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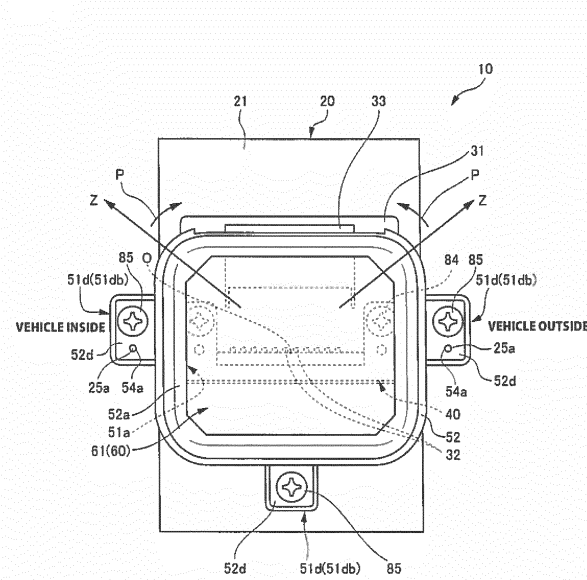
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(54) **VEHICULAR LAMP**

(57) A vehicular lamp is provided with: a light source which comprises light-emitting chips on a substrate; a heatsink which comprises a base part; a lens which is positioned in front of the light source, and which comprises an attachment part on the perimeter of a lens part; and a lens holder by which the lens is attached to the heatsink, and which comprises an opening edge part that receives the attachment part, and a perimeter part that

extends from the opening edge part towards the heatsink. A width of the lens part in the horizontal direction is the same as or less than the width of the substrate in the horizontal direction, and the width of the opening of the opening edge part in the horizontal direction is the same as or less than the width of the substrate in the horizontal direction.

[FIG. 2]



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Description**TECHNICAL FIELD**

[0001] The present invention relates to a vehicular lamp.

BACKGROUND ART

[0002] Conventionally, a vehicular front lamp is known that includes a semiconductor light-emitting element used as a light source, and a projection lens that projects light emitted from the semiconductor light-emitting element and irradiates the projected light toward the outside from an irradiation surface. The projection lens is such that at least a center part of the irradiation surface is formed as a first control portion and at least a portion of at least an outer peripheral portion of the irradiation surface is formed as a second control portion. Light emitted from a light emitting point on an optical axis that passes through the focal point of the projection lens is radiated from the first control portion as parallel light that is parallel to the optical axis, and is radiated from the second control portion to the outside with respect to a line segment that is parallel to the optical axis. At least the first control portion of the projection lens is formed as a diffusion portion that diffuses light (see Patent Literature 1).

[0003] Patent Literature 1 discloses that the blue component of the light emitted from the semiconductor light-emitting element will not easily reach the outer peripheral portion of the light distribution pattern, and thus chromatic aberration will not easily occur, and light radiated from the diffusion portion diffuses and tends to mix with the blue component. As a result, the generation of the color blue in the light distribution pattern is suppressed, so a good light distribution pattern is able to be formed.

[0004] When looking at Fig. 2 of Patent Literature 1, the projection lens will emit light and be visible when illuminated, but a considerably large projection lens is used for a light emitter formed by a base portion and a semiconductor light-emitting element arranged on the base portion. Therefore, in Patent Literature 1, the light-emitting part as the vehicular lamp is considered to be comparatively large.

CITATION LIST**PATENT LITERATURE**

[0005] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2013-152844

SUMMARY OF THE INVENTION**PROBLEM TO BE SOLVED BY THE INVENTION**

[0006] In recent years, with a reduction in size of vehicular lamps, there have come to be cases in which ve-

hicular lamps having a slim appearance with smaller light-emitting parts are needed.

[0007] The present invention has been made in view of the problem described above, and it is an object of the present invention to provide a vehicular lamp that can be made small and has a small light-emitting part.

SOLUTION TO PROBLEM

[0008] In order to achieve the above object, the present invention is realized by the following constitution.

(1) A vehicular lamp according to the present invention comprising: a semiconductor light source that has a light-emitting chip on a circuit board; a heat sink having a base portion in which the light source is arranged on a front surface; a lens that is arranged in front of the light source and having a mounting portion on an outer periphery of a lens portion; and a lens holder which has an opening edge portion that receives the mounting portion and an outer peripheral portion that extends toward the heat sink side from the opening edge portion, and which mounts the lens to the heat sink, wherein a width in a horizontal direction of the lens portion is equal to or less than a lateral width in the horizontal direction of the circuit board, and an opening width in the horizontal direction of the opening edge portion is equal to or less than the lateral width in the horizontal direction of the circuit board.

(2) In the configuration of (1) above, a vertical width in a vertical direction of the circuit board is equal to or greater than a width in the vertical direction of the lens portion, and the vertical width in the vertical direction of the circuit board is equal to or greater than an opening width in the vertical direction of the opening edge portion.

(3) In the configuration of (1) above, further comprising: a plurality of heat dissipating fins provided on a rear surface of the base portion; and a cooling fan arranged behind the heat dissipating fins, wherein a cutout by which a front surface and a rear surface are communicated is formed in a portion between the heat dissipating fins, and the cutout is formed to at least a position overlapping with a portion of the circuit board.

(4) In the configuration of (2) above, a surface on a side of the circuit board on which the light-emitting chip is provided is white.

(5) In the configuration of (1) above, an electric connector that is positioned on an upper side or a lower side in a vertical direction of the light-emitting chip and is provided on the circuit board, wherein an outer shape of the opening edge portion is substantially identical to the outer shape of the mounting portion, the lens holder includes one other side leg portion that is formed protruding out toward the heat sink side from the outer peripheral portion, and is posi-

tioned on an upper side or a lower side in the vertical direction, on the opposite side from the electric connector, with the light-emitting chip sandwiched therebetween, when viewed in a front view, and two one side leg portions formed protruding out toward the heat sink side from the outer peripheral portion, and positioned to left and right outsides of the electric connector on the electric connector side of the light-emitting chip, when viewed in a front view, the one side leg portions and the other side leg portion each have a standing leg portion that extends toward the heat sink side from the outer peripheral portion such that the heat sink side is positioned farther toward the outside than the outer peripheral portion side, and a bent portion that is bent so as to be substantially parallel to the front surface of the base portion from the standing leg portion, and the bend portions of the one side leg portions are positioned in a range on the electric connector side from diagonal lines of the opening edge portion, and are formed extending in a direction that intersects with the horizontal direction.

(6) In the configuration of (5) above, the outer peripheral portion is formed in a shape that widens toward the heat sink side from the opening edge portion, and the base portion side is positioned to the outside of the outer peripheral portion side, by the standing leg portions of the one side leg portions and the standing leg portion of the other side leg portion being formed following the widening incline of the outer peripheral portion.

EFFECT OF THE INVENTION

[0009] According to the present invention, a vehicular lamp that can be made small and has a small light-emitting part can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

[Fig. 1] Fig. 1 is a plan view of a vehicle provided with a vehicular lamp according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a front view of a lamp unit according to a first embodiment of the present invention, viewed from the front.

[Fig. 3] Fig. 3 is an exploded perspective view of the lamp unit according to the first embodiment of the present invention.

[Fig. 4] Fig. 4 is a top view of the lamp unit according to the first embodiment of the present invention, viewed from above.

[Fig. 5] Fig. 5 is a front view of a lamp unit according to a second embodiment of the present invention, viewed from the front.

MODE FOR CARRYING OUT THE INVENTION

[0011] Hereinafter, modes for carrying out the present invention (hereinafter, simply referred to as "embodiments") will be described in detail with reference to the accompanying drawings. Like elements throughout the entire description of the embodiments will be denoted by like numerals. Also, unless otherwise noted, in the embodiments and drawings, "front" and "rear" indicate the "forward direction" and "reverse direction," respectively, of a vehicle, and "upper," "lower," "left," and "right" all indicate directions from the viewpoint of a driver riding in the vehicle.

[0012] A vehicular lamp according to an embodiment of the present invention is a vehicular front lamp (101R, 101L) provided on the left and right sides, respectively, at the front of a vehicle 102 illustrated in Fig. 1, but will hereinafter simply be referred to as a vehicular lamp.

(First embodiment)

[0013] The vehicular lamp of the present embodiment includes a housing (not shown) that is open to the vehicle front side, and an outer lens (not shown) that attaches to the housing so as to cover the opening. A lamp unit 10 (see Fig. 2) and the like is arranged inside a lamp chamber formed by the housing and the outer lens.

(Lamp unit)

[0014] Fig. 2 is a front view of the lamp unit 10 for the left side of a vehicle.

[0015] As illustrated in Fig. 2, the lamp unit 10 is a variable light distribution type high beam light distribution unit in which a plurality of light-emitting chips 32 are arranged lined up side by side, and that is capable of performing so-called ADB (Adaptive Driving Beam) control that turns some or all of the light-emitting chips 32 on/off in accordance with the positional relationship with a leading vehicle and the like.

[0016] Note that a lamp unit for the right side of the vehicle is just symmetrical with the lamp unit 10 for the left side of the vehicle, so hereinafter, mainly the lamp unit 10 for the left side of the vehicle will be described as an example.

[0017] Fig. 3 is an exploded perspective view of the lamp unit 10.

[0018] As illustrated in Fig. 3, the lamp unit 10 includes a heat sink 20, a light source 30, a reflecting board 40, a lens holder 50, a lens 60, and a cooling fan 70.

(Heat sink)

[0019] The heat sink 20 has a base portion 21, heat dissipating fins 22, and cooling fan mounting portions 23.

[0020] A front surface 21a of the base portion 21 forms a light source arranging portion for arranging the light source 30. On a rear surface 21b positioned on the op-

posite side from the front surface 21a of the base portion 21, a plurality of the heat dissipating fins 22 are formed lined up in the horizontal direction and extending rearward from the rear surface 21b.

[0021] On left and right outsides in the horizontal direction of the rear surface 21b of the base portion 21, the cooling fan mounting portions 23 for mounting the cooling fan 70 are formed extending rearward from the rear surface 21b, similar to the heat dissipating fins 22.

[0022] In generally the vertical center in the vertical direction of the front surface 21a of the base portion 21 is formed a pair of left and right bosses 24a for positioning the light source 30 and the reflecting board 40 when mounting the light source 30 and the reflecting board 40, and a pair of left and right screw fixing holes 24b, for screwing screws 84 to mount and fix the light source 30 and the reflecting board 40 into, are formed in positions slightly above the pair of left and right bosses 24a.

[0023] Also, the base portion 21 has shaped portions in which a portion protrudes toward the outside, formed in positions on the left and right outsides in generally the vertical center in the vertical direction. On these protruding portions is formed a pair of left and right bosses 25a for positioning the lens holder 50 when mounting the lens holder 50 to the heat sink 20, and a pair of left and right screw fixing holes 25b, for screwing screws 85 to mount and fix the lens holder 50 into, are formed in positions slightly above the pair of left and right bosses 25a.

[0024] Furthermore, one screw fixing hole 25b, for screwing the screw 85 to mount and fix the lens holder 50 into, is also provided on the lower side, in generally the lateral center in the horizontal direction, of the base portion 21.

[0025] Meanwhile, screw fixing holes (not shown), for screwing screws 87 to mount the cooling fan 70 into, are also provided in the cooling fan mounting portions 23.

(Cooling fan)

[0026] The cooling fan 70 has an impeller 71 that rotates in response to electricity being supplied, and is arranged behind the heat dissipating fins 22 so as to send wind generated by the impeller 71 to the heat dissipating fins 22.

[0027] More specifically, in the cooling fan 70, screw holes 72 through which the screws 87 pass are formed in a casing 73 that covers the outer periphery of the impeller 71. The cooling fan 70 is mounted in a position behind the heat dissipating fins 22, by passing the screws 87 through these screw holes 72 from behind and screwing the screws 87 into screw fixing holes (not shown) provided in the cooling fan mounting portions 23 of the heat sink 20.

[0028] Note that although it is not absolutely necessary to provide the cooling fan 70, in a case where a plurality of light-emitting chips 32 are provided, as in the present embodiment, the amount of heat that is generated increases with the increase in the number of light-emitting

chips 32, so it is preferable to provide the cooling fan 70 to efficiently cool the light-emitting chips 32.

(Light source)

[0029] The light source 30 is a semiconductor light source in which a plurality of (11) light-emitting chips 32 (LED chips) are arranged side by side on a circuit board 31. An electric connector 33 for supplying electricity and the like to the light-emitting chips 32 (LED chips) is provided on the circuit board 31.

[0030] Also, boss holes 34a through which the bosses 24a provided on the base portion 21 of the heat sink 20 pass and screw holes 34b through which the screws 84 pass are formed to the left and right outsides of the position where the light-emitting chips 32 are provided on the circuit board 31.

[0031] In the present embodiment, five light-emitting chips 32 are provided on the vehicle outside and six light-emitting chips 32 are provided on the vehicle inside, with the optical axis center O of the lamp unit 10 sandwiched therebetween, as illustrated in Fig. 2.

[0032] The lamp unit 10 of the present embodiment takes the lamp unit 10 provided in a vehicular lamp for the left side of a vehicle as an example, as described above, and forms a light distribution pattern corresponding to the left half of a high beam light distribution pattern. Note that the vehicular lamp according to the present invention includes a left side lamp unit 10 that forms a light distribution pattern upward on the left side of the vehicle, and a right side lamp unit 10 that forms a light distribution pattern upward on the right side of the vehicle.

[0033] Therefore, the left side of Fig. 2 is the vehicle inside, and the right side of Fig. 2 is the vehicle outside. In the present embodiment, the number of light-emitting chips 32 arranged sandwiching the optical axis center O is greater by one on the vehicle inside.

[0034] Here, the image of the light from the light-emitting chips 32 on the vehicle inside is radiated toward the vehicle outside through the lens 60.

[0035] Therefore, the high beam light distribution pattern is able to be wider on the vehicle outside, such that the visibility range on the vehicle outside is able to be wider, by arranging more of the light-emitting chips 32 on the vehicle inside, as in the present embodiment.

[0036] Note that in the lamp unit for the right side of the vehicle as well, the visibility range on the vehicle outside can be made wider by increasing the number of light-emitting chips on the vehicle inside.

[0037] In the present embodiment, a case is illustrated in which the number of light-emitting chips 32 arranged on the vehicle inside is one more than the number of light-emitting chips 32 arranged on the vehicle outside with the optical axis center O sandwiched therebetween, but the number of light-emitting chips 32 arranged on the vehicle inside may be even more than one more than the number of light-emitting chips 32 arranged on the vehicle inside with the optical axis center O sandwiched there-

between.

[0038] Further, it goes without saying that the number of light-emitting chips 32 provided on the circuit board 31 is not particularly limited unless ADB control and the like is taken into consideration. However, if there are five or more, the circuit board 31 and the like tends to become large, so achieving slimness may be said to be of great significance. Thus, it may be said that the case of the light source 30 having five or more light-emitting chips 32 is preferable.

[0039] Note that in the present embodiment, a case with the semiconductor light source 30 in which the light-emitting chips 32 are LED chips is described, but the present invention is not limited to this. For example, a semiconductor light source in which the light-emitting chips 32 are semiconductor laser chips or EL (organic EL) chips may also be used.

[0040] Incidentally, as described above, when a plurality of light-emitting chips 32 are used, the amount of heat generated increases by a corresponding amount, so it is preferable that efficient cooling be able to be performed.

[0041] Therefore, in the present embodiment, a heat dissipation circuit board in which power supply wiring and the like is printed, so that it will not short circuit, on a copper plate is used for the circuit board 31.

[0042] By doing so, the heat generated when the light-emitting chips 32 emit light is able to be quickly transmitted to the heat sink 20 via the circuit board 31 that has low thermal resistance, thus making it possible to increase cooling efficiency.

[0043] Note that the circuit board 31 is not limited to being made using a copper plate, and may also be, for example, a heat dissipation circuit board having an aluminum plate base, or a heat dissipation circuit board in which an epoxy layer and a metal material layer are laminated in multiple layers.

(Reflecting board)

[0044] As illustrated in Fig. 3, the reflecting board 40 has a bottom portion 41, and a pair of left and right mounting arm portions 42 that are provided on the left and right outsides in the horizontal direction of the bottom portion 41 and extend upward in the vertical direction from the bottom portion 41.

[0045] Also, boss holes 44a through which the bosses 24a provided on the base portion 21 of the heat sink 20 pass, and screw holes 44b through which the screws 84 pass, are formed in these mounting arm portions 42. Therefore, the light source 30 and the reflecting board 40 can be mounted to the heat sink 20 by the following process.

[0046] First, the bosses 24a of the base portion 21 are passed through the boss holes 34a in the circuit board 31 of the light source 30, and the light source 30 is arranged on the front surface 21a of the base portion 21. At this time, tip end sides of the bosses 24a protrude out

from the boss holes 34a in the circuit board 31.

[0047] Next, these protruding bosses 24a are passed through the boss holes 44a in the mounting arm portions 42 of the reflecting board 40, and the reflecting board 40 is abuttingly arranged on the circuit board 31. Then, the screws 84 are passed through the screw holes 44b in the mounting arm portions 42 of the reflecting board 40 and the screw holes 34b in the circuit board 31, and screwed into the screw fixing holes 24b in the base portion 21.

[0048] That is, the reflecting board 40 and the light source 30 are fixed to the base portion 21 in a co-locked state by the screws 84.

[0049] As illustrated in Fig. 3, a reflective surface 45 is formed on the bottom portion 41 of the reflecting board 40.

[0050] More specifically, the reflective surface 45 is a surface that is inclined downward toward the front from an upper side 45a arranged near the lower end of the light-emitting chips 32.

[0051] Then, when the light-emitting chips 32 are made to emit light, an image of light is reflected on this reflective surface 45, and an image of light in which the light emitting surface and the reflected image appear connected is radiated forward through the lens 60.

[0052] Therefore, the light distribution patterns formed by the light-emitting chips 32 are able to be expanded in the vertical direction compared to when the light distribution patterns are formed by only light from the actual light emitting surface.

[0053] However, while it is preferable to provide the reflecting board 40 from an optical viewpoint, there are cases where the reflecting board 40 is visibly recognizable through the lens 60, so it is sometimes desirable not to provide the reflecting board 40 from the viewpoint of appearance.

[0054] Note that when it is desirable to form a light emission image similar to when using the reflecting board 40, without using the reflecting board 40, a row of the light-emitting chips 32 may be further provided on the lower side. In this way, the reflecting board 40 is not an essential structure, but an optional structure provided as necessary.

(Lens)

[0055] The lens 60 has a lens portion 61 and a flange portion 62 (mounting portion) provided on the outer periphery of the lens portion 61. The lens portion 61 is a portion that light distribution controls the light from the light-emitting chips 32 and radiates the light forward so as to form a predetermined light distribution pattern. The lens 60 in the present embodiment has a rectangular shape when viewed from the front.

[0056] More specifically, the lens portion 61 is formed by a freeform surface in which an incident surface 61a into which light on the light-emitting chip 32 side enters and a light emission surface 61b from which the light is

emitted are both formed protruding out. The incident surface 61a and the light emission surface 61b are formed so as to create a surface shape that performs a predetermined light distribution control.

[0057] Also, a polycarbonate resin or an acrylic resin can be suitably used for the lens 60, but if heat from the light-emitting chips 32 is an issue, polycarbonate resin that has excellent heat resistance is better. However, if the lens 60 is desirable to suppress the generation of the blue spectral color in the light distribution pattern, then it is preferable to use an acrylic resin in which the wavelength dependence of the refractive index is small and spectroscopy is easily suppressed.

[0058] Also, as is evident from Fig. 2, the width in the horizontal direction of the lens portion 61 is reduced to such an extent that it does not exceed twice the row width of the light-emitting chips 32 when viewed from the horizontal direction, and is reduced so that it is equal to or less than the lateral width in the horizontal direction of the circuit board 31.

[0059] Therefore, when the light-emitting chips 32 are made to emit light, the lens portion 61 that emits light to become the light-emitting part is quite small, so a slim appearance can be realized.

[0060] Incidentally, although not illustrated, the lens portion 61 in the present embodiment is such that micro light diffusion structures of ridges that extend in the horizontal direction (more specifically, micro light diffusion structures having horizontally long semi-cylindrical shapes) are provided on the incident surface 61a in a continuous manner in the vertical direction.

[0061] As a result, light from each of the light-emitting chips 32 spreads out in the vertical direction when the light enters the lens portion 61 from the incident surface 61a, so the light distribution patterns are able to be blurred in the vertical direction.

[0062] Also, although not illustrated, the lens portion 61 in the present embodiment is such that micro light diffusion structures of ridges that extend in the vertical direction (more specifically, micro light diffusion structures having vertically long semi-cylindrical shapes) are provided on the light emission surface 61b in a continuous manner in the horizontal direction.

[0063] As a result, light spreads out in the left-right direction when emitted from the light emission surface 61b, so the light distribution patterns are able to be blurred in the left-right direction.

[0064] As described above, the lamp unit 10 of the present embodiment can be ADB controlled. Light from each of the light-emitting chips 32 is radiated forward in a manner such that light distribution patterns having a rectangular shape, for example, that are formed by the light from the light-emitting chips 32 partially overlap with adjacent light distribution patterns. Glare light with respect to a leading vehicle is able to be suppressed by turning some or all of the light-emitting chips 32 on/off in accordance with the positional relationship with the leading vehicle and the like.

[0065] However, when the light distribution patterns overlap in this way, streaks due to a difference in luminosity may appear at the boundary lines where the light distribution patterns overlap. However, streaks due to a difference in luminosity can be inhibited from appearing by blurring the distribution patterns, as described above.

[0066] Also, the micro light diffusion structures of ridges on the incident surface 61a and the light emission surface 61b are in a state similar to when mesh-like micro light diffusion structures are provided crossed when the lens portion 61 is viewed from the front.

[0067] Therefore, it is difficult to visually recognize the state of the inside through the lens 60, so Fig. 2 shows straight through to the inside so that the state of the inside can be known. The light-emitting chips 32, the reflecting board 40, the screws 84 and the electric connector 33 can be made so as not to stand out, so there is also the effect that the appearance is able to be improved.

20 (Lens holder)

[0068] As illustrated in Fig. 3, the lens holder 50 is formed by a first lens holder 51 arranged on the heat sink 20 side and a second lens holder 52 arranged on the front side of the first lens holder 51.

[0069] The first lens holder 51 has an opening edge portion 51a that receives the flange portion 62 (mounting portion) of the lens 60 and an outer peripheral portion 51b that extends toward the heat sink 20 side from the opening edge portion 51a. A cutout portion 51c corresponding to a connecting portion 33a of the electric connector 33 is provided, so as to enable access to the connecting portion 33a of the electric connector 33 from the outside, on a portion on the upper side in the vertical direction of the outer peripheral portion 51b.

[0070] The inner opening shape of the opening edge portion 51a is substantially identical to the outer shape of the lens portion 61 of the lens 60, and the outer shape of the opening edge portion 51a is substantially identical to the outer shape of the flange portion 62 (mounting portion) of the lens 60.

[0071] In this way, the opening edge portion 51a is designed to be about the same size as the lens 60, so as to not waste the design of the lens 60 that has been reduced in size.

[0072] Therefore, as can be understood from Fig. 2, the opening width in the horizontal direction of the opening edge portion 51a is equal to or less than the lateral width in the horizontal direction of the circuit board 31.

[0073] Meanwhile, if the outer peripheral portion 51b were formed in a straight shape from this opening edge portion 51a, the outer peripheral portion 51b would end up contacting the circuit board 31, so the outer peripheral portion 51b has a shape that gradually widens toward the heat sink 20 side, so as to widen to approximately the same extent as the lateral width in the horizontal direction as the circuit board 31, as illustrated in Fig. 3.

[0074] Moreover, as illustrated in Fig. 3, three leg por-

tions 51d (see Fig. 2) formed by standing leg portions 51da that extend toward the heat sink 20 side from the outer peripheral portion 51b following the widening of the outer peripheral portion 51b, and bent portions 51db that are bent so as to be substantially parallel to the front surface 21a of the base portion 21 from these standing leg portions 51da, are provided on the first lens holder 51.

[0075] Fig. 4 is a top view of the lamp unit 10 viewed from above.

[0076] As illustrated in Fig. 4, the standing leg portions 51da are formed extending from the outer peripheral portion 51b following the widening, so the heat sink 20 side of the standing leg portions 51da are positioned farther to the outside than the outer peripheral portion 51b side of the standing leg portions 51da. Furthermore, the bent portions 51db are arranged on the base portion 21 avoiding the circuit board 31, by the bent portions 51db being formed while staying clear by a rounded shape to the outside.

[0077] Therefore, degradation of the leg portions 51d from the heat of the circuit board 31 can be avoided, and damage to the circuit board 31 during installation work can also be avoided.

[0078] Furthermore, the arrangement and the like of these three leg portions 51d will be described in detail with reference to Fig. 2.

[0079] In Fig. 2, the second lens holder 52 is positioned so as to cover the first lens holder 51, so the first lens holder 51 itself is not visible. However, as is evident from Fig. 3, the shape of the second lens holder 52 is basically the same as the shape of the first lens holder 51, and the leg portions 51d of the first lens holder 51 are located directly behind leg portions 52d of the second lens holder 52.

[0080] Also, the opening edge portion 51a of the first lens holder 51 is also positioned directly behind an opening edge portion 52a of the second lens holder 52.

[0081] Therefore, it should be noted that the description below points out the leg portions 51d and the opening edge portion 51a of the first lens holder 51 that are positioned directly behind the leg portions 52d and the opening edge portion 52a of the second lens holder 52.

[0082] As is evident from Fig. 2, the arrangement of the three leg portions 51d is such that, in a front view, two leg portions 51d (one side leg portions) are in vertical positions in the vertical direction, and positioned slightly closer toward the electric connector 33 side than the light-emitting chips 32, and farther to the left and right outsides in the horizontal direction than the electric connector 33, and the remaining one leg portion 51d (other side leg portion) is positioned on a vertically lower side opposite the electric connector 33 with the light-emitting chips 32 sandwiched therebetween, and in substantially the center in the horizontal direction.

[0083] Note that in the present embodiment, the electric connector 33 is arranged vertically above the light-emitting chips 32, but the electric connector 33 may also be arranged vertically below the light-emitting chips 32.

In this case as well, three leg portions 51d may on the whole be arranged in the state shown in Fig. 2 (that is, a state in which the upper and lower sides in Fig. 2 are reversed) based on the electric connector 33.

[0084] That is, the arrangement of the three leg portions 51d need simply be such that, in the description above, the upper side is read as the lower side, and the lower side is read as the upper side.

[0085] Boss holes 55a through which the bosses 25a provided on the base portion 21 of the heat sink 20 pass and screw holes 55b through which the screws 85 pass are formed, as illustrated in Fig. 3, in the bent portions 51db on the two leg portions 51d (one side leg portions) positioned to the left and right outsides in the horizontal direction of the electric connector 33. Meanwhile, as is evident from Fig. 2, only the screw hole 55b (not illustrated) through which the screw 85 passes is formed in the bent portion 51db of the leg portion 51d (other side leg portion) positioned on the vertically lower side opposite the electric connector 33 with the light-emitting chips 32 sandwiched therebetween.

[0086] In this way, by not having a boss for positioning pass through the bent portion 51db of the leg portion 51d (other side leg portion) positioned on the lower side, it is not necessary to perform the work of arranging the first lens holder 51 on the heat sink 20 so as to position the first lens holder 51 with respect to three bosses arranged in a triangle, so workability is able to be remarkably improved.

[0087] Also, with the arrangement of the leg portions 51d described with reference to Fig. 2, the arrangement of the leg portions 51d can be one in which the leg portions 51d are positioned at the vertices of a triangle, so stable fixing to the heat sink 20 can be performed.

[0088] Incidentally, a further reduction in size is possible if the leg portions 51d (one side leg portions) positioned on the left and right outsides in the horizontal direction are not arranged protruding out on the left and right outsides.

[0089] Therefore, the diagonal lines of the opening edge portion 51a are shown as the Z axes in Fig. 2, and if the bent portions 51db of the leg portions 51d (one side leg portions) positioned on the left and right outsides in the horizontal direction are placed in positions not overlapping with the electric connector 33, in a range on the electric connector 33 side indicated by the arrows P from the diagonal lines, and these bent portions 51db are formed extending in a direction (for example, the vertical direction) that intersects with the horizontal direction, so as not to protrude out on the left and right sides, an even further reduction in size is possible, which is preferable.

[0090] Note that at this time, the positions of the leg portions 52d of the second lens holder 52 are of course also changed to match the change in the positions of the leg portions 51d (one side leg portions) of the first lens holder 51.

[0091] Next, the second lens holder 52 will be described.

[0092] As illustrated in Fig. 3, the second lens holder 52 has basically the same shape as the first lens holder 51, and has the opening edge portion 52a of an opening shape substantially identical to the outer shape of the lens portion 61 of the lens 60. The flange portion 62 (mounting portion) of the lens 60 is sandwiched from in front and behind by this opening edge portion 52a pushing the flange portion 62 (mounting portion) of the lens 60 toward the opening edge portion 51a side of the first lens holder 51. As a result, the lens 60 is held by the lens holder 50.

[0093] The second lens holder 52 also has an outer peripheral portion 52b that widens so as to follow the widening of the outer peripheral portion 51b of the first lens holder 51, from the opening edge portion 52a toward the heat sink 20 side.

[0094] A cutout portion 52c corresponding to the electric connector 33 is also formed, similar to the first lens holder 51, on a portion on the upper side in the vertical direction of this outer peripheral portion 52b.

[0095] Meanwhile, the second lens holder 52 is arranged overlapping over the first lens holder 51. Therefore, as illustrated in Fig. 3, the leg portions 52d are leg portions 52d that are formed by only bent portions formed following the bent portions 51db of the leg portions 51d of the first lens holder 51, on the outside from substantially the peripheral edge portion on the heat sink 20 side of the outer peripheral portion 52b.

[0096] Also, as is evident from Fig. 2, boss holes 54a through which the bosses 25a provided on the base portion 21 of the heat sink 20 pass and screw holes 54b (see Fig. 3) through which the screws 85 pass, are formed in the two leg portions 52d positioned to the left and right outsides of the electric connector 33. Meanwhile, only the screw hole 54b (not illustrated) through which the screw 85 passes is formed in the leg portion 52d positioned on the vertically lower side opposite the electric connector 33 with the light-emitting chips 32 sandwiched therebetween.

[0097] The second lens holder 52 is also formed having outer dimensions that are as small as possible so as to not waste the design of the lens 60 that has been reduced in size.

[0098] More specifically, the second lens holder 52 only has larger dimensions than the outer dimensions of the first lens holder 51 by approximately the thickness amount of the second lens holder 52, such that the second lens holder 52 can be overlapped over the first lens holder 51.

[0099] Also, the mounting of the lens 60 to the heat sink 20 by the lens holder 50 can be performed as described below with reference to Fig. 3. First, the bosses 25a of the base portion 21 are passed through the boss holes 55a in the first lens holder 51, and the first lens holder 51 is arranged on the base portion 21. At this time, the tip end sides of the bosses 25a protrude out from the boss holes 55a in the first lens holder 51.

[0100] Then, the lens 60 is inserted from the rear side

of the outer peripheral portion 52b into the second lens holder 52 such that the flange portion 62 (mounting portion) of the lens 60 abuts against the opening edge portion 52a and the lens portion 61 of the lens 60 is in a state sticking out forward through the opening of the opening edge portion 52a. After this, the second lens holder 52 is placed over the first lens holder 51 such that the first lens holder 51 is housed inside the outer peripheral portion 52b of the second lens holder 52, and the bosses 25a are inserted into the boss holes 54a in the second lens holder 52.

[0101] Lastly, the screws 85 are passed through the screw holes 54b in the second lens holder and the screw holes 55b in the first lens holder from the second lens holder 52 side, and screwed into the screw fixing holes 25b in the base portion 21. That is, the first lens holder 51 and the second lens holder 52 are fixed to the base portion 21 in a co-locked state by the screws 85.

[0102] In this way, when assembly is finished, the lamp unit 10 illustrated in Fig. 2 and Fig. 4 is obtained. In the description above, the lens holder 50 is formed by two lens holders, i.e., the first lens holder 51 and the second lens holder 52, but the second lens holder 52 is preferably omitted to further reduce the size.

[0103] In this case, the lens 60 is no longer able to be held by being sandwiched, so the lens 60 may be fixed to the first lens holder 51 by directly welding or adhering the flange portion 62 of the lens 60 to the opening edge portion 51a of the first lens holder 51, for example.

[0104] Meanwhile, as is evident from Fig. 2, the lateral width in the horizontal direction of the circuit board 31 can be further reduced by omitting the reflecting board 40, but if this were done, the end in the horizontal direction of the circuit board 31 would be positioned inside the lens portion 61 when viewed from the front, and as a result, steps on the left and right sides of the circuit board 31 would be visible and the like, which would reduce the appearance.

[0105] Also, if the circuit board 31 were made smaller, it would lead to a reduction in the ability to radiate heat.

[0106] Therefore, even if the reflecting board 40 is omitted, it is desirable to have the lateral width in the horizontal direction of the circuit board 31 be larger than the lens portion 61, the opening width of the opening edge portion 51a and the opening width of the opening edge portion 52a, as described above.

[0107] As described above, in the present embodiment, the lens 60 is reduced in size, and the lens holder 50 and the like is also reduced in size so as not to waste the design of this size reduction.

[0108] In particular, at the periphery of the lens 60, the outer shape is no larger than about the thickness of the second lens holder 52 with respect to the size of the lens 60. Therefore, the outer shape of the periphery of the lens 60 that is arranged in a position on the side that is visibly recognizable from a bezel and an inner panel is able to be kept extremely slim. Therefore, not only is the vehicular lamp simply able to be reduced in size, the ve-

hicular lamp is also able to exhibit a slim light-emitting portion (lens portion) suitable for this reduction in size.

(Second embodiment)

[0109] Fig. 5 is a front view of a lamp unit 10' of a vehicular lamp according to a second embodiment of the present invention, viewed from the front.

[0110] The basic configuration of the second embodiment is similar to that of the first embodiment, so in the description below, mainly the points that differ will be described. Descriptions of portions similar to those of the first embodiment may be omitted.

[0111] First, as is evident from Fig. 2, in the first embodiment, the circuit board 31 of the light source 30 is such that the lower end in the vertical direction is in a position substantially even with the lower end in the vertical direction of the reflecting board 40.

[0112] On the other hand, in the second embodiment, the vertical width in the vertical direction of the circuit board 31 extends to the lower side. As illustrated in Fig. 5, the vertical width in the vertical direction of the circuit board 31 is equal to or greater than the width in the vertical direction of the lens portion 61 of the lens 60, and equal to or greater than the opening width in the vertical direction of the opening edge portion 51a of the first lens holder 51 and the opening width in the vertical direction of the opening edge portion 52a of the second lens holder 52.

[0113] Therefore, as illustrated in Fig. 5, when viewing the lens portion 61 in a front view, the circuit board 31 is positioned over the entire surface of the lens portion 61, so the end of the circuit board 31 is not visually recognized. Thus, the appearance is able to be even further improved.

[0114] Moreover, in the present embodiment, the circuit board 31 is a heat dissipation circuit board, so by increasing the surface area of the circuit board 31 in this way, heat dissipation is able to be increased.

[0115] Meanwhile, the circuit board 31 is on the entire surface of the lens portion 61, so when coloring the surface of this circuit board 31 on which the light-emitting chips 32 are provided, this color is reflected onto the lens portion 61, so the appearance of the lens portion 61 can be controlled.

[0116] For example, when it is desirable that the lens portion 61 not stand out when the light-emitting chips 32 are not illuminated, the color of the surface of the circuit board 31 on which the light-emitting chips 32 are provided may be black.

[0117] Note that when colored black in this way, heat absorption also improves, so heat dissipation efficiency can be improved.

[0118] On the other hand, when the color of the surface of the circuit board 31 on which the light-emitting chips 32 are provided is white, the lens portion 61 can be made to appear whitish, so an appearance with a clear look can be obtained.

[0119] From the point of appearance, a clear look is

often desired, so it is considered preferable to have the color of the surface of the circuit board 31 on which the light-emitting chips 32 are provided be white.

[0120] Incidentally, if the circuit board 31 fills up the entire inside of the lens portion 61 when viewed from the front, as in the second embodiment, then behind the circuit board 31 will naturally not be visibly recognized, as is evident from Fig. 5.

[0121] Therefore, as illustrated in Fig. 5, cutouts 27 by which the front surface 21a and the rear surface 21b (see Fig. 3) of the base portion 21 are communicated are formed in the base portion 21. More specifically, the cutouts 27 are formed by cutting out areas between heat dissipating fins 22. In the present embodiment, the cutouts 27 are cut out from the lower side toward the upper side in the vertical direction of the base portion 21, to the portion where the light-emitting chips 32 of the circuit board 31 are positioned, or the vicinity thereof.

[0122] Accordingly, when the cooling fan 70 (see Fig. 3) is provided, as in the present embodiment, wind from the cooling fan 70 is able to directly hit the circuit board 31 that is a heat dissipation circuit board, thereby enabling the cooling efficiency to be even further increased.

[0123] Note that when the cutouts 27 are provided in this way, postural stability is maintained by abutting the bent portion 51db of the leg portion 51d (other side leg portion) of the first lens holder 51 and the leg portion 52d of the second lens holder 52 positioned on the side opposite the electric connector 33 with the light-emitting chips 32 sandwiched therebetween, against the heat sink 20, instead of fixing them with a screw, as illustrated in Fig. 5, and priority may be given to the formation of the cutouts 27.

[0124] Further, similar to the first embodiment, a screw hole may be provided in the bent portion 51db of the leg portion 51d (other side leg portion) of the first lens holder 51 and the leg portion 52d of the second lens holder 52 positioned on the side opposite the electric connector 33, and a screw fixing hole may be provided in a portion of the base portion 21 of the heat sink 20 corresponding to this screw hole, and fixing by a screw may be performed.

[0125] Although the present invention has heretofore been described based on a specific embodiment, the present invention is not limited to the above embodiment.

[0126] In the first embodiment and the second embodiment, mainly a vehicular lamp in which ADB (Adaptive Driving Beam) control can be performed has been described. However, the present invention is not limited to this. Modifications and improvements that do not depart from the technical aspects are also included in the technical scope of the invention. This is evident to a person skilled in the art from the description of the scope of the claims for patent.

DESCRIPTION OF REFERENCE NUMERALS

[0127]

10, 10'	Lamp unit			a semiconductor light source that has a light-emitting chip on a circuit board;
20	Heat sink			a heat sink having a base portion in which the light source is arranged on a front surface;
21	Base portion			a lens that is arranged in front of the light source and having a mounting portion on an outer periphery of a lens portion; and
21a	Front surface			a lens holder which has an opening edge portion that receives the mounting portion and an outer peripheral portion that extends toward the heat sink side from the opening edge portion, and which mounts the lens to the heat sink,
21b	Rear surface	5		wherein a width in a horizontal direction of the lens portion is equal to or less than a lateral width in the horizontal direction of the circuit board, and an opening width in the horizontal direction of the opening edge portion is equal to or less than the lateral width in the horizontal direction of the circuit board.
22	Heat dissipating fin			
23	Cooling fan mounting portion			
24a, 25a	Boss			
24b, 25b	Screw fixing hole			
27	Cutout	10		
30	Light source			
31	Circuit board			
32	Light-emitting chip			
33	Electric connector			
34a	Boss hole	15		
35b	Screw hole			
40	Reflecting board			
41	Bottom portion			
42	Mounting arm portion			
44a	Boss hole	20		
44b	Screw hole			
45	Reflective surface			
45a	Upper side			
50	Lens holder			
51	First lens holder	25		
51a	Opening edge portion			
51b	Outer peripheral portion			
51c	Cutout portion			
51d	Leg portion			
51da	Standing leg portion	30		
51db	Bent portion			
52	Second lens holder			
52a	Opening edge portion			
52b	Outer peripheral portion			
52c	Cutout portion	35		
52d	Leg portion			
54a, 55a	Boss hole			
54b, 55b	Screw hole			
60	Lens			
61	Lens portion	40		
61a	Incident surface			
61b	Light emission surface			
62	Flange portion			
70	Cooling fan			
71	Impeller	45		
72	Screw hole			
73	Casing			
84, 85, 87	Screw			
101L, 101R	Vehicular front lamp			
102	Vehicle	50		
O	Optical axis center			
Z	Diagonal line			

Claims

1. A vehicular lamp comprising:

- a semiconductor light source that has a light-emitting chip on a circuit board;
- a heat sink having a base portion in which the light source is arranged on a front surface;
- a lens that is arranged in front of the light source and having a mounting portion on an outer periphery of a lens portion; and
- a lens holder which has an opening edge portion that receives the mounting portion and an outer peripheral portion that extends toward the heat sink side from the opening edge portion, and which mounts the lens to the heat sink, wherein a width in a horizontal direction of the lens portion is equal to or less than a lateral width in the horizontal direction of the circuit board, and an opening width in the horizontal direction of the opening edge portion is equal to or less than the lateral width in the horizontal direction of the circuit board.
2. The vehicular lamp according to claim 1, wherein a vertical width in a vertical direction of the circuit board is equal to or greater than a width in the vertical direction of the lens portion, and the vertical width in the vertical direction of the circuit board is equal to or greater than an opening width in the vertical direction of the opening edge portion.
3. The vehicular lamp according to claim 2, further comprising:
- a plurality of heat dissipating fins provided on a rear surface of the base portion; and
- a cooling fan arranged behind the heat dissipating fins, wherein a cutout by which a front surface and a rear surface are communicated is formed in a portion between the heat dissipating fins, and the cutout is formed to at least a position overlapping with a portion of the circuit board.
4. The vehicular lamp according to claim 2, wherein a surface on a side of the circuit board on which the light-emitting chip is provided is white.
5. The vehicular lamp according to claim 1, further comprising:
- an electric connector that is positioned on an upper side or a lower side in a vertical direction of the light-emitting chip and is provided on the circuit board, wherein an outer shape of the opening edge portion is substantially identical to the outer shape of the mounting portion, the lens holder includes one other side leg portion that is formed protruding out toward the heat sink side from the outer

peripheral portion, and is positioned on an upper side or a lower side in the vertical direction, on the opposite side from the electric connector, with the light-emitting chip sandwiched therebetween, when viewed in a front view, and two one side leg portions formed protruding out toward the heat sink side from the outer peripheral portion, and positioned to left and right out-sides of the electric connector on the electric connector side of the light-emitting chip, when viewed in a front view, the one side leg portions and the other side leg portion each have a standing leg portion that extends toward the heat sink side from the outer peripheral portion such that the heat sink side is positioned farther toward the outside than the outer peripheral portion side, and a bent portion that is bent so as to be substantially parallel to the front surface of the base portion from the standing leg portion, and the bend portions of the one side leg portions are positioned in a range on the electric connector side from diagonal lines of the opening edge portion, and are formed extending in a direction that intersects with the horizontal direction.

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6. The vehicular lamp according to claim 5, wherein the outer peripheral portion is formed in a shape that widens toward the heat sink side from the opening edge portion, and the base portion side is positioned to the outside of the outer peripheral portion side, by the standing leg portions of the one side leg portions and the standing leg portion of the other side leg portion being formed following the widening incline of the outer peripheral portion.

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7. The vehicular lamp according to claim 1, wherein the circuit board has the light source in which at least five or more of the light-emitting chips are arranged, in the horizontal direction of the circuit board.

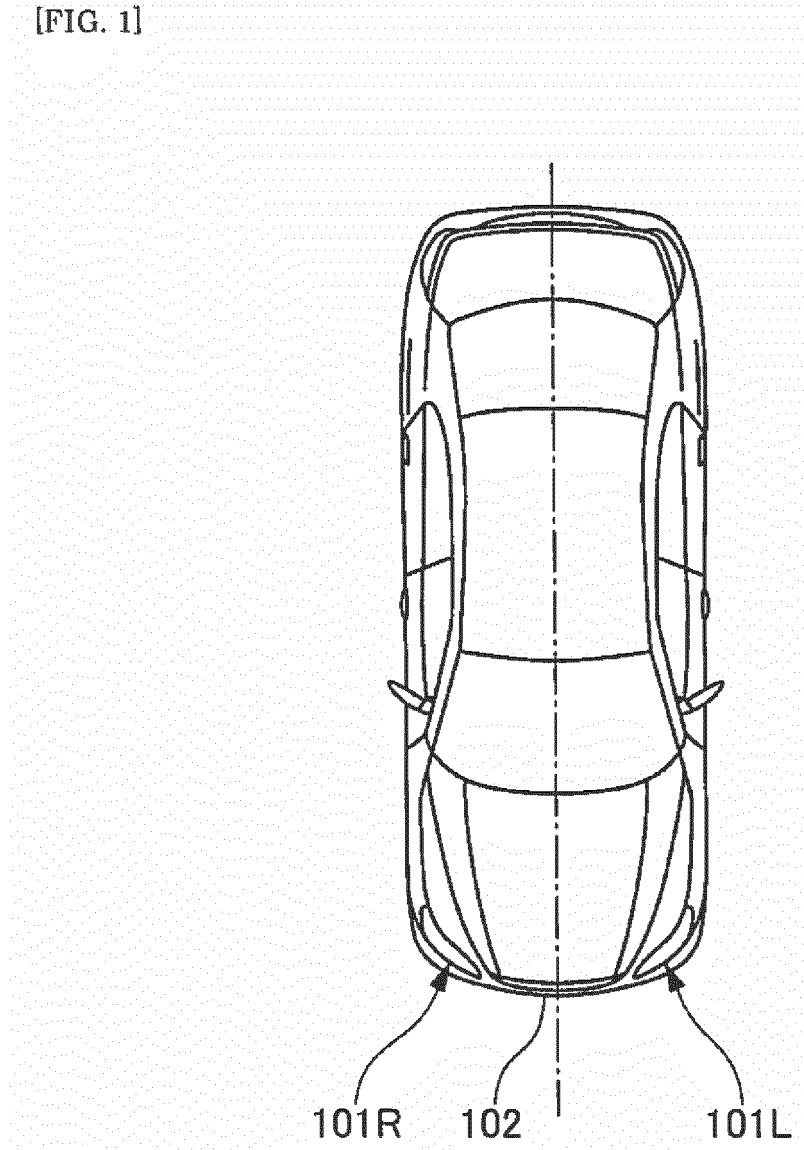
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8. The vehicular lamp according to claim 1, wherein the vehicular lamp includes a left side vehicular lamp that forms a light distribution pattern upward on a left side of a vehicle, and a right side vehicular lamp that forms a light distribution pattern upward on a right side of the vehicle.

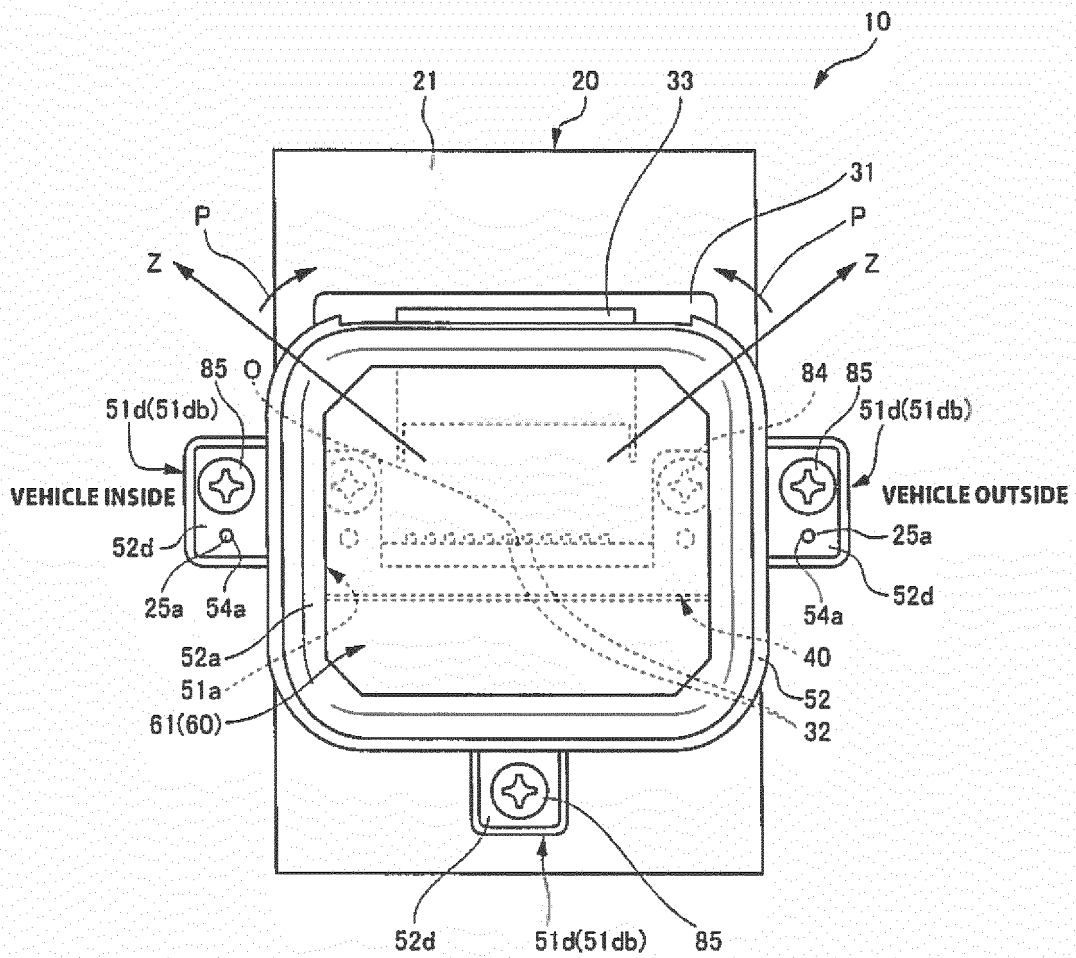
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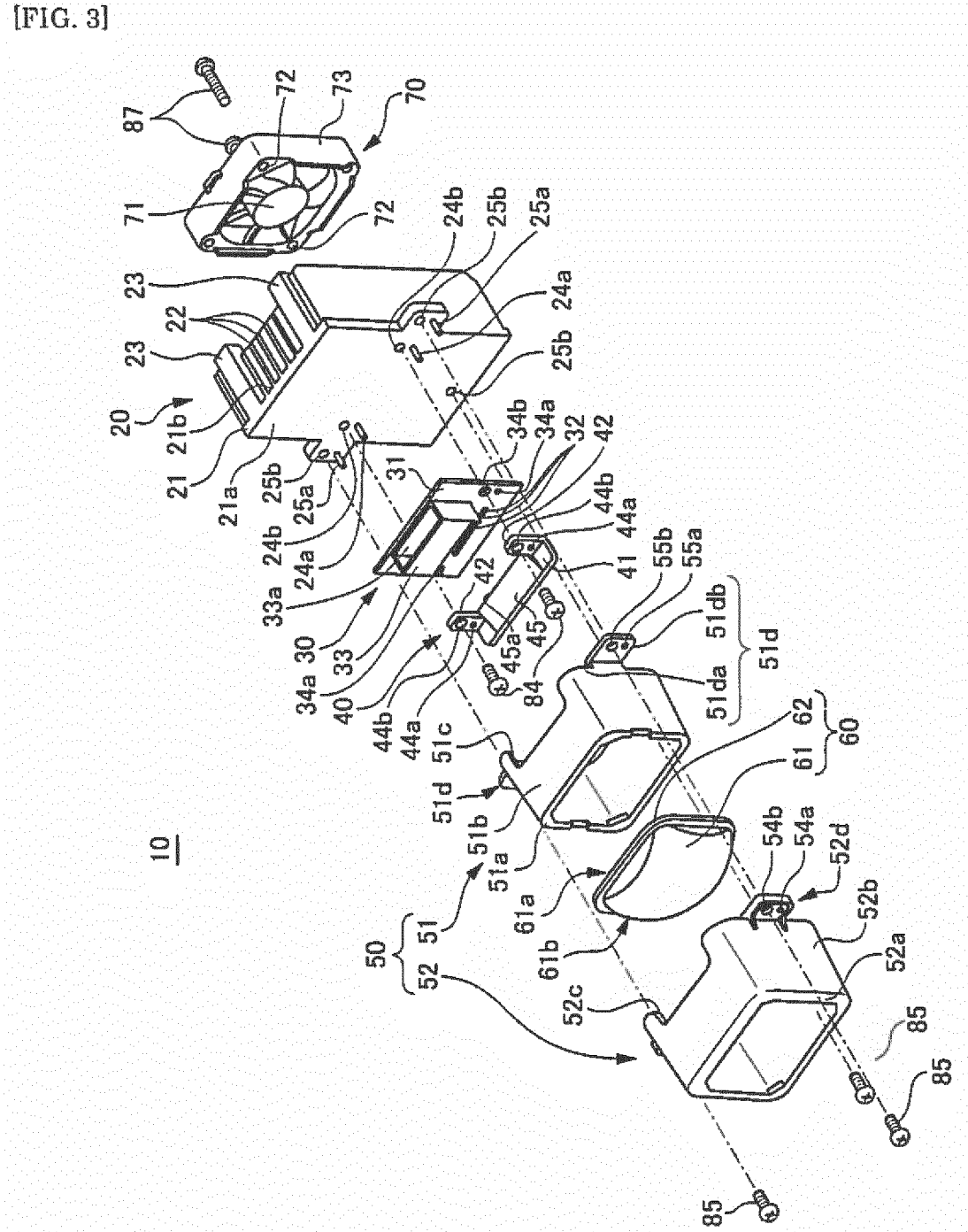
[FIG. 1]



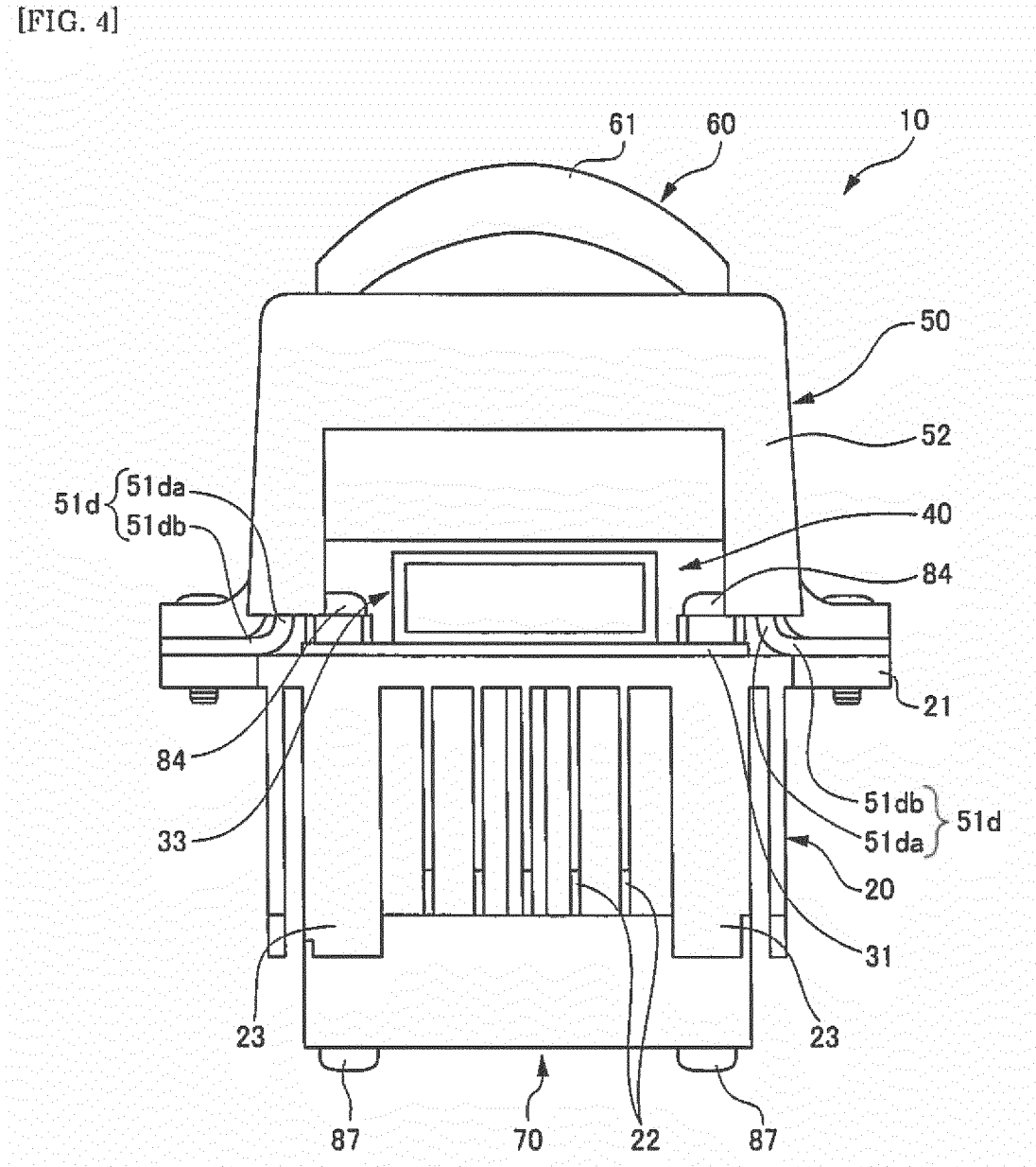
[FIG. 2]



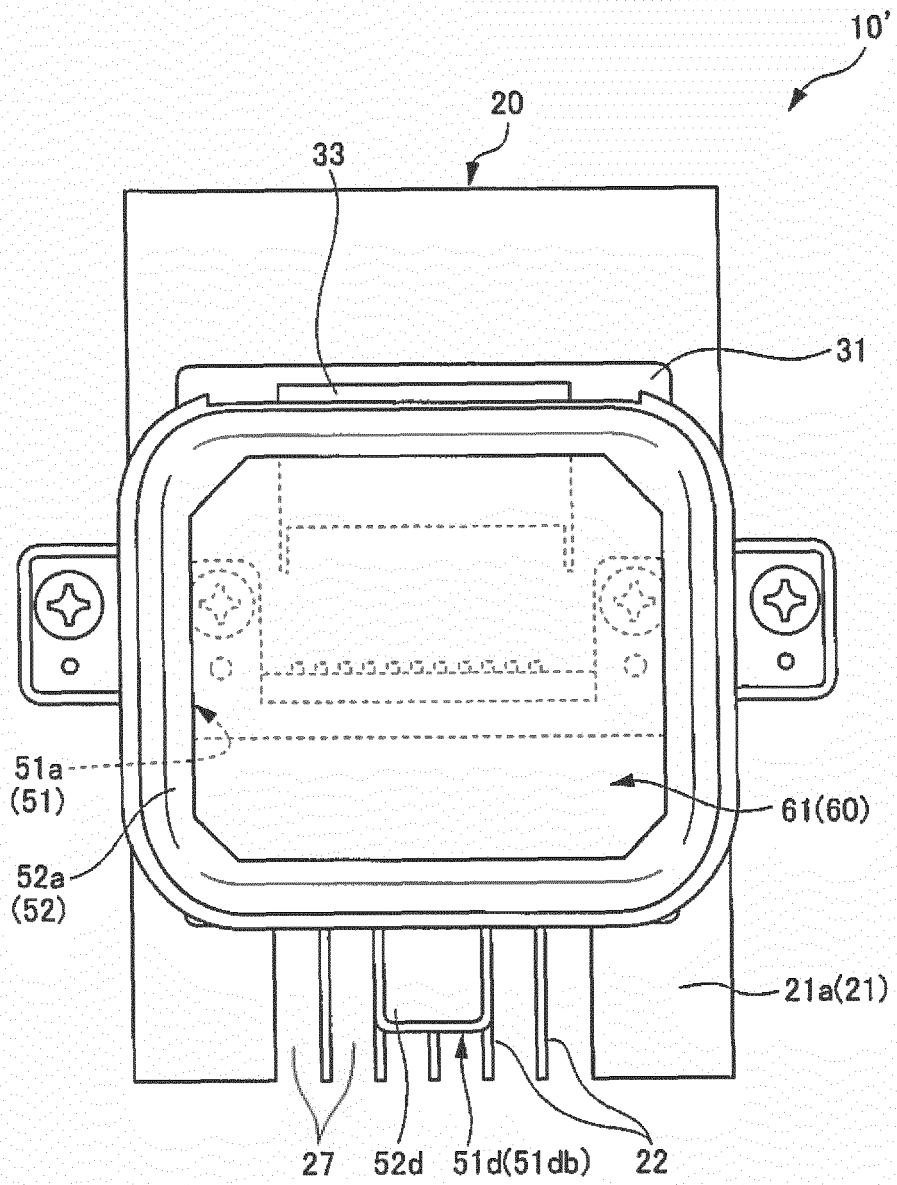
[FIG. 3]



[FIG. 4]



[FIG. 5]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/070739

A. CLASSIFICATION OF SUBJECT MATTER

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 F21S8/10(2006.01)i, F21V23/06(2006.01)i, F21V29/76(2015.01)i, F21Y115/10
 (2016.01)n

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

10
 Minimum documentation searched (classification system followed by classification symbols)
 F21S8/10, F21V23/06, F21V29/76, F21Y115/10

15
 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
 Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
25 X Y A	JP 2013-161536 A (Koito Manufacturing Co., Ltd.), 19 August 2013 (19.08.2013), paragraphs [0014] to [0029]; fig. 1 to 7 & EP 2623370 A2 paragraphs [0007] to [0022]; fig. 1 to 7 & CN 103244893 A	1-2 4, 7-8 3, 5-6
30 Y	JP 2011-141503 A (Citizen Electronics Co., Ltd.), 21 July 2011 (21.07.2011), paragraphs [0022], [0037] & US 2011/0216543 A1 paragraphs [0053], [0065] & DE 102011002483 A1	4

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 Further documents are listed in the continuation of Box C. See patent family annex.

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 "&" document member of the same patent family

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 Date of the actual completion of the international search
 07 October 2016 (07.10.16)

Date of mailing of the international search report
 18 October 2016 (18.10.16)

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 Name and mailing address of the ISA/
 Japan Patent Office
 3-4-3, Kasumigaseki, Chiyoda-ku,
 Tokyo 100-8915, Japan

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-137902 A (Stanley Electric Co., Ltd.), 28 July 2014 (28.07.2014), paragraph [0015]; fig. 1 (Family: none)	7
Y	JP 2014-136504 A (Ichikoh Industries Ltd.), 28 July 2014 (28.07.2014), paragraphs [0014], [0021]; fig. 7 to 10 (Family: none)	8
A	JP 2015-76375 A (Koito Manufacturing Co., Ltd.), 20 April 2015 (20.04.2015), paragraphs [0012] to [0018]; fig. 1 & US 2015/0103551 A1 paragraphs [0016] to [0022]; fig. 1 & EP 2860441 A1	1-8

REFERENCES CITED IN THE DESCRIPTION

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