

(22) Date of filing: **19.04.2012**

(72) Inventors:
• **Uchida, Naoki**
Shizuoka-shi, Shizuoka 424-8764 (JP)

the first opening portion (34), and a second opening portion (35) through which the light reflected from the reflection portion (33) is radiated, wherein the area of the first opening portion (34) is smaller than the area of the light emitting surface of the LED (40); and a projection lens (30) that controls the light radiated from the reflector (25) and radiates the light to the front of the lamp.

This cross-sectional view shows a semiconductor device assembly. A substrate 18 is at the base. A central layer 20 is positioned on the substrate. Above this layer is a structure 23, which includes a central region 36 and side regions 37 and 38. A layer 40 is located between the central region 36 and the side regions 37 and 38. A layer 33 is positioned above the central region 36. A layer 34 is positioned above the side regions 37 and 38. A layer 35 is positioned above the central region 36. A layer 25 is positioned above the side regions 37 and 38. A layer 39 is positioned above the central region 36. A layer 29 is positioned above the side regions 37 and 38. A layer 27 is positioned above the central region 36. A layer 41 is positioned above the side regions 37 and 38.

Description

1. Field of the Invention

[0001] The present invention relates to a vehicular lamp and, more particularly, to a vehicular lamp that uses a light emitting diode (LED).

2. Description of Related Art

[0002] Vehicular lamps that use an LED as a light source have been known (e.g., Japanese Patent Application Publication No. 2006-286395 (JP 2006-286395 A)).

[0003] In a vehicular lamp which uses an LED, it is desirable that the uniformity of the radiated light be high in order to uniformly light a front area without producing a dark, hard-to-see region.

SUMMARY OF THE INVENTION

[0004] The present invention has been accomplished in light of the foregoing circumstances. An object of the present invention is to provide a vehicular lamp that uses a light emitting diode (LED), and with which it is possible to improve the uniformity of radiated light.

[0005] A vehicular lamp in accordance with one aspect of the present invention includes: a light emitting diode; an LED mount portion, on which the LED is mounted; a reflector having a first opening portion that is disposed in front of a light emitting surface of the LED and through which light from the LED enters, a reflection portion that reflects the light that has entered through the first opening portion, and a second opening portion through which the light reflected from the reflection portion is radiated, wherein the area of the first opening portion is smaller than the area of the light emitting surface of the LED; and an optical member that controls the light radiated from the reflector and radiates the light to a front of the vehicular lamp.

[0006] It is preferable that an edge of the first opening portion of the reflector be positioned immediately close to the light emitting surface of the LED.

[0007] It is preferable that an edge of the first opening portion of the reflector be in contact with the light emitting surface of the LED.

[0008] The optical member may be, for example, a projection lens that projects the light from the reflector to the front of the lamp, or another reflector that reflects the light from the foregoing reflector to the front of the lamp.

[0009] It is preferable that the reflector have a heat dissipation portion for dissipating heat produced by the LED.

[0010] It is preferable that a periphery portion around the second opening portion of the reflector have been subjected to a reflectivity reduction treatment for reducing reflection of light.

[0011] It is preferable that a region of the periphery

portion around the second opening portion have not been subjected to the reflectivity reduction treatment, wherein an image of the region projected by the optical member when the vehicular lamp is mounted in a vehicle is above an optical axis of the optical member.

[0012] It is preferable that a periphery portion around the second opening portion of the reflector is tilted outward with respect to a plane perpendicular to an optical axis of the LED.

[0013] It is preferable that the optical member be a projection lens that projects an inverted image of the second opening portion, and a shape of an opening of the second opening portion be a shape that corresponds to a low-beam light distribution pattern that has a predetermined cut-off line.

[0014] It is preferable that the reflector have a recess, in which the LED is placed; the first opening portion be formed at a bottom of the recess; and an inner side surface of the recess include a reflective surface.

[0015] According to the present invention, it is possible to provide a vehicular lamp, with which it is possible to improve the uniformity of radiated light that is emitted from LED(s) and radiated to the front of the lamp.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Features, advantages, and technical and industrial significance of exemplary embodiments of the present invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a cross sectional view of a vehicular lamp in accordance with an embodiment of the present invention;

FIG. 2 is an exploded perspective view of an LED package in accordance with the embodiment of the present invention;

FIG. 3 is a front view of an LED package in accordance with the embodiment of the present invention; FIG. 4 is a cross sectional view of the LED package, taken along line IV-IV in FIG. 3;

FIG. 5 is a cross sectional view of an LED package in accordance with another embodiment of the present invention; and

FIG. 6 is a plan view of an LED package in accordance with still another embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0017] Embodiments of the present invention will be described in detail hereinafter with reference to the accompanying drawings.

[0018] FIG. 1 is a cross sectional view of a vehicular lamp 100 in accordance with an embodiment of the present invention. The vehicular lamp 100 is what is called a projector type vehicular headlamp that has a

projection lens.

[0019] As shown in FIG. 1, the lamp 100 includes a lamp body 12 having a recess portion that has an opening in a front portion of the lamp, and a cover 14 that closes the opening of the lamp body 12. An internal space defined by the lamp body 12 and the cover 14 is formed as a lamp chamber 16.

[0020] A lamp unit 10 is disposed in the lamp chamber 16. As shown in FIG. 1, the lamp unit 10 is attached to a substantially central portion of a bracket 18 that is formed from a metal such as aluminum. A first aiming screw 21 is attached to an upper portion of the bracket 18. A second aiming screw 22 is attached to a lower portion of the bracket 18. The bracket 18 is tiltably supported on the lamp body 12 by the first aiming screw 21 and the second aiming screw 22. The lower second aiming screw 22 is provided with an aiming actuator 24. As the aiming actuator 24 is driven, the bracket 18 is tilted so that, in turn, the lamp unit 10 is tilted. Thus, the adjustment of the optical axis of illumination light (aiming adjustment) is performed.

[0021] The lamp unit 10 includes a light emitting diode (LED) package 20, a projection lens 30, a lens support member 32, a heat sink 26, and a fan 28.

[0022] The LED package 20 is provided on a front surface side of the bracket 18. The LED package 20 includes a white LED, and emits white light toward the projection lens 30. A detailed description of the structure of the LED package 20 will be given later.

[0023] The projection lens 30 projects the light from the LED package 20 forward. The projection lens 30 is a plano-convex aspherical lens whose light entry surface is formed as a flat surface and whose light exit surface is formed as a convex surface. The projection lens 30 is supported in front of the LED package 20 by the lens support member 32. The optical axis Ax of the projection lens 30 is substantially parallel to the longitudinal direction of the vehicle.

[0024] The heat sink 26 is provided on the back surface side of the bracket 18. The heat sink 26 is formed of a high-thermal-conductivity metal such as aluminum, and dissipates heat generated by the LED package 20. The fan 28 is provided rearward of the heat sink 26, and performs a forced cooling of the heat sink 26.

[0025] FIG. 2 is an exploded perspective view of an LED package in accordance with the embodiment of the present invention. As shown in FIG. 2, the LED package 20 has a structure in which an LED module 23 is mounted on a substantially central portion of an LED mount portion 27 that is formed integrally with the bracket 18 by aluminum die casting, and in which a reflector 25 that has an opening is provided on the LED module 23. The reflector 25 is fixed to the LED mount portion 27 by screws 29. The LED module 23 is sandwiched between the LED mount portion 27 and the reflector 25, so that the LED module 23 is fixed therebetween.

[0026] FIG. 3 shows a front view of an LED package in accordance with the embodiment of the present inven-

tion. FIG. 4 is a cross sectional view of the LED package, taken along line IV-IV in FIG. 3. As shown in FIGS. 3 and 4, the LED package 20 includes the LED module 23, the LED mount portion 27, the reflector 25, and heat dissipation portions 39. The LED module 23 includes an LED circuit board 36 and an LED 40.

[0027] The LED 40 is a white LED that has a rectangular light emitting surface. The LED 40 includes four LED chips 37 and a fluorescent layer 38. Each LED chip 37 is a blue LED whose size is about 1 mm square. The four LED chips 37 are disposed in a line on the LED circuit board 36. The LED circuit board 36 is formed of aluminum nitride or the like, and has a function of supplying electric current to the LED chips 37. The fluorescent layer 38 is obtained by preparing a yellow fluorescent substance that converts blue light into yellow light as a ceramic material in a rectangular plate shape. Alternatively, the fluorescent layer 38 may be formed by sealing a yellow fluorescent substance in glass. The fluorescent layer 38 is provided on the light emitting surface of the four LED chips 37. The area of each of the light entry surface and the light emitting surface is at least larger than or equal to the area of the light emitting surface of the four LED chips 37. In other words, the fluorescent layer 38 completely covers the light emitting surface of the four LED chips 37. When the LED chips 37 are caused to emit light, the blue light passing through the fluorescent layer 38 and the yellow light converted from the blue light by the fluorescent layer 38 are mixed to provide white light. Hereinafter, the surface of the fluorescent layer 38 will also be referred to as the light emitting surface of the LED 40 in some cases.

[0028] The reflector 25 has a rectangular parallelepiped shape in which a hole for allowing light from the LED 40 to pass is formed in a substantially central portion. The hole portion of the reflector 25 has a first opening portion 34 which is disposed in front of the light emitting surface of the LED 40 and through which the light from the LED 40 enters the hole portion, a reflection portion 33 that reflects the light that has entered through the first opening portion 34, and a second opening portion 35 through which the light reflected from the reflection portion 33 is radiated. The first opening portion 34 and the second opening portion 35 are rectangular opening portions. The second opening portion 35 is larger than the first opening portion 34. The reflection portion 33 has four reflective surfaces having a parabolic sectional shape which are provided corresponding to the sides of the rectangular first opening portion 34 and the rectangular second opening portion 35. The reflector 25 is fixed onto the LED mount portion 27 by using the two screws 29 so that the first opening portion 34 is positioned on the light emitting surface of the LED 40.

[0029] In the reflector 25, the light emitted from the LED 40 is reflected by the reflection portion 33, and is directed to the projection lens 30. By providing the small-size reflector 25 immediately close to the LED 40 as in this embodiment, the traveling direction of the light emit-

ted from the LED 40 can be suitably controlled so that it is possible to allow the light to efficiently enter the projection lens 30.

[0030] However, in the LED package employing the LED 40 and the small-size reflector 25 as described above, the precision in installation of the reflector 25 onto the LED 40 is important. If the reflector 25 is attached with a deviation from a right position, there is a possibility that the first opening portion 34 of the reflector partially overlaps a region outside of the edge of the light emitting surface of the LED 40 and therefore the uniformity of the radiated light may decline.

[0031] Therefore, in this embodiment, the area of the first opening portion 34 is set smaller than the area of the light emitting surface of the LED 40. FIG. 3 shows the four LED chips 37 of the LED 40, in interrupted lines. In FIG. 3, it can be seen that the area of the first opening portion 34 is smaller than the area of the light emitting surface of the LED 40. In other words, the long sides and the short sides of the rectangular first opening portion 34 are shorter than the long sides and the short sides, respectively, of the rectangular light emitting surface of the LED 40. This makes it possible to prevent the first opening portion 34 of the reflector from partially overlapping a region outside of the edge of the light emitting surface of the LED 40 even if the reflector 25 is attached with a slight deviation from the right position. Thus, the first opening portion 34 does not overlap a dark region and the uniformity of the radiated light is therefore secured, so that it is possible to uniformly light a front area. In addition, severe enhancement of the attachment precision of the reflector 25 is made unnecessary, and the cost of component parts and the production cost can be reduced.

[0032] In the embodiment, the peripheral edge portion 41 of the second opening portion 35 of the reflector 25 has been subjected to a reflectivity reduction treatment for reducing the reflection of light. If light emitted from the LED package 20 is reflected by other component parts (e.g., the projection lens 30, etc.) in the lamp chamber 16, and returns into the LED package 20, the light reflected from the peripheral edge portion 41 becomes stray light, which may give glare to pedestrians and the like. Therefore, the reflectivity reduction treatment of the peripheral edge portion 41 as in the embodiment reduces the reflection from the peripheral edge portion 41, so that the glare that is given to pedestrians and the like can be reduced. The reflectivity reduction treatment may also be, for example, a treatment in which graining is performed on the peripheral edge portion 41. Alternatively, the reflectivity reduction treatment may be a treatment in which a light absorption film is formed on the peripheral edge portion 41.

[0033] Besides, in this embodiment, a perimeter of the peripheral edge portion 41 of the reflector 25 is provided with the heat dissipation portions 39 for dissipating heat produced by the LED 40. Each heat dissipation portion 39 has a plurality of flat plate fins. The heat dissipation

portions 39 are formed integrally with the reflector 25. By forming the heat dissipation portions 39 integrally with the reflector 25, the number of component parts can be reduced.

[0034] FIG. 5 is a cross sectional view of an LED package in accordance with another embodiment of the present invention. In an LED package 20 in accordance with this embodiment, the component elements that are the same as or correspond to those of the LED package shown in FIGS. 3 and 4 are denoted by the same reference characters, and redundant descriptions will be omitted as appropriate.

[0035] The LED package 20 in accordance with this embodiment is different from the LED package shown in FIG. 4, in the fixing method for the reflector 25. As shown in FIG. 5, in the LED package 20 in accordance with this embodiment, the reflector 25 is fixed by fitting a plurality of pins 42 provided on a lower surface of the reflector 25 into holes 43 that are formed in an upper surface of the LED circuit board 36. Besides, the LED 40 is sandwiched between the reflector 25 and the LED circuit board 36, so that the LED 40 is fixed therebetween.

[0036] By fixing the reflector 25 and the LED circuit board 36 to each other through the fitting between the pins 42 and the holes 43 as in the embodiment, the attachment precision of the reflector 25 to the LED 40 will improve, and the assembly process is facilitated.

[0037] Also in the embodiment, the area of the first opening portion 34 is smaller than the area of the light emitting surface of the LED 40. Thus, for example, even if the positions of the holes 43 formed in the upper surface of the LED circuit board 36 are slightly deviated, it is possible to prevent the first opening portion 34 of the reflector from partially overlapping a region outside of the edge of the light emitting surface of the LED 40. Thus, the first opening portion 34 does not overlap a dark region and the uniformity of the radiated light is therefore secured, so that it is possible to uniformly light a front area.

[0038] Besides, in this embodiment, a portion 44 of the reflector 25 that laterally surrounds the LED chips 37 is formed so as to have a reflective surface. This heightens the light use efficiency.

[0039] Besides, in the embodiment, a peripheral edge portion 41 of the second opening portion 35 in the reflector 25 is not a flat surface perpendicular to the optical axis as in the LED package shown in FIG. 4, but is an outwardly tilted surface. Thus, light reflected from the peripheral edge portion 41 is restrained from entering the projection lens 30, and glare can be reduced.

[0040] FIG. 6 is a plan view of an LED package in accordance with still another embodiment of the present invention. Also with regard to the LED package 20 in accordance with this embodiment, component elements that are the same as or correspond to those of the LED package shown in FIGS. 3 and 4 are denoted by the same reference characters, and redundant descriptions will be omitted as appropriate.

[0041] In this embodiment, as shown in FIG. 6, the

shape of opening of a second opening portion 35 in the reflector 25 is a shape that corresponds to a low-beam light distribution pattern that has a predetermined cut-off line. Specifically, the shape of opening of the second opening portion 35 is a shape obtained by inverting the low-beam light distribution pattern. Incidentally, the shape of opening of the first opening portion 34 is rectangular. When the second opening portion 35 is formed in such a shape, the image formed by the light emitted from the second opening portion 35 becomes a shape obtained by inverting the low-beam light distribution pattern. The projection lens 30 projects an inverted image of this image. Specifically, a vehicular lamp 100 in accordance with the embodiment is able to radiate light in the low-beam light distribution pattern.

[0042] Also in this embodiment, the area of the first opening portion 34 is smaller than the area of the light emitting surface of the LED 40. Thus, even if the reflector 25 is attached with a slight deviation from the right position, it is possible to prevent the first opening portion 34 of the reflector from partially overlapping a region outside of the edge of the light emitting surface of the LED 40. Thus, the first opening portion 34 does not overlap a dark region and the uniformity of the radiated light is therefore secured, so that it is possible to uniformly light a front area.

[0043] Also in this embodiment, a peripheral edge portion 41 of the second opening portion 35 in the reflector 25 has been subjected to a reflectivity reduction treatment for reducing reflection of light. However, in this embodiment, a region 45 in the peripheral edge portion 41 (a region located below the second opening portion 35 in FIG. 6) is not subjected to the reflectivity reduction treatment. Thus, by allowing the region 45, that is, a portion of the peripheral edge portion 41, to reflect light, it is possible to create light that travels upward from the vehicular lamp 100, and therefore to light traffic signs above the vehicle, that is, irradiate so-called overhead signs.

[0044] The present invention has been described with reference to embodiments. These embodiments are merely illustrative. It is to be understood by a person with ordinary skill in the art that various modifications of the combinations of component elements and working processes can be made and that such modifications are also within the scope of the present invention.

[0045] For example, although, in the foregoing embodiments, the projection lens is used as an example of the optical member that controls the light radiated from the reflector and radiates it to the front of the lamp, the optical member is not limited to the projection lens, but may also be, for example, a reflector or the like. In addition, also in the embodiments shown in FIGS. 5 and 6, the reflector may include the heat dissipation portion.

Claims

1. A vehicular lamp (100) characterized by compris-

ing:

a light emitting diode (LED) (40);
an LED mount portion (27), on which the LED (40) is mounted;
a reflector (25) having a first opening portion (34) that is disposed in front of a light emitting surface of the LED (40) and through which light from the LED (40) enters, a reflection portion (33) that reflects the light that has entered through the first opening portion (34), and a second opening portion (35) through which the light reflected from the reflection portion (33) is radiated, wherein an area of the first opening portion (34) is smaller than an area of the light emitting surface of the LED (40); and
an optical member (30) that controls the light radiated from the reflector (25) and radiates the light to a front of the vehicular lamp (100).

2. The vehicular lamp according to claim 1, wherein an edge of the first opening portion (34) of the reflector (25) is positioned immediately close to the light emitting surface of the LED (40).
3. The vehicular lamp according to claim 1, wherein an edge of the first opening portion (34) of the reflector (25) is in contact with the light emitting surface of the LED (40).
4. The vehicular lamp according to any one of claims 1 to 3, wherein the reflector (25) has a heat dissipation portion (39) for dissipating heat produced by the LED (40).
5. The vehicular lamp according to any one of claims 1 to 4, wherein a periphery portion (41) around the second opening portion (35) of the reflector (25) has been subjected to a reflectivity reduction treatment for reducing reflection of light.
6. The vehicular lamp according to claim 5, wherein a region (45) of the periphery portion (41) around the second opening portion (35) has not been subjected to the reflectivity reduction treatment, wherein an image of the region (45) projected by the optical member (30) when the vehicular lamp (100) is mounted in a vehicle is above an optical axis of the optical member (30).
7. The vehicular lamp according to any one of claims 1 to 6, wherein a periphery portion (41) around the second opening portion (35) of the reflector (25) is tilted outward with respect to a plane perpendicular to an optical axis of the LED (40).

8. The vehicular lamp according to any one of claims 1 to 7, wherein
the optical member (30) is a projection lens (30) that
projects an inverted image of the second opening
portion (35), and 5
a shape of an opening of the second opening portion
(35) is a shape that corresponds to a low-beam light
distribution pattern that has a predetermined cut-off
line. 10
9. The vehicular lamp according to any one of claims 1 to 8, wherein
the reflector (25) has a recess, in which the LED (40)
is placed; 15
the first opening portion (34) is formed at a bottom
of the recess; and 20
an inner side surface (44) of the recess includes a
reflective surface. 25
- 30
- 35
- 40
- 45
- 50
- 55

FIG. 1

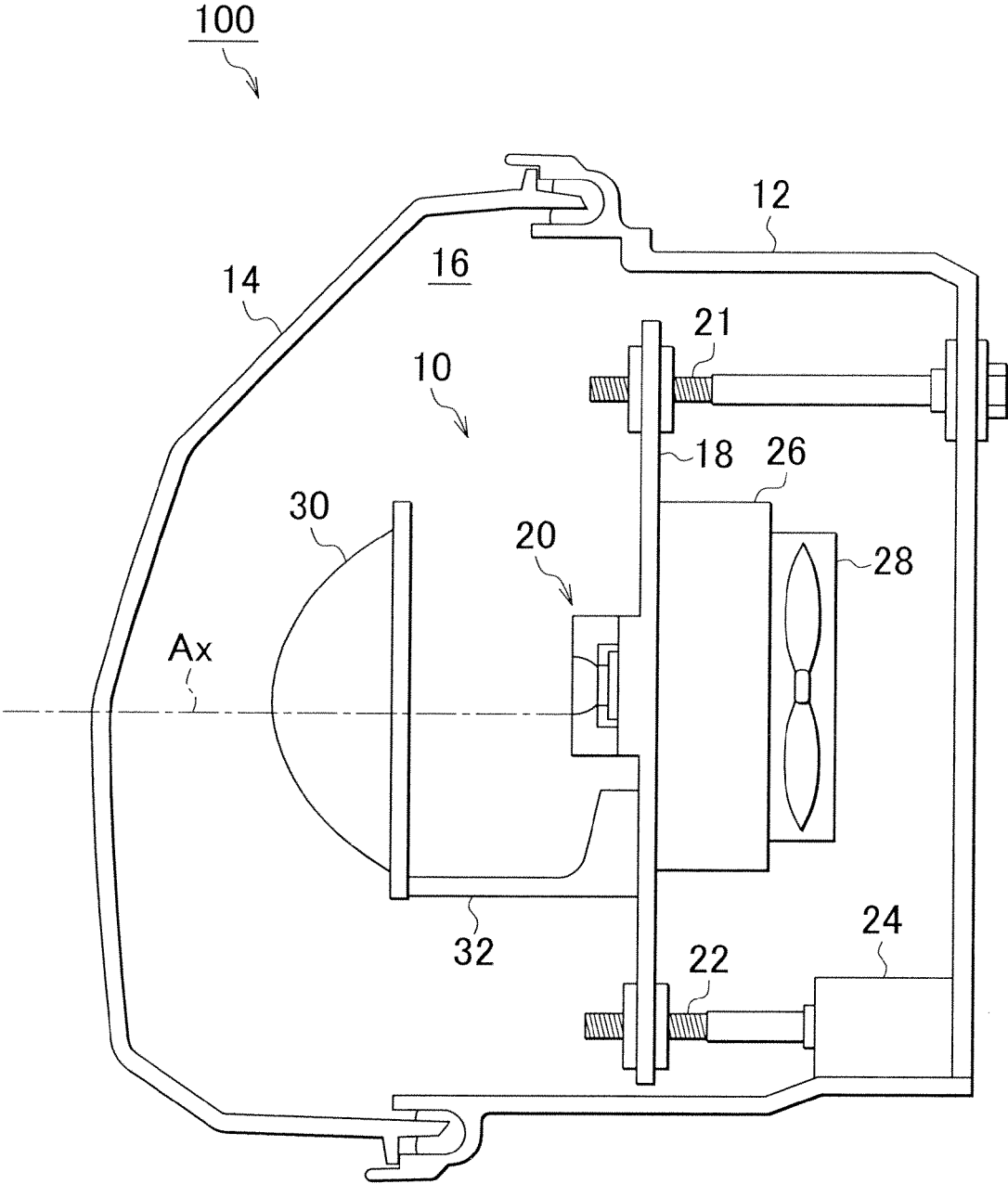


FIG. 2

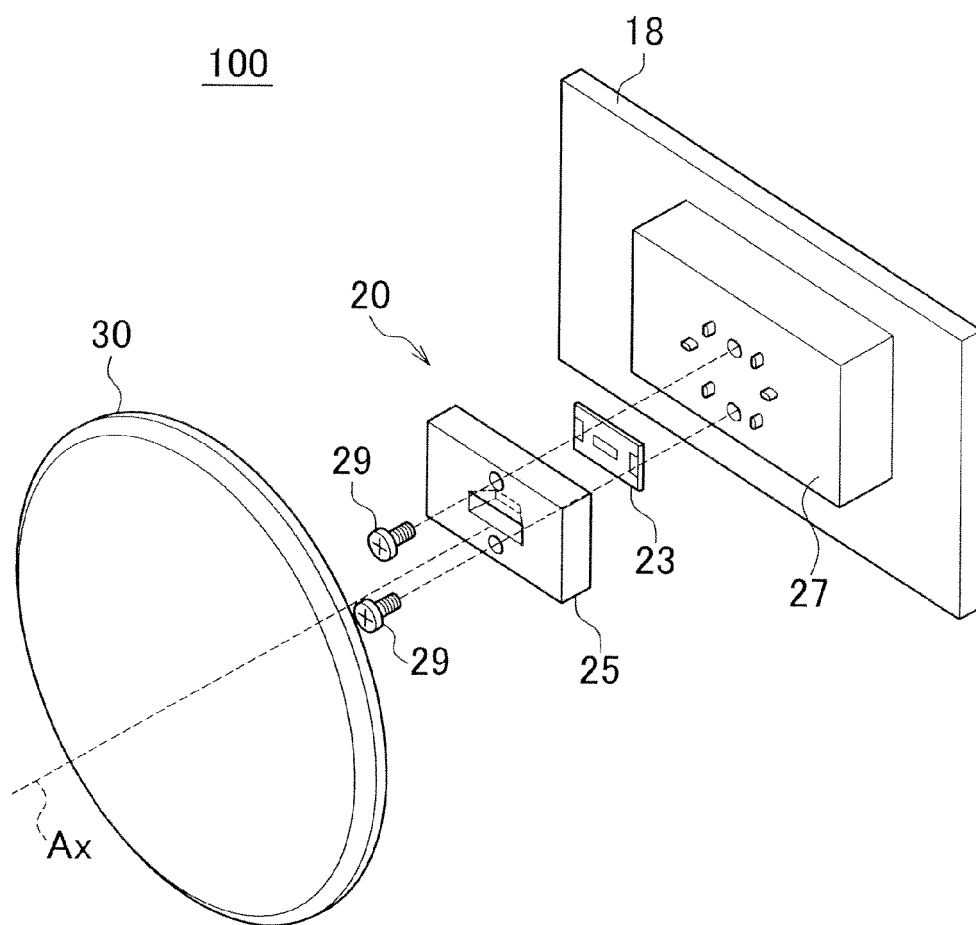


FIG. 3

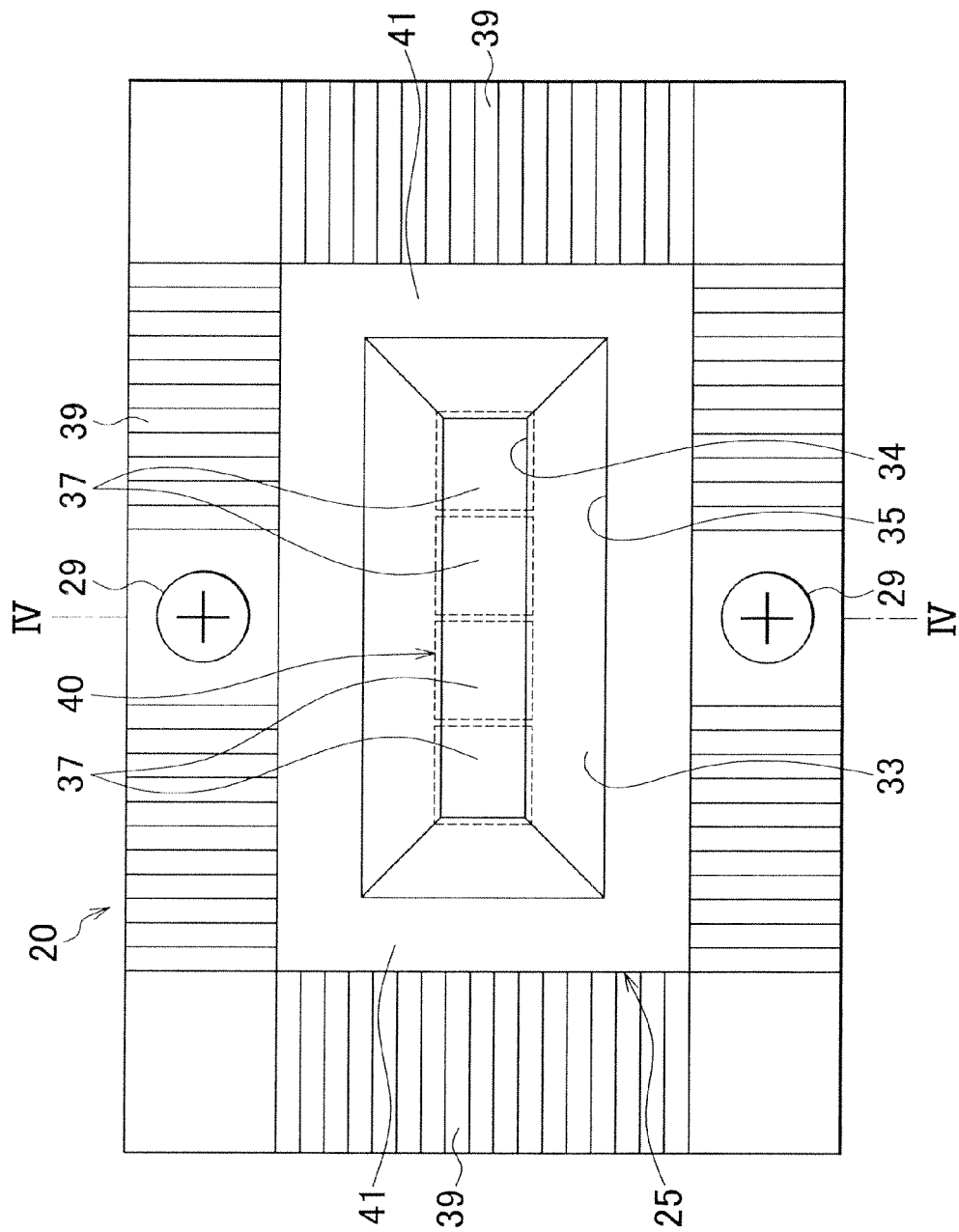


FIG. 4

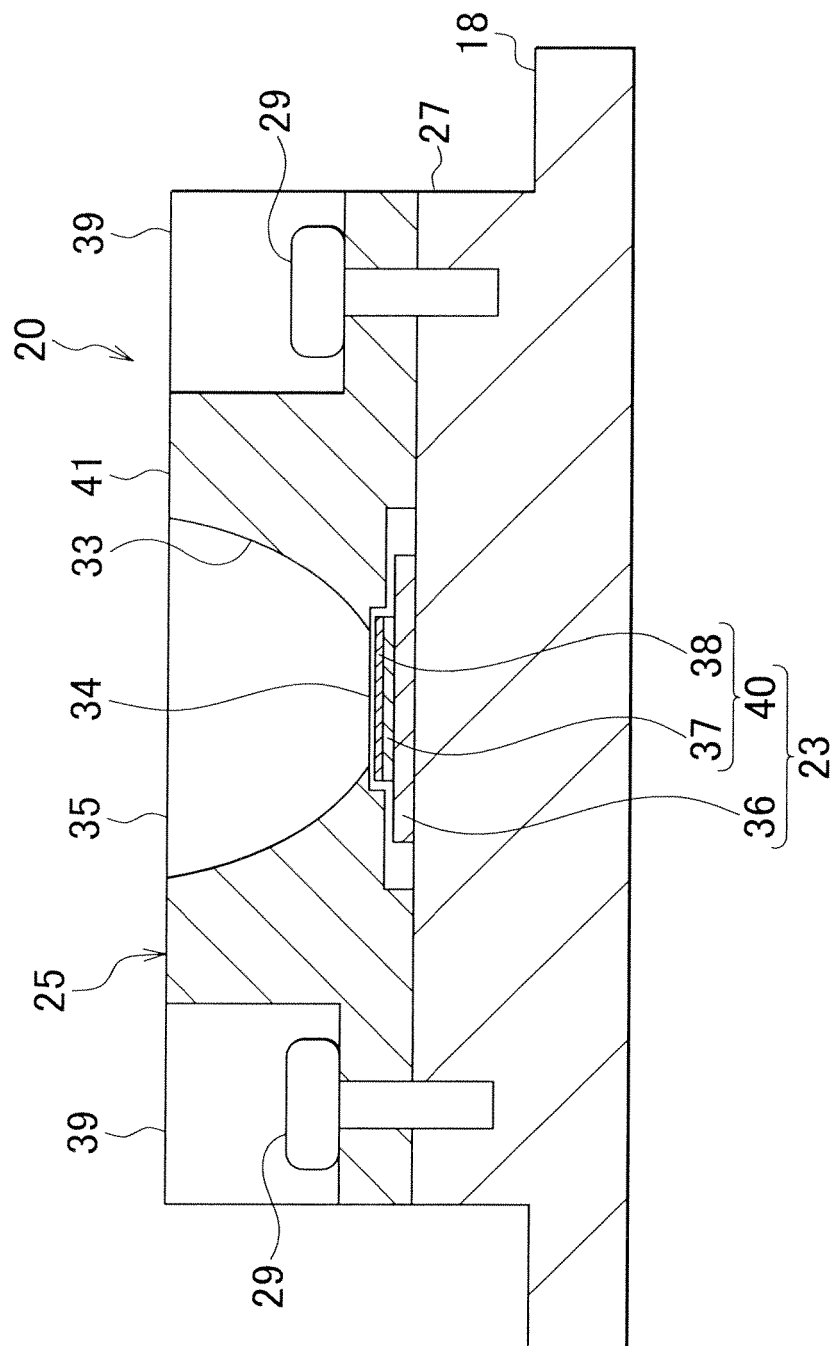


FIG. 5

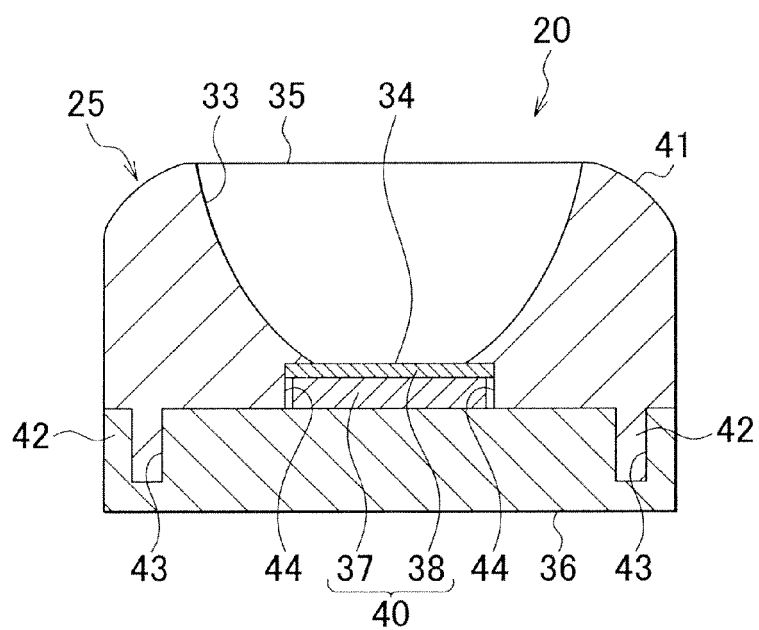
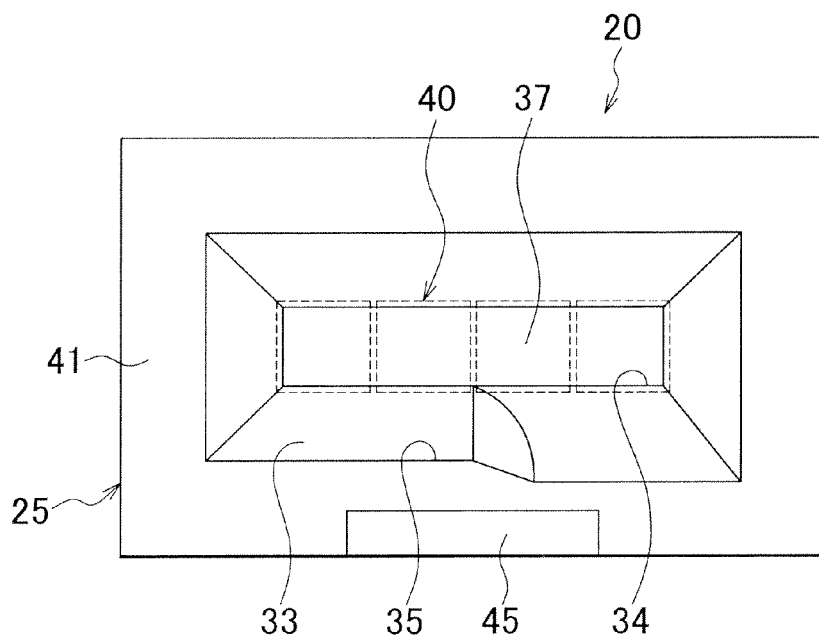


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006286395 A [0002]