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(54) **DOUBLE-SIDED LIQUID CRYSTAL DISPLAY DEVICE**

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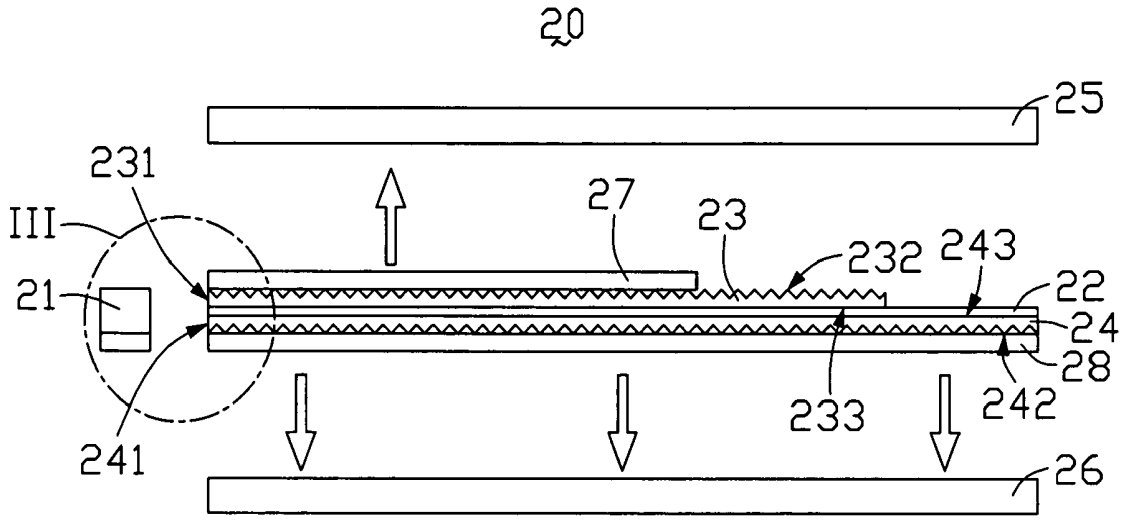
(52) **U.S. Cl.** **349/64**

(57) **ABSTRACT**

A liquid crystal display device (**20**) includes two liquid crystal display panels (**25, 26**) and a backlight module sandwiched between the two liquid crystal display panels. The backlight module includes a first light guide plate (**23**), a second light guide plate (**24**), a light source (**21**) disposed adjacent to the first and second light guide plates, and a double-sided reflecting plate (**22**) sandwiched between the first and second light guide plates. The liquid crystal display device includes the double-sided reflecting plate, which is sandwiched between the first and second light guide plates, and can reflect light beams from the light source toward the first and second light guide plates. The first and second light guide plates, which are pressuredly pressed together by molds with the reflecting plate to form the backlight module, are two independent optical members, and do not affect each other. Therefore, the liquid crystal display device has good display quality.



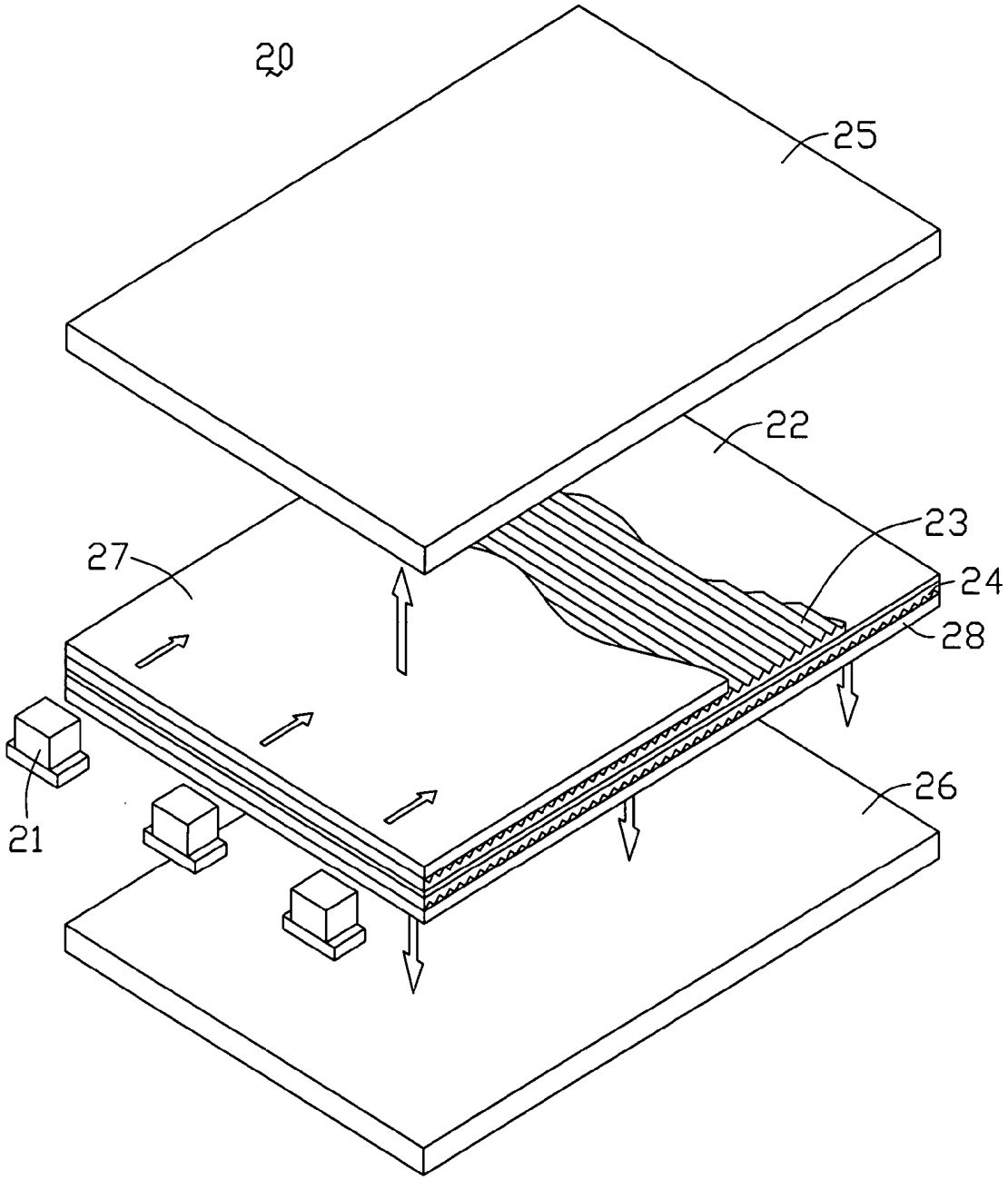


FIG. 1

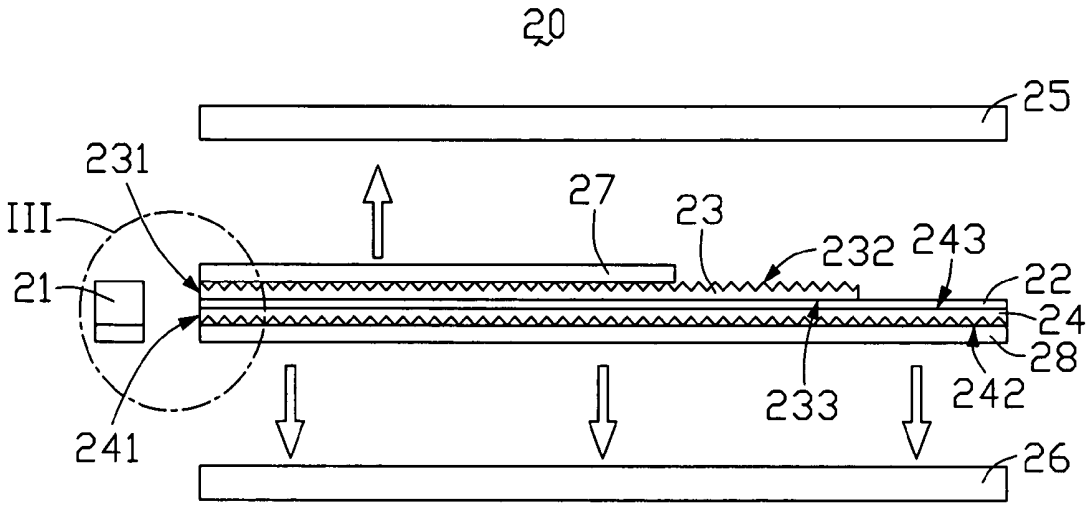

20
25
231
III
27
23
232
243
21
22
24
28
233
242
241
26

FIG. 2

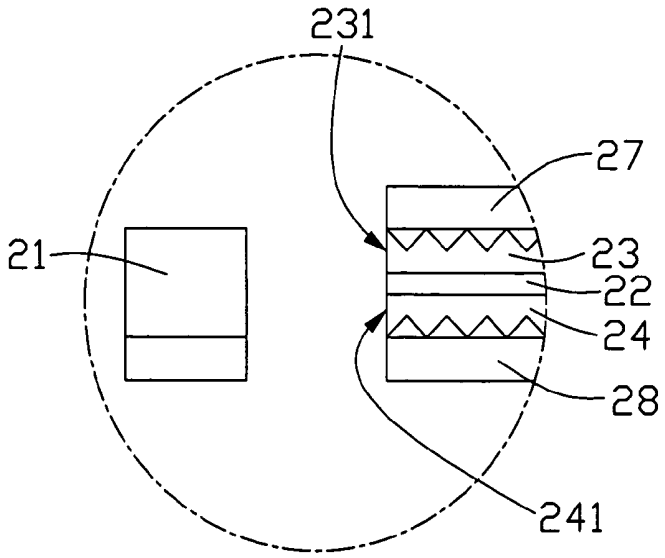

231
27
21
23
22
24
28
241

FIG. 3

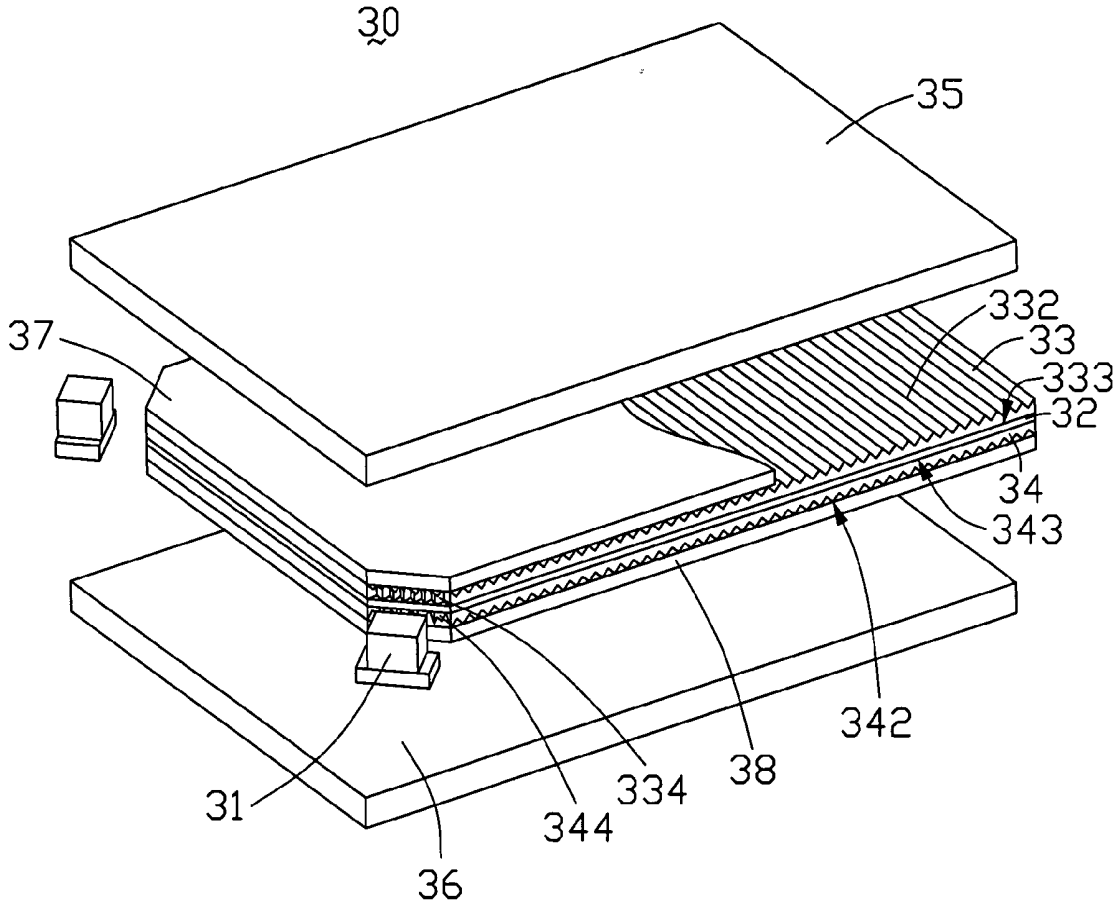


FIG. 4

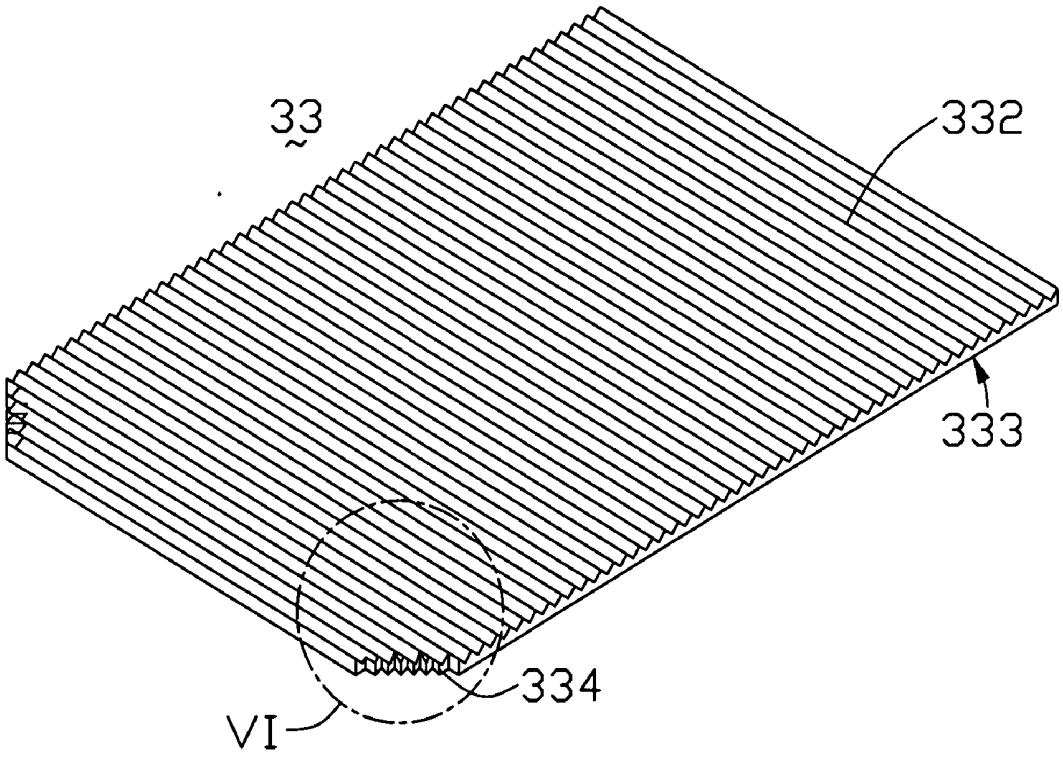


FIG. 5

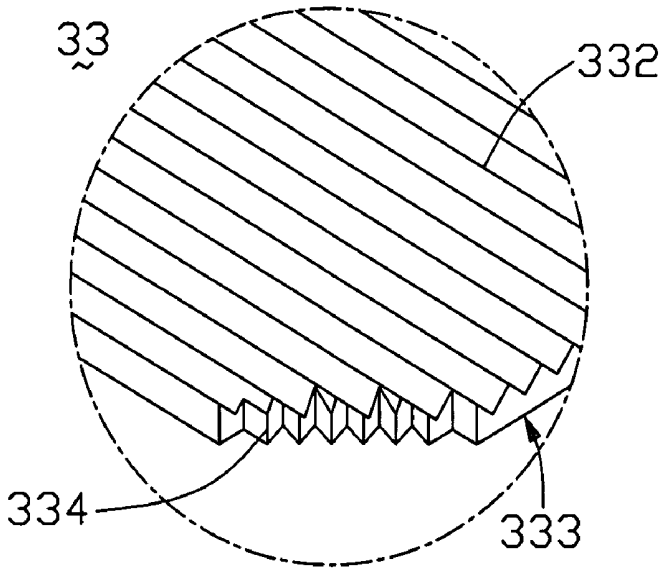


FIG. 6

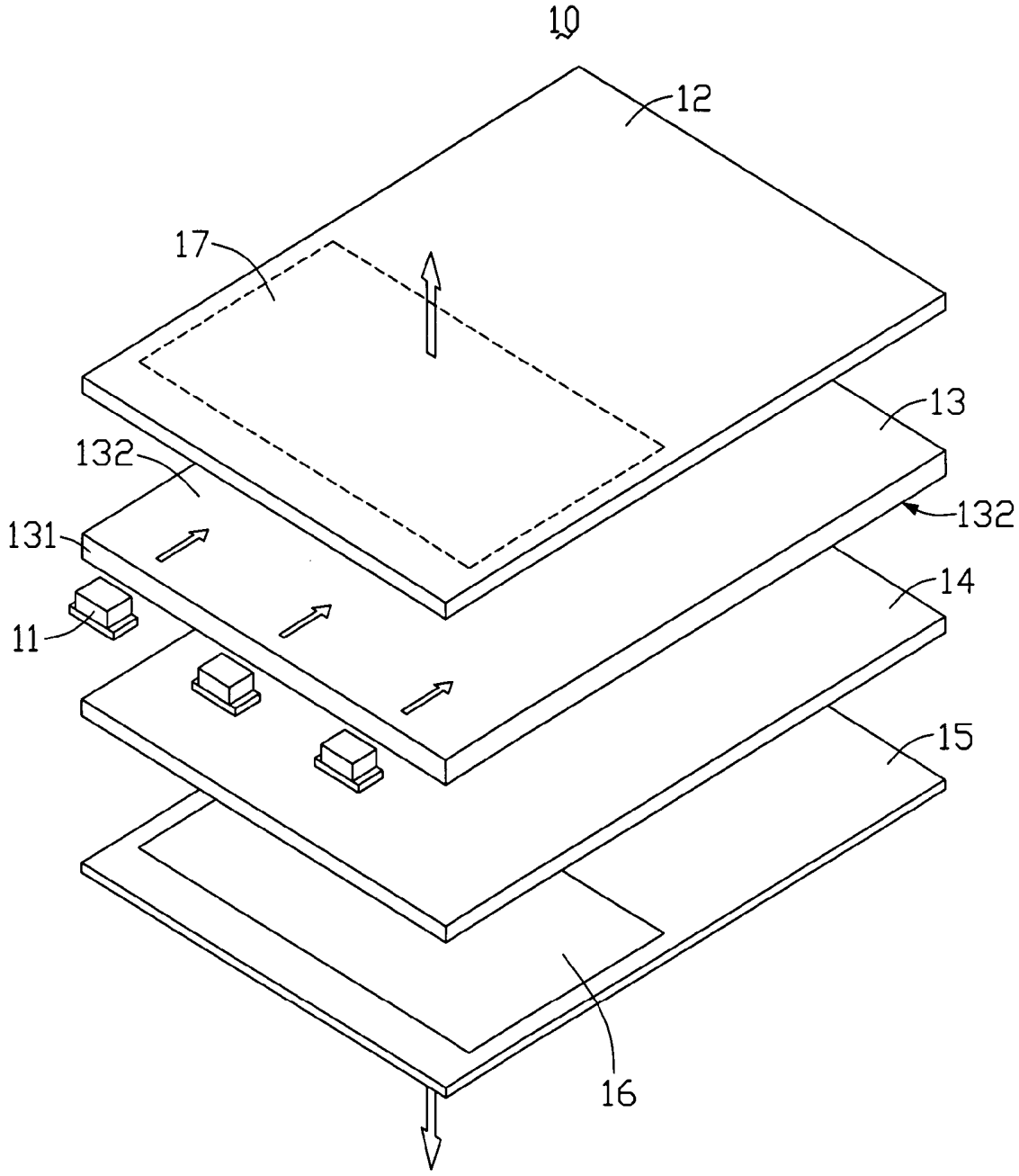


FIG. 7
(PRIOR ART)

DOUBLE-SIDED LIQUID CRYSTAL DISPLAY DEVICE

BACKGROUND

[0001] 1. Field of the Invention

[0002] The present invention relates to a double-sided liquid crystal display (LCD) device, and a backlight module used therein.

[0003] 2. General Background

[0004] Different kinds of LCD devices have been used in a variety of applications. A double-sided LCD device has front and rear LCD panels, which are coupled together back-to-back. The LCD panels used in the double-sided LCD device generally have the same size. The double-sided LCD device further includes a double-sided emitting backlight module disposed between the front and rear LCD panels.

[0005] Referring to **FIG. 7**, a double-sided emitting backlight module typically includes an upper film **12**, a light guide plate **13**, a lower film **14**, and a masking plate **15** in that order. The light guide plate **13** includes an incident surface **131**, and two opposite emitting surfaces **132** which face the upper film **12** and the lower film **14** respectively. A plurality of light sources **11** is disposed adjacent to the incident surface **131**. After light beams emitted from the light sources **11** enter the light guide plate **13** through the incident surface **131**, they separate into two parts. The two parts of the light beams leave the light guide plate **13** from the two emitting surfaces **132**, and enter the upper film **12** and the lower film **14** respectively. When the light beams respectively propagate through the upper and lower films **12**, **14**, the light beams define a first illuminating region (not labeled) on the upper film **12** and a second illuminating region **16** on the masking plate **15**. Thereafter the light beams transmit toward two liquid crystal display panels (not shown), respectively.

[0006] A thickness of the light guide plate **13** is generally in the range from 0.5~0.8 mm, which adds to the overall thickness of the backlight module **10**. The upper and lower films **12**, **14** are transflective. When proportions of the first and second illuminating regions are not identical due to different display regions, sizes of the upper and lower films **12**, **14** need to be adjusted. Consequently, a "shadow"**17** of the smaller of the films (for example, the lower film **14**) is visible at the larger illuminating region (for example, the first illuminating region, not labeled). The shadow **17** degrades the display quality of the corresponding liquid crystal display panel.

[0007] What is needed, therefore, is a liquid crystal display having good display quality.

SUMMARY

[0008] In a preferred embodiment of the present invention, a liquid crystal display device includes two liquid crystal display panels and a backlight module sandwiched between the two liquid crystal display panels. The backlight module includes a first light guide plate, a second light guide plate, a light source, and a double-sided reflecting plate sandwiched between the first and second light guide plates. The light source is disposed adjacent to the first and second light guide plates. The first light guide plate, the double-sided reflecting plate and the second light guide plate are originally separate components and are pressuredly pressed together by molds to form the backlight module.

[0009] The liquid crystal display device includes the double-sided reflecting plate, which is sandwiched between the first and second light guide plates, and can reflect light beams from the light source toward the first and second light guide plates. The first and second light guide plates are two independent optical members, and do not affect each other. Therefore, the liquid crystal display device has good display quality.

[0010] Other advantages and novel features of embodiments of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is an exploded, isometric cut-away view of a liquid crystal display device according to a first embodiment of the present invention;

[0012] **FIG. 2** is an exploded, side cut-away view of the liquid crystal display device of **FIG. 1**;

[0013] **FIG. 3** is an enlarged view of a circled portion III of **FIG. 2**;

[0014] **FIG. 4** is an exploded, isometric cut-away view of a liquid crystal display device according to a second embodiment of the present invention;

[0015] **FIG. 5** is an isometric view of a first light guide plate of the backlight module of **FIG. 4**;

[0016] **FIG. 6** is an enlarged view of a circled portion VI of **FIG. 5**; and

[0017] **FIG. 7** is an exploded, isometric view of a conventional backlight module.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] Reference will now be made to the drawings to describe embodiments of the present invention in detail.

[0019] **FIG. 1** is an isometric view of a double-sided liquid crystal display device **20** according to a first embodiment of the present invention. The liquid crystal display device **20** includes a first liquid crystal display panel **25**, a second liquid crystal display panel **26**, and a backlight module sandwiched between the first and second liquid crystal display panels **25**, **26**. The backlight module includes a plurality of light sources **21**, a first plate-like light guide member **23**, a second plate-like light guide member **24**, a reflector like a double-sided reflecting plate **22** sandwiched between the first and second light guide plates **23**, **24**, a first optical film **27**, and a second optical film **28**. The first light guide plate **23**, the double-sided reflecting plate **22** and the second light guide plate **24** are originally separate components and are pressuredly pressed together by molds to form the backlight module.

[0020] **FIG. 2** is a side view of the liquid crystal display device **20**, and **FIG. 3** is an enlarged view of a circled portion III of **FIG. 2**. The first and second light guide plates

23, **24** are substantially rectangular, and can be formed by an injection molding method or a hot-pressing method. The first light guide plate **23** includes a first incident surface **231**, a first light emitting surface **232** adjacent to the first incident surface **231**, and a first bottom surface **233** opposite to the first emitting surface **232**. The second light guide plate **24** includes a second light incident surface **241**, a second light emitting surface **242** adjacent to the second incident surface **241**, and a second bottom surface **243** opposite to the second emitting surface **242**. The first and second emitting surfaces **232**, **242** both have a plurality of v-shape cuts (not labeled) formed thereat. The v-shape cuts can improve the uniformity of light provided by the liquid crystal display **20**.

[**0021**] The light sources **21** can be light emitting diodes (LEDs), and are arranged in a single row adjacent to the first and second incident surfaces **231**, **241**. The reflecting plate **22** can be a polyethylene terephthalate (PET) substrate having silver coated on both main surfaces thereof. The first optical film **27** is adjacent to the first emitting surface **232**, and is sandwiched between the first light guide plate **23** and the first liquid crystal display panel **25**. The second optical film **28** is adjacent to the second emitting surface **242**, and is sandwiched between the second light guide plate **24** and the second liquid crystal display panel **26**.

[**0022**] Light beams emitted from the light sources **21** enter the first and second light guide plates **23**, **24** through the first and second incident surfaces **231**, **241**, respectively. Some of the light beams are then emitted directly from the first and second emitting surfaces **232**, **242**. Other of the light beams are emitted from the first and second emitting surfaces **232**, **242** after being reflected one or more times by the reflecting plate **22**. All light beams emitted from the first and second emitting surfaces **232**, **242** respectively propagate through the first and second optical films **27**, **28**, and transmit toward the first and second liquid crystal display panels **25**, **26**, respectively, thereby achieving a double-sided display.

[**0023**] The liquid crystal display device **20** includes the double-sided reflecting plate **22**, which is sandwiched between the first and second light guide plates **23**, **24**, and can reflect light beams from the light sources **21** toward the first and second light guide plates **23**, **24**. The first and second light guide plates **23**, **24** are two independent optical members, and do not affect each other. Therefore, the liquid crystal display device **20** has good display quality.

[**0024**] **FIG. 4** is an isometric view of a liquid crystal display device **30** according to a second embodiment of the present invention. The liquid crystal display device **30** includes a first liquid crystal display panel **35**, a second liquid crystal display panel **36**, and a backlight module sandwiched between the first and second liquid crystal display panels **35**, **36**. The backlight module includes two light sources **31**, a first light guide plate **33**, a second light guide plate **34**, a reflecting plate **32** sandwiched between the first and second light guide plates **33**, **34**, a first optical film **37**, and a second optical film **38**.

[**0025**] The first and second light guide plates **33**, **34** are substantially rectangular, and can be formed by an injection molding method or a hot-pressing method. The first light guide plate **33** includes a first emitting surface **332**, and a first bottom surface **333** opposite to the first emitting surface **332**. Two corners of the first light guide plate **33** are bevel-cut, thereby defining two first light incident surfaces **334**. The second light guide plate **34** includes a second light emitting surface **342**, and a second bottom surface **343** opposite to the second emitting surface **342**. Two corners of the second light guide plate **34** are bevel-cut, therefore defining two second light incident surfaces **344**. The first and second emitting surfaces **332**, **342** each have a plurality of v-shape cuts (not labeled) formed thereat. The v-shape cuts can improve the uniformity of light provided by the liquid crystal display device **30**.

[**0026**] The two light sources **31** can be light emitting diodes. Each light sources **31** is arranged adjacent to a corresponding pair of first and second incident surfaces **331**, **341**. The reflecting plate **32** can be a polyethylene terephthalate substrate having silver coated on both two main surfaces thereof. The first optical film **37** is adjacent to the first emitting surface **332**, and is sandwiched between the first light guide plate **33** and the first liquid crystal display panel **35**. The second optical film **38** is adjacent to the second emitting surface **342**, and is sandwiched between the second light guide plate **34** and the second liquid crystal display panel **36**.

[**0027**] Light beams emitted from the light sources **31** enter the first and second light guide plates **33**, **34** through the first and second incident surfaces **331**, **341**. Some of the light beams are then emitted directly from the first and second emitting surfaces **332**, **342**. Other of the light beams are emitted from the first and second emitting surfaces **332**, **242** after being reflected one or more times by the reflecting plate **32**. All light beams emitted from the first and second emitting surfaces **332**, **342** respectively propagate through the first and second optical films **37**, **38**, and transmit toward the first and second liquid crystal display panels **25**, **26**, thereby achieving a double-sided display.

[**0028**] The liquid crystal display device **30** includes the double-sided reflecting plate **32**, which is sandwiched between the first and second light guide plates **33**, **34**, and can reflect light beams from the light sources **31** toward the first and second light guide plates **33**, **34**. The first and second light guide plates **33**, **34** are two independent optical members, and do not affect each other. Therefore, the liquid crystal display device **30** has good display quality.

[**0029**] The present invention may have further and/or alternative embodiments as follows. The light sources **21**, **31** of the liquid crystal display device **20**, **30** can instead be linear light sources such as cold cathode fluorescent lamps (CCFLs). The reflecting plate **22**, **32** can be a polyethylene terephthalate substrate having titanium oxide (TiO_2) coated on both main surfaces thereof, or a polyethylene terephthalate substrate having silver coated on one main surface thereof and titanium oxide coated on the other main surface thereof, or a substrate made from reflective material. A frame may be provided for receiving and retaining the liquid crystal display panels **25**, **26** (**35**, **36**) and the backlight module therein.

[**0030**] It is to be further understood that even though numerous characteristics and advantages of the embodiments have been set forth in the foregoing description, together with details of the structure and function of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

We claim:

1. A backlight module, comprising:

a first light guide plate;

a second light guide plate;

a light source disposed adjacent to the first and second light guide plates; and

a double-sided reflecting plate sandwiched between the first and second light guide plates for reflecting light beams from the light source toward the first and second light guide plates, respectively.

2. The backlight module as claimed in claim 1, wherein the first and second light emitting surfaces each comprise a plurality of v-shape cuts thereat.

3. The backlight module as claimed in claim 1, wherein the light source comprises one of a light emitting diode (LED) and a cold cathode fluorescent lamp (CCFL).

4. The backlight module as claimed in claim 1, wherein the reflecting plate is a polyethylene terephthalate (PET) substrate having reflective material coated on both main surfaces thereof.

5. The backlight module as claimed in claim 4, wherein the reflective material is selected from silver and titanium oxide (TiO_2).

6. The backlight module as claimed in claim 1, wherein the reflecting plate is a polyethylene terephthalate substrate having silver coated on one main surface thereof and titanium oxide coated on the other main surface thereof.

7. The backlight module as claimed in claim 1, wherein the reflecting plate is a substrate made from reflective material.

8. The backlight module as claimed in claim 1, wherein a corner of the first light guide plate is bevel-cut, thereby defining a first light incident surface, and a corner of the second light guide plate is bevel-cut, thereby defining a second light incident surface, and the light source is arranged adjacent to the first and second incident surfaces.

9. A liquid crystal display device, comprising:

two liquid crystal display panels; and

a backlight module sandwiched between the two liquid crystal display panels, comprising:

a first light guide plate;

a second light guide plate;

a light source disposed adjacent to the first and second light guide plates; and

a double-sided reflecting plate sandwiched between the first and second light guide plates for reflecting light beams from the light source toward the first and second light guide plates, respectively.

10. The liquid crystal display device as claimed in claim 9, wherein the first and second light emitting surfaces each comprise a plurality of v-shape cuts thereat.

11. The liquid crystal display device as claimed in claim 9, wherein the light source comprises an item selected from the group consisting of a light emitting diode and a cold cathode fluorescent lamp.

12. The liquid crystal display device as claimed in claim 9, wherein the reflecting plate is a polyethylene terephthalate substrate having reflective material coated on both main surfaces thereof.

13. The liquid crystal display device as claimed in claim 12, wherein the reflective material is selected from silver and titanium oxide (TiO_2).

14. The liquid crystal display device as claimed in claim 9, wherein the reflecting plate is a polyethylene terephthalate substrate having silver coated on one main surface thereof and titanium oxide coated on the other main surface thereof.

15. The liquid crystal display device as claimed in claim 9, wherein the reflecting plate is a substrate made from reflective material.

16. The liquid crystal display device as claimed in claim 9, wherein a corner of the first light guide plate is bevel-cut, thereby defining a first light incident surface, and a corner of the second light guide plate is bevel-cut, thereby defining a second light incident surface, and the light source is arranged adjacent to the first and second incident surfaces.

17. The liquid crystal display device as claimed in claim 9, further comprising a frame receiving the liquid crystal display panels and the backlight module.

18. A display device comprising:

a light source in said display device providing light for said display device; and

a backlight module of said display device disposed next to said light source to receive said light from said light source, said backlight module comprising at least two light guide members integrally formed therein and physically separate by a reflector integrally sandwiched between said at least two light guide members, said light of said light source capable of being transmitted separately and respectively into each of said at least two light guide members, and capable of being reflected respectively by said reflector within said each of said at least two light guide members so as to be emitted out of said each of said at least two light guide members along different directions.

19. The display device as claimed in claim 18, wherein said reflector and said at least two light guide members are pressuredly pressed together to integrally form said backlight module.

20. The display device as claimed in claim 18, wherein said each of at least two light guide members has an emitting surface to emit said light out of said each of at least two light guide members along one of said different directions, a plurality of v-shape cuts is formed on said emitting surface.

* * * * *

专利名称(译)	双面液晶显示装置		
公开(公告)号	US20060050199A1	公开(公告)日	2006-03-09
申请号	US11/220330	申请日	2005-09-06
[标]申请(专利权)人(译)	鸿海精密工业股份有限公司		
申请(专利权)人(译)	鸿海精密工业股份有限公司.		
当前申请(专利权)人(译)	鸿海精密工业股份有限公司		
[标]发明人	HSU MU CHI HSU TUNG MING CHEN CHIEN MIN HSU MING FU CHENG WEN FENG		
发明人	HSU, MU-CHI HSU, TUNG-MING CHEN, CHIEN-MIN HSU, MING-FU CHENG, WEN-FENG		
IPC分类号	G02F1/1335		
CPC分类号	G02F2001/133342 G02F1/133615		
优先权	093126632 2004-09-03 TW		
外部链接	Espacenet USPTO		

摘要(译)

液晶显示装置（20）包括两个液晶显示面板（25,26）和夹在两个液晶显示面板之间的背光模块。背光模块包括第一导光板（23），第二导光板（24），邻近第一导光板和第二导光板设置的光源（21），以及夹在中间的双面反射板（22）在第一和第二导光板之间。液晶显示装置包括双面反射板，该双面反射板夹在第一和第二导光板之间，并且可以将来自光源的光束反射向第一和第二导光板。第一导光板和第二导光板通过模具与反射板压合在一起以形成背光模块，是两个独立的光学构件，并且彼此不相互影响。因此，液晶显示装置具有良好的显示质量。