US 20130100381A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2013/0100381 A1

(43) Pub. Date: Apr. 25, 2013

Hu et al.

(54) **BACKLIGHT MODULE AND LIQUID CRYSTAL DISPLAY DEVICE**

(75) Inventors: **Chechang Hu**, Shenzhen (CN); **Hu He**, Shenzhen (CN)

(73) Assignee: **SHENZHEN CHINA STAR OPTOELECTRONICS TECHNOLOGY CO., LTD.**, Shenzhen, Guangdong (CN)

(21) Appl. No.: **13/378,044**

(22) PCT Filed: **Nov. 15, 2011**

(86) PCT No.: **PCT/CN2011/082189**

§ 371 (c)(1),
(2), (4) Date: **Dec. 13, 2011**

(30) **Foreign Application Priority Data**

Oct. 25, 2011 (CN) 201110327162.2

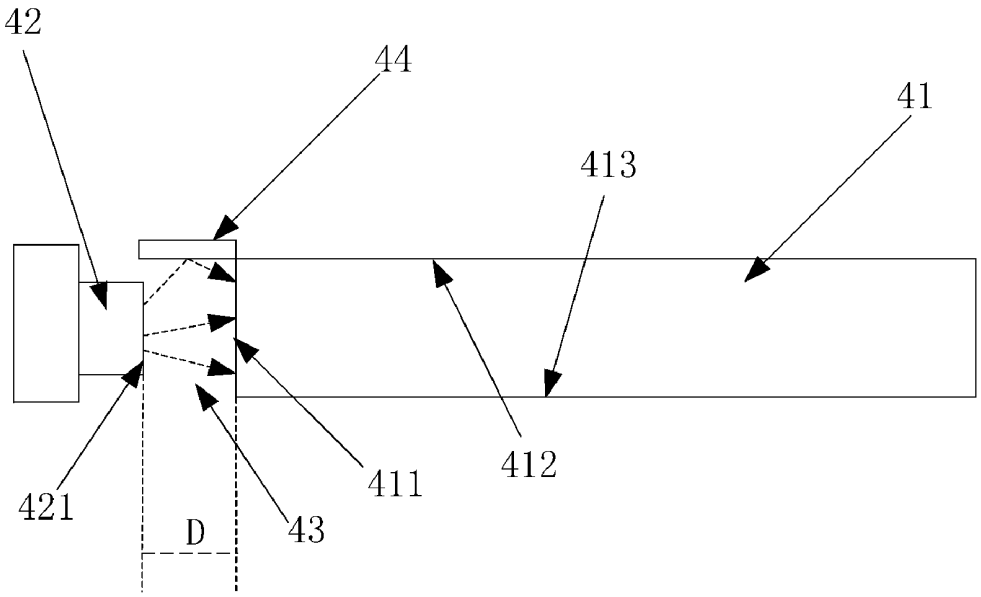
Publication Classification

(51) **Int. Cl.**
G02F 1/13357 (2006.01)
F21V 7/04 (2006.01)

(52) **U.S. Cl.**
USPC **349/65**; 362/609

(57) **ABSTRACT**

The present invention provides a backlight module, which comprises a light guide plate and a light source. The light guide plate comprises a light input side, a light output surface which adjoins to the light input side, and a bottom surface corresponding to the light output surface. The light source comprising a light-emitting surface is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate. The backlight module further comprises a specular reflector which is disposed between the light-emitting surface of the light source and the light input side of the light guide plate. Light beams which are emitted from the light-emitting surface of the light source toward the outside of the light guide plate will enter the light guide plate after being specularly reflected by the specular reflector. The present invention further provides a liquid crystal display device.



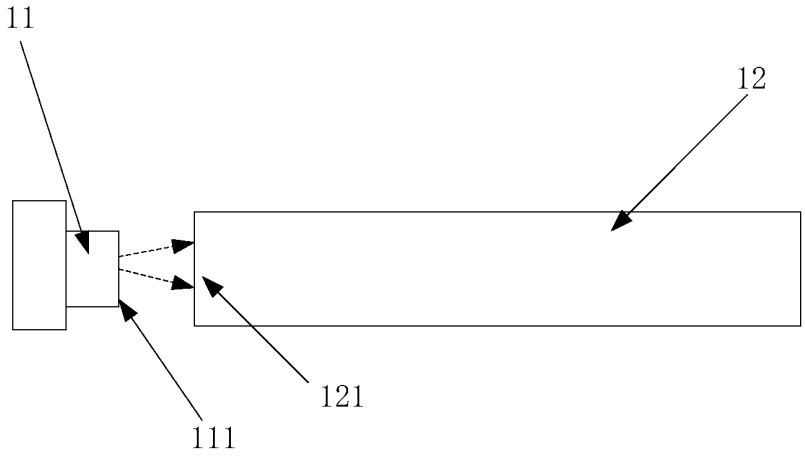


Fig. 1
Prior Art

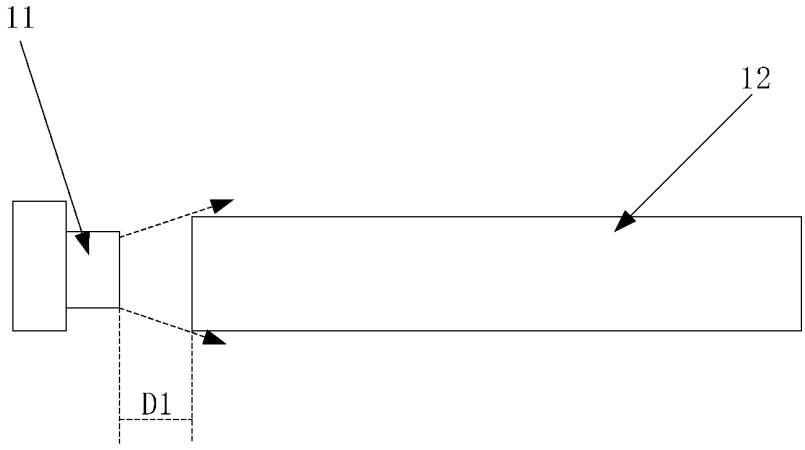


Fig. 2A
Prior Art

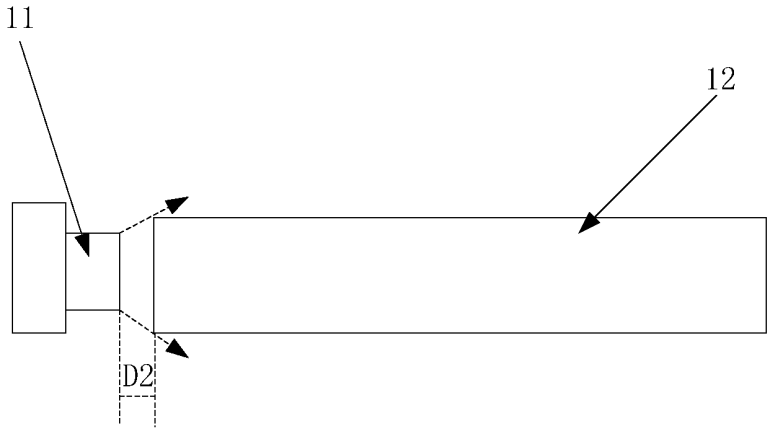


Fig. 2B
Prior Art

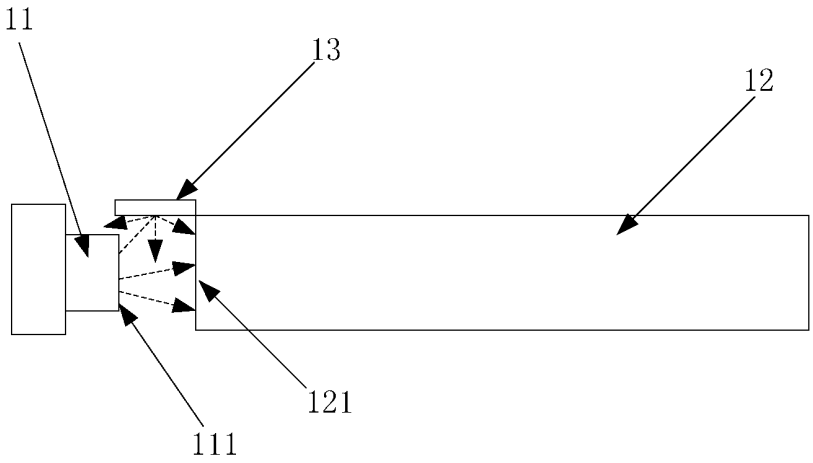


Fig. 3
Prior Art

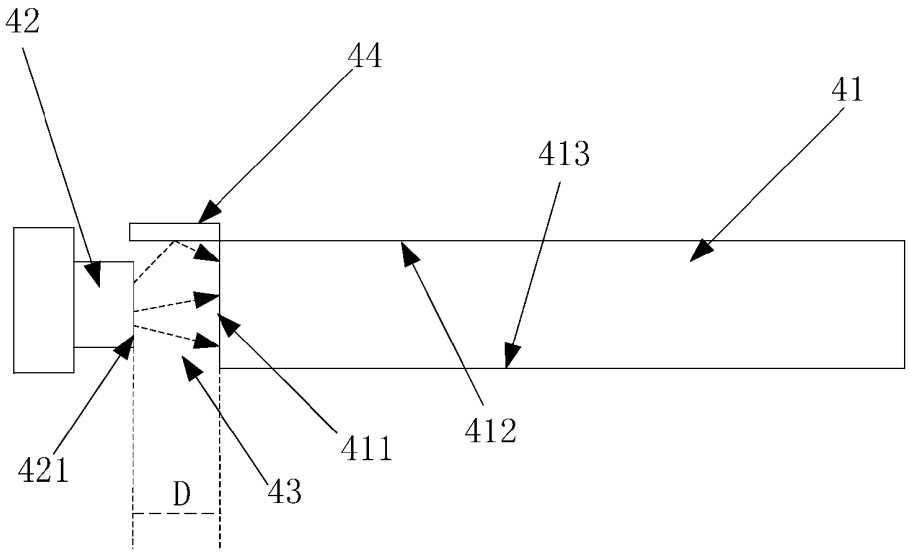


Fig. 4

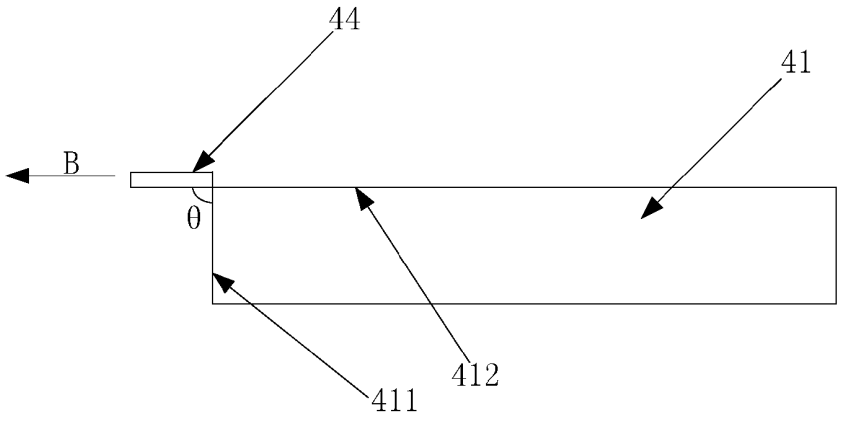


Fig. 5

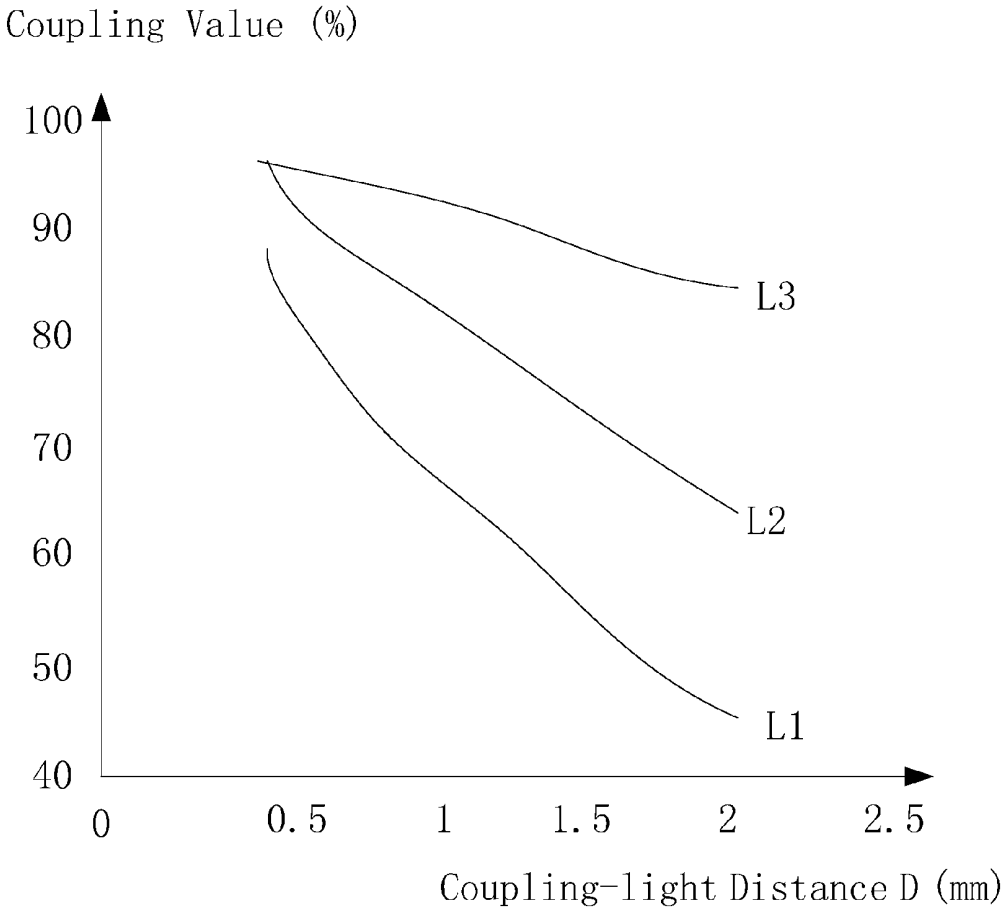

Coupling Value (%)
100
90
80
70
60
50
40
0
0.5
1
1.5
2
2.5
L3
L2
L1
Coupling-light Distance D (mm)

Fig. 6

BACKLIGHT MODULE AND LIQUID CRYSTAL DISPLAY DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to a scope of a liquid crystal display device, and more particularly to a backlight module and a liquid crystal display device.

BACKGROUND OF THE INVENTION

[0002] With the development of the liquid crystal display technology, people have higher and higher functional requirements in the liquid crystal display.

[0003] Referring to FIG. **1**, a partially structural view of a traditional backlight module is illustrated. The backlight module comprises a light source **11** and a light guide plate **12**, wherein the light source **11** may be a light-emitting diode (LED) for emitting light beams. The light beams emitted by the light source **11** enter the light guide plate **12**, wherein a coupling efficiency between the light source **11** and the light guide plate **12** is directly relative to a luminous utilization of the whole backlight module.

[0004] The traditional light source **11** generally adopts an LED with a similar Lambertian-type. This kind of the LED has a characteristic with the low voltage and high luminous-flux. The light beams emitted by the Lambertian-type LED mainly concentrate in an angle which faces the light guide plate **12**. While the angle is larger than a certain extent, the light beams within the angle may be relatively reduced.

[0005] In a case of an LED package for the 5630 model, which has a package size of 5.6 mm×3.0 mm×0.8 mm, the luminous-flux of the LED package at various viewing angles in horizontal and vertical directions are measured. It will be measured that the viewing angle at about 60-degree, the luminous-flux has been reduced to half. Apparently, the larger viewing angle has the smaller relative proportion of the luminous-flux, wherein the luminous-flux is an illuminating proportion of the light source **11**.

[0006] Moreover, a distance between a light-emitting surface **111** of the light source **11** and a light input side **121** of the light guide plate **12** is 2.4 mm. If the distance is smaller, a leakage proportion of light beams may be decreased.

[0007] Please refer to FIGS. **2**A to **2**B, comparative schematic views of leakage proportions of the light beams in different distances D**1** and D**2** are illustrated in FIGS. **2**A to **2**B, wherein D**1**>D**2**. Apparently, in a situation of the unchanged model of the light source **11**, the larger leakage angle of the light beams has the larger leakage proportion of the light beams in the situation of distance D**1**, and the smaller leakage angle of the light beams has the smaller leakage proportion of the light beams in the situation of distance D**2**.

[0008] However, considering a character of thermal expansion of the light guide plate **12**, a certain space has to be reserved between the light source **11** and the light guide plate **12**, so that the light guide plate **12** may have an expansible space.

[0009] Please refer to FIG. **3**, for solving problems of loss light beams induced by the space between the light source **11** and the light guide plate **12**, a white reflector **13** is generally disposed between the light source **11** and the light guide plate **12**, so that light beams which may be emitted toward the outside of the light guide plate **12** are reflected back to the light guide plate **12** by the white reflector **13**.

[0010] But, because of the white reflector **13** has a character of light scattering, the white reflector **13** will scatter the light beams to various angles after being emitting toward the white reflector **13**. Finally, only the limited light beams are gathered into the light guide plate **12**, so as to reduce the luminous utilization of the backlight module and affect a light-emitting effect of the backlight module, resulting in affecting the quality of images of the liquid crystal display device.

SUMMARY OF THE INVENTION

[0011] An object of the present invention is to provide a backlight module for solving the technical problems of the white reflector of the traditional technology that cannot effectively reflect the light beams which are emitted from the light source toward the outside of the light guide plate to enter the light guide plate resulting in reducing the luminous utilization of the backlight module and affecting the display quality of a liquid crystal display device.

[0012] For solving the above problems, the present inventor provides a backlight module which comprises a light guide plate and a light source. The light guide plate comprises a light input side, a light output surface which adjoins to the light input side, and a bottom surface which is corresponding to the light output surface. The light source comprises a light-emitting surface which is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate.

[0013] The backlight module further comprises a specular reflector which extends along a reflecting plane; and the reflecting plane and the light input side of the light guide plate form a predetermined angle therebetween. The light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter.

[0014] The specular reflector is disposed between the light-emitting surface of the light source and the light input side of the light guide plate. Light beams which are emitted from the light-emitting surface of the light source toward the outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

[0015] In the backlight module of the present invention, a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate. The specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

[0016] In the backlight module of the present invention, the specular reflector is a silver reflector.

[0017] A secondary object of the present invention is to provide a backlight module for solving the technical problems of the white reflector of the traditional technology that cannot effectively reflect the light beams which are emitted from the light source toward the outside of the light guide plate to enter the light guide plate resulting in reducing the luminous utilization of the backlight module and affecting the display quality of a liquid crystal display device.

[0018] For solving the above problems, the present inventor provides a backlight module which comprises a light guide plate and a light source. The light guide plate comprises a light input side, a light output surface which adjoins to the

light input side, and a bottom surface which is corresponding to the light output surface. The light source comprises a light-emitting surface which is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate.

[0019] The backlight module further comprises a specular reflector, which is disposed between the light-emitting surface of the light source and the light input side of the light guide plate. Light beams which are emitted from the light-emitting surface of the light source toward the outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

[0020] In the backlight module of the present invention, the specular reflector extends along a reflecting plane, and the reflecting plane and the light input side of the light guide plate form a predetermined angle therebetween.

[0021] In the backlight module of the present invention, a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate. The specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

[0022] In the backlight module of the present invention, the specular reflector is a silver reflector.

[0023] In the backlight module of the present invention, the light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter.

[0024] A third object of the present invention is to provide a liquid crystal display device for solving the technical problems of the white reflector of the traditional technology that cannot effectively reflect the light beams which are emitted from the light source toward the outside of the light guide plate to enter the light guide plate resulting in reducing the luminous utilization of the backlight module and affecting the display quality of the liquid crystal display device.

[0025] For solving the above problems, the present inventor provides a liquid crystal display device comprises a liquid crystal display panel. The liquid crystal display device further comprises a backlight module which comprises a light guide plate and a light source. The light guide plate comprises a light input side, a light output surface which adjoins to the light input side, and a bottom surface which is corresponding to the light output surface. The light source comprises a light-emitting surface which is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate.

[0026] The backlight module further comprises a specular reflector, which is disposed between the light-emitting surface of the light source and the light input side of the light guide plate. Light beams which are emitted from the light-emitting surface of the light source toward the outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

[0027] In the liquid crystal display device of the present invention, the specular reflector extends along a reflecting plane, and the reflecting plane and the light input side of the light guide plate form a predetermined angle therebetween.

[0028] In the liquid crystal display device of the present invention, a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate. The specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

[0029] In the liquid crystal display device of the present invention, the specular reflector is a silver reflector.

[0030] In the liquid crystal display device of the present invention, the light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter.

[0031] Comparing to the existing technology, the present invention solves the technical problems of the white reflector of the existing technology that cannot effectively reflect the light beams which are emitted from the light source toward the outside of the light guide plate to enter the light guide plate resulting in reducing the luminous utilization of the backlight module, so that the display quality of a liquid crystal display device may be enhanced.

[0032] The foregoing contents adopted by the present invention can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings:

DESCRIPTION OF THE DRAWINGS

[0033] FIG. **1** is a partially structural view of a traditional backlight module;

[0034] FIGS. **2**A to **2**B are comparative schematic views of leakage proportions of light beams in different distances between the traditional light source and light guide plate;

[0035] FIG. **3** is a partially structural view of the traditional backlight module;

[0036] FIG. **4** is a schematic structural view of a preferred embodiment of a backlight module of the present invention;

[0037] FIG. **5** is a schematic view of the preferred embodiment of connecting a specular reflector with a light guide plate in the backlight module of the present invention; and

[0038] FIG. **6** is a comparative diagram of coupling value of the specular reflector of the present invention and coupling efficiency in other situations.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] The foregoing description of embodiments is referring to the accompanying drawings for description of the specific embodiments which can be carried out in the present invention.

[0040] FIG. **4** is a schematic structural view according to a preferred embodiment of a backlight module of the present invention, and the backlight module comprises a light guide plate **41** and a light source **42**.

[0041] Please refer to FIG. **4**, the light guide plate **41** comprises a light input side **411**, a light output surface **412** which adjoins to the light input side **411**, and a bottom surface **413** which is corresponding to the light output surface **412**. The light source **42** is disposed at one side of the light input side **411** of the light guide plate **41**, and the light source **42** comprises a plurality of LED. Resin of each LED comprises a

light-emitting surface **421**, and light beams which are emitted from the light-emitting surface **421** of the light source **42** toward the light input side **411** of the light guide plate **41**. A coupling-light area **43** is formed between the light-emitting surface **421** of the light source **42** and the light input side **411** of the light guide plate **41**.

[0042] In this preferred embodiment, the light-emitting surface **421** of the light source **42** and the light input side **411** of the light guide plate **41** have a coupling-light distance D therebetween, wherein the coupling-light distance D is ranged within a predetermined coupling-light range. For example, the predetermined coupling-light range is greater than 0.1 mm and less than 2.5 mm, and the coupling-light distance D is 1.0 mm.

[0043] In this embodiment, the backlight module further comprises a specular reflector **44**. The specular reflector **44** is disposed between the light-emitting surface **421** of the light source **42** and the light input side **411** of the light guide plate **41**, wherein the specular reflector **44** uses to generate specular reflection. The light beams which are emitted from the light-emitting surface **421** of the light source **42** toward the outside of the light input side **411** of the light guide plate **41** enter the light guide plate **41** after being specularly reflected by the specular reflector **44**.

[0044] Please refer to FIG. **5**, the specular reflector **44** extends along a reflecting plane B, and the reflecting plane B and the light input side **411** of the light guide plate **41** form a predetermined angle θ therebetween.

[0045] In the embodiment shown in FIG. **4**, the specular reflector **44** is disposed at an adjoining region of the coupling-light area **43** and the light-emitting surface **421** of the light source **42**, and the reflecting plane B is perpendicular to the light input side **411** of the light guide plate **41**. Of course, during the specifically implementing process, the specular reflector **44** also may be disposed on other positions of the coupling-light area **43** or outside of the coupling-light area **43**, as long as the specular reflector **44** shall specularly reflect the light beams emitted from the light source **42** toward the outside of the light guide plate **41** beck to the light guide plate **41**. Here will not to enumerate one by one.

[0046] Referring to FIG. **5**, in this embodiment, the predetermined angle θ is 90-degree. Of course, it can be other predetermined degrees, as long as the light beams emitted toward the specular reflector **44** shall enter the light guide plate **41** after being specularly reflected by the specular reflector **44**. Here will not to enumerate one by one.

[0047] Wherein, when the predetermined angle θ is 90-degree, a coupling value which the specular reflector **44** couples the light beams emitted by the light source **42** is greater than a predetermined coupling value, and the coupling value is a proportion of specularly reflecting the light beams to enter the light guide plate **41**. For example, when a viewing angle is 60-degree and the predetermined angle θ is set 90-degree, the proportion of the specular reflector **44** specularly reflects the light beams which the light source **42** emits toward the specular reflector **44** to enter the light guide plate **41** is greater than 70%.

[0048] The preferred choice is that the specular reflector **44** is a silver reflector, and of course it may be other material reflector, as long as what can make the specular reflection for the light beams to be emitted toward the specular reflector **44**. Here will not to enumerate one by one.

[0049] The principle of the preferred embodiment of the backlight module of the present invention is:

[0050] Please refer to FIGS. **4** to **5**, during light-emitting processes of the backlight module, parts of the light beams emitted from the light-emitting surface **421** of the light source **42** directly enter the light input side **411** of the light guide plate **41**, and other parts are emitted the outside of the light input side **411** of the light guide plate **41**. Referring to FIG. **4**, the specular reflector **44** will specularly reflect the light beams emitted toward the specular reflector **44** according as positing the specular reflector **44** on the coupling-light area **43**. Thus, the light beams emitted toward the specular reflector **44** will enter the light guide plate **41** after specularly reflecting by the specular reflector **44**.

[0051] Moreover, because of the light beams emitted toward the specular reflector **44** only can occur to the specular reflection, elastically disposing the predetermined angle θ may let the light beams emitted toward the specular reflector **44** all be specularly reflected to the light guide plate **41**.

[0052] Please refer to FIG. **6**, which is a comparative diagram of corresponding couplings in three situations of different coupling distances, wherein L**1** is the coupling is disposed with no any reflector, L**2** is the coupling of adopting a white reflector, and L**3** is the coupling of adopting the specular reflector **44** of the embodiment of the present invention.

[0053] Evidently, because of the specular reflector **44** provides the specular reflection, it shall ensure that the light beams emitted toward the specular reflector **44** only can occur to specularly reflect and then enter the light guide plate **41**. Thus, it may promise the higher coupling and greatly improve the luminous utilization, thereby upgrading the image displaying quality of a liquid crystal display device.

[0054] The present invention also provides a liquid crystal display device, which comprises a liquid crystal display panel. The liquid crystal display further comprises the backlight module of the present invention, and the backlight module is connected to the liquid crystal display panel, and the light beams which are emitted from the backlight module enter the liquid crystal display panel. Because of the backlight module has been detailed description in the above, here will no longer redundancy.

[0055] In summary, when the present invention has been described in terms of a preferred embodiment thereof, it is to be understood that the invention is not limited thereto. Other skilled in this art may change and modification to the described embodiment without departing from the true scope and the spirit of the invention that is intended to be limited only by the appended claims.

What is claimed is:

1. A backlight module comprising: a light guide plate and a light source, the light guide plate comprising a light input side, a light output surface which adjoins to the light input side, and a bottom surface corresponding to the light output surface; wherein the light source comprising a light-emitting surface is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate, characterized in that:

the backlight module further comprises: a specular reflector, which extends along a reflecting plane, and the reflecting plane and the light input side of the light guide plate have a predetermined angle therebetween; the light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light

distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter; and

wherein the specular reflector is disposed between the light-emitting surface of the light source and the light input side of the light guide plate; and light beams which are emitted from the light-emitting surface of the light source toward an outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

2. The backlight module according to claim **1**, characterized in that: a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate, the specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

3. The backlight module according to claim **1**, characterized in that: the specular reflector is a silver reflector.

4. A backlight module comprising: a light guide plate and a light source, the light guide plate comprising a light input side, a light output surface which adjoins to the light input side, and a bottom surface corresponding to the light output surface; wherein the light source comprising a light-emitting surface is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate, characterized in that:

the backlight module further comprises: a specular reflector, which is disposed between the light-emitting surface of the light source and the light input side of the light guide plate, and light beams which are emitted from the light-emitting surface of the light source toward an outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

5. The backlight module according to claim **4**, characterized in that: the specular reflector extends along a reflecting plane, and the reflecting plane and the light input side of the light guide plate form a predetermined angle therebetween.

6. The backlight module according to claim **5**, characterized in that: a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate, the specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

7. The backlight module according to claim **4**, characterized in that: the light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter.

8. The backlight module according to claim **4**, characterized in that: the specular reflector is a silver reflector.

9. A liquid crystal display device comprising: a liquid crystal display panel, characterized in that: the liquid crystal display device further comprises: a backlight module, and the liquid crystal display panel is connected to the backlight module, and the backlight module comprises a light guide plate and a light source, the light guide plate comprises: a light input side, a light output surface which adjoins to the light input side, and a bottom surface corresponding to the light output surface; wherein the light source comprises a light-emitting surface, the light source is disposed at one side of the light input side of the light guide plate, and the light-emitting surface of the light source is corresponding to the light input side of the light guide plate;

wherein the backlight module further comprises a specular reflector, the specular reflector is disposed between the light-emitting surface of the light source and the light input side of the light guide plate; and light beams emitted from the light-emitting surface of the light source toward an outside of the light input side of the light guide plate enter the light guide plate after being specularly reflected by the specular reflector.

10. The liquid crystal display device according to claim **9**, characterized in that: the specular reflector extends along a reflecting plane, and the reflecting plane and the light input side of the light guide plate form a predetermined angle therebetween.

11. The liquid crystal display device according to claim **10**, characterized in that: a coupling-light area is formed between the light-emitting surface of the light source and the light input side of the light guide plate, the specular reflector is disposed at an adjoining region of the coupling-light area and the light output surface of the light guide plate, and the reflecting plane is perpendicular to the light input side of the light guide plate, wherein the predetermined angle is a right angle.

12. The liquid crystal display device according to claim **9**, characterized in that: the light-emitting surface of the light source and the light input side of the light guide plate have a coupling-light distance therebetween, and the coupling-light distance is ranged within a coupling-light range between 0.1 millimeter and 2.5 millimeter.

13. The liquid crystal display according to claim **9**, characterized in that: the specular reflector is a silver reflector.

* * * * *

专利名称(译)	背光模块和液晶显示装置		
公开(公告)号	US20130100381A1	公开(公告)日	2013-04-25
申请号	US13/378044	申请日	2011-11-15
[标]申请(专利权)人(译)	胡CHECHANG 何虎		
申请(专利权)人(译)	HU，CHECHANG 何，胡		
当前申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
[标]发明人	HU CHECHANG HE HU		
发明人	HU, CHECHANG HE, HU		
IPC分类号	G02F1/13357 F21V7/04		
CPC分类号	G02B6/0031		
优先权	201110327162.2 2011-10-25 CN		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种背光模组，包括导光板和光源。导光板包括光输入侧，与光输入侧邻接的光输出表面，以及与光输出表面对应的底表面。包括发光表面的光源设置在导光板的光输入侧的一侧，并且光源的发光表面对应于导光板的光输入侧。背光模块还包括镜面反射器，镜面反射器设置在光源的发光表面和导光板的光输入侧之间。从光源的光发射表面朝向导光板的外部发射的光束在被镜面反射器镜面反射之后将进入导光板。本发明还提供一种液晶显示装置。