US007884895B2

(12) **United States Patent**
Kim et al.

(10) **Patent No.: US 7,884,895 B2**
(45) **Date of Patent: Feb. 8, 2011**

(54) **PORTABLE DISPLAY DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 380 days.

(21) Appl. No.: **11/580,563**

(22) Filed: **Oct. 13, 2006**

(65) **Prior Publication Data**

US 2007/0132917 A1 Jun. 14, 2007

(30) **Foreign Application Priority Data**

Dec. 8, 2005 (KR) 10-2005-0119868

(51) **Int. Cl.**
G02F 1/1335 (2006.01)

(52) **U.S. Cl.** **349/65**

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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(57) **ABSTRACT**

A portable display device including a liquid crystal display panel, a backlight assembly having a light source for supplying light to the liquid crystal display panel, a mold frame included in the backlight assembly, the mold frame formed with a step unit such that the liquid crystal display panel can be mounted in the mold frame, and a light fence located in the step unit, the light fence screening light supplied from the light source to the liquid crystal display panel.

8 Claims, 7 Drawing Sheets

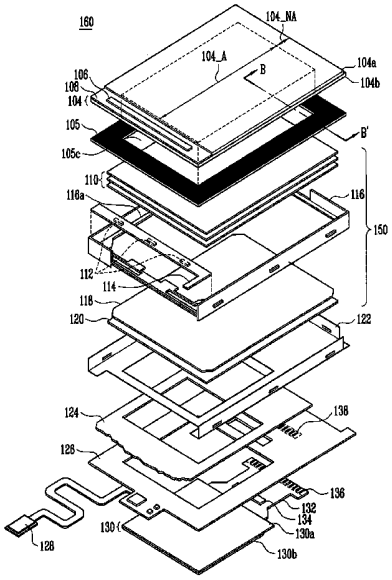

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FIG. 1
(PRIOR ART)

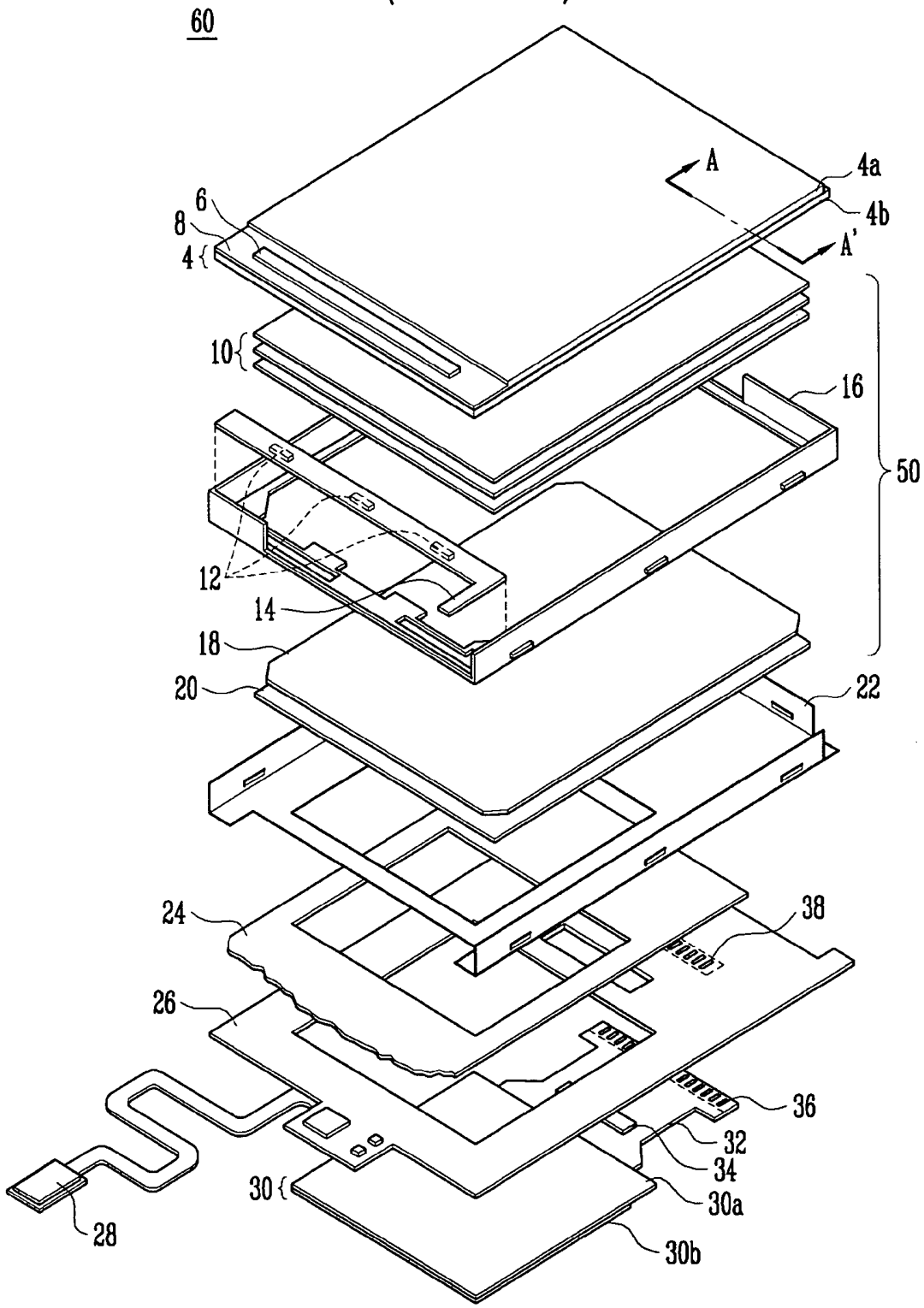


FIG. 2
(PRIOR ART)

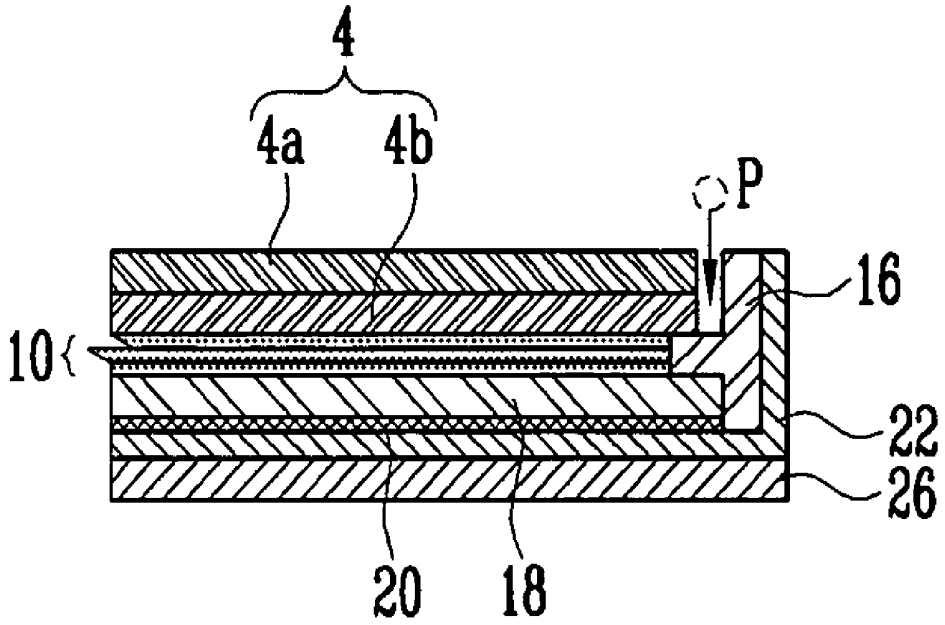


FIG. 3

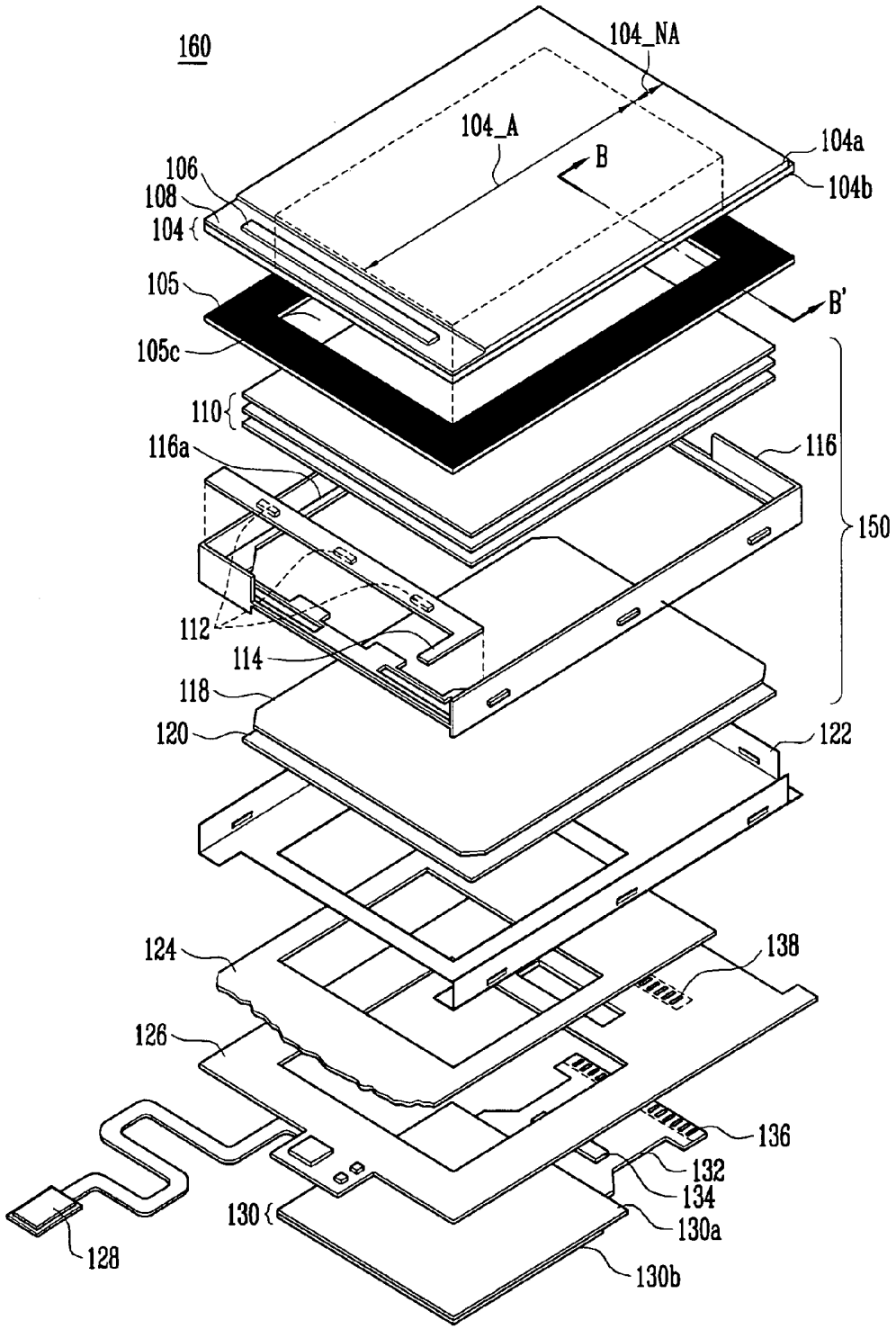

160
104_NA
104_A
B
104a
104b
106
108
104
105
B'
105c
110
116a
116
150
112
114
118
120
122
124
138
126
136
132
134
130
130a
128
130b

FIG. 4

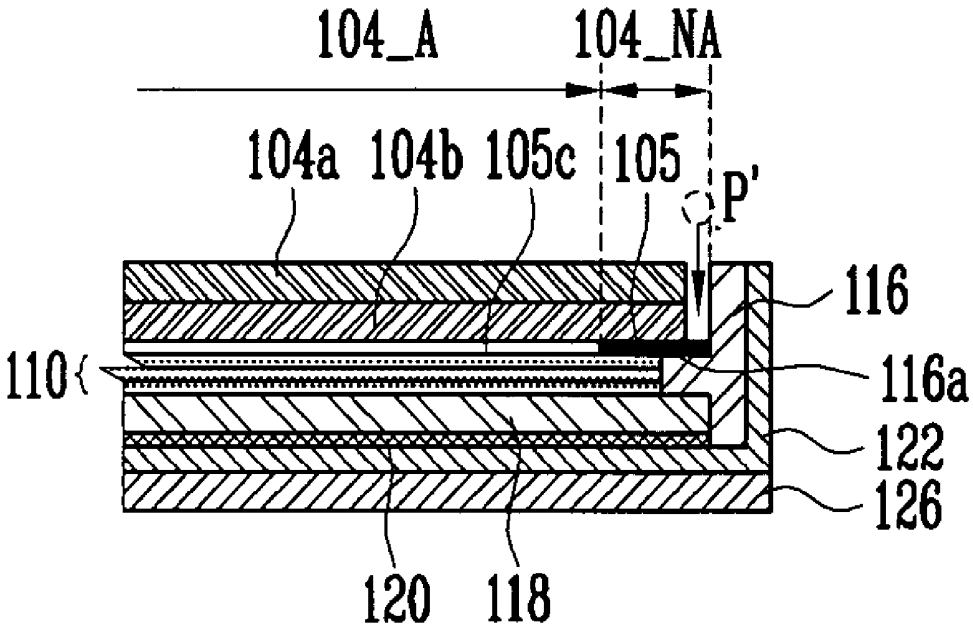


FIG. 5A

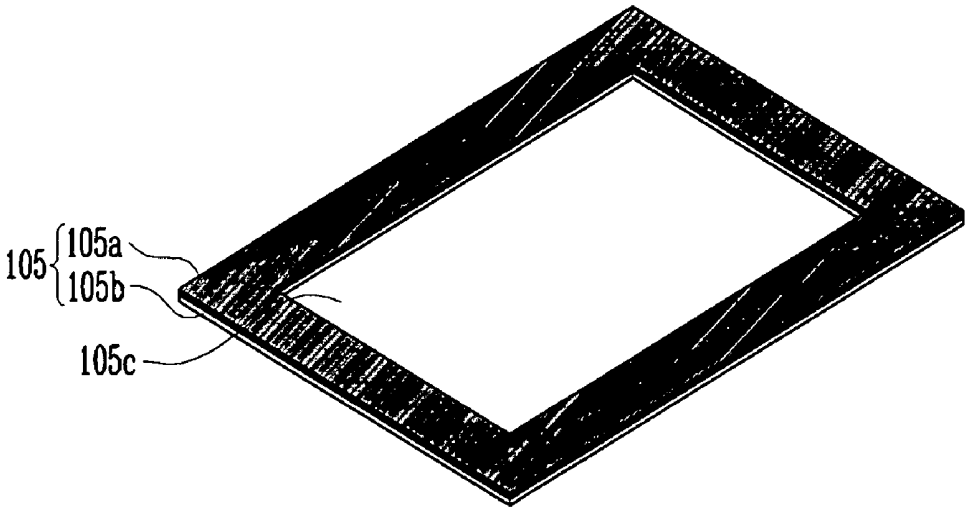


FIG. 5B

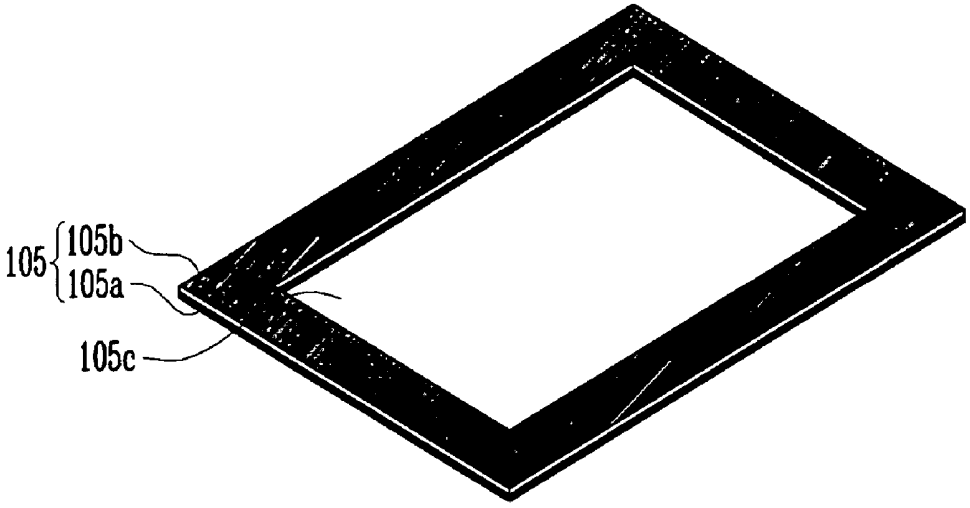


FIG. 6

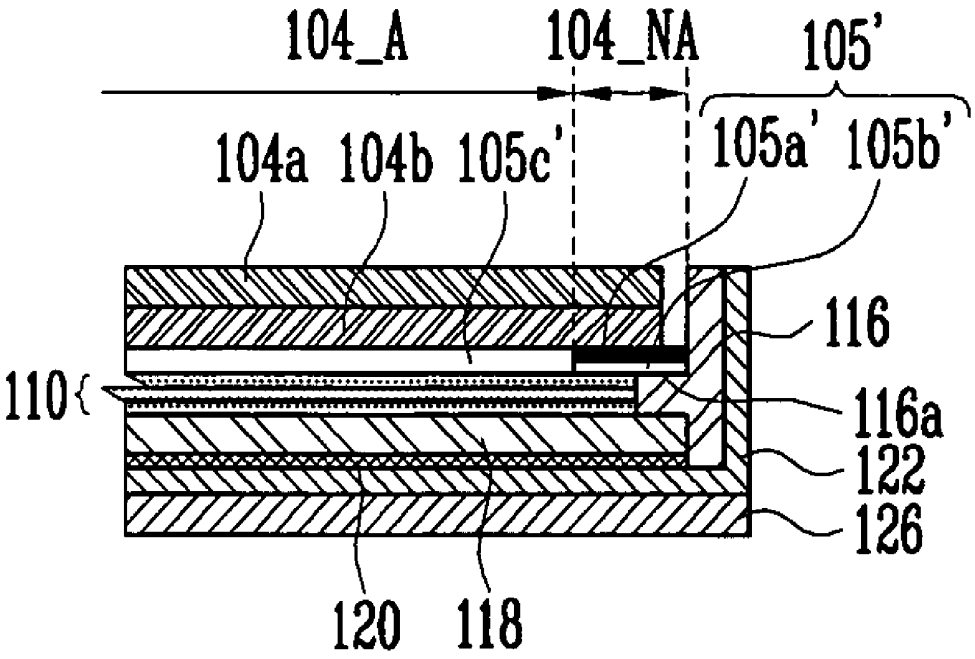

104_A
104_NA
105'
104a
104b
105c'
105a'
105b'
116
110
116a
122
126
120
118

FIG. 7A

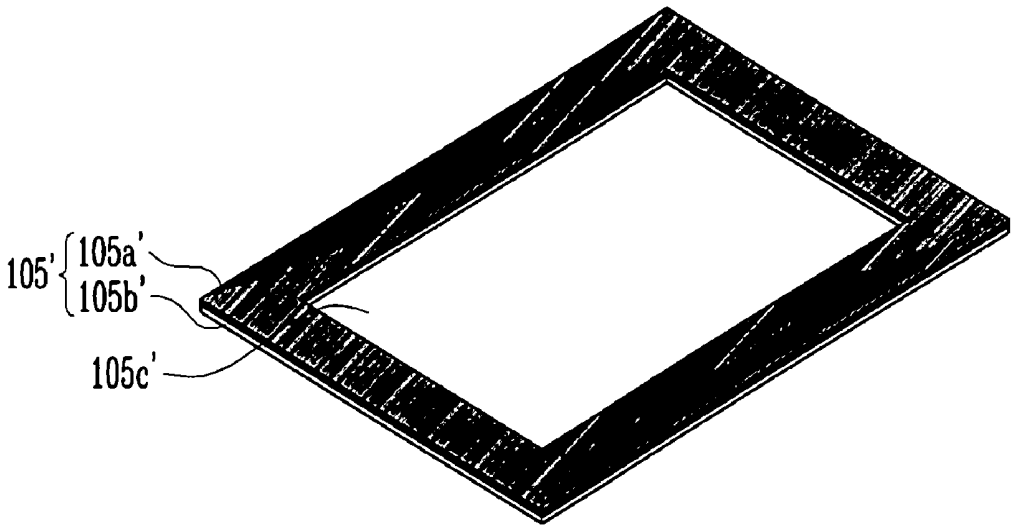
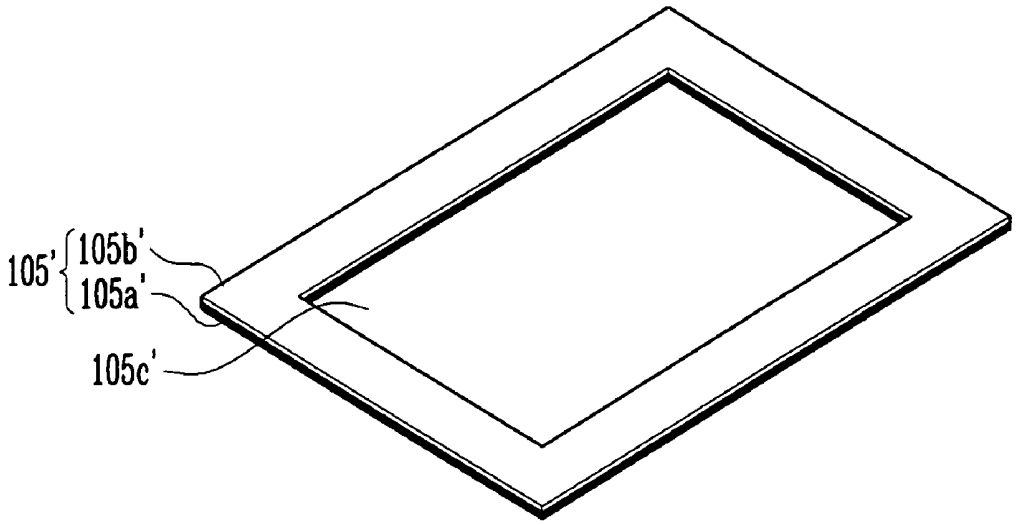


FIG. 7B



PORTABLE DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to and the benefit of Korean Patent Application No. 2005-119868, filed on Dec. 8, 2005, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Field of the Invention

The present invention relates to a portable display device, and more particularly to a portable display device having improved light leakage prevention.

2. Discussion of Related Art

Recently, various flat panel display devices have been developed having reduced weight and size. Exemplary flat panel display devices include a liquid crystal display, a field emission display, a plasma display panel, a light emitting display, etc.

Particularly, liquid crystal displays have become popular as an alternative to cathode ray tubes due to the liquid crystal displays' small size, light weight, and low power consumption. Such devices may be used in large-sized monitors and televisions as well as mobile phones and personal digital assistants (PDAs).

FIG. **1** is a exploded prospective view of a conventional portable display device. FIG. **1** shows a dual display device used in a mobile phone and the like and mounted with at least one liquid crystal display. FIG. **2** is an assembled sectional view taken along line A-A' of FIG. **1**.

Referring to FIGS. **1** and **2**, the conventional portable display device **60** includes a liquid crystal display panel **4**, a backlight assembly **50**, a bottom chassis **22**, a first printed circuit board **24**, a second printed circuit board **26**, and a light-emitting display panel **30**.

The liquid crystal display panel **4**, displays predetermined images using a first substrate **4***a*, a second substrate **4***b* and a liquid crystal (not shown) injected between the first substrate **4***a* and the second substrate **4***b*.

The second substrate **4***b* includes a plurality of thin film transistors (TFT) arranged in matrix form. A source electrode of the TFT is connected to a data line, and a gate electrode thereof is connected to a scan line. A drain electrode of the TFT is connected to a pixel electrode made of transparent indium tin oxide (ITO), a conductive material. The TFTs are turned on when the scan line is supplied with a scan signal, and the TFTs supply a data signal from the data line to the pixel electrode.

An integrated circuit **6** is inserted on one side of the second substrate **4***b*, and the data signal and scan signal are supplied from the integrated circuit **6**. A protective layer **8** is deposited around the integrated circuit **6**.

The first substrate **4***a* is arranged facing the second substrate **4***b*. A common electrode made of ITO is deposited on the front surface of the first substrate **4***a*. The common electrode is applied with a predetermined voltage, and accordingly a predetermined electric field is generated between the common electrode and the pixel electrode. The array angle of the liquid crystal injected between the first substrate **4***a* and the second substrate **4***b* varies with the electric field, and the optical transparency also varies according to array angle to thereby display desired images. Upper and lower polarized light films (not shown) are provided in the upper and lower sides of the liquid crystal display panel **4**.

The backlight assembly **50** includes a mold frame **16**, LEDs **12**, an LED substrate **14**, a light guide plate **18**, a reflective plate **20** and optical sheets **10**.

The LEDs **12** emit an amount of light corresponding to a drive signal from the LED substrate **14**. The light guide plate **18** supplies the light from the LEDs **12** to the liquid crystal display panel **4**. That is, the light guide plate **18** supplies the light from its side surface to the liquid crystal display panel **4** located on its upper side.

The reflective plate **20** arranged on a back surface of the light guide plate **18** supplies incidence light from the light guide plate **18** back to the light guide plate **18**. The optical sheets **10** enhance the brightness of light from the light guide plate **18** to supply the enhanced light to the liquid crystal display panel **4**.

The LED substrate **14**, which is connected to the first printed circuit board **24**, supplies the drive signal to the LEDs **12** corresponding to control signal from the first printed circuit board **24**. The LED substrate **14** mounted with LEDs **12** is received and fixed in the mold frame **6**. Additionally, the liquid crystal display panel **4** and backlight assembly **50** are fixed and supported in the mold frame **16**.

The bottom chassis **22** is fixed to the mold frame **16** on the lower side thereof. An opening is formed in a portion of the bottom chassis **22** such that a light emitting display panel **30** may be inserted therein.

The second printed circuit board **26** is supplied with a drive signal from a drive circuit (not shown) located in the mobile phone side by a mobile phone connector **28**. The mobile phone connector **28** is fixed to another connector attached to the drive circuit located in the mobile phone side to be supplied with the drive signal from the drive circuit in the mobile phone side. The second printed circuit board **26** supplied with the drive signal generates various control signals corresponding to the drive signal.

The first printed circuit board **24** is connected to the second printed circuit board **26** through a first pad unit **38** formed in the second printed circuit board **26**. The first printed circuit board **24** is connected to the integrated circuit **6** of the liquid crystal display panel **4** and LED substrate **14** by a flexible printed circuit board (not shown). The first printed circuit board **24** connected to the integrated circuit **6** and LED substrate **14** drives the integrated circuit **6** and LED substrate **14** corresponding to the control signals supplied from the second printed circuit substrate **26**.

The light emitting display panel **30** includes a first substrate **30***a* and a second substrate **30***b*. Organic LEDs (not shown) are arranged on the first substrate **30***a* in matrix form. Organic LEDs generate a predetermined amount of light corresponding to the amount of current supplied. The light emitting display panel **30** is connected to the second printed circuit board **26** by the second pad unit **36** of the flexible printed circuit board **32**. An integrated circuit **34** is mounted on the flexible printed circuit board **32**. The integrated circuit **34** lets the light emitting display panel **30** to display a predetermined image in response to the control signals supplied from the second printed circuit board **26**.

However, the conventional portable display device **60** may allow light to leak into an undesired region. More specifically, since the light supplied from the backlight assembly **50** is emitted to the non-pixel regions of liquid crystal display panel **4**, the light efficiency and the image quality of the conventional portable display device are deteriorated. In addition, as shown in FIG. **2**, if debris P enters the backlight assembly **50** through a space between the liquid crystal display panel **4** and the mold frame **16**, light is blocked and the image quality is further deteriorated. Further, conventional portable display

devices **60** have relatively weak mold frames since the panel **4** is mounted to and supported by the mold frame **16**.

SUMMARY OF THE INVENTION

A portable display device is provided which enhances the light efficiency and prevents light leakage. Additionally, a portable display device is provided which enhances the connection between the liquid crystal display panel and the mold frame to prevent debris from entering the backlight assembly.

A portable display device is provided including a backlight assembly having a light source for supplying light to the display panel and having a mold frame with a periphery step platform. A light fence is mounted in the periphery step platform, the light fence supporting the display panel and screening at a periphery of the backlight assembly light supplied from the light source.

In one exemplary embodiment, the light fence is superimposed on a non-pixel region of the liquid crystal display panel. A predetermined part of the light fence is formed with a opening corresponding to a pixel region of the liquid crystal display panel. The liquid crystal display panel is located in the upper side of the light fence, and at least one optical sheet is located in the lower side of the light fence to enhance the uniformity or brightness of light supplied from the light source. Both surfaces of the light fence may be opaque. Both surfaces of the light fence may be different colors from each other. A first surface, which adjoins the liquid crystal display panel, of both surfaces of the light fence, may be opaque, and a second surface, which adjoins the step unit, is set up in a reflective color such as white or silver. The light fence may be double-sided tape. The light fence surrounds the rear perimeter of the liquid crystal display panel, and the pixel region of the liquid crystal display panel is located within an enclosed region of the light fence.

An alternate embodiment of a light fence for a display device includes a planar frame sized to conform to the display area and having an inner through-hole sized to correspond to at least a portion of the non-display area, the planar frame being mountable on the step unit and having a first planar surface and a second planar surface, the first planar surface and the second planar surface being respectively both opaque or the first planar surface being opaque and the second planar surface being reflective.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded prospective view of a conventional portable display device.

FIG. **2** is an assembled sectional view taken along line A-A' of FIG. **1**.

FIG. **3** is an exploded prospective view of a portable display device having a light fence according to one embodiment of the present invention.

FIG. **4** is an assembled sectional view taken along line B-B' of FIG. **3**.

FIGS. **5**A and **5**B are prospective views of one side and its opposite side of a light fence according to the embodiment of the present invention shown in FIGS. **3** and **4**.

FIG. **6** is a sectional view of the application of the light fence according to another exemplary embodiment of the present invention

FIGS. **7**A and **7**B are perspective views of one side and its opposite side of a light fence according to the embodiment of the present invention shown in FIG. **6**.

DETAILED DESCRIPTION

Referring to FIGS. **3**, **4**, **5**A and **5**B, a portable display device **160** according to an embodiment of the present invention includes a liquid crystal display panel **104**, a backlight assembly **150**, a bottom chassis **122**, a first printed circuit board **124**, a second printed circuit board **126**, a light-emitting display panel **130**, and a light fence **105** placed between the liquid crystal display panel **104** and the backlight assembly **150**.

The liquid crystal display panel **104**, displays predetermined images and includes a first substrate **104***a*, a second substrate **104***b* and a liquid crystal (not shown) injected between the first substrate **104***a* and the second substrate **104***b*.

The second substrate **104***b* includes a plurality TFTs arranged in matrix form. A source electrode of the TFT is connected to a data line, and a gate electrode thereof is connected to a scan line. A drain electrode of the TFT is connected to a pixel electrode made of transparent ITO. The TFTs are turned on when the scan line is supplied with a scan signal, and the TFTs supply a data signal from the data line to the pixel electrode.

An integrated circuit **106** is inserted on one side of the second substrate **104***b*, and the data signal and scan signal are supplied from the integrated circuit **106**. A protective layer **108** is deposited around the integrated circuit **106**.

The first substrate **104***a* is arranged facing the second substrate **104***b*. A common electrode made of ITO is applied on the front surface of the first substrate **104***a*. The common electrode is applied with a predetermined voltage, generating a predetermined electric field between the common electrode and the pixel electrode. The array angle of the liquid crystal injected between the first substrate **104***a* and the second substrate **104***b* varies with the electric field, and the optical transparency varies according to the array angle to thereby display desired images. Upper and lower polarized light films (not shown) are provided in the upper and lower sides, respectively, of the liquid crystal display panel **104**.

The backlight assembly **150** includes a mold frame **116**, LEDs **112**, a LED substrate **114**, a light guide plate **118**, a reflective plate **120** and optical sheets **110**.

The LEDs **112** emit a predetermined amount of light corresponding to a drive signal from the LED substrate **114**. The light guide plate **118** supplies the light from the LEDs **112** to the liquid crystal display panel **104**.

The reflective plate **120** which is arranged in the back surface of the light guide plate **118** supplies the incidence light from the light guide plate **118** back to the light guide plate **118** to improve optical efficiency.

The first optical sheets **110** enhance the uniformity and brightness of light from the light guide plate **118** to supply the enhanced light to the liquid crystal display panel **104**.

The LED substrate **114** which is connected to the first printed circuit board **124** supplies the drive signal to the LEDs **112** corresponding to control signal from the first printed circuit board **124**.

The LED substrate **114** mounted with LEDs **112** is fixed to the mold frame **116**. Additionally, the liquid crystal display panel **104** and backlight assembly **150** are fixed and supported by the mold frame **116**. A step unit **116***a* for receiving the liquid crystal display panel **104** is formed on the inner side surface of the mold frame **116**.

The bottom chassis **122** is fixed to the mold frame **116** underneath the mold frame. An opening is formed in a portion of the bottom chassis **122** such that a light emitting display panel **130** may be inserted therein.

The second printed circuit board **126** is supplied with the drive signal from a drive circuit (not shown) located in the mobile phone side by a mobile phone connector **128**. The mobile phone connector **128** is fixed to another connector attached to the drive circuit located in the mobile phone side to be supplied with the drive signal from the drive circuit. The second printed circuit board **126** supplied with the drive signal generates various control signals corresponding to the drive signal.

The first printed circuit board **124** is connected to the second printed circuit board **126** through a first pad unit **138** formed in the second printed circuit board **126**. The first printed circuit board **124** is connected to the integrated circuit **106** of the first liquid crystal display panel **104** and LED substrate **114** by a flexible printed circuit board (not shown). The first printed circuit board **124** connected to the integrated circuit **106** and LED substrate **114** drives the integrated circuit **106** and LED substrate **114** corresponding to the control signals supplied from the second printed circuit substrate **126**.

The light emitting display panel **130** includes a first substrate **130***a* and a second substrate **130***b*. Organic LEDs (not shown) are arranged on the first substrate **130***a* in matrix form. The organic LEDs generate a predetermined amount of light corresponding to the amount of current supplied. The light emitting display panel **130** is connected to the second printed circuit board **126** by the second pad unit **136** of the flexible printed circuit board **132**. An integrated circuit **134** is mounted on the flexible printed circuit board **132**. The integrated circuit **134** lets the light emitting display panel **130** display a predetermined image in response to the control signals supplied from the second printed circuit board **126**.

A light fence **105** is provided between the liquid crystal display panel **104** and the backlight assembly **150**. For example, the light fence **105** may be placed on the step unit **116***a* of the mold frame **116** mounted with the liquid crystal display panel **104**. In this case, the light fence **105** is placed between the liquid crystal display panel **104** and optical sheets **110** as shown in FIG. **4**. Both sides of the light fence **105** may be opaque to raise the efficiency of the light fence **105** superimposed on the non-pixel region **104**_NA of the liquid crystal display panel **104** while surrounding the perimeter of the back surface of the liquid crystal display panel **104**. An opening is formed in a predetermined part of the light fence **105** corresponding to the pixel region **104**_A of the liquid crystal display panel **104**. Thus, it is possible to prevent the light from being emitted into the non-pixel region **104**_NA, thereby improving the image quality.

In addition, the light fence **105** may enhance the connection between the liquid crystal display panel **104** and the mold frame **116** since the light fence **105** is made of an adhesive member such as double-sided tape. The light fence **105** is attached with an inner opening to the liquid crystal panel **104** so that it surrounds the entire perimeter of the panel **104**. For example, the light fence **105** may be attached in the shape of a flattened rectangular border frame to be superimposed on the non-pixel region **104**_NA. When the light fence **105** is attached with an inner enclosed structure to the panel **104**, debris P' is effectively screened from entering the backlight assembly **150**. More specifically, although the debris P' may enter the space between the liquid crystal display panel **104** and the side surface of the mold frame **116**, it is difficult for the debris to enter the backlight assembly **150** due to the light fence **105** formed of double-sided tape. Thus, it is possible to prevent image quality from being deteriorated due to the inflow of debris.

In an alternate embodiment as shown in FIGS. **6**, **7**A and **7**B, the color of both sides of the light fence **105** may be different from each other to raise the brightness of pixel region **104**_A by increasing the light efficiency. More specifically, a first surface **105***a'* of the light fence **105'** may be opaque, such as black, and a second surface **105***b'* of the light fence **105'** may be white or silver. However, the color of the second surface **105***b'* of the light fence **105'** is not limited to white or silver, but may be any color.

The principle of preventing light leakage into the non-pixel region **104**_NA by the light fence will be described below using the display device of FIG. **4**, but with the light fence embodiment shown in FIGS. **6**, **7**A and **7**B.

A light leak occurs if light from the backlight assembly **150** is emitted into the non-pixel region **104**_NA. For example, light leakage can occur when light is emitted from the LEDs **112** via the light sheets **110** to the non-pixel region **104**_NA between the liquid crystal display panel **104** and the mold frame **116**. When the light fence **105'** is placed between the liquid crystal display panel **104** and the step unit **116***a* of mold frame **116**, the first surface **105***a'* of light fence **105'** being opaque and the second surface **105***b'* being a reflective color such as white or silver, light which directed to the non-pixel region **104**_NA is reflected by the second surface **105***b'* of light fence **105'** and is directed via the optical sheets **110** to the light guide plate **118**. Thus, most of light supplied to the light guide plate **118** is supplied to the pixel region **104**_A of the liquid crystal display panel **104**. As such, directing light into the pixel region **104**_A instead of the non-pixel region **104**_NA prevents light leakage and raises the light efficiency, improving the brightness of the pixel region **104**_A. In addition, setting up the first surface **105***a'* of the light fence **105'** as opaque reduces future light leaks. The second display panel may be set up as a light-emitting display panel **130**, for instance, a liquid crystal display panel. In this case, light reflected from the light fence **105'** to the light guide plate **118** is supplied to the second display panel, thus enhancing the brightness of the second display panel.

As described above, a portable display device according to the present invention may prevent light leakage and enhance light efficiency, improving image quality. In one exemplary embodiment, a light fence is placed between a liquid crystal display panel and the backlight assembly. In addition, a portable display device according to the present invention may enhance the connection between a liquid crystal display panel and a mold frame to prevent the deterioration of image quality due to debris by forming the light fence with an adhesive member such as double-sided tape.

Although exemplary embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes might be made to these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A portable display device comprising:

a display panel;

a backlight assembly having a light source for supplying light to the display panel and having a molded frame with a periphery step; and

a light fence having a first planar surface and a second planar surface opposite the first planar surface, the light fence mounted on the periphery step to support the display panel at a periphery of the backlight assembly and to screen light supplied from the light source, wherein the first planar surface and the second planar surface are light absorbing surfaces and wherein the light fence has an opening configured to generally correspond to a por-

tion of the display panel such that an open space is between the display panel and the backlight assembly.

2. The portable display device as claimed in claim **1**, wherein the light fence is attached to a non-pixel region of the display panel.

3. The portable display device as claimed in claim **1**, wherein the first planar surface has a first color; and wherein the second planar surface has a second color.

4. The portable display device as claimed in claim **1**, wherein the light fence comprises double-sided tape.

5. The portable display device as claimed in claim **1**, wherein the display panel comprises a liquid crystal display panel.

6. A light fence for a display device, the display device having a display panel with both a display area and a non-display area and a backlight assembly having a light source for supplying light to the display panel and having a molded frame with a periphery step, the light fence comprising:

a planar frame sized to conform to the display area and having an opening sized to correspond to at least a portion of the display area, the planar frame being mountable on the step unit and having a first planar surface and a second planar surface, wherein the first planar surface and the second planar surface are light absorbing surfaces and wherein the opening serves to provide an open space between the display panel and the backlight assembly.

7. The light fence of claim **6**, wherein the light fence comprises an adhesive.

8. The light fence of claim **7**, wherein the light fence comprises double-sided tape.

* * * * *

专利名称(译)	便携式显示设备		
公开(公告)号	US7884895	公开(公告)日	2011-02-08
申请号	US11/580563	申请日	2006-10-13
[标]申请(专利权)人(译)	金圣ħ 金泰小号 BAE KYU ^ h HAN KYU小号		
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当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	KIM SUNG HWAN KIM TAE SOO BAE KYU HAN HAN KYU SEOB		
发明人	KIM, SUNG HWAN KIM, TAE SOO BAE, KYU HAN HAN, KYU SEOB		
IPC分类号	G02F1/1335		
CPC分类号	G02F1/133512 G02F1/133608 G02F2001/133317 G02F2001/133388		
优先权	1020050119868 2005-12-08 KR		
其他公开文献	US20070132917A1		
外部链接	Espacenet USPTO		

摘要(译)

一种便携式显示装置，包括液晶显示面板，具有用于向液晶显示面板提供光的光源的背光组件，包括在背光组件中的模框，该模框形成有台阶单元，使得液晶显示面板可以安装在模框中，并且光栅位于台阶单元中，光栅屏蔽光从光源提供给液晶显示面板。