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Lee et al.

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(54) **BACKLIGHT ASSEMBLY AND LIQUID CRYSTAL DISPLAY APPARATUS**

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(30) **Foreign Application Priority Data**

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G02F 1/1335

(52) **U.S. Cl.** **362/225**; **362/219**; **362/223**;
362/247; **349/70**; **439/235**

(58) **Field of Search** 362/23, 29, 217,
362/219, 221-225, 240, 241, 245-247,
260; 313/318.02; 349/70; 439/235, 239,
698; 315/56-60, 169.3, 312, 324

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(57) **ABSTRACT**

Disclosed is a backlight assembly and an LCD apparatus having uniform brightness and low power consumption. The backlight assembly has a plurality of lamps for providing light to the LCD panel. Each of the plurality of lamps has two or more sub-lamps connected to each other in series. The backlight assembly has a brightness control unit disposed between the sub-lamps to reduce a brightness difference.

28 Claims, 11 Drawing Sheets

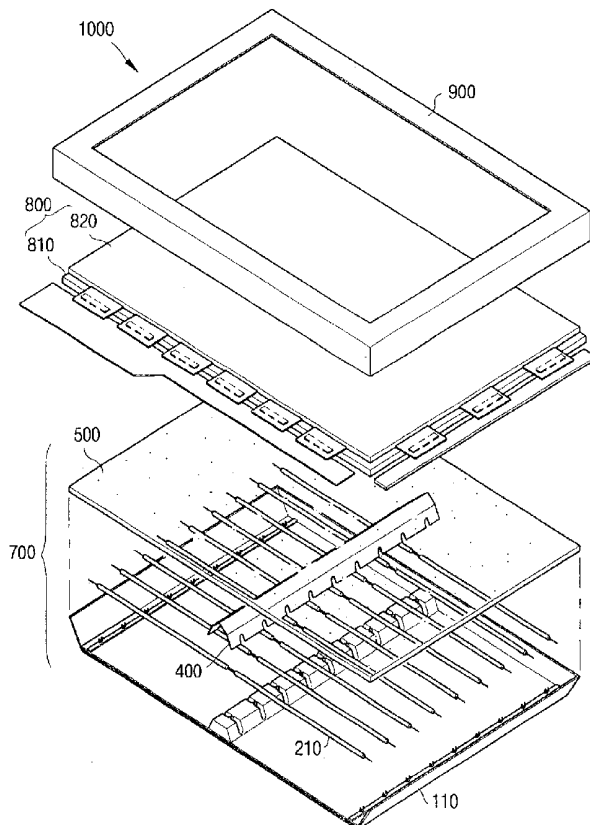


FIG. 2

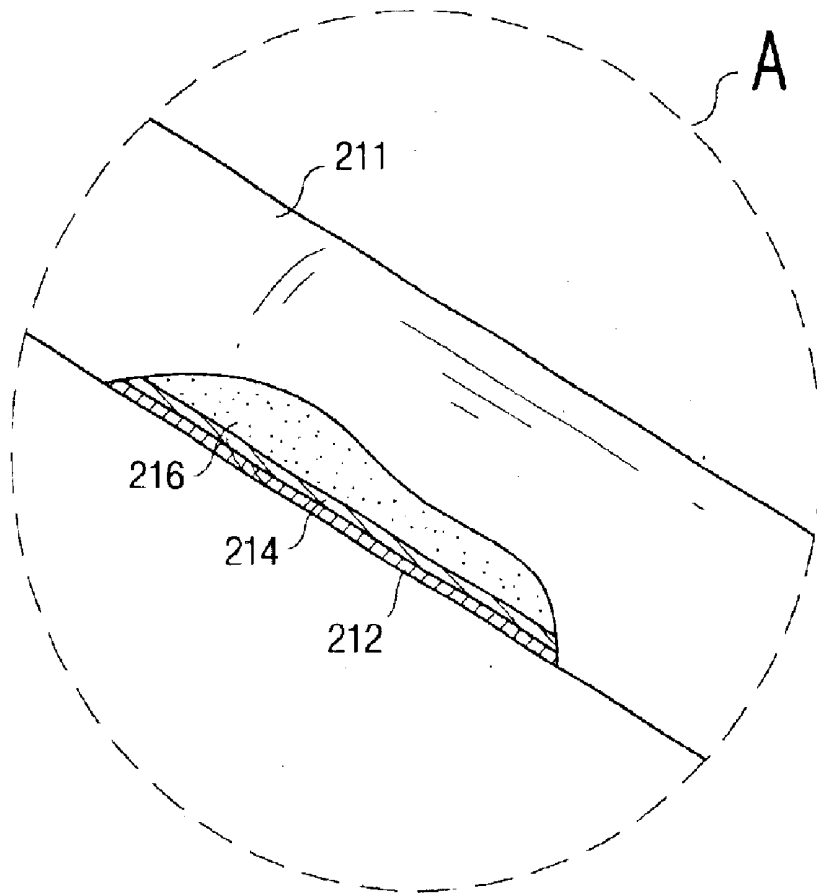


FIG. 3

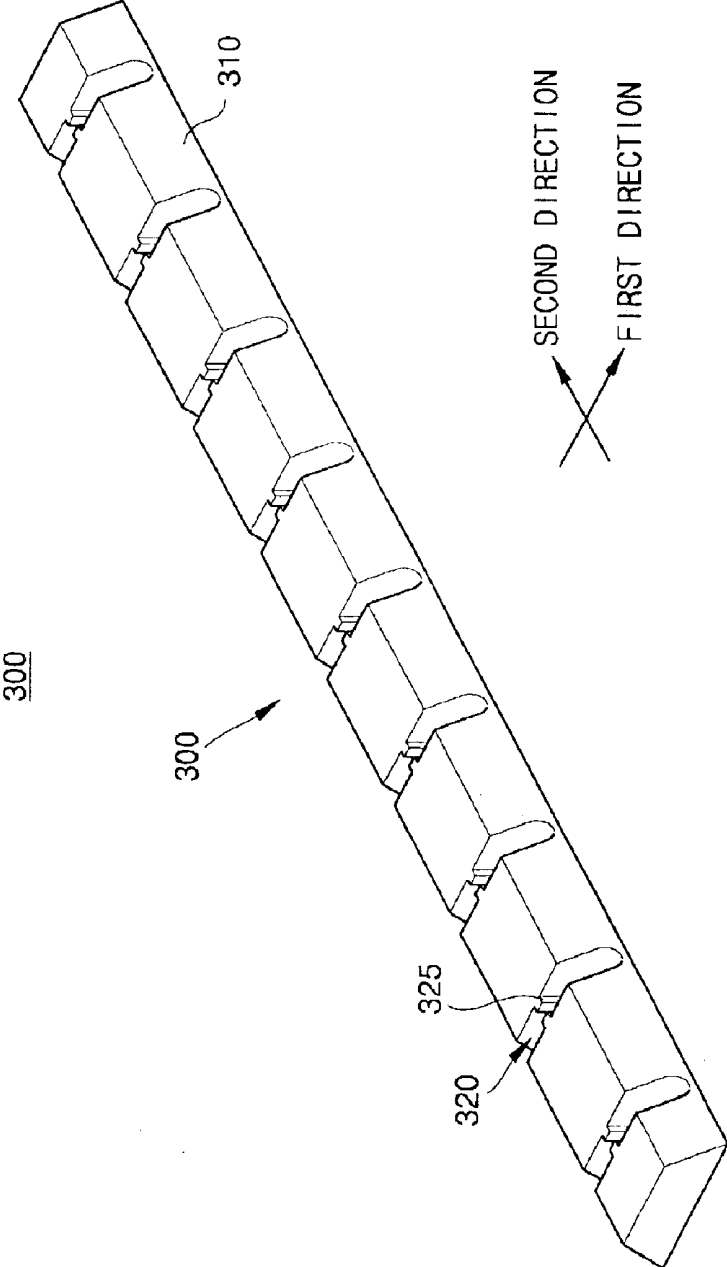


FIG. 4

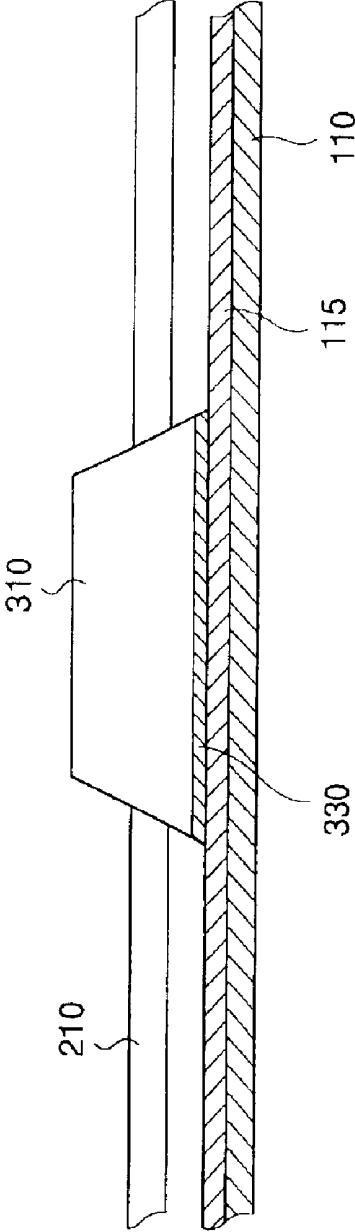


FIG. 5

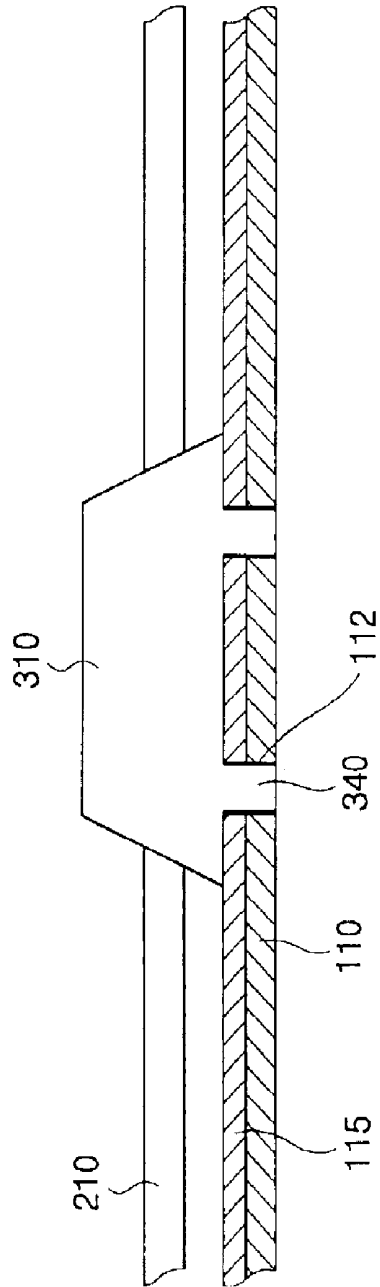


FIG. 6

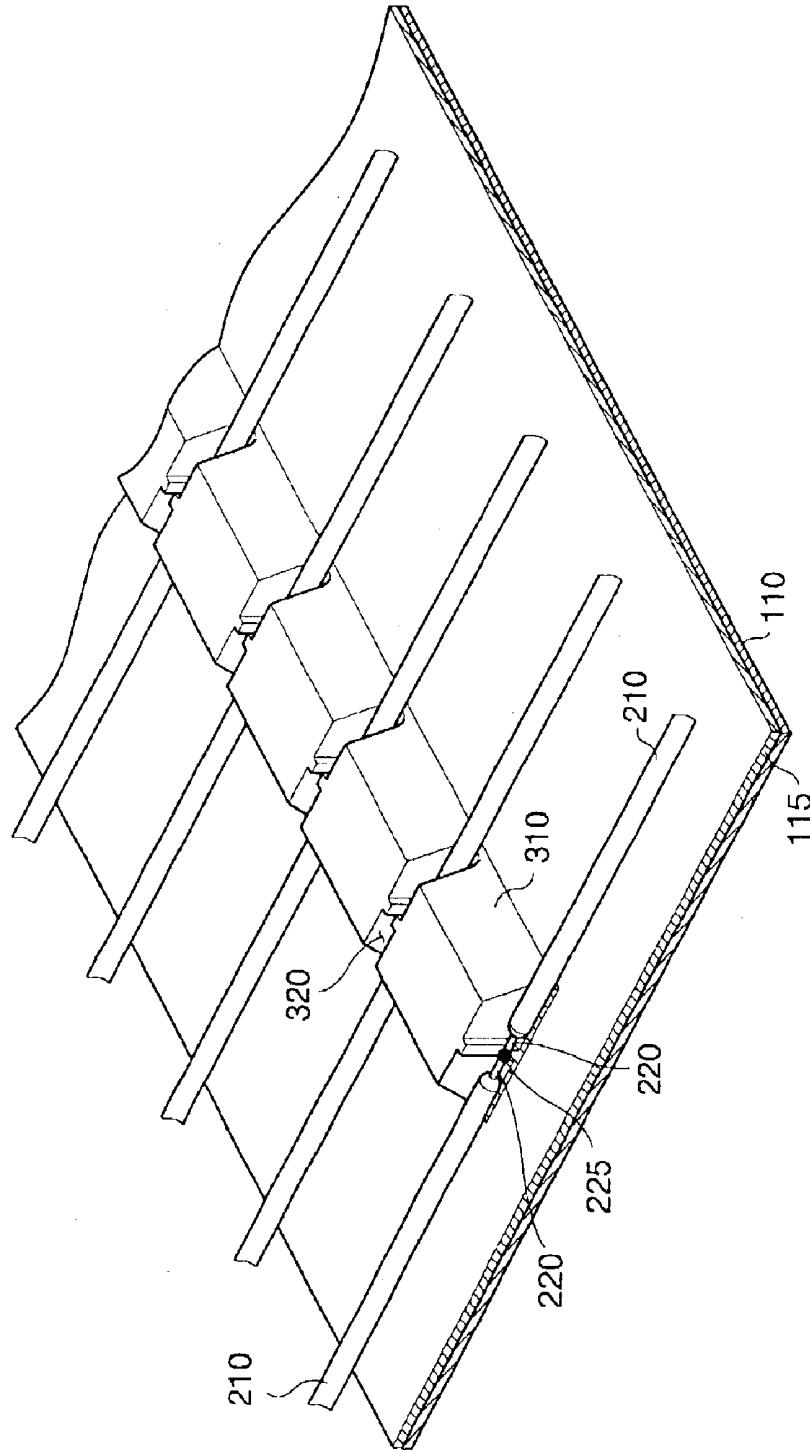


FIG. 7

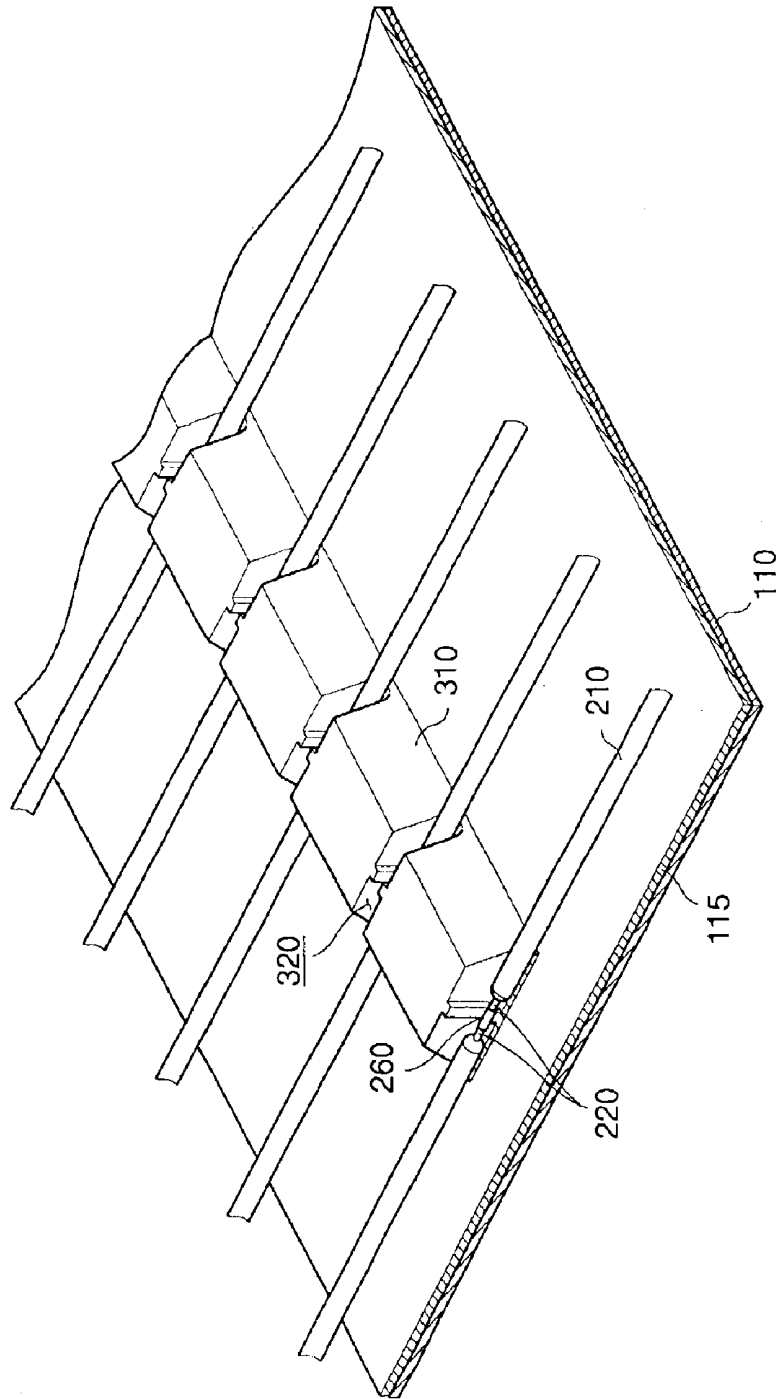


FIG. 8

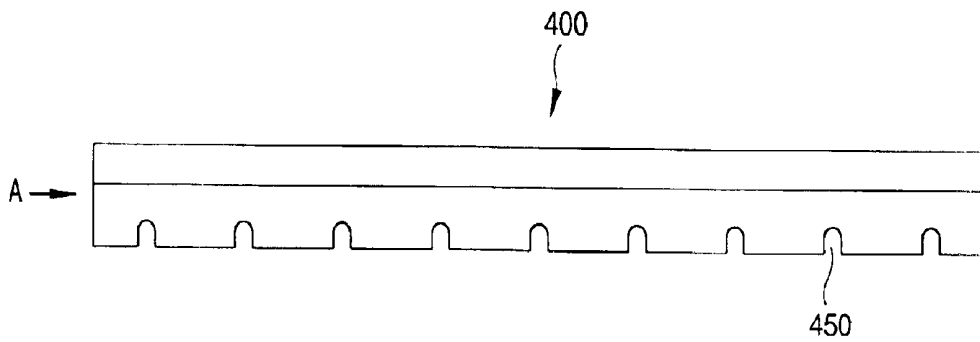


FIG. 9

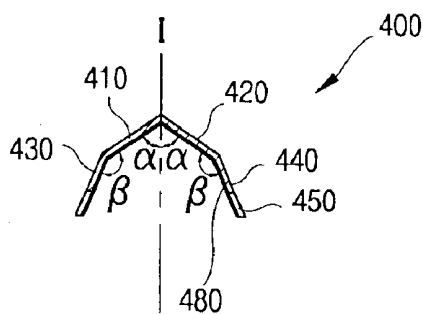


FIG. 10

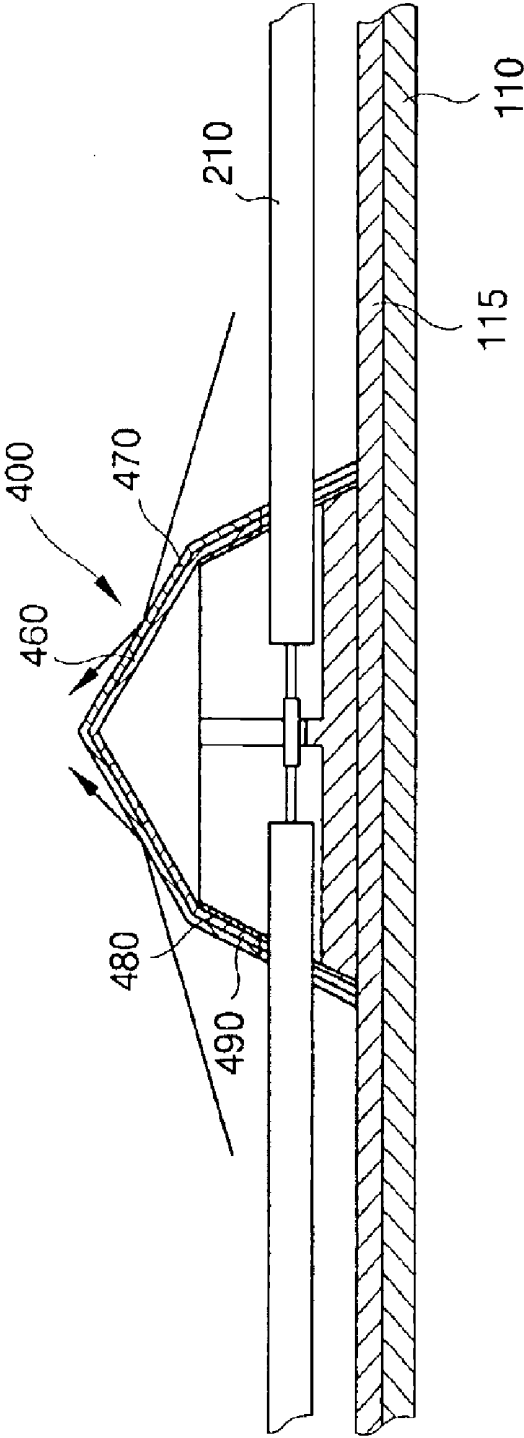


FIG. 11

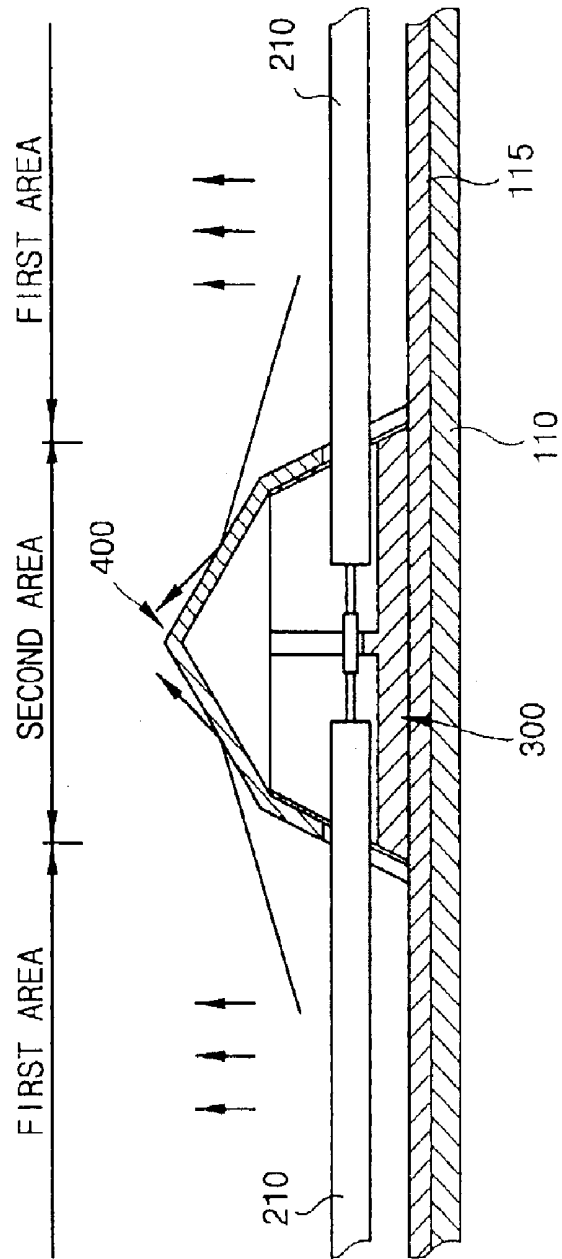
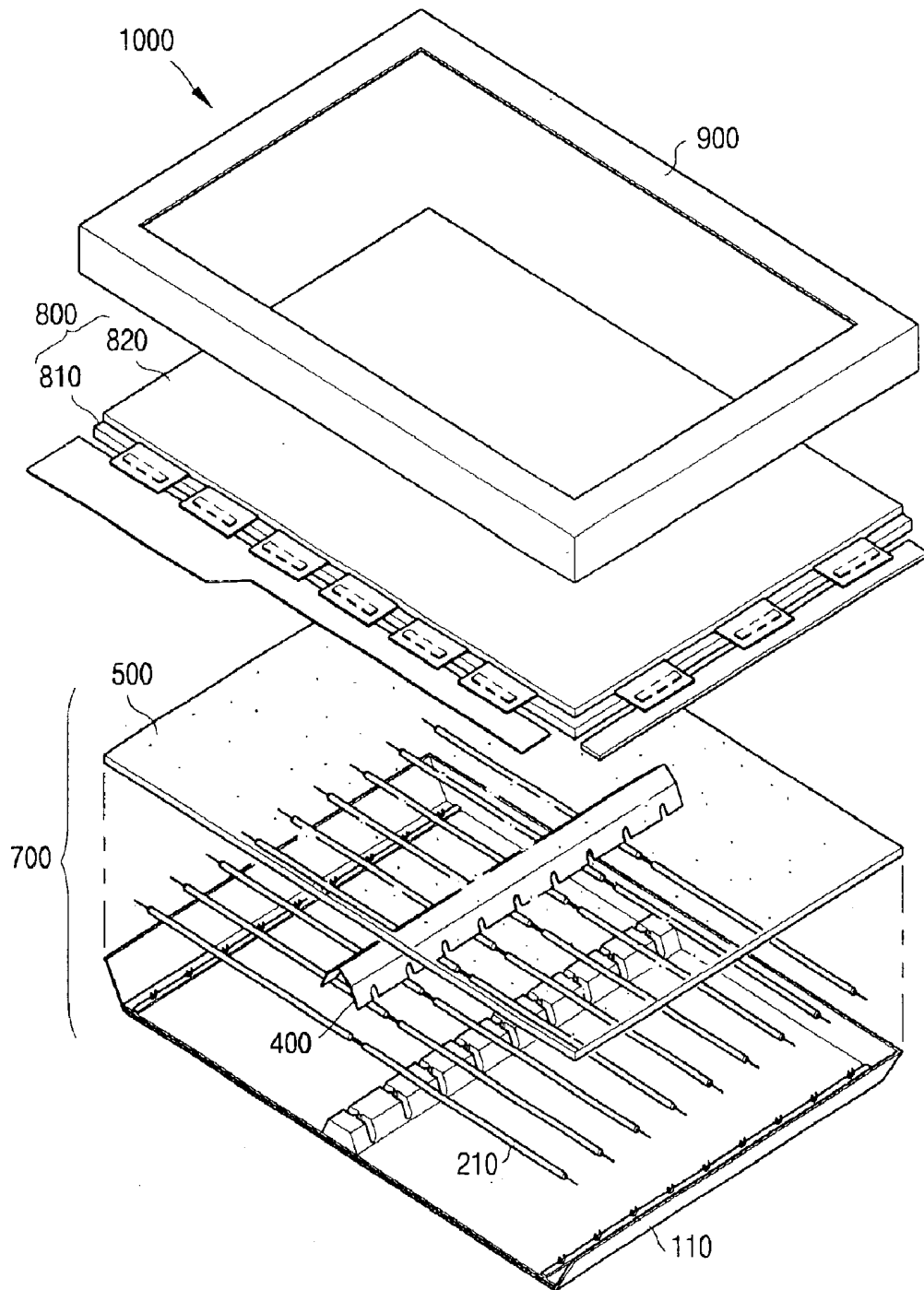


FIG. 12



BACKLIGHT ASSEMBLY AND LIQUID CRYSTAL DISPLAY APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a backlight assembly and an LCD (Liquid Crystal Display) apparatus, and more particularly to a backlight assembly and LCD apparatus having uniform brightness and low power consumption.

2. Description of the Related Art

An LCD apparatus displays images using electric signals generated from a device processing image information. In order to display images, an LCD apparatus is generally provided with a liquid crystal control device and a light supply device. The liquid crystal control device controls the liquid crystal in response to the electric signals from the image information processing device, and the light supply device supplies light to the liquid crystal control device.

The light supply device may be an one-dimensional light source for generating one-dimensional light such as point light or linear light, or a two-dimensional light source for generating two-dimensional light such as surface light. The LCD apparatus employs the one-dimensional light source such as a CCFL (Cold Cathode Fluorescent Lamp) generating one-dimensional light.

However, the length of a CCFL becomes longer as the display size of an LCD apparatus becomes larger. Where the length of a CCFL becomes longer, a voltage for driving the CCFL, heat emitted from the CCFL and power consumption in the CCFL increase. Also, since the weight of a CCFL increases in accordance with increase in its length, the CCFL may be bent, thereby deteriorating display quality of the LCD apparatus.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a backlight assembly having uniform brightness and requiring low power consumption.

The present invention also provides an LCD apparatus having uniform brightness and requiring low power consumption. In one aspect of the invention, there is provided a backlight assembly comprising:

a receiving container having a bottom surface and a sidewall extended from the bottom surface; a plurality of lamps disposed on the bottom surface, each of the lamps having two or more sub-lamps connected to each other in series, the two or more sub-lamps being disposed in a first direction, for generating light; a lamp holder disposed on the bottom surface in a second direction perpendicular to the first direction, for receiving a connection portion where the sub-lamps are connected to each other; and a diffusing plate disposed on the receiving container, for diffusing the light emitted from the lamps.

In another aspect, there is provided an LCD apparatus comprising:

a receiving container having a bottom surface and a sidewall extended from the bottom surface; a plurality of lamps disposed on the bottom surface, each of the lamps having two or more sub-lamps connected to each other in series and disposed in a first direction, wherein the sub-lamps generate light having first brightness at an area proximate the sub-lamps and light having second brightness at an area proximate a connection portion where the sub-lamps are connected to each other; a lamp holder disposed

on the bottom surface, for receiving the connection portion; a brightness control unit for reflecting a portion of the light emitted from the lamps to reduce a brightness difference between the first brightness and the second brightness, the brightness control unit being disposed on the lamp holder; a diffusing plate disposed on the receiving container, for diffusing the light emitted from the lamps; and an LCD panel disposed on the diffusing plate, for receiving the light from the diffusing plate and displaying an image.

According to the present invention, a backlight assembly has the plurality of lamps for providing light to an LCD panel. Each of the lamps has two or more sub-lamps connected to each other in series. Also, a backlight assembly has a brightness control unit disposed between the sub-lamps to reduce the brightness difference between the sub-lamps. Thus, the backlight assembly may reduce consumption power of the lamps having the two or more sub-lamps and provide the light having uniform brightness to the LCD panel.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other advantages of the present invention will become readily apparent by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is an exploded perspective view showing a backlight assembly according to an exemplary embodiment of the present invention;

FIG. 2 is a schematic view showing a structure of a lamp shown in FIG. 1;

FIG. 3 is a perspective view showing a structure of the lamp holder shown in FIG. 1;

FIG. 4 is a schematic view showing an assembled structure between a lamp holder and a receiving container according to an exemplary embodiment of the present invention;

FIG. 5 is a schematic view showing an assembled structure between a lamp holder and a receiving container according to another embodiment of the present invention;

FIG. 6 is a schematic view showing a connection structure of two sub-lamps according to an exemplary embodiment of the present invention;

FIG. 7 is a schematic view showing a connection structure of two sub-lamps according to another embodiment of the present invention;

FIG. 8 is a schematic view showing a structure of the brightness control unit shown in FIG. 1;

FIGS. 9 and 10 are cross-sectional views of the brightness control unit shown in FIG. 8;

FIG. 11 is a schematic view for illustrating an operation of the brightness control unit shown in FIG. 10; and

FIG. 12 is a perspective view showing a structure of an LCD apparatus according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is an exploded perspective view showing a backlight assembly according to an exemplary embodiment of the present invention.

Referring to FIG. 1, the backlight assembly 700 includes a receiving container 100, a reflecting plate 115, lamps 200, a lamp holder 300, a brightness control unit 400 and a diffusing plate 500. A lamp 200 may have, for example, two or more sub-lamps 210 and the backlight assembly 700 may have the lamps 200 each having two or more sub lamps 210.

The receiving container **100** includes a bottom surface **110** and sidewalls **120** each extended from an edge portion of the bottom surface **110**. The bottom surface **110**, for example, has a rectangular shape. In FIG. 1, a first direction is the longitudinal direction of the bottom surface **110** and a second direction is the widthwise direction perpendicular to the first direction. The lamps **200** are disposed on the bottom surface **110** of the receiving container **100**. Each of the sub-lamps **210** includes a lamp tube **211**, a first electrode **220**, and a second electrode **230**.

FIG. 2 is an enlarged view of portion A in FIG. 1. Referring to FIG. 2, the lamp tube **211** includes a tube body **212**, a fluorescent material **214** and a discharge gas **216**. The tube body **212** has a tube shape sealed at opposite end portions thereof. The fluorescent material **214** is deposited on an inner surface of the tube body **212** and the discharge gas **216** is injected into the tube body **212**.

The first and second electrodes **220** and **230** are disposed inside the opposite end portions of the tube body **212** and connected to a lead line, respectively. The first and second electrodes **220** and **230** receive a discharge voltage having a potential difference appropriate to ionize the discharge gas **216** in the lamp tube **211**, so that light is emitted from the lamp tube **211**.

The lamp **200** having the two sub-lamps **210** is disposed on the bottom surface **110** of the receiving container **100** in the first and second directions. The two sub-lamps **210** of the lamp **200** are electrically connected in series through the first electrodes **220** thereof. Where the backlight assembly **700** has two or more lamps having a structure such as the lamp **200** having the two sub-lamps **210**, the lamps are connected to each other in parallel.

FIG. 3 is a perspective view showing the lamp holder **300** shown in FIG. 1. Referring to FIG. 3, the lamp holder **300** includes a lamp holder body **310** and lamp receiving grooves **320** disposed on the lamp holder body **310**. The lamp holder body **310** is disposed on the bottom surface **110** in the second direction and has a bar shape, as a whole, with a bottom surface wider than its top surface.

The lamp receiving grooves **320** are formed on the lamp holder body **310**, and the number of the lamp receiving grooves **320** is corresponding to the number of the lamps **200** employed in the backlight assembly **700**. Each of the lamp receiving grooves **320** has a depth and a width suitable to receive the sub-lamp **210**. The lamp receiving grooves **320** are each provided with a protrusion portion **325** for preventing the sub-lamps **210** from being movable because the sub-lamps **210** received into the lamp receiving grooves **320** may move in the first direction. The protrusion portions **325** are protruded from sidewalls, respectively, of the lamp receiving groove **320** and are disposed between the sub-lamps **210** of the lamp **200**.

FIG. 4 is a schematic view showing an assembled structure between a lamp holder and a receiving container according to an exemplary embodiment of the present invention. Referring to FIG. 4, the lamp holder body **310** may be adhered to the bottom surface **110** using adhesive, for example, double-sided tape **330**.

FIG. 5 is a schematic view showing an assembled structure between a lamp holder and a receiving container according to another embodiment of the present invention.

Referring to FIG. 5, the lamp holder body **310** is provided with engaging protrusions **340** and the bottom surface **110** is provided with engaging openings **112** corresponding to the engaging protrusions **340**, respectively. The lamp holder body **310** and bottom surface **110** are engaged to each other

by engaging the engaging protrusions **340** into the engaging openings **112**, respectively.

FIG. 6 is a schematic view showing a connection structure of the two sub-lamps **210** according to an exemplary embodiment of the present invention. Referring to FIG. 6, the lead lines each connected to the corresponding first electrode **220** of the respective sub-lamps **210** are soldered to each other by a solder **225**.

FIG. 7 is a schematic view showing a connection structure of the two sub-lamps according to another embodiment of the present invention.

Referring to FIG. 7, the lead lines each connected to the corresponding first electrode **220** of the respective sub-lamps **210** are electrically connected to each other by a conductive connection member **260** having, for example, a cylindrical shape. In this embodiment, the two sub-lamps **210** are connected to each other using the conductive connection member **260** such that a sub-lamp **210** may be easily replaced with a new sub-lamp when the sub-lamp **210** is in trouble.

Referring to FIG. 1 again, the second electrodes **230** of the sub-lamps **210** are connected to a first power supply unit **600** and a second power supply unit **650** on which power is externally applied.

The first power supply unit **600** is disposed on one end portion of the bottom surface **110** in the second direction. The first power supply unit **600** includes a first metal plate **610** having a band shape and a first gripping clip **620** for gripping one lead line of the second electrodes **230** of the two sub-lamps **210**. The first gripping clip **620** provides the external power to the corresponding sub-lamp **210**. As shown in FIG. 1, the first power supply unit **600** may have multiple first gripping clips **620** each for providing the external power to the corresponding sub-lamp **210**.

The second power supply unit **650** is disposed on the other end portion of the bottom surface **110** in the second direction. In other words, the first and second power supply units **600** and **650** are disposed at the opposite end portions of the bottom surface **110**. The second power supply unit **650** includes a second metal plate **660** having a band shape and a second gripping clip **670** for gripping one lead line of the second electrodes **230** of the two sub-lamps **210**. The second gripping clip **670** provides the external power to the corresponding sub-lamp **210**. The second supply unit **650** may also have multiple second gripping clips **670** each for providing the external power to the corresponding sub-lamp **210**.

The first and second power supply units **600** and **650** receive the discharge voltage to make a predetermined potential difference between the first and second electrodes **220** and **230**. The first electrodes **220** of the two sub-lamps **210** connected to each other may be connected to a separate power supply line. The power supply line may be grounded or receive an alternating current. The second electrodes **230** receive an alternating current from the first and second power supply units **600** and **650** as the discharge voltage.

On the other hand, the two sub-lamps **210** may receive the alternating current having a phase difference of 180 degrees through the second electrodes **230** from the first and second power supply units **600** and **650**. In this case, the first electrodes **220** of the two sub-lamps **210** are electrically connected to each other using the solder or conductive connection member **260** without the separate power supply line.

FIG. 8 is a schematic view showing a structure of the brightness control unit **400** shown in FIG. 1 and FIGS. 9 and

10 are cross-sectional views of the brightness control unit 400 shown in FIG. 8.

Referring to FIGS. 8 and 9, the brightness control unit 400 includes a first light diffusing surface 410, a second light diffusing surface 420, a third light diffusing surface 430 and a fourth light diffusing surface 440.

The first and second light diffusing surfaces 410 and 420 are inclined with respect to an imaginary line "I" at a first angle " α " and the first and second light diffusing surfaces 410 and 420 are symmetrical to each other. The third and fourth light diffusing surfaces 430 and 440 are inclined with respect to the first and second light diffusing surfaces 410 and 420 at a second angle " β ", respectively. The third and fourth diffusing surfaces 430 and 440 are symmetrical to each other. The imaginary line "I" is perpendicular to the bottom surface 110 of the receiving container 100. The brightness control unit 400 diffuses the light from the lamps 200 and may be formed by an injection-molding manner of resin.

Referring to FIG. 10, the brightness control unit 400 includes a metal plate 460 bent to have the first to fourth light diffusion surfaces 410-440, a light diffusing layer 470, an adhesive 480 and an insulating layer 490.

The light diffusing layer 470 is disposed on an outer surface of the metal plate 460 by coating light diffusing material or adhering a light diffusing sheet thereto. The insulating layer 490 is disposed on an inner surface of the metal plate 460 so as to reduce a parasitic capacitance caused by disposing the light diffusing layer 470 on the metal plate 460.

Referring to FIGS. 8 and 9, the third and fourth light diffusing surfaces 430 and 440 are provided with lamp receiving openings 450 disposed at edge portions thereof. The lamp receiving openings 450 respectively receive the lamps 200 when combining to the lamp holder 300. In order to combine the brightness control unit 400 to the lamp holder 300, the adhesive 480 is partially disposed on an inner surface of the third and fourth light diffusing surfaces 430 and 440.

FIG. 11 is a schematic view for illustrating an operation of the brightness control unit 400 shown in FIG. 10.

Referring to FIG. 11, when turning on the lamps 200, the light emitting region may be divided into a first area having first brightness and a second area having second brightness darker than the first brightness. The second area is about an area between the two sub-lamps 210. A user may realize that the second area is darker than the first area due to the brightness difference between the first and second areas. The brightness control unit 400 reflects the light provided from the first area to the first and second light diffusing surfaces 410 and 420 on which the light is diffused toward the second area to reduce the brightness difference between the first and second areas. Then, the diffusing plate 500 (referring to FIG. 1) diffuses the light emitted from the lamps 200 and the light reflected from the brightness control unit 400 to provide light having uniform brightness. The diffusing plate 500 is disposed on the receiving container 100.

FIG. 12 is a perspective view showing a structure of an LCD apparatus according to the present invention.

Referring to FIG. 12, the LCD apparatus 1000 includes a backlight assembly 700, an LCD panel assembly 800 and a chassis 900.

The LCD panel assembly 800 includes a TFT (Thin Film Transistor) substrate 810, a color filter substrate 820, and liquid crystal (not shown) interposed between the TFT substrate 810 and color filter substrate 820. The TFT substrate 810 comprises TFTs disposed on a transparent glass substrate in a matrix configuration and pixel electrodes for receiving a power voltage from the TFTs. The color filter

substrate 820 is disposed facing the TFT substrate 810. The color filter substrate 820 includes a color filter disposed on a glass substrate facing the pixel electrode and a common electrode disposed over the glass substrate to cover the color filter. The LCD panel assembly 800 is disposed on the receiving container 100 of the backlight assembly 700.

The chassis 900 is combined to the receiving container 100 to prevent the LCD panel assembly 800 from being deviated from the receiving container 100.

According to the exemplary embodiments of the present invention, the backlight assembly has the plurality of lamps for providing light to the LCD panel. Each of the lamps has two or more sub-lamps connected to each other in series. Also, the backlight assembly has the brightness control unit disposed between the sub-lamps to reduce the brightness difference between the sub-lamps. Thus, the backlight assembly may reduce consumption power of the lamps and provide the light having uniform brightness. Further, an LCD apparatus according to the present invention may use sub-lamps each having a length shorter than that of a display area thereof.

Although the exemplary embodiments of the present invention have been described, it is understood that the present invention should not be limited to these exemplary embodiments but various changes and modifications can be made by one ordinary skilled in the art within the spirit and scope of the present invention as hereinafter claimed.

What is claimed is:

1. A backlight assembly comprising:

a receiving container having a bottom surface and side-wall extended from the bottom surface;

a plurality of lamps, disposed on the bottom surface, to generate light, each of the lamps having two or more sub-lamps connected to each other in series, the two or more sub-lamps being disposed in a first direction;

a lamp holder, disposed on the bottom surface in a second direction perpendicular to the first direction, to receive a connection portion where the sub-lamps are connected to each other; and

a diffusing plate, disposed on the receiving container, to diffuse the light emitted from the lamps.

2. The backlight assembly or claim 1, wherein the lamps are disposed in parallel with the first direction and connected to each other in parallel.

3. The backlight assembly of claim 1, wherein the lamp holder comprises:

a lamp holder body having a bar shape; and

a lamp receiving groove disposed on the lamp holder body to receive the connection portion or the sub-lamps.

4. The backlight assembly or claim 3, wherein the lamp holder further comprises a protrusion portion disposed at the lamp receiving groove to prevent the sub-lamps from being moved.

5. The backlight assembly of claim 1, wherein the lamp holder is adhered to the bottom surface by an adhesive.

6. The backlight assembly of claim 1, wherein the lamp holder comprises an engaging protrusion disposed on a bottom surface of the lamp holder and the receiving container comprises an engaging opening corresponding to the engaging protrusion.

7. The backlight assembly of claim 1, further comprising a brightness control unit to reflect a portion of the light emitted from the lamps to reduce a brightness difference between a first area proximate the sub-lamps and a second area proximate the connection portion of the sub-lamps.

8. The backlight assembly of claim 7, wherein the brightness control unit comprises:

- a first light diffusing surface to cover the connection portion;
- a second light diffusing surface connected to the first light diffusing surface to cover the connection portion, the second light diffusing surface being inclined at a first angle with respect to the first light diffusing surface;
- a third light diffusing surface connected to the first light diffusing surface and secured onto the lamp holder; and
- a fourth light diffusing surface connected to the second light diffusing surface and secured onto the lamp holder.

9. The backlight assembly of claim 8, wherein the third and fourth light diffusing surfaces comprise a plurality of lamp receiving openings each for receiving a corresponding one of the lamps.

10. The backlight assembly of claim 8, wherein the third and fourth light diffusing surfaces are adhered to the lamp holder by an adhesive.

11. The backlight assembly of claim 8, wherein the brightness control unit further comprises a metal plate disposed on inner surfaces of the first, second, third and fourth light diffusing surfaces.

12. The backlight assembly of claim 11, wherein the brightness control unit further comprises an insulating layer disposed on an inner surface of the metal plate to reduce a parasitic capacitance generated between the lamps and the metal plate.

13. The backlight assembly of claim 1, wherein each of the sub-lamps comprises a lamp body and first and second electrodes disposed at end portions of the lamp body.

14. The backlight assembly of claim 13, wherein the first electrodes of the respective sub-lamps are connected to each other with a solder.

15. The backlight assembly of claim 13, wherein the first electrodes of the respective sub-lamps are connected to each other with a conductive connection member having a cylindrical shape.

16. The backlight assembly of claim 13, further comprising a power supply unit, disposed at an end portion of the bottom surface of the receiving container in the second direction for providing power to the second electrodes of the sub-lamps.

17. The backlight assembly of claim 16, wherein the power supply unit comprises a metal plate having a band shape and a gripping clip which grips the second electrode of the sub-lamp to provide the power to the sub-lamp.

18. An LCD apparatus, comprising:

- a receiving container having a bottom surface and a sidewall extended from the bottom surface;
- a plurality of lamps disposed on the bottom surface, each of the lamps having two or more sub-lamps connected to each other in series, the two or more sub-lamps being disposed in a first direction, the lamps generating light having first brightness at an area proximate the sub-lamps and light having second brightness at an area proximate a connection portion where the sub-lamps are connected to each other;
- a lamp holder, disposed on the bottom surface, for to receive the connection portion;
- a brightness control unit or to reflect a portion of the light emitted from the sub-lamps to reduce a brightness difference between the first brightness and the second brightness, the brightness control unit being disposed on the lamp holder;
- a diffusing plate, disposed on the receiving container, to diffuse the light emitted from the lamps; and
- an LCD panel, disposed on the diffusing plate, to receive the light from the diffusing plate and displaying an image.

19. The LCD apparatus of claim 18, wherein the brightness control unit comprises:

- a first light diffusing surface to cover the connection portion;
- a second light diffusing surface connected to the first light diffusing surface to cover the connection portion, the second light diffusing surface being inclined at a first angle with respect to the first light diffusing surface;
- a third light diffusing surface connected to the first light diffusing surface and secured onto the lamp holder; and
- a fourth light diffusing surface connected to the second light diffusing surface and secured onto the lamp holder.

20. The LCD apparatus of claim 19, wherein the brightness control unit further comprises a plurality of lamp receiving openings each for receiving a corresponding one of the lamps, the lamp receiving openings being disposed on the third and fourth light diffusing surfaces.

21. The LCD apparatus of claim 19, further comprising an adhesive for adhering the third and fourth light diffusing surfaces to the lamp holder, the adhesive being deposited on the third and fourth light diffusing surfaces.

22. The LCD apparatus of claim 19, wherein the brightness control unit further comprises a metal plate disposed on inner surfaces of the first to fourth light diffusing surfaces.

23. The LCD apparatus of claim 22, wherein the brightness control unit further comprises an insulating layer disposed on an inner surface of the metal plate to reduce a parasitic capacitance generated between the lamps and metal plate.

24. A backlight assembly comprising:

- a receiving container having a bottom surface and a sidewall extended from the bottom surface;
- a plurality of lamps, disposed on the bottom surface, to generate light, each of the lamps having two or more sub-lamps connected to each other in series, the two or more sub-lamps being disposed in a first direction;
- a lamp holder, disposed on the bottom surface in a second direction perpendicular to the first direction, to receive a connection portion where the sub-lamps are connected to each other;
- a diffusing plate, disposed on the receiving container, to diffuse the light emitted from the lamps; and
- a cover unit, disposed on lamps, to cover the connection portion.

25. The backlight assembly of claim 24, wherein the cover unit reflects a portion of the light emitted from the lamps to reduce a brightness difference between a first area proximate the sub-lamps and a second area proximate the connection portion of the sub-lamps.

26. The backlight assembly of claim 24, wherein the lamps are disposed in parallel with the first direction and connected to each other in parallel.

27. The backlight assembly of claim 24, wherein the lamp holder comprises:

- a lamp holder body having a bar shape; and
- a lamp receiving groove disposed on the lamp holder body to receive the connection portion of the sub-lamps.

28. The backlight assembly of claim 27, wherein the lamp holder further comprises a protrusion portion, disposed at the lamp receiving groove, to prevent the sub-lamps from being moved to the first direction.

专利名称(译)	背光组件和液晶显示装置		
公开(公告)号	US6857759	公开(公告)日	2005-02-22
申请号	US10/390110	申请日	2003-03-17
[标]申请(专利权)人(译)	李泰金 朴钟DAE 李贞焕 李根雨 李宰桑 崔容硕 BANG张师弟		
申请(专利权)人(译)	李泰金 朴钟DAE 李贞焕 李槿WOO 李在桑 崔容硕 BANG CHANG-YOUNG		
当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
[标]发明人	LEE TAE JIN PARK JONG DAE LEE JEONG HWAN LEE KEUN WOO LEE JAE SANG CHOI YONG SEOK BANG CHANG YOUNG		
发明人	LEE, TAE-JIN PARK, JONG-DAE LEE, JEONG-HWAN LEE, KEUN-WOO LEE, JAE-SANG CHOI, YONG-SEOK BANG, CHANG-YOUNG		
IPC分类号	G02F1/1335 G02F1/13 F21S2/00 F21S4/00 F21S8/04 F21Y103/00 G02F1/13357 F21V7/04		
CPC分类号	G02F1/133604		
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摘要(译)

公开了一种具有均匀亮度和低功耗的背光组件和LCD装置。背光组件具有多个灯，用于向LCD面板提供光。多个灯中的每一个具有两个或更多个彼此串联连接的子灯。背光组件具有设置在子灯之间的亮度控制单元，以减小亮度差。

