US 20150219829A1

(19) **United States**

(12) **Patent Application Publication**

CHEN et al.

(10) **Pub. No.: US 2015/0219829 A1**

(43) **Pub. Date: Aug. 6, 2015**

(54) **LIGHTING ASSEMBLY**

(71) Applicant: **Radiant Opto-Electronics Corporation**, Kaohsiung City (TW)

(72) Inventors: **Wei-Hsuan CHEN**, Kaohsiung City (TW); **Yung-Hui TAI**, Kaohsiung City (TW); **Chun-Yi WU**, Kaohsiung City (TW)

(73) Assignee: **Radiant Opto-Electronics Corporation**, Kaohsiung City (TW)

(21) Appl. No.: **14/688,338**

(22) Filed: **Apr. 16, 2015**

Related U.S. Application Data

(63) Continuation of application No. 14/148,058, filed on Jan. 6, 2014, now Pat. No. 9,033,566.

(30) **Foreign Application Priority Data**

May 27, 2013 (TW) 102118628

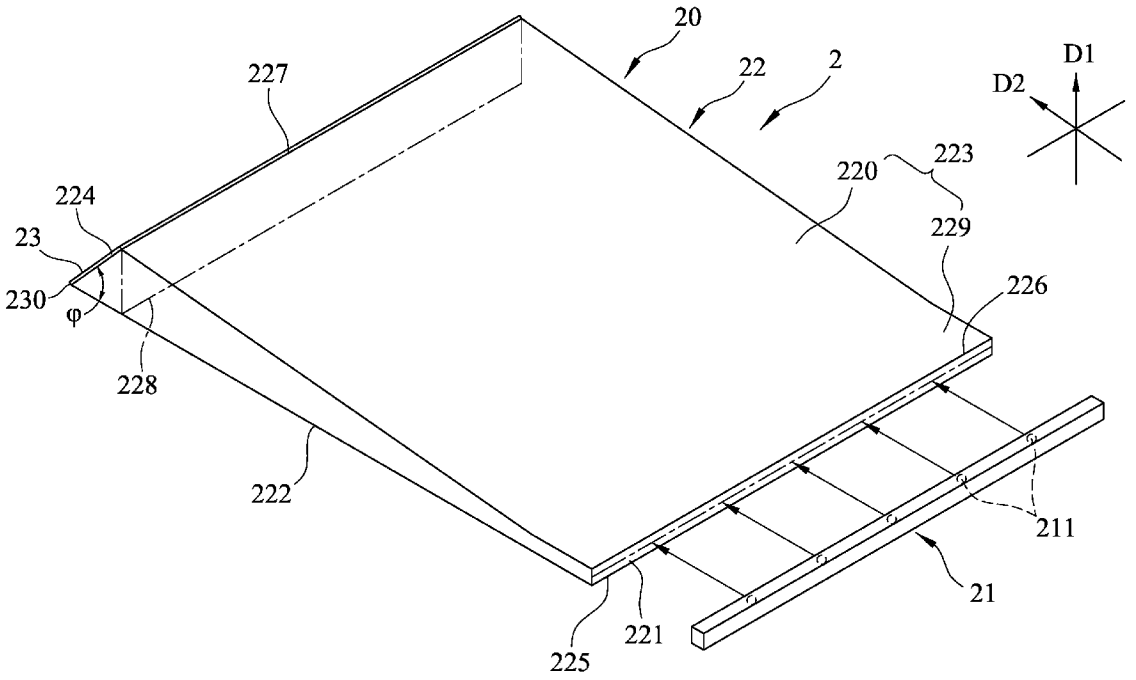
Publication Classification

(51) **Int. Cl.**
F21V 8/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/0046*** (2013.01); ***G02B 6/0055*** (2013.01); ***G02B 6/0073*** (2013.01)

(57) **ABSTRACT**

A lighting assembly includes a light source, a light guiding plate and a reflecting member. The light guiding plate has a light input surface, a light output surface extending from the light input surface, a connecting surface and a reflecting surface. The connecting surface has an inclined segment. Extensions of the inclined segment and the light output surface cooperatively define a first included angle. The reflecting surface interconnects the connecting surface and the light output surface, cooperates with the light output surface to define a second included angle, and mounted with the reflecting member. A thickness of the light guiding plate at the reflecting surface is greater than that at the light input surface.



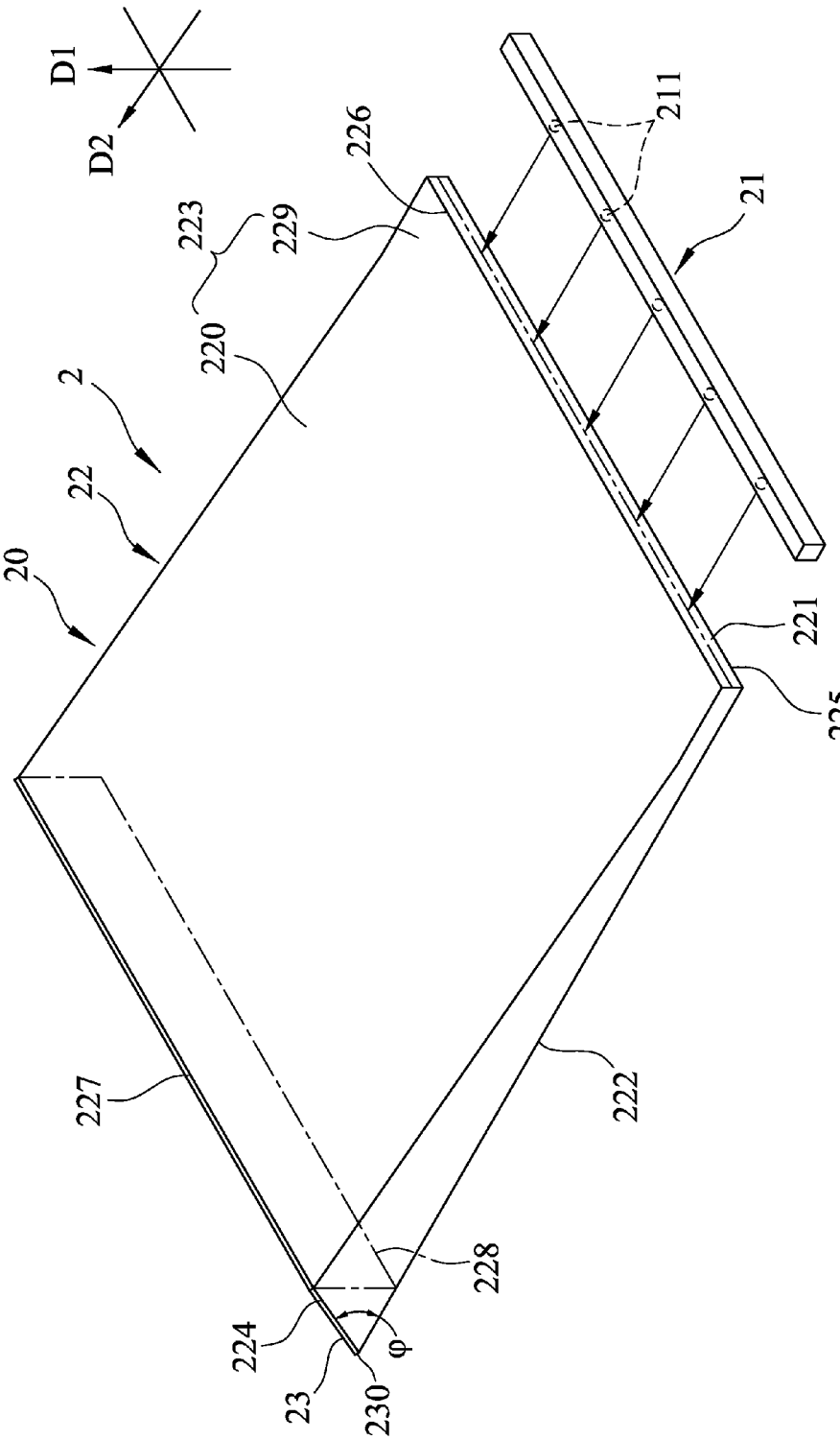

D1
D2
226
211
223
229
21
220
2
22
20
221
225
227
222
228
224
φ
23
230

FIG.1

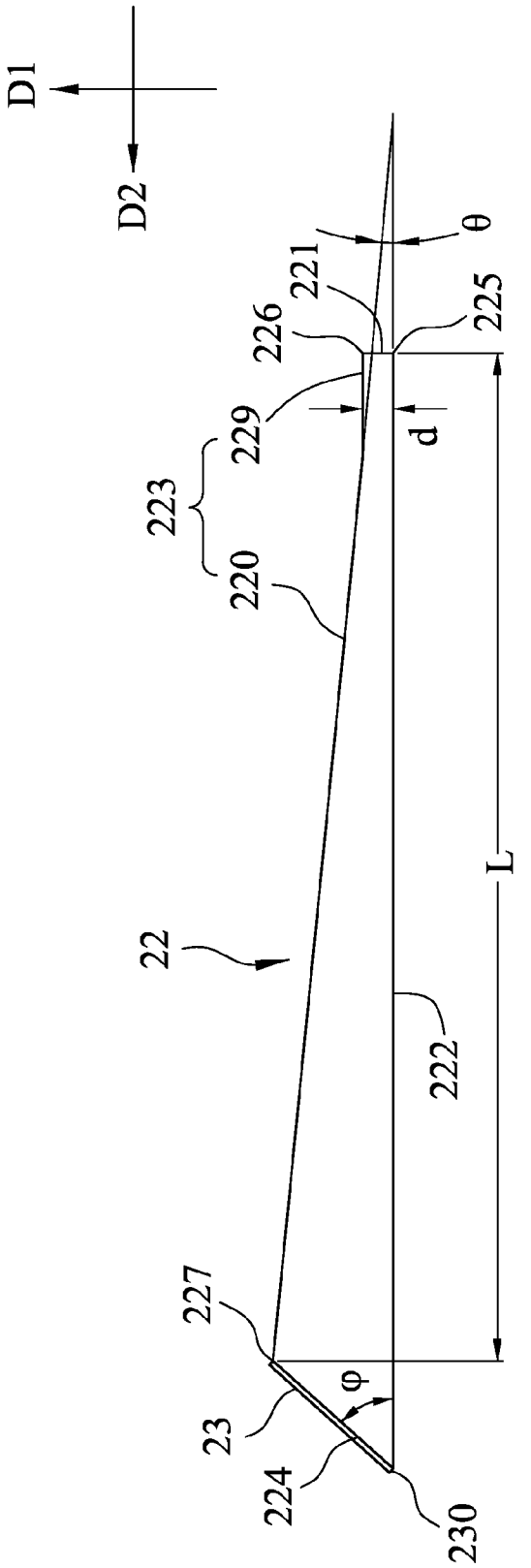


FIG.2

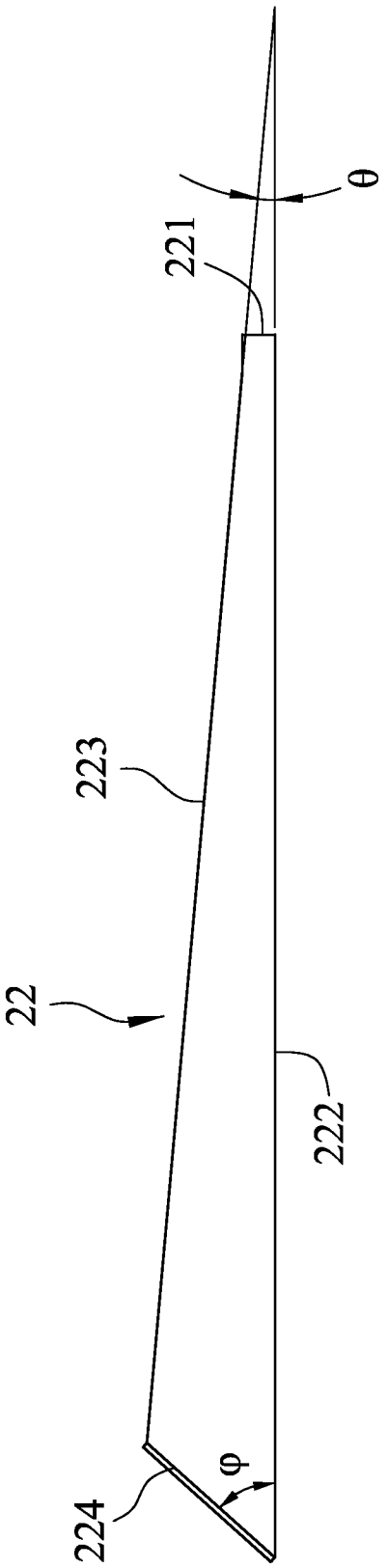


FIG.3

LIGHTING ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation patent application of U.S. patent application Ser. No. 14/148,058 filed on Jan. 6, 2014 which claims priority of Taiwanese Application No. 102118628, filed on May 27, 2013.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to an optical device, more particularly to a light guiding assembly incorporating a light guiding device and a light source.

[0004] 2. Description of the Related Art

[0005] A long fluorescent lamp or multiple round light bulbs are often used in exhibition venues where sufficient lighting for a long or large display area is required. However, the light emitted by a single fluorescent lamp tends to be scattered and inefficient, and the light from multiple round light bulbs tends to overlap and is thus uneven. In addition, increasing the number of lamps also increases the costs of lighting.

[0006] A light guiding device is often used to regulate light emitted from a light source for a more even lighting effect. U.S. Pat. No. 6,328,453 and U.S. Pat. No. 6,752,507 disclose light guiding plates with micro structures formed thereon for controlling directions of light outputted from the light guiding plates to result in a relatively even lighting effect. However, designing and processing the micro structures on the light guiding plates increases the manufacturing complexity and costs.

SUMMARY OF THE INVENTION

[0007] Therefore, the object of the present invention is to provide a lighting assembly including a light guiding device that is able to manipulate an illuminating region without micro structures to alleviate the aforesaid drawbacks of the prior art.

[0008] According to the present invention, a lighting assembly includes a light source capable of emitting light, a light guiding plate and a reflecting member. The light guiding plate has a light input surface, a light output surface, a connecting surface and a reflecting surface. The light output surface extends from the light input surface. The connecting surface is opposite to the light output surface and has an inclined segment inclining away from the light output surface. Extensions of the inclined segment and the light output surface cooperatively define a first included angle therebetween. The reflecting surface interconnects the connecting surface and the light output surface, and cooperates with the light output surface to define a second included angle therebetween. A thickness of the light guiding plate at the reflecting surface is greater than that at the light input surface. The reflecting member is mounted to the reflecting surface of the light guiding plate.

[0009] The lighting assembly according to the present invention is able to regulate scattered light emitted from the light source into an even light projection that is suitable for illuminating a large area. The parameters of the light guiding plate can be changed during the manufacturing process to control the luminous flux of the light exiting the light guiding plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Other features and advantages of the present disclosure will become apparent in the following detailed description of the preferred embodiment with reference to the accompanying drawings, of which:

[0011] FIG. **1** is an exploded perspective view of a preferred embodiment of a lighting assembly according to the present invention;

[0012] FIG. **2** is a side view of a light guiding device of the preferred embodiment; and

[0013] FIG. **3** is a side view of a variation of the light guiding device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] With reference to FIG. **1**, the preferred embodiment of a lighting assembly **2** according to the present invention includes a light guiding device **20** and a light source **21**. The light guiding device **20** includes a light guiding plate **22** for receiving light emitted from the light source **21**, and a reflecting member **23** mounted to the light guiding plate **22**. In this embodiment, the light source **21** includes a plurality of light emitting diodes (LEDs) **211**, but it is not limited thereto.

[0015] With further reference to FIG. **2**, the light guiding plate **22** has a light input surface **221**, a light output surface **222**, a connecting surface **223** and a reflecting surface **224**. The light input surface **221** has a first edge **225** and a second edge **226** opposite to each other in a first direction (D**1**). The light output surface **222** extends from the first edge **225** of the light input surface **221** in a second direction (D**2**) transverse to the first direction (D**1**), and has a distal edge **230** opposite to the first edge **225** of the light input surface **221**. The connecting surface **223** is opposite to the light output surface **222** in the first direction (D**1**), and has a straight segment **229** extending from the second edge **226** of the light input surface **221** and an inclined segment **220** extending from the straight segment **229**, inclining away from the light output surface **222** and terminating at an end edge **227**. In this embodiment, the straight segment **229** of the connecting surface **223** is parallel to the light output surface **222**. The reflecting surface **224** interconnects the end edge **227** of the connecting surface **223** and the distal edge **230** of the light output surface **222**. Extensions of the inclined segment **220** of the connecting surface **223** and the light output surface **222** cooperatively define a first included angle θ therebetween. The reflecting surface **224** and the light output surface **222** cooperatively define a second included angle ϕ therebetween. A distance between the second edge **226** of the light input surface **221** and the end edge **227** of the connecting surface **223** in the second direction (D**2**) is shorter than that between the first edge **225** of the light input surface **221** and the distal edge **230** of the light output surface **222**.

[0016] With the above mentioned configuration, relationships of $\theta<\phi$, $\theta<\theta_T$ and $L\geq(AD)/\tan\theta$ are satisfied, where θ_T is a critical angle for total internal reflection associated with the light guiding plate **22**, (AD) is a distance between a location of incidence of a light beam on the light input surface **221** and one of the first edge **225** and the second edge **226** of the light input surface **221**, and (L) is the distance between the second edge **226** of the light input surface **221** and the end edge **227** of the connecting surface **223** in the second direction (D**2**). The second included angle ϕ is a parameter for controlling an angle of beam exiting the light guiding plate

22, and the distance (L) and the first included angle θ are parameters for controlling a width of beam exiting the light guiding plate **22**. These three parameters cooperatively control the luminous flux of the light exiting the light guiding plate **22**.

[0017] The reflecting member **23** is mounted to the reflecting surface **224** of the light guiding plate **22**. The light emitted by the light source **21** enters the light guiding plate **22** via the light input surface **221**, and part of the light is reflected by the reflecting member **23** to exit the light guiding plate **22** through the light output surface **222**.

[0018] Light guiding plates **22** of two different materials, Polycarbonate (PC) and Polymethylmethacrylate (PMMA), and with different dimensions are made for testing purposes. In the tests, the light measured at the light input surface **221** is 90.67 lm, and the LEDs **211** of the light source **21** were linearly arranged and correspond in position to the central axis of the light input surface **221** (see FIG. **1**), such that AD=(d/2) where (d) is the distance between the first edge **225** and the second edge **226** of the light input surface **221**. The light output of each test group is measured in lm and percentages of the light output with respect to the light input are computed, and the test results are shown in Tables 1 and 2.

[0019] It is noted herein that AD may vary depending on the position and orientation of the LEDs **211** that affect the angle and position of incidence of the light beam on the light input surface **221**. A condensed lighting effect may still be achieved if AD is varied such as when AD is 0.3 d or 0.7 d.

[0020] Referring to Table 1, test group (1) satisfies all the above mentioned three relationships where $\theta<\phi$ (11°<30°), $\theta<\theta_T$ (11°<42.16°) and $L\geq(d/2)/\tan\theta$ (79 mm>2.2 mm). Therefore, 90% efficiency is achieved. Test group (2) has a similar result to group (1).

[0021] Test groups (3) to (6) show that the efficiency is reduced proximately to 50% or less if any of the three relationships is not satisfied.

TABLE 1

Material	PMMA					
Index of Reflection (n)	1.49					
Critical Angle (θ_T)	42.16°					
d (mm)	4					
$(d/2)/(\tan\theta_T)$ (mm)	2.2					
Flux of light at the light input surface (lm)	90.67					
L (mm)	79	79	79	79	2	79
ϕ	30	44	44	44	44	44
θ (°)	11	11	42.16	44	11	50
Flux of light at the light output surface (lm)	81.8	86.5	47.4	48.1	42.2	48.8
Ratio of Light Output to Light Input (%)	90.2	95.4	52.3	53	46.5	53.8
Test Group Number	(1)	(2)	(3)	(4)	(5)	(6)

[0022] Table 2 indicates similar results from experiments carried out with the light guiding devices **20** whose light guiding plates **22** are made of PC.

TABLE 2

Material	PC					
Index of Reflection (n)	1.59					
Critical Angle (θ_T)	38.97°					
d (mm)	4					
$(d/2)/(\tan\theta_T)$ (mm)	2.5					
L (mm)	79	79	79	79	2	79
ϕ	30	44	44	44	44	44
θ (°)	11	11	42.16	44	11	50
Flux of Light Input from the Light Guiding Plate (lm)	81.8	84.1	46.2	46.7	41.7	47.5
Ratio of Light Output to Light Input (%)	90.2	95.4	50.9	51.5	46	52.4
Test Group Number	(1)	(2)	(3)	(4)	(5)	(6)

[0023] With reference to FIG. **3**, an alternative design of the connecting surface **223** without any segment parallel to the light output surface **222** will obtain similar test results to those shown in Tables 1 and 2.

[0024] To conclude, the lighting assembly **2** according to the present invention is able to regulate scattered light emitted from the light source **21** into an even light projection that is suitable for illuminating a large area. The parameters of the light guiding plate **22** can be changed during the manufacturing process to control the luminous flux of the light exiting the light guiding plate **22**.

[0025] While the present invention has been described in connection with what is considered the most practical and preferred embodiment, it is understood that this invention is not limited to the disclosed embodiment but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

What is claimed is:

1. A lighting assembly comprising:

a light source capable of emitting light;

a light guiding plate having

a light input surface,

a light output surface that extends from said light input surface,

a connecting surface that is opposite to said light output surface, and that has an inclined segment inclining away from said light output surface, extensions of said inclined segment and said light output surface cooperatively defining a first included angle therebetween, and

a reflecting surface that interconnects said connecting surface and said light output surface, and that cooperates with said light output surface to define a second included angle therebetween, a thickness of said light guiding plate at said reflecting surface being greater than that at said light input surface; and

a reflecting member for reflecting light emitted from said light guiding plate back into said light guiding plate.

2. The lighting assembly of claim **1**, wherein said connecting surface further has a straight segment that is connected between said inclined segment and said second edge of said light input surface, and that is parallel to said light output surface.

3. The lighting assembly of claim **1**, wherein said light source includes a plurality of light emitting diodes (LEDs) disposed linearly along an axis.

4. The lighting assembly of claim **3**, wherein the length of said light input surface is extended along said axis.

5. The lighting assembly of claim **1**, wherein said light input surface is a flat surface without serration.

6. The lighting assembly of claim **1**, wherein the length a projection of said light output surface on said connecting surface is greater than the length of said connecting surface.

7. The lighting assembly of claim **1**, wherein said reflecting surface of said light guide plate is covered by said reflecting member, and no surface of said light guiding plate other than said reflecting surface is covered.

8. The lighting assembly of claim **1**, wherein said reflecting surface is slanted with a constant slope rate.

9. The lighting assembly of claim **1**, wherein said light output surface is directly exposed to surroundings without being covered.

10. The lighting assembly of claim **1**, wherein said light connecting surface is mirror surface without sandblasting.

* * * * *