$ und/oder F und/oder Cl repräsentiert wird, wobei 0 < x, y ≤ 2, 0 ≤ z ≤ 2, 0 ppm ≤ F, Cl ≤ 5000000 ppm und β-SiAlON.

2. Oberflächenlichtquelle nach Anspruch 1, wobei ein Emissionsspektrum des blauen Leuchtdiodenchips eine Halbwertsbreite (Weite bei halben Maximum) von 10 bis 30 nm hat, der grüne Leuchtstoff eine Halbwertsbreite von 30 bis 100 nm hat und der rote Leuchtstoff eine Halbwertsbreite von 50 bis 200 nm hat.

3. Oberflächenlichtquelle nach Anspruch 1 oder Anspruch 2, wobei die weißen Leuchtdioden (110) in einer Matrix aus Spalten und Zeilen angeordnet sind, die jeweils einen Abstand von 8,2 bis 70 mm voneinander haben.

4. Oberflächenlichtquelle nach einem der Ansprüche 1 bis 3, wobei die weißen Leuchtdioden (110) angeordnet werden, indem die Beabstandung von Spalten und/oder die Beabstandung von Zeilen und/oder deren Anordnungsdinkel justiert werden.

5. Flüssigkristallanzeige-Hintergrundbeleuchtungseinheit, umfassend:

eine Platine (210);
eine reflektierende Platte (220), die auf der Platine angeordnet ist;
eine Oberflächenlichtquelle nach einem der Ansprüche 1 bis 4, die auf der reflektierenden Platte angeordnet ist;
eine Lichtstreuungsschicht (240), die auf der Oberflächenlichtquelle angeordnet ist, um Licht, das von der Oberflächenlichtquelle auftrifft, gleichmäßig zu streuen; und
eine Lichtsammelschicht (250), die auf der Lichtstreuungsschicht angeordnet ist, um das von der Lichtstreuungsschicht gestreute Licht zu sammeln.

6. Flüssigkristallanzeige-Hintergrundbeleuchtungseinheit nach Anspruch 5, weiterhin umfassend eine Schutzschicht (260), die auf der Lichtsammelschicht angeordnet ist.

Revendications

1. Source lumineuse de surface (100) utilisant des diodes émettant de la lumière blanche (110) comprenant :

une pluralité de diodes émettant de la lumière blanche(110) arrangées à une distance prédéterminée les unes des autres,
dans laquelle les diodes émettant de la lumière blanche (110) sont disposées de telle sorte qu'une unité de diode luminescente définie par chacune des diodes émettant de la lumière blanche (110) et les diodes émettant de la lumière blanche (110) disposées de manière la plus proche de chaque diode émettant de la lumière blanche ait une quantité de lumière centrale allant de 80 % à 120 % par rapport à une quantité de lumière moyenne des diodes émettant de la lumière blanche (110), **caractérisée en ce que**
la diode émettant de la lumière blanche comprend une puce à diode émettant de la lumière bleue ayant une longueur d'onde dominante de 430 à 456 nm, un phosphore rouge émettant de la lumière rouge et un phosphore vert émettant de la lumière verte, et
dans laquelle la lumière rouge émise par le phosphore rouge a une coordonnée chromatique tombant dans un espace défini par quatre points de coordonnées (0,6448, 0,4544), (0,8079, 0,2920), (0,6427, 0,2905) et (0,4794, 0,4633) sur la base du diagramme de chromaticité CIE 1931, et
la lumière verte émise par le phosphore vert a une coordonnée chromatique tombant dans un espace défini par quatre points de coordonnées (0,1270, 0,8037), (0,4117, 0,5861), (0,4197, 0,5316) et (0,2555, 0,5030) sur la base du diagramme de chromaticité CIE 1931 ; et
dans laquelle le phosphore rouge est représenté par $CaAlSiN_3$:Eu et le phosphore vert est représenté par au moins un de $(Ba_x, Sr_y, Mg_z)SiO_4:Eu^{2+}$, F, Cl, où $0 < x, y \leq 2$, $0 \leq z \leq 2$, 0 ppm ≤ F, Cl ≤ 5 000 000 ppm et β-SiAlON.

2. Source lumineuse de surface selon la revendication 1, dans laquelle un spectre d'émission de la puce à diode émettant de la lumière bleue a une largeur totale à mi-hauteur de 10 à 30 nm, le phosphore vert a une largeur totale à mi-hauteur de 30 à 100 nm et le phosphore rouge a une largeur totale à mi-hauteur de 50 à 200 nm.

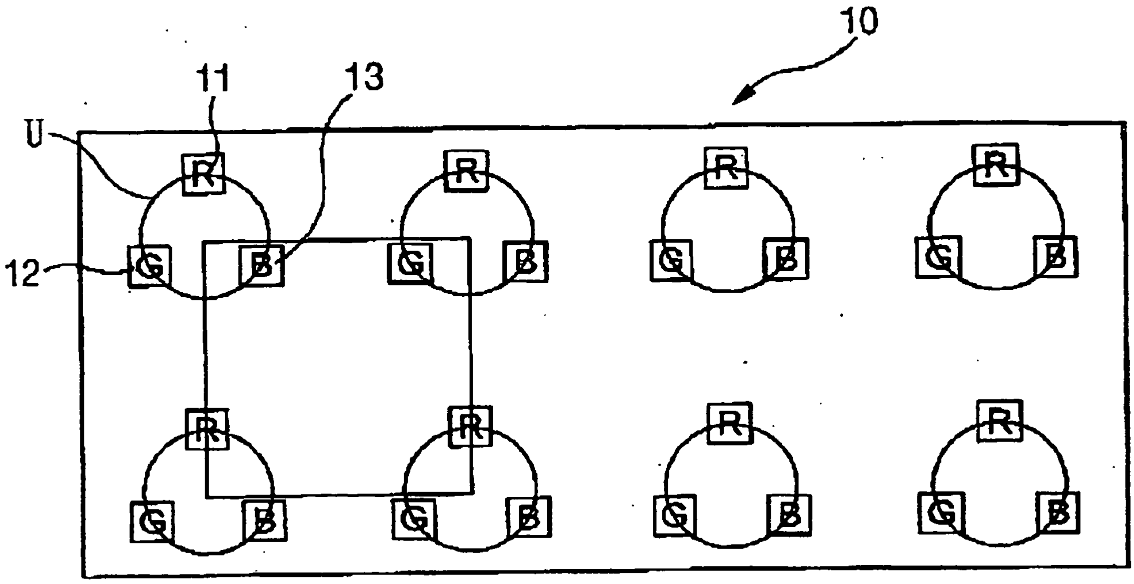
3. Source lumineuse de surface selon la revendication 1 ou la revendication 2, dans laquelle les diodes émettant de la lumière blanche (110) sont disposées selon une matrice de colonnes et de rangées ayant un espacement de 8,2 à 70 mm l'une par rapport à l'autre, respectivement.

4. Source lumineuse de surface selon l'une quelconque des revendications 1 à 3, dans laquelle les diodes émettant de la lumière blanche (110) sont agencées en ajustant au moins un de l'espacement des colonnes, de l'espacement des rangées et des angles d'agencement de celles-ci.

5. Unité de rétroéclairage à cristaux liquide comprenant :

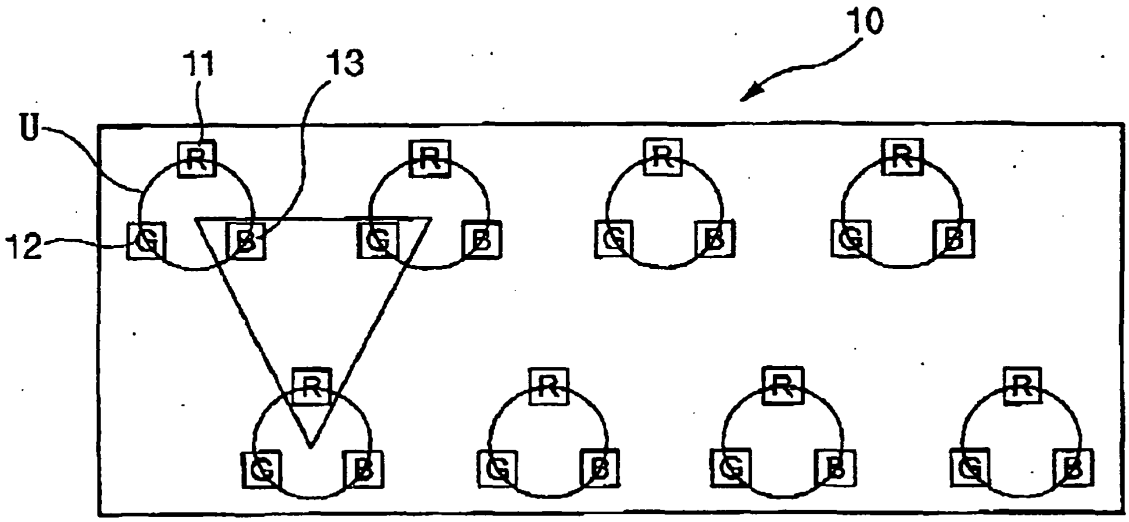
un panneau (210) ;
une plaque réfléchissante (220) disposée sur le panneau ;
une source lumineuse de surface selon l'une quelconque des revendications 1 à 4, disposée sur la plaque réfléchissante ;
une feuille diffusante (240) disposée sur la source lumineuse de surface pour diffuser la lumière incidente depuis la source lumineuse de surface de manière uniforme ; et
une feuille captant la lumière (250) disposée sur la feuille diffusante pour capter la lumière diffusée par la feuille diffusante.

6. Unité de rétroéclairage à cristaux liquide selon la revendication 5, comprenant en outre une feuille de protection (260) disposée sur la feuille captant la lumière.



PRIOR ART

FIG. 1



PRIOR ART

FIG. 2

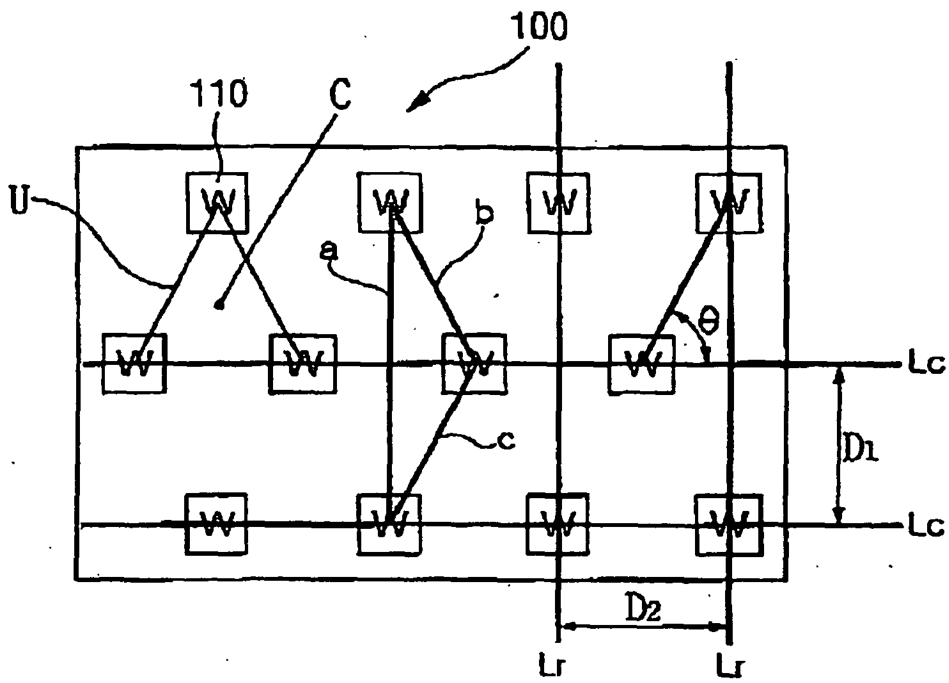


FIG. 3

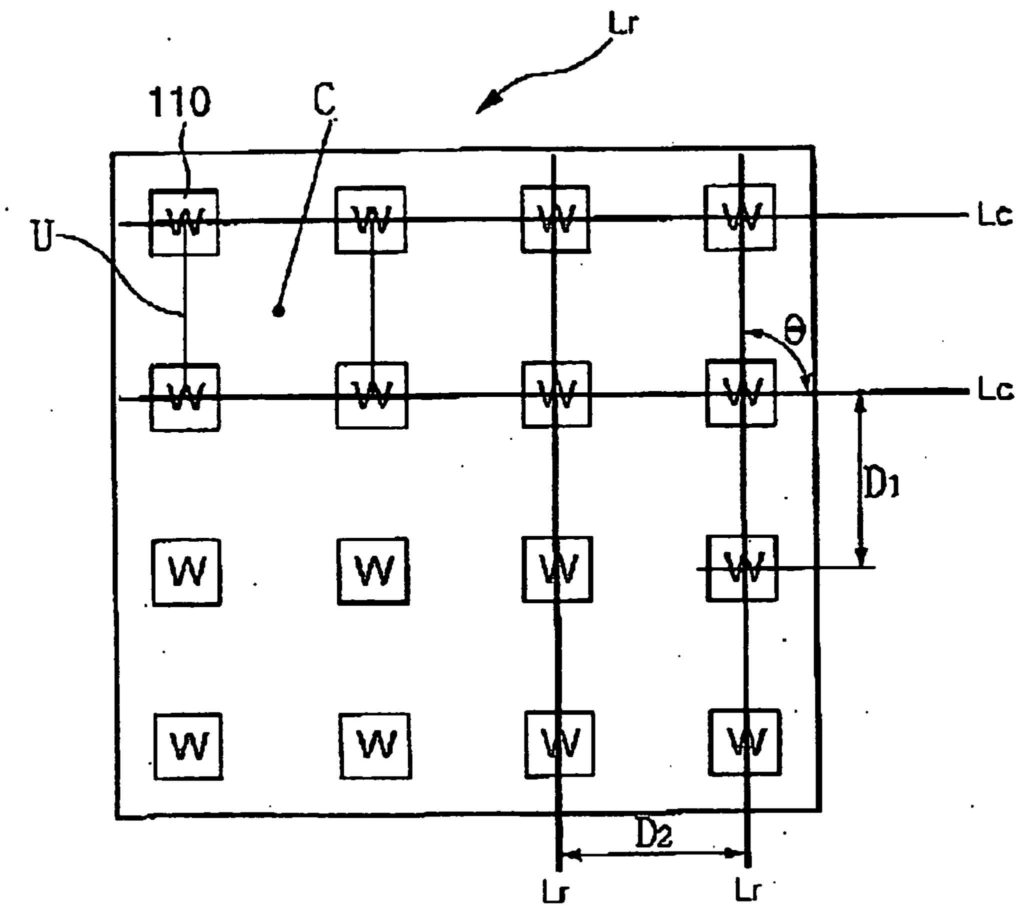


FIG. 4

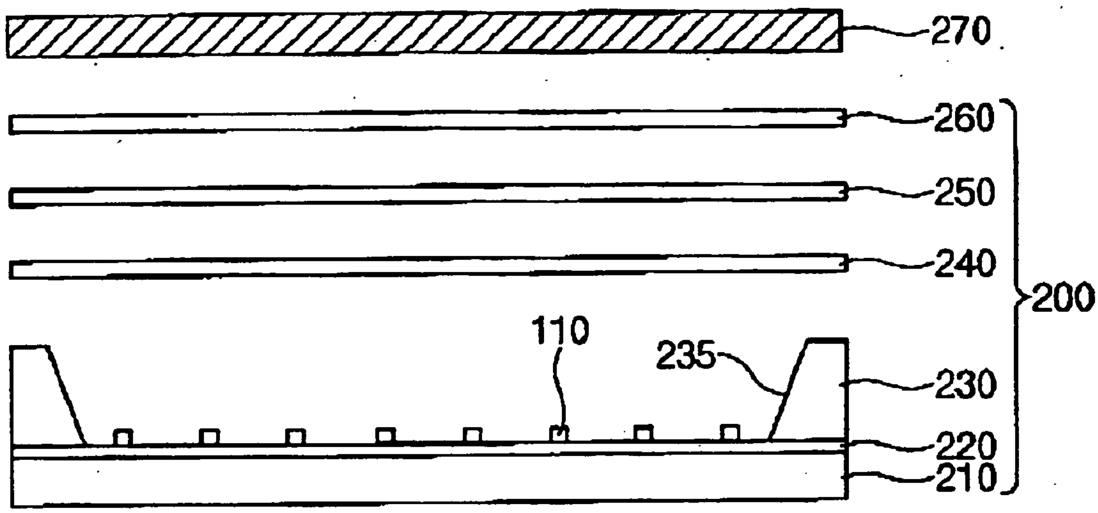


FIG. 5

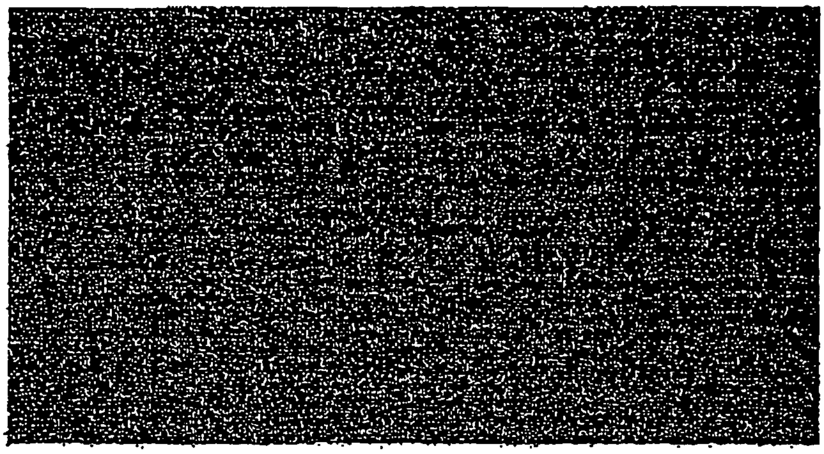


FIG. 6A

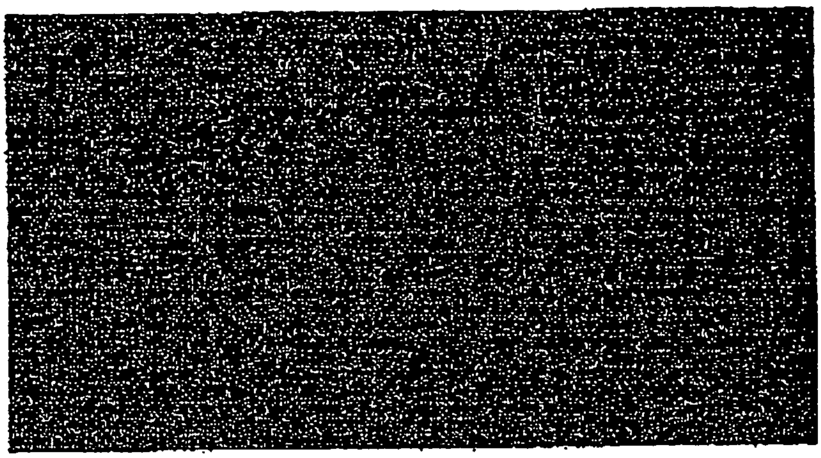


FIG. 6B

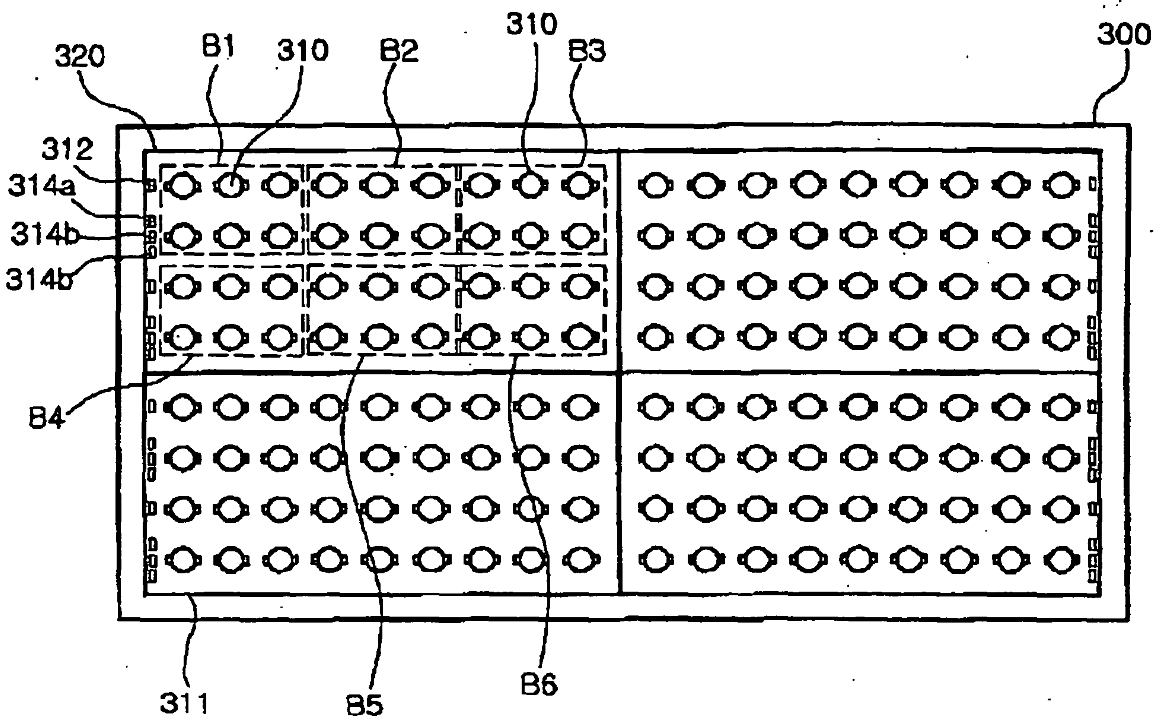


FIG. 7

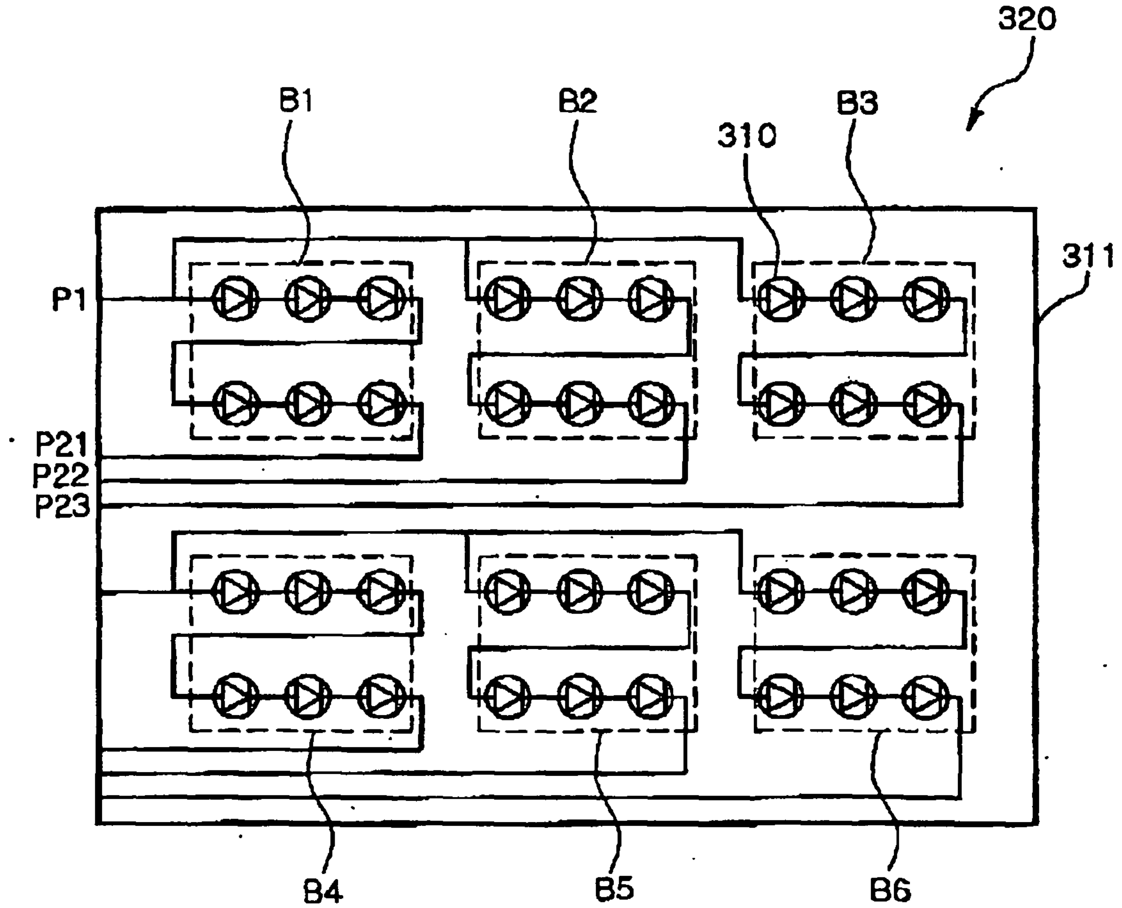
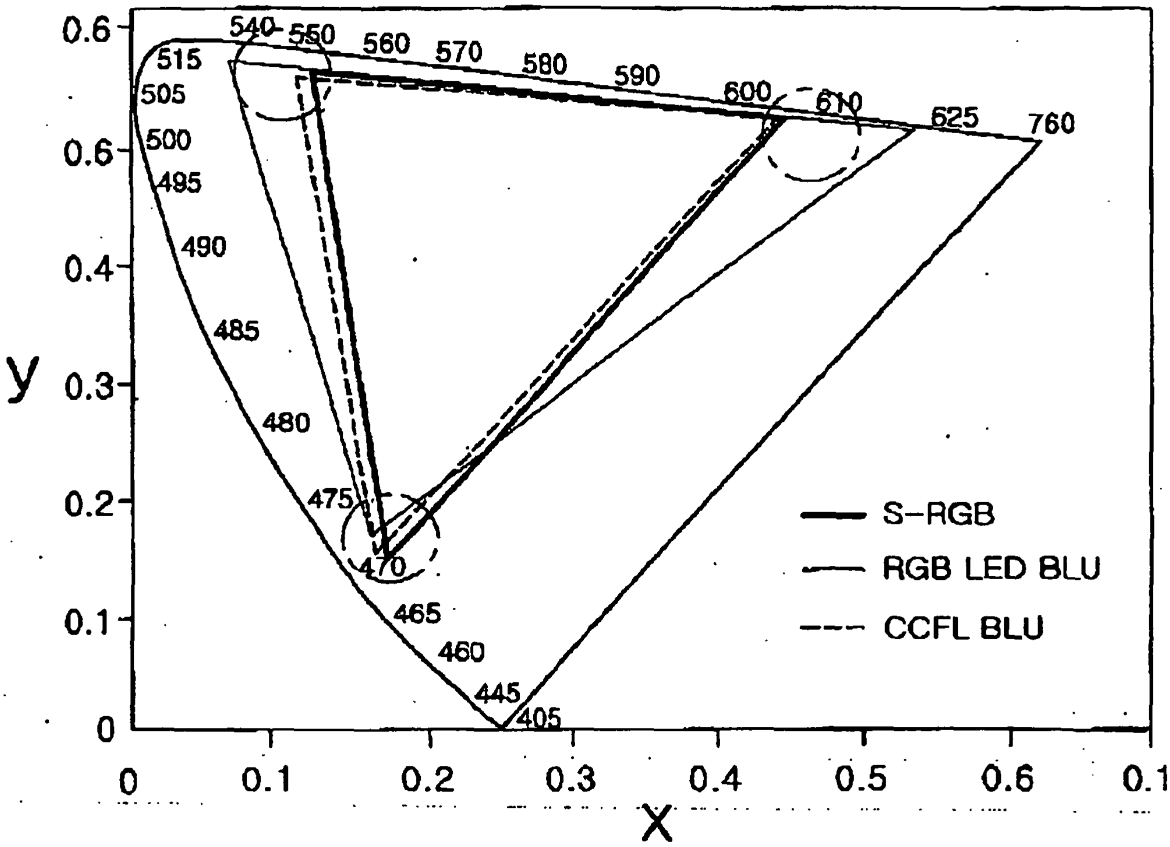


FIG. 8


y
x
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0.6
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.1
540
550
560
570
580
590
600
610
625
760
515
505
500
495
490
485
480
475
470
465
460
445
405
S-RGB
RGB LED BLU
CCFL BLU

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 200786197 **[0001]**
- KR 200822437 **[0001]**
- EP 1717633 A **[0008]**

专利名称(译)	使用白色发光二极管的表面光源和具有该表面光源的液晶显示器的背光单元		
公开(公告)号	EP2031437B1	公开(公告)日	2012-05-23
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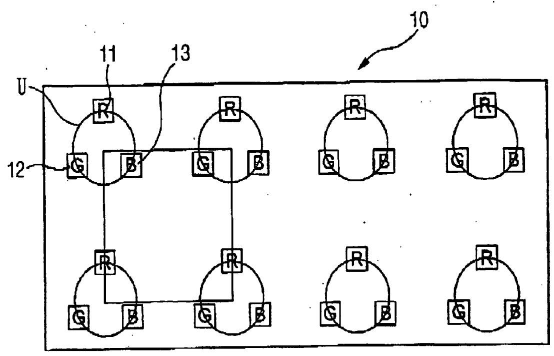
[标]申请(专利权)人(译)	三星电机株式会社		
申请(专利权)人(译)	三星机电股份有限公司.		
当前申请(专利权)人(译)	三星LED有限公司.		
[标]发明人	SHIN CHANG HO CHO DONG HYUN YOO CHUL HEE KIM DAE YEON KIM HYUNG SUK HAHM HUN JOO SHIN JAE HONG		
发明人	SHIN, CHANG HO CHO, DONG HYUN YOO, CHUL HEE KIM, DAE YEON KIM, HYUNG SUK HAHM, HUN JOO SHIN, JAE HONG		
IPC分类号	G02F1/13357 G09G3/34 F21V9/40 H01L33/50 H01L33/60		
CPC分类号	G02F1/133603 G02F1/133606 G02F1/133611 G09G3/3413 G09G3/3426 G09G2320/0233		
代理机构(译)	ZIMMERMANN & PARTNER		
优先权	1020070086197 2007-08-27 KR 1020080022437 2008-03-11 KR		
其他公开文献	EP2031437A1		
外部链接	Espacenet		

摘要(译)

提供一种使用白色发光二极管(110)的面光源(200),包括:多个白光发光二极管(110),彼此以预定距离(a,b,c)布置,其中白光发光二极管被布置成使得由每个白色发光二极管限定的发光二极管单元和设置在距每个白色发光二极管最近距离(U)的相应白色发光二极管具有中心光量范围相对于白色发光二极管的平均光量,鳟鱼为80%至120%。



PRIOR ART

FIG. 1