US007964943B2

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

(10) **Patent No.: US 7,964,943 B2**
(45) **Date of Patent: Jun. 21, 2011**

(54) **LIGHT EMITTING 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 250 days.

(21) Appl. No.: **12/339,665**

(22) Filed: **Dec. 19, 2008**

(65) **Prior Publication Data**

US 2010/0123156 A1 May 20, 2010

(30) **Foreign Application Priority Data**

Nov. 18, 2008 (KR) 10-2008-0114624

(51) **Int. Cl.**
H01L 23/495 (2006.01)

(52) **U.S. Cl.** **257/676**; 257/E23.059

(58) **Field of Classification Search** 257/98, 257/99, 675, E33.059, 666, 676, 79
See application file for complete search history.

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(57) **ABSTRACT**

Provided is a light emitting device. The light emitting device includes: a plurality of lead frame units spaced apart from each other, each of the lead frame units being provided with at least one fixing space perforating a body thereof in a vertical direction; a light emitting diode chip mounted on one of the lead frame units; and a molding unit that is integrally formed on top surfaces of the lead frame units and in the fixing spaces to protect the light emitting diode chip.

15 Claims, 9 Drawing Sheets

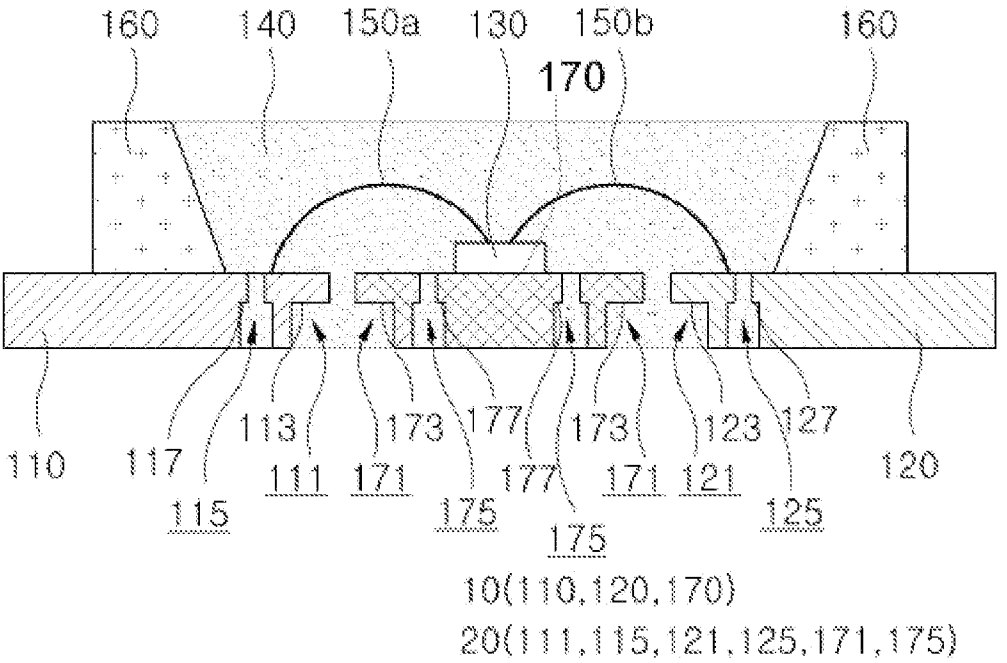


FIG. 1

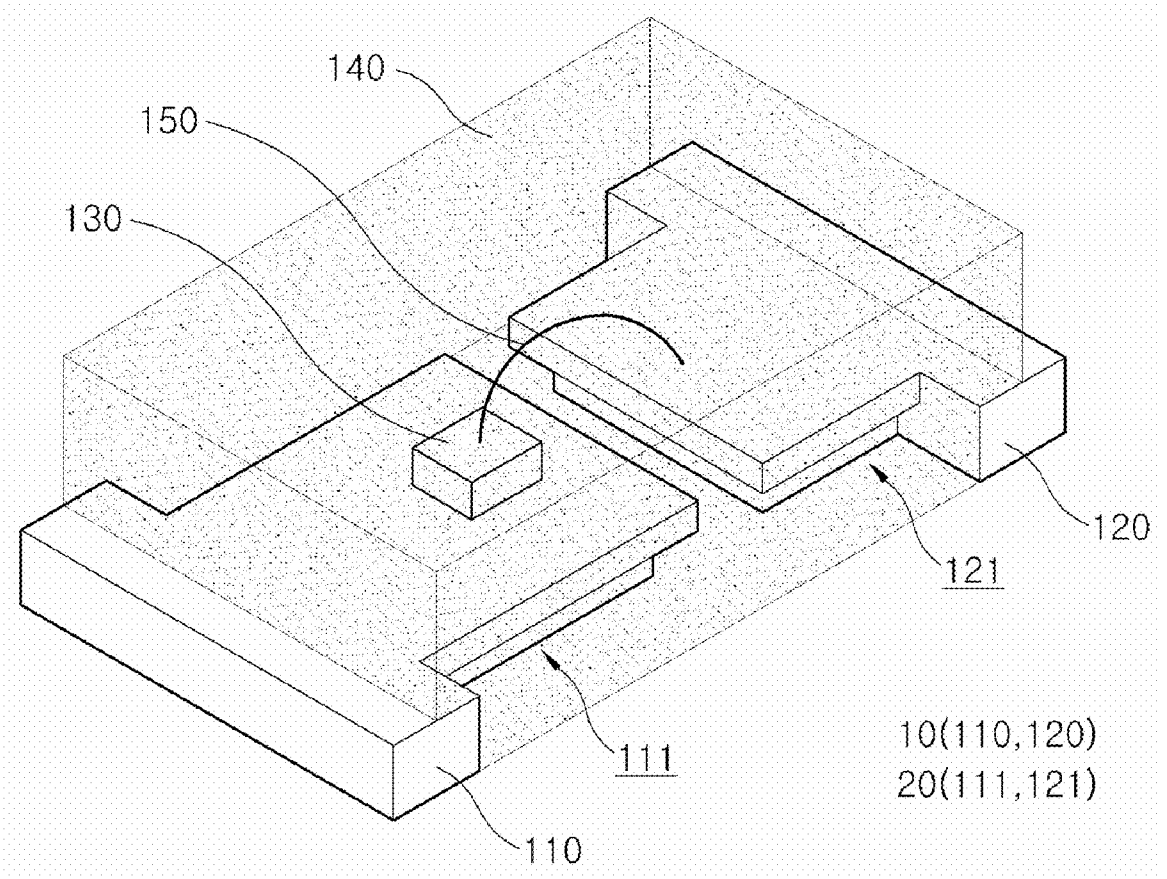


FIG. 2

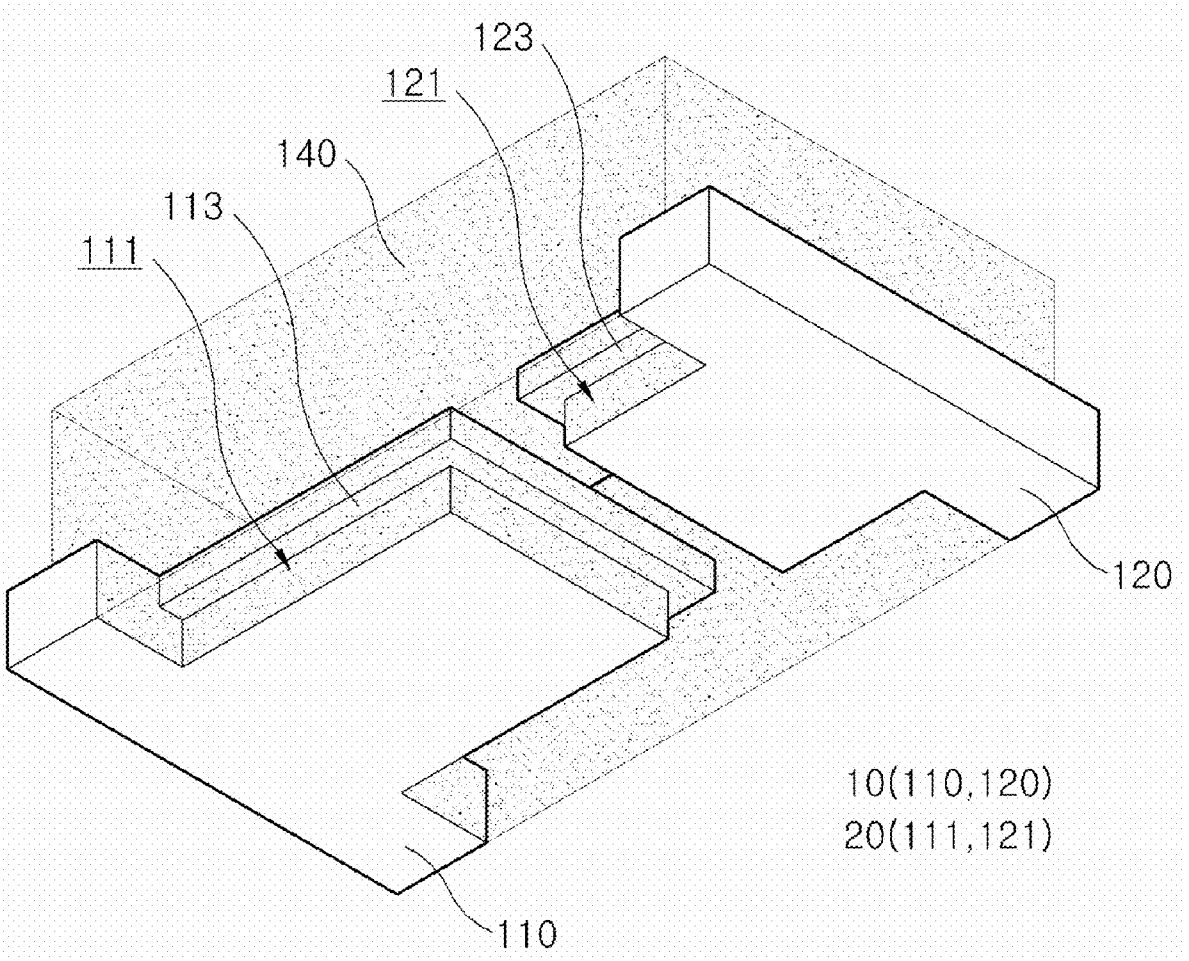


FIG. 3A

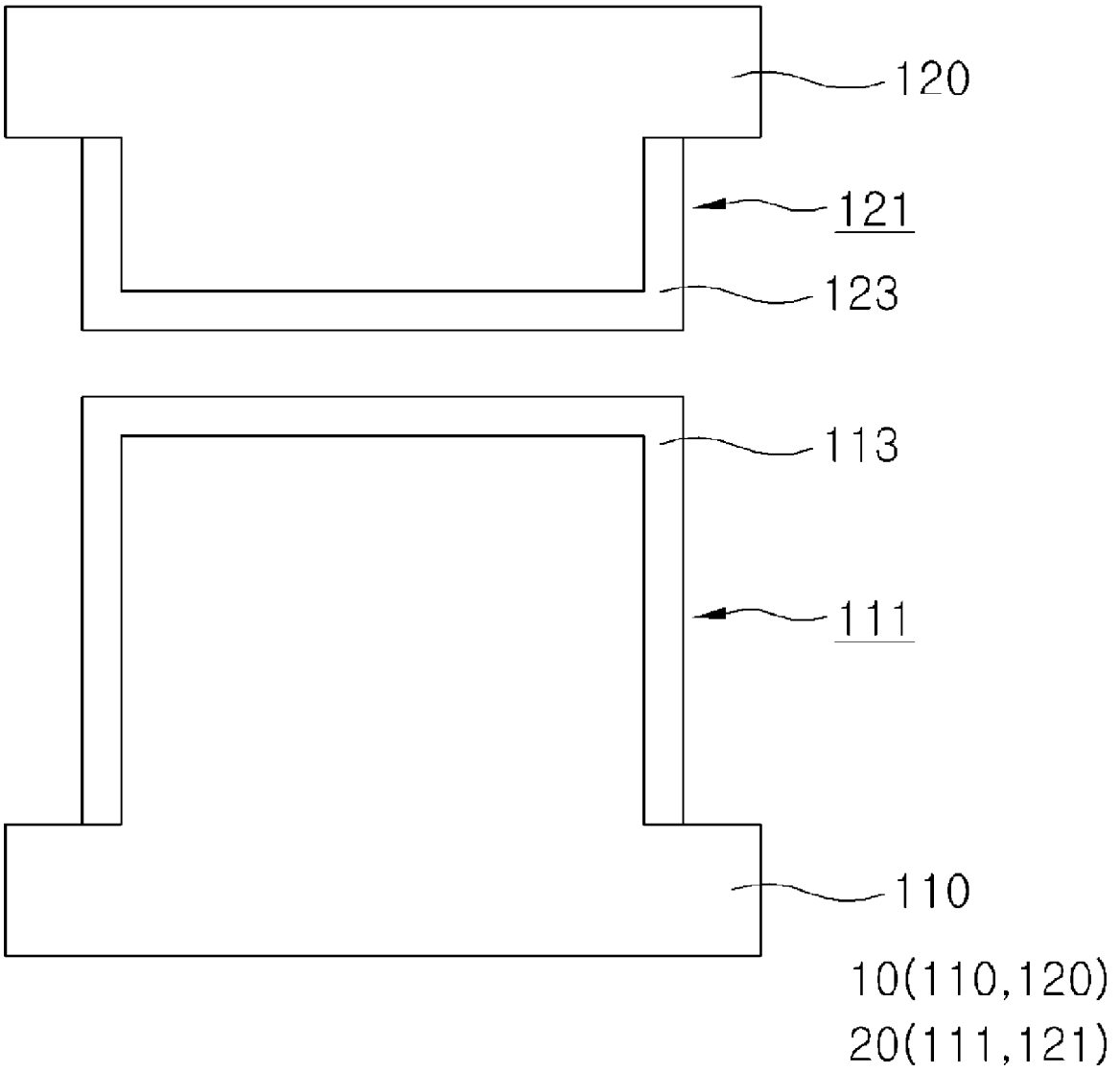


FIG. 3B

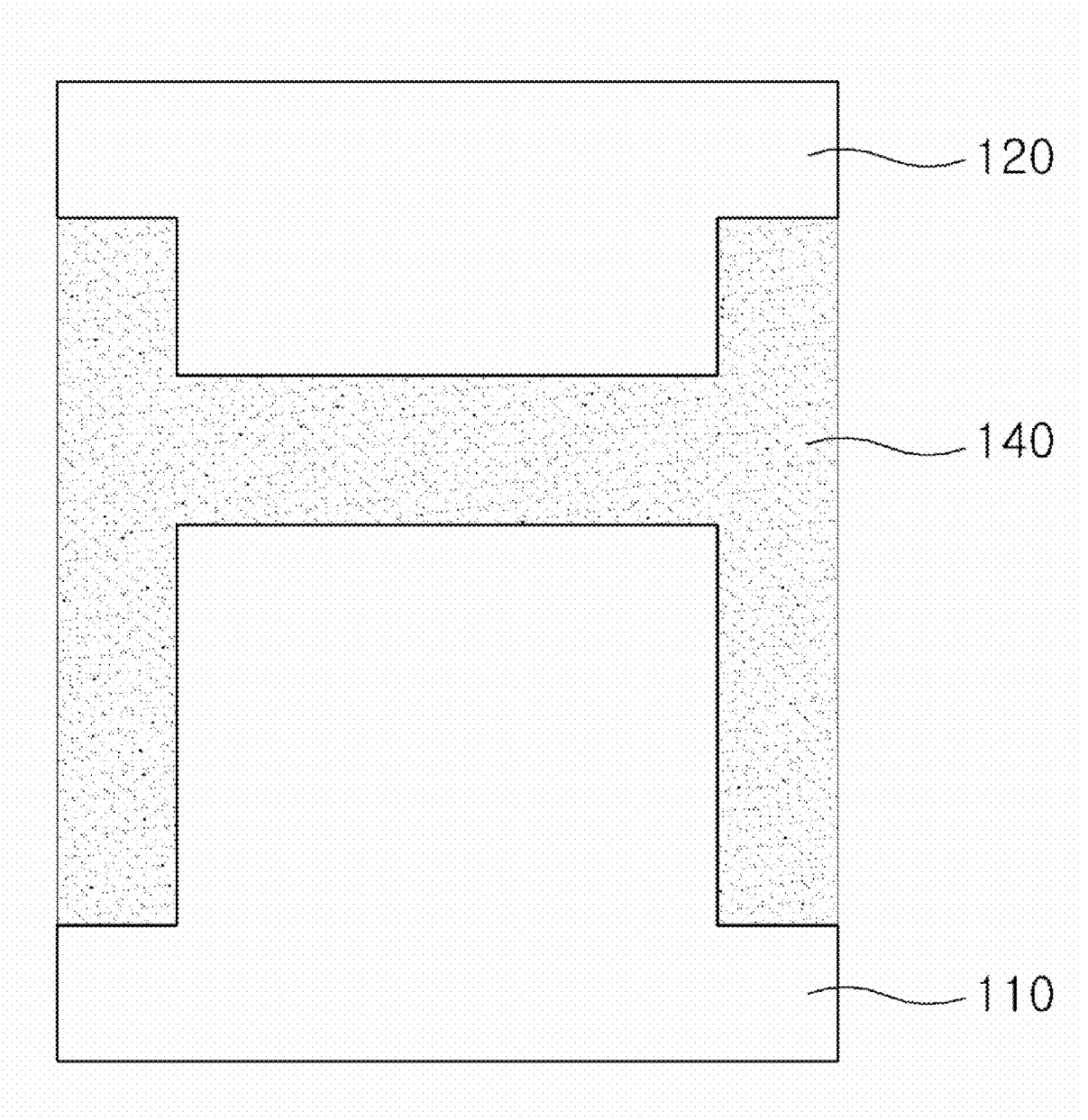


FIG. 4

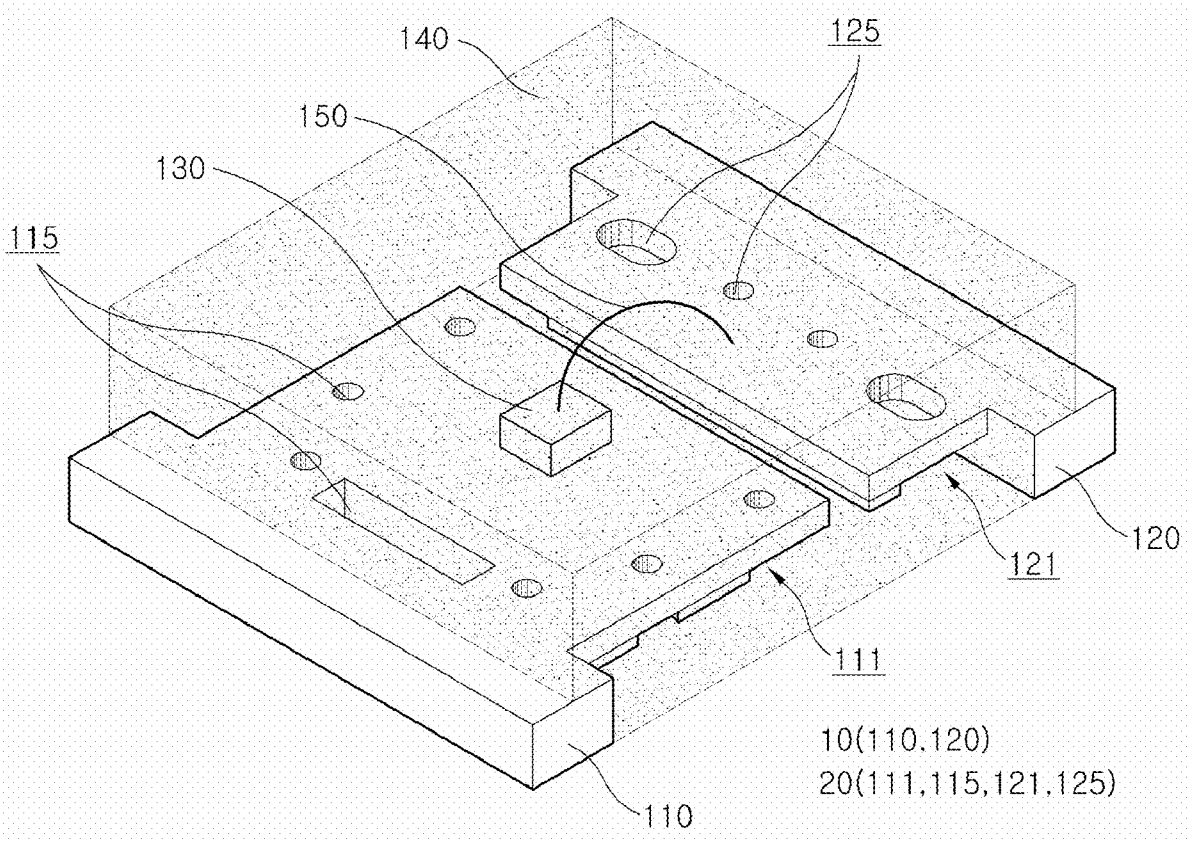


FIG. 5

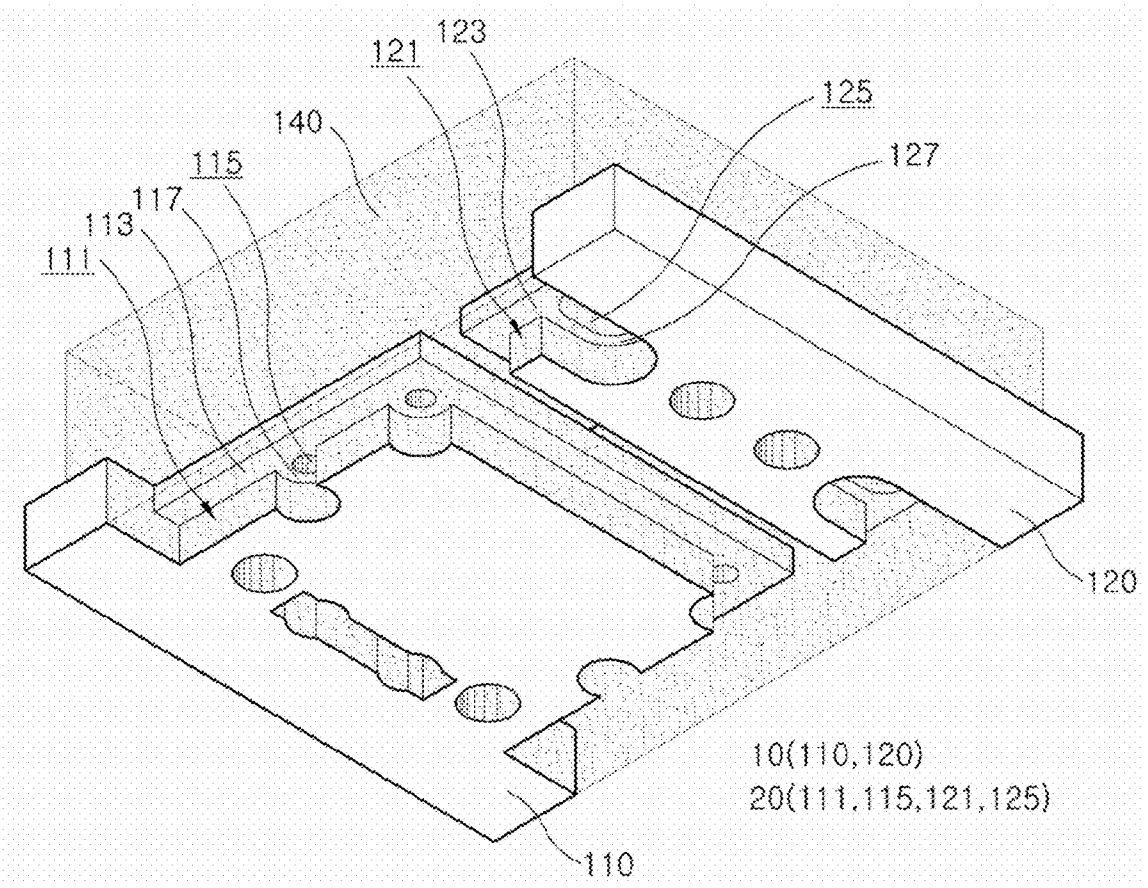
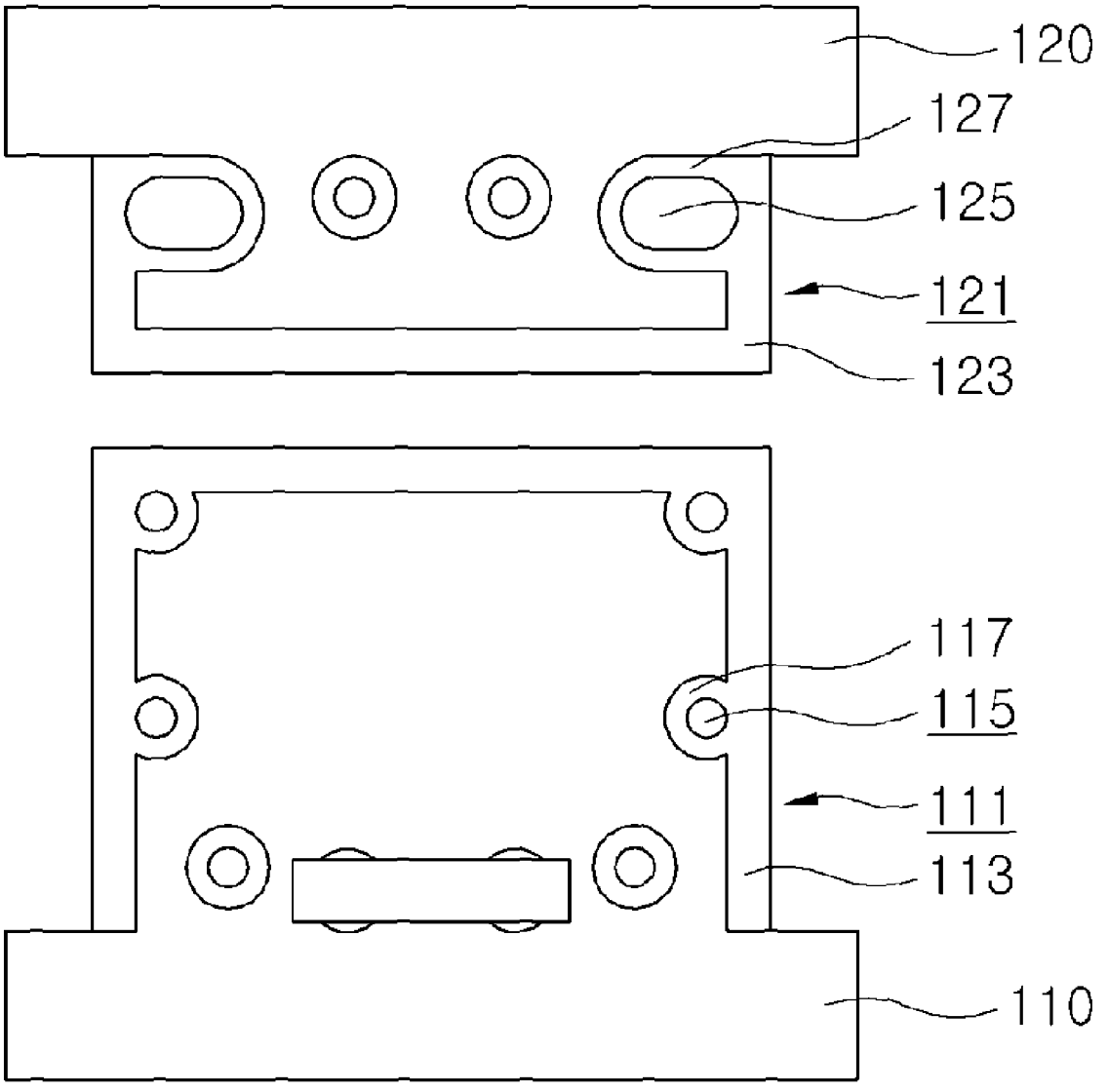

121
123
125
140
127
115
117
113
111
120
10(110,120)
20(111,115,121,125)
110

FIG. 6A


120
127
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121
123
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115
111
113
110
10(110,120)
20(111,115,121,125)

FIG. 6B

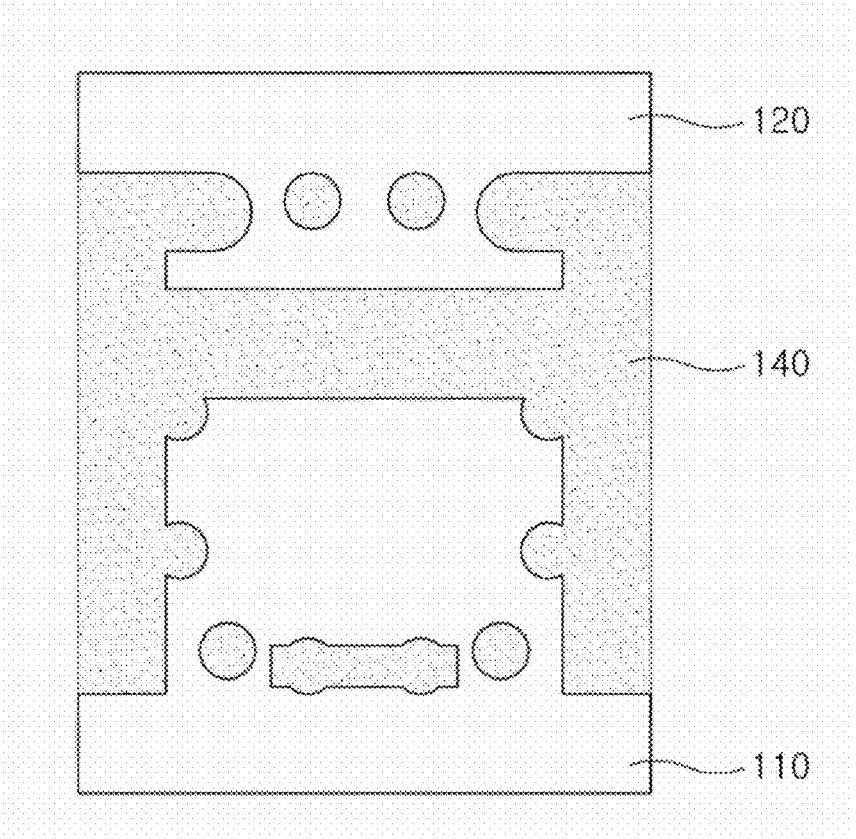

120
140
110

FIG. 7

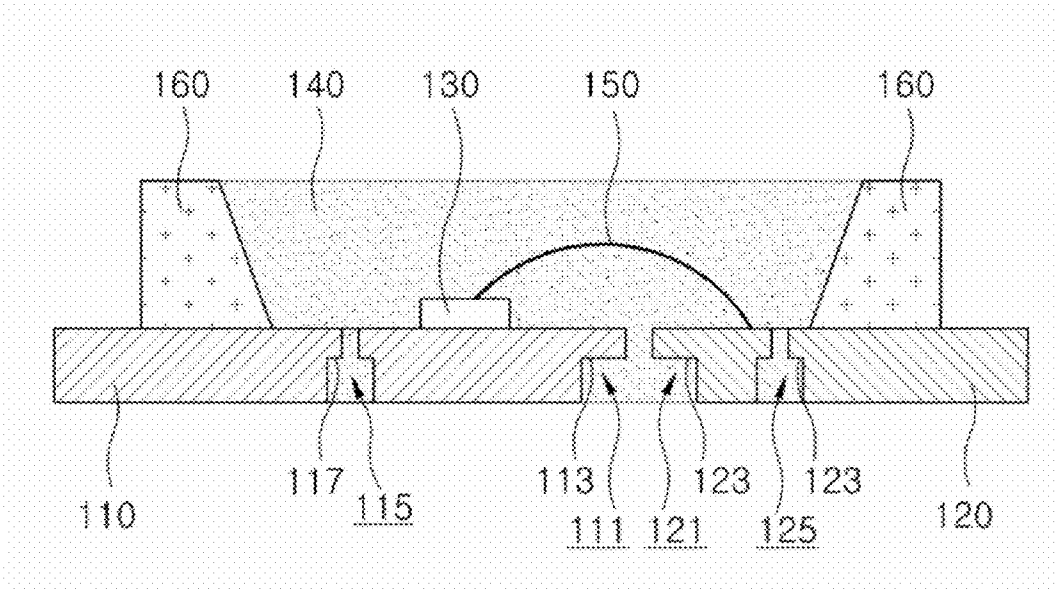

160
140
130
150
160
110
117
115
113
123
123
120
111
121
125

FIG. 8

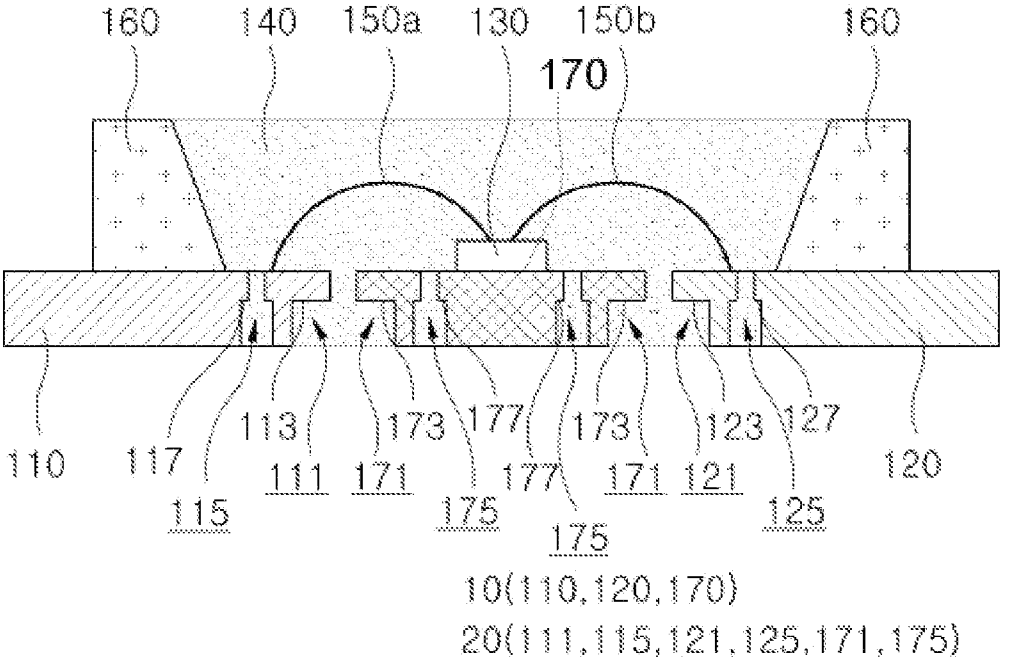
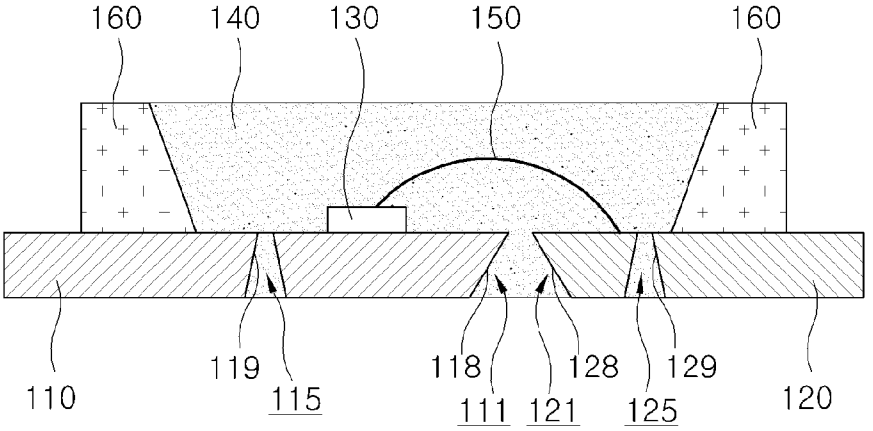

160
140
150a
130
150b
160
170
110
117
115
113
111
173
171
177
175
177
175
173
171
123
121
127
125
120
10(110,120,170)
20(111,115,121,125,171,175)

FIG. 9


160
140
130
150
160
110
119
115
118
111
128
121
129
125
120

LIGHT EMITTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to Korean Patent Application No. 10-2008-0114624 filed on Nov. 18, 2008 and all the benefits accruing therefrom under 35 U.S.C. §119, the contents of which are incorporated by reference in their entirety.

BACKGROUND

The present disclosure relates to a light emitting device, and more particularly, to a light emitting device that is configured to enhance adhesive force between a lead frame and a molding unit by forming a fixing space through the lead frame and integrally forming the molding unit on the top surface of the lead frame and in the fixing space.

Generally, a light emitting device uses a variety of light emitting chips. For example, a light emitting diode (LED) uses an element that generates minority carriers (electrons or holes) injected using a p-n junction of a semiconductor and emits light by recombination of the carriers. The LED consumes less electricity and has several to tens times more service life than the incandescent light bulb or a fluorescent lamp. That is, the LED is excellent in terms of the power consumption and endurance.

Since the LEDs can efficiently emit the light using a low voltage, they have been used for home appliances, electronic display boards, display devices, and a variety of automated machines. Recently, as the devices are getting smaller and slimmer, the LEDs have been made in a surface mount device type so that they can be directly mounted on a printed circuit board. Particularly, a light emitting device that is designed such that a separate insulation substrate is not used but a lead frame is used instead of the insulation substrate and a molding unit is directly formed on the lead frame has been recently proposed.

However, there are limitations due to a structure of the molding unit formed only on a top surface of the lead frame in that a phenomenon where a boundary surface between the lead frame and the molding unit is widened as the molding unit is easily separated from the lead frame by external causes such as increase of ambient temperature during a reflow process occurs.

Accordingly, the light emitting diode and wires enclosed by the molding unit may be damaged by being exposed to air or moisture. In addition, a bending portion may be cut by the separation of the molding unit.

SUMMARY

The present disclosure provides a light emitting device that is designed to physically improve adhesive force between a lead frame and a molding unit by forming a fixing space through the lead frame and integrally forming the molding unit on a top surface of the lead frame and in the fixing space during a molding unit forming process.

In accordance with an exemplary embodiment, a light emitting device including: a plurality of lead frame units spaced apart from each other, each of the lead frame units being provided with at least one fixing space perforating a body thereof in a vertical direction; a light emitting diode chip mounted on one of the lead frame units; and a molding unit that is integrally formed on top surfaces of the lead frame units and in the fixing spaces to protect the light emitting diode chip.

The fixing spaces may include outer fixing holes that are formed at all or some of a region where the lead frame units face each other and opposite side edge regions of the lead frame units.

The fixing spaces may include at least one inner fixing hole formed in an inner region of the lead frame units.

Stepped portions may be formed on sidewalls of the fixing spaces spaces so that a lower portion area of the fixing space is greater than an upper portion area of the fixing space.

Inclined surfaces may be formed at the sidewalls of the fixing spaces so that a lower portion area of the fixing space is greater than an upper portion area of the fixing space.

The light emitting device may further include a reflector formed on top surfaces of the lead frame units and surrounding the light emitting diode chip.

The molding unit may include a phosphor to alter a wavelength of light emitted from the light emitting diode chip.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments can be understood in more detail from the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view of a light emitting device according to an exemplary embodiment;

FIG. **2** is a bottom perspective view of the light emitting device of FIG. **1**;

FIG. **3***a* is a bottom view of a lead frame depicted in FIGS. **1** and **2**;

FIG. **3***b* is a bottom view of the light emitting device of FIGS. **1** and **2**.

FIG. **4** is a perspective view of a light emitting device according to another exemplary embodiment;

FIG. **5** is a bottom perspective view of the light emitting device of FIG. **4**;

FIG. **6***a* is a bottom view of a lead frame depicted in FIGS. **4** and **5**;

FIG. **6***b* is a bottom view of the light emitting device of FIGS. **4** and **5**; and

FIGS. **7** to **9** are cross-sectional views illustrating modified examples of the light emitting devices of the exemplary embodiments of FIGS. **1** through **6***b*.

DETAILED DESCRIPTION OF EMBODIMENTS

Hereinafter, specific embodiments will be described in detail with reference to the accompanying drawings.

FIG. **1** is a perspective view of a light emitting device according to an exemplary embodiment, FIG. **2** is a bottom perspective view of the light emitting device of FIG. **1**, FIG. **3***a* is a bottom view of a lead frame depicted in FIGS. **1** and **2**, and FIG. **3***b* is a bottom view of the light emitting device of FIGS. **1** and **2**.

As shown in FIGS. **1** to **3***b*, a light emitting device according to an exemplary embodiment includes a plurality of lead frame units **10**, a light emitting diode chip **130** mounted on one of the lead frame units **10**, and a molding unit **140** that is formed on a top surface of the lead frame units **10** to protect the light emitting diode chip **130**.

The lead frame units **10** are for mounting the light emitting diode chip **130** or connected to the light emitting diode chip **130** to apply external power to the light emitting diode chip **130**. In this exemplary embodiment, a separate supporting unit such as a separate insulation substrate for supporting the lead frame units **10** is not provided, but the lead frame unit **10** formed of metal functions as the substrate. For example, the lead frame units **10** include first and second lead frames **110**

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and **120** that are spaced apart from each other at a predetermined interval. At this point, the first and second lead frames **110** and **120** may not be formed in a plate shape but in a convex shape.

The first and second lead frames **110** and **120** are provided with fixing spaces formed through bodies of the first and second lead frames **110** and **120** in a vertical direction.

When the molding unit **140** is formed on top surfaces of the first and second lead frames **110** and **120**, molding resin for the molding unit **140** is filled in the fixing spaces **20** such that the molding resin applied on the top surfaces of the first and second lead frames **110** and **120** and the molding resin filled in the fixing spaces **20** can be monolithic. That is, the fixing spaces **20** function to allow the molding unit **140** to be securely adhered to the top surfaces of the lead frame units **10**.

As shown in FIGS. **1** through **3***b*, the fixing spaces include outer fixing holes **111** and **121** that are formed at a region where the first and second lead frames **110** and **120** face each other and a region surrounding opposite side edges of the respective first and second lead frames **110** and **120**. At this point, the outer fixing holes **111** and **121** may be some or all of the above described regions. In this exemplary embodiment, the fixing holes **111** and **121** are formed to be connected to each other at the facing region where the first and second lead frames **110** and **120** face each other and the regions adjacent to the facing regions.

At this point, stepped portions **113** and **123** may be formed on sidewalls of the outer fixing holes **111** and **121** such that an area of a lower portion of each of the outer fixing holes **111** and **121** is greater than an upper portion of each of the outer fixing holes **111** and **121**. Therefore, the molding unit **140** formed on the top surfaces of the first and second lead frames **110** and **120** extends to the outer fixing holes **111** and **121** and is hooked on the stepped portions **113** and **123**. Therefore, the separation of the molding unit **140** from the first and second lead frames **110** and **120** can be physically prevented. A method for making the lower portion of the molding unit **140** formed in the outer fixing holes **111** and **121** have a greater area than the upper portion of the molding portion **140** is not limited to the above. That is, the method may be variously modified and the modified examples will be described later.

The light emitting diode chip **130** is for emitting light by receiving the external power. The light emitting diode chip **130** may be selected among chips that emit light from an infrared band to a ultraviolet band. The light emitting diode chip **130** is mounted on the first lead frame **110** and electrically connected to the second lead frame **120** by a wire **150**. The wire **150** may be formed of gold (Au) or aluminum (Al) through and connected to the second lead frame **120** through, for example, a wire connecting process.

The molding unit **140** is for protecting the light emitting diode chip **130** and the wire **150** by enclosing the same. A method of forming the molding unit **140** and a shape of the molding unit **140** can be variously realized. For example, the molding unit **140** may be formed through a transfer molding method where a mold having a cavity having a polygonal or hemispherical cavity and molding resin is filled in the cavity. In this exemplary embodiment, the molding unit **140** is formed through a transfer molding method using a mold having a cavity that is designed to apply the molding resin on a portion of the top surfaces of the first and second lead frames **110** and **120** and fill the molding resin in the fixing holes **111** and **121**. Therefore, the molding unit **140** is integrally formed a portion of the top surfaces of the first and second lead frames **110** and **120**, which includes a first region at which the light emitting diode chip **130** and the wire **150** are formed, a second region around the first region, and a third region defining the fixing space **20**.

The molding unit **140** may be formed of transparent silicon resin or epoxy resin that has a relatively high rigidity. However, the present invention is not limited to this. That is, other kinds of resin that is transparent to transmit light may be used in accordance with the use of the light emitting device. Further, a variety of phosphors (not shown) may be mixed with the molding unit **140** to realize a variety of colors by changing a wavelength of the light emitted from the light emitting diode chip **130**.

FIG. **4** is a perspective view of a light emitting device according to another exemplary embodiment, FIG. **5** is a bottom perspective view of the light emitting device of FIG. **4**, FIG. **6***a* is a bottom view of a lead frame depicted in FIGS. **4** and **5**, and FIG. **6***b* is a bottom view of the light emitting device of FIGS. **4** and **5**.

The light emitting device of this exemplary embodiment is almost identical to that of the foregoing embodiment of FIGS. **1** through **3***b* except that the fixing spaces **20** are modified. In the following description for this exemplary embodiment, parts identical to those of the foregoing exemplary embodiment will not be described.

Referring to FIGS. **4** through **6***b*, according to this exemplary embodiment, the fixing space **20** further includes one or more inner fixing holes **115** and **125** formed through the bodies of the first and second lead frames **110** and **120** in the vertical direction. Sizes, shapes, and number of the inner fixing holes **115** and **125** are not specifically limited. Any things will be possible as far as the portions of the molding unit **140**, which are filled and formed in the inner fixing holes **115** and **125** are monolithic with the portion of the molding unit **140**, which is formed on the top surfaces of the first and second lead frames **110** and **120**. In this exemplary embodiment, the inner fixing holes **115** and **125** are formed in a variety of shapes such as a circular shape, an oval shape, and a rectangular shape. At this point, like the stepped portions **113** and **123** formed in the sidewalls of the outer fixing holes **111** and **121** in the foregoing exemplary embodiment, stepped portions **117** and **127** are formed on inner sidewalls of the inner fixing holes **115** and **125** such that an lower area is greater than an upper area. Accordingly, the molding unit **140** is hooked on the stepped portions **113**, **117**, **123**, and **127** and thus the separation of the molding unit **140** from the first and second lead frames **110** and **120** can be prevented. are formed on inner walls.

Although the fixing spaces **20** include all of the outer fixing holes **111** and **121** and the inner fixing holes **115** and **125** as in this exemplary embodiment, it may be possible the fixing spaces **20** include only the inner fixing holes **115** and **125**.

FIGS. **7** to **9** are cross-sectional views illustrating modified examples of the light emitting device of the foregoing exemplary embodiments.

The modified examples of FIGS. **7** to **9** are almost similar to the foregoing embodiments of FIGS. **1** through **6***a* except that a reflector **160** is further provided, the lead frame unit **10** is modified, and the fixing spaces **20** are modified. In the following description for the modified example, parts identical to those of the foregoing embodiments will not be described.

In the modified example of FIG. **7**, a reflector **160** for collecting or scattering the light emitted from the light emitting diode chip **130** is formed on an edge of the top surfaces of the lead frame units **10**. At this point, a reflecting surface is formed on an inner surface of the reflector **160** to direct the light emitted from the light emitting diode chip **130** in a

desired direction. Alternatively, the reflector **160** may be formed of a transparent material to scatter the light generated from the light emitting diode chip **130** in a desired direction.

The reflector **160** may be formed through the previously described transfer molding method. In addition, as the reflector **160** is formed, the molding unit **140** may be formed through not only the transfer molding method but also a dotting method.

In the modified example of FIG. **8**, unlike the foregoing embodiments, the lead frame units **10** include three lead frames spaced apart from each other. For example, the lead frame units **10** may further include a third lead frame **170** disposed between the first and second lead frames **110** and **120** and the light emitting diode chip **130** is mounted on the third lead frame **170**. At this point, a contacting surface between the light emitting diode chip **130** and the third lead frame **170** may be insulated. In addition, the light emitting diode chip **130** is electrically connected to the first and second lead frames **110** and **120** by respective wires **150***a* and **150***b*.

At this point, the outer fixing holes **111** and **121** and the inner fixing holes **115** and **125** are formed through the first and second lead frames **110** and **120** and the stepped portions **113**, **117**, **123**, and **127** are formed on the sidewalls of the outer and inner fixing holes **111**, **121**, **115**, and **125**. Likewise, outer and inner fixing holes **171** and **175** are formed through the third lead frame **170** and stepped portions **137** and **177** are formed on sidewalls of the outer and inner fixing holes **171** and **175**. Accordingly, the adhesive force between the molding unit **140** and the lead frame units **10** can be improved. Further, the reflector **160** may be formed on the first and second lead frames **110** and **120**.

In the modified example of FIG. **9**, a shape of the fixing spaces is varied. That is, instead of forming the stepped portions **113**, **117**, **123**, and **127** on the sidewalls of the outer and inner fixing holes **111**, **121**, **115**, and **125** so that the lower area can be greater than the upper area, the inner sidewalls of the outer and inner fixing holes **111**, **121**, **115**, and **125** are provided with inclined surfaces **118**, **119**, **128**, and **129** such that the areas of the outer and inner fixing holes **111**, **121**, **115**, and **125** gradually increase downward. Although the inclined surfaces are formed on all of the inner sidewalls of the fixing spaces **20**, the present invention is not limited to this configuration. That is, the inclined surfaces may be formed only on some of the inner walls. Accordingly, the separation of the molding unit **140** can be prevented by portions of the molding unit **140** that are filled and formed in the outer and inner fixing holes **111**, **121**, **115**, and **125**.

According to the exemplary embodiments, a phenomenon where a boundary surface between the lead frame and the molding unit is widened can be prevented by improving an adhering performance of the molding unit to the lead frame by forming the fixing space through the body of the lead frame in the vertical direction and integrally forming the molding unit on a top surface of the lead frame and in the fixing space of the lead frame.

Furthermore, as the upper area of the fixing space is less than the lower area of the fixing space, the separation of a portion of the molding unit, which is formed on the top surface of the lead frame, from the lead frame can be physically prevented by a portion of the molding unit, which is formed on the fixing space.

Although the light emitting device has been described with reference to the specific embodiments, it is not limited thereto. Therefore, it will be readily understood by those skilled in the art that various modifications and changes can be made thereto without departing from the spirit and scope of the present invention defined by the appended claims.

What is claimed is:

1. A light emitting device comprising:
- a plurality of lead frame units spaced apart from each other, each of the lead frame units having a top surface, an opposing bottom surface, and side walls disposed between the top surface and the bottom surface, wherein the sidewalls are inset, so as to undercut the to surface and at least partially define a fixing space;
- a light emitting diode chip mounted on the top surface of one of the lead frame units; and
- a molding unit that is disposed on the top surfaces of the lead frame units, covers the light emitting diode chip, and extends into the fixing spaces.

2. The light emitting device of claim **1**, wherein the bottom surfaces have a smaller surface area than the top surfaces.

3. The light emitting device of claim **1**, wherein the sidewalls form a stepped structure.

4. The light emitting device of claim **1**, wherein at least one of the sidewalls is inclined, such that the corresponding bottom surface has a smaller surface area than the corresponding to surface.

5. The light emitting device of claim **1**, further comprising a reflector formed on top surfaces of the lead frame units and surrounding the light emitting diode chip.

6. The light emitting device of claim **1**, wherein the molding unit comprises a phosphor to alter a wavelength of light emitted from the light emitting diode chip.

7. The light emitting device of claim **1**, wherein one of the lead frame units comprises a fixing hole that extends between the bottom and top surfaces and is not connected to the fixing space.

8. The light emitting device of claim **1**, wherein the lead frame units have fixing holes that extend from the top surfaces to the fixing spaces.

9. The light emitting device of claim **8**, wherein the sidewalls form a stepped structure.

10. The light emitting device of claim **8**, wherein the sidewalls are inclined.

11. A light emitting device comprising:
- a plurality of lead frame units spaced apart from each other, each of the lead frame units having a top surface, an opposing bottom surface, and side walls disposed between the top and bottom surfaces, along three edges of the lead frame unit, the sidewalls being inset so as to undercut the top surface and least partially define a fixing space;
- a light emitting diode chip mounted on the tops surface of one of the lead frame units; and
- a molding unit that is disposed on the top surfaces of the lead frame units, covers the light emitting diode chip, and extends into the fixing spaces.

12. The light emitting device of claim **11**, wherein the lead frame units have fixing holes that extend from the top surfaces to the fixing spaces.

13. The light emitting device of claim **11**, wherein the sidewalls form a stepped structure.

14. The light emitting device of claim **11**, wherein the bottom surfaces have a smaller surface area than the top surfaces.

15. The light emitting device of claim **11**, wherein the sidewalls are inclined, such that the bottom surfaces have a smaller surface area than the top surfaces.

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