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(71) Applicant: **Toshiba Lighting&Technology Corporation**
Yokosuka-shi, Kanagawa 237-8510 (JP)

(72) Inventors:
- **HONDA, Yutaka**
Kanagawa 237-8510 (JP)
- **MORIYAMA, Takayoshi**
Kanagawa 237-8510 (JP)
- **OGAWA, Kozo**
Kanagawa 237-8510 (JP)
- **HIGUCHI, Kazunari**
Kanagawa 237-8510 (JP)
- **KOMIYAMA, Shigetoshi**
Kanagawa 237-8510 (JP)
- **KUMASHIRO, Shinichi**
Kanagawa 237-8510 (JP)

(74) Representative: **Willquist, Sofia Ellinor**
Awapatent AB
Junkersgatan 1
582 35 Linköping (SE)

(54) LIGHTING FIXTURE

(57) The present invention is a luminaire (1) includes a light-emitting module (2) having light-emitting elements as a light source, a light outputting portion (23) configured to allow light from the light source to go out, and a housing (21) at least part of which has thermal conductivity and is thermally coupled to the light-emitting element a heat sink (3) provided on the back side of the light-emitting module (2) and is thermally coupled to the part of the housing (21) a thermally conductive luminous intensity distributing member (4) surrounding the periphery of the light outputting portion (23) of the light-emitting module (2) and provided with a reflecting surface widening toward the direction of irradiation of light and a connecting member (5) configured to connect the luminous intensity distributing member (4) and the part of the housing (21) to transfer heat from the housing (21) to the luminous intensity distributing member (4).

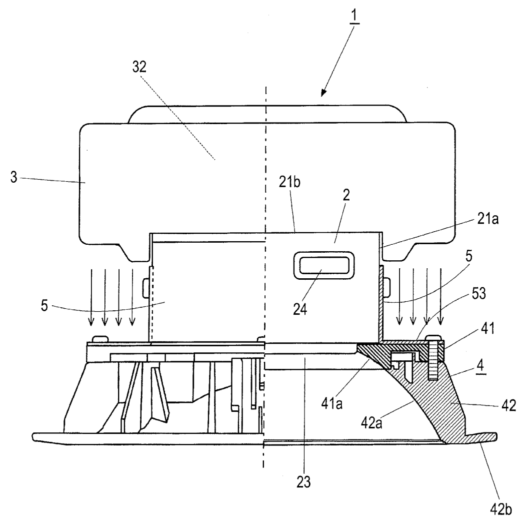

FIG. 2

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Description

Technical Field

[0001] Embodiments of the present invention relate to a luminaire which employs light-emitting elements such as LEDs as a light source, and is capable of improving thermal radiation properties of the light-emitting elements.

Background Art

[0002] Light-emitting elements such as LEDs are subject to lowering of light output in association with increase in temperature thereof, and the service life is shortened correspondingly. Therefore, luminaires having solid light-emitting elements such as the LEDs or EL elements as a light source are required to inhibit temperature rise of the light-emitting elements in order to elongate the service life or improve characteristics such as light-emitting efficiency.

[0003] Therefore, in the luminaire in which the LEDs are used as a light source, an attempt is made to improve thermal radiation properties by transferring heat generated from the LED to a luminaire body or distributing outside air into the luminaire body. In such a luminaire, luminous intensity distribution control is performed by a luminous intensity distributing member (for example, a reflecting plate) in order to cause light emitted from the LED to radiate in an intended direction.

Citation List

Patent Literature

[0004]

PTL 1: JP-A-2006-172895
PTL 2: JP-A-2008-186776

Summary of Invention

Technical Problem

[0005] However, the luminaire of the related art is not configured to improve a thermal radiation effect by effectively utilizing the luminous intensity distributing member.

[0006] It is an object of the present invention to provide a luminaire configured to utilize a luminous intensity distributing member effectively to encourage thermal radiation from the front side and the back side of a light-emitting module to effectively inhibit a temperature increase of light-emitting elements.

Solution to Problem

[0007] A luminaire of the present invention includes a light-emitting module, which includes a light-emitting element as a light source, a light outputting portion configured to allow light from the light source to go out, and has a housing at least part of which has thermal conductivity and is thermally coupled to the light-emitting elements. A heat sink provided on the back side of the light-emitting module and thermally coupled to the part of the housing, and a thermally conductive luminous intensity distributing member surrounding the periphery of the light outputting portion of the light-emitting module and provided with a reflecting surface widening toward the direction of irradiation of light are provided. Then, the luminous intensity distributing member and the part of the housing are connected by a connecting member to transfer heat from the housing to the luminous intensity distributing member.

Advantageous Effects of Invention

[0008] According to the present invention, a luminaire configured to utilize a luminous intensity distributing member effectively to encourage thermal radiation from the front side and the back side of a light-emitting module to effectively inhibit a temperature increase of light-emitting elements can be provided.

Brief Description of Drawings

[0009]

FIG. 1 illustrates a perspective view of a luminaire according to a first embodiment of the present invention.
FIG. 2 illustrates a side view of a right half portion of a luminous intensity distributing member and a connecting member of the same luminaire in cross section.
FIG. 3 illustrates a plan view of the same luminaire viewed from the lower side.
FIG. 4 illustrates a perspective view of a light-emitting module and the connecting member of the same luminaire.
FIG. 5 illustrates a plan view of the connecting member of the same luminaire.
FIG. 6 illustrates a back view of the connecting member of the same luminaire.
FIG. 7 illustrates a side view of the connecting member of the same luminaire.
FIG. 8 illustrates a plan view of the luminaire viewed from the upper side.
FIG. 9 illustrates a plan view of a contact state between the connecting member and the luminous intensity distributing member in FIG. 8 by hatching.
FIG. 10 illustrates a plan view corresponding to FIG. 8 of a luminaire according to a second embodiment of the present invention.
FIG. 11 illustrates a plan view of a contact state between a connecting member and a luminous intensity distributing member in FIG. 10 by hatching.

FIG. 12 illustrates a perspective view of a luminaire according to a third embodiment of the present invention.

FIG. 13 illustrates a side view of a right half portion of a luminous intensity distributing member and a connecting member of the same luminaire in cross section.

FIG. 14 illustrates a plan view of the connecting member of the same luminaire.

FIG. 15 illustrates a side view of the connecting member of the same luminaire.

FIG. 16 illustrates a side view of a right half portion of a luminous intensity distributing member and a connecting member of a luminaire according to a fourth embodiment of the present invention in cross section.

Description of Embodiments

[0010] Referring now to FIG. 1 to FIG. 8, a luminaire according to a first embodiment of the present invention will be described. In respective drawings, the same parts are designated by the same reference numerals and overlapped descriptions are omitted.

[0011] A luminaire according to this embodiment is a down light 1 of a type installed by embedding into a ceiling, and includes a light-emitting module 2, a heat sink 3, a luminous intensity distributing member 4, and a connecting member 5 as illustrated in FIG. 1 and FIG. 2, and a power supply unit, not illustrated. A pair of mounting leaf springs 6 are mounted on the outer peripheral side of the luminous intensity distributing member 4. In FIG. 2, illustration of thermal radiation fins 31 formed on the heat sink 3 and the mounting leaf springs 6 are omitted (the same applies to FIG. 13 and FIG. 16 described later).

[0012] As illustrated in FIG. 4 as representatives of the configuration, the light-emitting module 2 includes a housing 21 having a substantially parallelepiped shape, a substrate disposed in the housing 21, light-emitting elements as a light source mounted on the substrate, and a phosphor thin film layer 22 provided on the front side of the light-emitting elements. Incidentally, an LED down light module manufactured by Royal Philips Electronics, for example, may be applied to the light-emitting module 2.

[0013] The light-emitting elements are surface-mounted LEDs and a plurality of the LEDs are mounted on the substrate. The LEDs emitting blue light are employed in order to cause whitish light to be emitted therefrom. The circular phosphor thin film layer 22 is provided so as to cover the substrate. As the phosphor thin film layer 22, a yellow phosphor which emits yellowish light which is in a compensating relationship with the blue light in order to allow emission of white light is employed. Therefore, the front side of the phosphor thin film layer 22 is configured as a light outputting portion 23, so that light emitted from the LEDs is radiated through the phosphor thin film layer 22 to the outside as whitish light from the light outputting portion 23.

[0014] At least part, for example, both side surfaces 21a and a back surface 21b of the housing 21 are formed of a metallic material such as aluminum having thermal conductivity. The housing 21 is thermally coupled with the light-emitting elements via the substrate so that heat generated from the light-emitting elements is conducted. The housing 21 is formed with a light source line introducing port 24 through which a power source line that supplies electric power to the LEDs is introduced on one surface thereof.

[0015] As illustrated in FIG. 1, the heat sink 3 has a substantially short cylindrical shape. The heat sink 3 includes a number of the thermal radiation fins 31 made of metal having thermal conductivity and formed on the outer periphery thereof so as to extend in the vertical direction. A blast mechanism 32 is integrated in a center portion of the heat sink 3. The blast mechanism 32 vibrates a diaphragm with an electromagnetic coil, thereby forcedly causing air to be distributed to the thermal radiation fins 31. The heat sink 3 is mounted so as to be thermally coupled to the back surface 21b of the housing 21 so as to be in contact therewith. Incidentally, Synjet DML cooler manufactured by Nuventix, Inc., for example, may be applied to the heat sink 3.

[0016] As illustrated mainly in FIG. 2, the luminous intensity distributing member 4 is formed into a substantially parasol shape widening in the direction of irradiation of light emitted from the light outputting portion 23, that is, toward the front. The luminous intensity distributing member 4 is provided so as to surround the periphery of the light outputting portion 23 in a circular shape. An inner peripheral surface of the luminous intensity distributing member 4 is configured as a curved reflecting surface.

[0017] More specifically, the luminous intensity distributing member 4 includes a first luminous intensity distributing member 41 positioned on the light outputting portion 23 side of the light-emitting module 2 and a second luminous intensity distributing member 42 positioned on the side of a light irradiation opening (the direction of irradiation) so as to be combined with a screw. The first luminous intensity distributing member 41 is formed of a metallic material having good thermal conductivity such as aluminum, and the surface thereof is applied with a white coating. An inner peripheral surface thereof has a rounded shape in cross section, and is formed with a reflecting surface 41a.

[0018] The second luminous intensity distributing member 42 is formed of a synthetic resin material such as polycarbonate or an ABS resin, and takes on white color. The inner peripheral surface thereof has a rounded shape in cross section, and is formed with a reflecting surface 42a so as to continue from the reflecting surface 41a of the first luminous intensity distributing member 41.

[0019] However, radii of curvatures R of the reflecting surface 41a of the first luminous intensity distributing member 41 and the reflecting surface 42a of the second luminous intensity distributing member 42 are different.

For example, the radius of curvature R of the reflecting surface 41a of the first luminous intensity distributing member 41 is 80 mm, and the radius of curvature R of the reflecting surface 42a of the second luminous intensity distributing member 42 is 100 mm. Therefore, a curvature (1/R) of the reflecting surface 41a of the first luminous intensity distributing member 41 is set to be larger than a curvature (1/R) of the reflecting surface 42a of the second luminous intensity distributing member 42.

[0020] An annular flange 42b extending in the direction of an outer periphery is formed on the second luminous intensity distributing member 42 integrally with a substantially circular opening end portion widening as it goes toward the front as a decoration frame.

[0021] The luminous intensity distributing member 4 configured in this manner has a function to control luminous intensity distribution of light output from the light outputting portion 23 by the forms of the curved reflecting surfaces 41a and 42a widening toward the front. For example, the luminous intensity distributing member 4 has a function to inhibit glare.

[0022] As illustrated in FIG. 5 to FIG. 7 as representatives of the configuration, the connecting member 5 is formed of a material having thermal conductivity, and is formed from a cold rolling steel plate into a substantially angular U shape as a whole and is applied with a white coating, for example. The connecting member 5 is provided with a pair of side walls 51 facing each other, and a back wall 52 connecting the side walls 51. The pair of side walls 51 and the back wall 52 are formed into a substantially rectangular shape. The side walls 51 are formed with a pair of mounting strips 53 at a substantially center portion on the side of the lower sides so as to extend in the direction orthogonal to the side walls 51, that is, toward the outside. The pair of mounting strips 53 each include a screw through hole 53a. The back wall 52 is formed with an opening 52a at a position facing the light source line introducing port 24 of the light-emitting module 2.

[0023] The connecting member 5 configured in this manner is secured with screws in such a manner that the pair of side walls 51 come into tight contact with the both side surfaces 21a of the light-emit-ting module 2 as illustrated in FIG. 1, FIG. 2, and FIG. 4. Furthermore, the connecting member 5 is secured to the luminous intensity distributing member 4 with mounting screws with the pair of mounting strips 53 arranged on an upper surface of the first luminous intensity distributing member 41 on the back side. The mounting screws penetrate through the screw through holes 53a of the mounting strips 53, then penetrate through screw through holes of the first luminous intensity distributing member 41, and are screwed into screw holes of the second luminous intensity distributing member 42 (see FIG. 2).

[0024] Therefore, the luminous intensity distributing member 4 is mounted on the light-emitting module 2 on the side of the light outputting portion 23 by the connecting member 5. In this case, the pair of side walls 51 of the connecting member 5 are in surface contact with the both side surfaces 21a of the light-emitting module 2, and the mounting strips 53 are in surface contact with the luminous intensity distributing member 4, that is, the first luminous intensity distributing member 41. Accordingly, heat from the light-emitting module 2 may be effectively transferred to the first luminous intensity distributing member 41. FIG. 9 illustrates areas where the mounting strips 53 are in surface contact with the first luminous intensity distributing member 41 by hatching.

[0025] The power supply unit, not illustrated, is connected to a power supply, is provided with a power source circuit and a connecting terminal, and is electrically connected to the light-emitting module 2. Specifically, the power supply unit and the light-emitting module 2 are connected by the power supply line drawn from the light source line introducing port 24 of the light-emitting module 2. Electric power is supplied to the light-emitting module 2 via the power supply line.

[0026] When installing the down light 1 configured as described above, the down light 1 is inserted from the power supply unit into an embedding hole on a ceiling surface, and is supported by the mounting leaf springs 6 in a state of being embedded to the back side of the ceiling surface. In this case, the flange 42b of the second luminous intensity distributing member 42 has a diameter larger than the embedding hole of the ceiling surface, and is configured to be caught by a peripheral edge of the embedding hole from below in a state in which the down light 1 is installed on the ceiling surface.

[0027] Subsequently, when the power supply unit is energized by the power supply, the light-emitting elements emit light by electric power supplied to the substrate of the light-emitting module 2. Major part of the light emitted from the respective light-emitting elements through the phosphor thin film layer 22 is radiated toward the front (right beneath). Part of the light is subjected to luminous intensity distribution control by a reflecting surface of the luminous intensity distributing member 4 and irradiated toward the front.

[0028] Here, the curvature (1/R) of the reflecting surface 41a of the first luminous intensity distributing member 41 is set to be larger than the curvature (1/R) of the reflecting surface 42a of the second luminous intensity distributing member 42. Therefore, the light emitted from the respective light-emitting elements through the phosphor thin film layer 22 and reflected by the reflecting surface 41a is radiated efficiently right beneath (the direction of utilization). Suppose the curvature (1/R) of the reflecting surface 41a of the first luminous intensity distributing member 41 is the same or larger than the curvature (1/R) of the reflecting surface 42a of the second luminous intensity distributing member 42, the light reflected by the reflecting surface 41a may be subjected to irregular reflection within the reflecting surface, and may lower the usage efficiency of light.

[0029] Heat is generated while the light-emitting elements emit light. The heat generated from the light-emitting elements is conducted mainly to the both side surfaces 21a and the back surface 21b of the housing 21 of the light-emitting module 2. Then, the heat conducted to the back surface 21b is conducted to the heat sink 3, and hence transferred to a number of the thermal radiation fins 31 and radiated therefrom. The heat conducted to the both side surfaces 21a is conducted from the pair of side walls 51 to the mounting strips 53 of the connecting member 5, is conducted to the first luminous intensity distributing member 41, and is radiated from the front side.

[0030] In other words, the heat generated by the light-emitting elements is effectively radiated from the front side and the back side of the light-emitting module 2, so that a temperature increase of the light-emitting elements may be inhibited. When radiating the heat from the front side, the luminous intensity distributing member 4 may be used effectively. In addition, when being energized, air is blasted from the blast mechanism 32 of the heat sink 3 toward the luminous intensity distributing member 4 in the direction indicated by arrows in FIG. 2 and hence the thermal radiation fins 31 and the first luminous intensity distributing member 41 are forcedly cooled down, so that inhabitation of the temperature increase of the light-emitting elements is ensured.

[0031] The luminous intensity distributing member 4 is capable of realizing a predetermined luminous intensity distribution control while securing the encouragement of thermal radiating properties and reducing the weight, because the first luminous intensity distributing member 41 is formed of a metallic material having good thermal conductivity and the second luminous intensity distributing member 42 is formed of a synthetic resin material.

[0032] It is preferable to set the reflectance of the reflecting surface 41a of the first luminous intensity distributing member 41 located on the side of the light outputting portion 23 of the light-emitting module 2 to be higher than the reflectance of the reflecting surface 42a of the second luminous intensity distributing member 42. By setting the reflectance of the reflecting surface 41a of the first luminous intensity distributing member 41 to be higher, the proportion of reflecting light reflected by the reflecting surface 41a which returns to the light outputting portion 23 again by the irregular reflection may be reduced. Accordingly, lowering of the usage efficiency of light or a change in color temperature of the output light may be inhibited. When setting the reflectance of the reflecting surface 41a of the first luminous intensity distributing member 41 to be high is desired, for example, it may be realized by applying mirror finishing or the like of the reflecting surface 41a.

[0033] Furthermore, both of the first luminous intensity distributing member 41 and the second luminous intensity distributing member 42 may be formed of a metallic material having good thermal conductivity such as aluminum. Also, the first luminous intensity distributing member 41 and the second luminous intensity distributing member 42 may be integrally formed. In such a case, the thermal radiation efficiency of heat conducted from the light-emitting module 2 may be enhanced.

[0034] Furthermore, although the configuration in which the blast mechanism 32 is integrated in the heat sink 3 is described in this embodiment, the blast mechanism 32 is not necessarily required. It is because that the thermal radiation performance may be satisfied by an increase in thermal radiating surface area by the thermal radiation fins 31 or the like.

[0035] Subsequently, a luminaire according to a second embodiment of the present invention will be described with reference to FIG. 10 and FIG. 11. The same or corresponding parts as in the first embodiment are designated by the same reference numerals and overlapped descriptions are omitted.

[0036] In this embodiment, a mounting strip 54 is formed from the side of the lower sides of respective walls 51, 52 of the pair of side walls 51 and the back wall 52 of the connecting member 5 formed into a substantially angular U-shape. The mounting strip 54 extends in a direction orthogonal to the respective walls 51 and 52, that is, toward the outside. The mounting strip 54 extending from the respective walls 51 and 52 extend to an outer peripheral edge of the upper surface of the first luminous intensity distributing member 41 on the back side, and is formed into an arcuate shape.

[0037] Therefore, the mounting strip 54, with the configuration thereof extending from the respective walls 51 and 52, is capable of increasing the surface area of an area S where the mounting strip 54 comes into surface contact with the first luminous intensity distributing member 41 as illustrated in FIG. 11. Therefore, thermal conduction from the light-emitting module 2 to the luminous intensity distributing member 4 may be enhanced.

[0038] In this case, although the mounting strip 54 extends to the outer peripheral edge of the upper surface of the first luminous intensity distributing member 41, the diameter thereof is smaller than the outer diameter of the heat sink 3. Therefore, when installing the down light 1, an effect of easy insertion into the embedding hole of the ceiling surface may be expected.

[0039] The mounting strip 54 is preferably in surface contact over an area larger than a half the surface area of the upper surface of the first luminous intensity distributing member 41.

[0040] Subsequently, a luminaire according to a third embodiment of the present invention will be described with reference to FIG. 12 to FIG. 15. The same or corresponding parts as in the first embodiment are designated by the same reference numerals and overlapped descriptions are omitted.

[0041] In the third embodiment, a connecting member 7 configured to connect the heat sink 3 and the luminous intensity distributing member 4 and transfer heat from the heat sink 3 to the luminous intensity distributing member 4 is provided.

[0042] The basic configuration is the same as that of the first embodiment. The luminaire of this embodiment includes the light-emitting module 2, which includes light-emitting elements as a light source, the light outputting portion 23 configured to allow light from the light source to go out, and has the housing 21 at least part of which has thermal conductivity and is thermally coupled to the light-emitting element, and the heat sink 3 provided on the back side of the light-emitting module and thermally coupled to part of the housing 21, specifically, to the back surface 21b. The luminaire also includes the thermally conductive luminous intensity distributing member 4 surrounding the periphery of the light outputting portion 23 of the light-emitting module 2 and provided with the reflecting surface widening toward the direction of irradiation of light.

[0043] The luminaire is provided also with the connecting member 7 configured to transfer heat from the heat sink 3 to the luminous intensity distributing member 4.

[0044] The connecting member 7 is formed of a material having the thermal conductivity, and is formed from a cold rolling steel plate into a cylindrical shape and is applied with a white coating. The inner diameter of the connecting member 7 is formed to have the substantially same dimension as the outline of the heat sink 3, that is, the dimension of the outer peripheral diameter of the thermal radiation fins 31. A plurality of (four) mounting strips 73 are provided on the lower end side of a cylindrical shape. The mounting strips 73 each have a screw through hole 73a. The respective mounting strips 73 are formed so as to face each other at intervals of approximately 90° and extend in the direction orthogonal to the cylinder, that is, toward the inside.

[0045] The connecting member 7 configured in this manner is secured to the thermal radiation fins 31 with screws so as to cover the outer periphery of the light-emitting module 2 with a predetermined gap G and so that an inner peripheral surface thereof come into contact with the outer periphery of the thermal radiation fins 31 as illustrated in FIG. 12 and FIG. 13.

[0046] In contrast, the respective mounting strips 73 are provided on the upper surface of the first luminous intensity distributing member 41 on the back side, and is mounted on the luminous intensity distributing member 4 with mounting screws. The mounting screws penetrate through the screw through holes 73a of the mounting strips 73, then penetrate through the screw through holes of the first luminous intensity distributing member 41, and are screwed into the screw holes of the second luminous intensity distributing member 42.

[0047] In such a configuration, heat is generated while the light-emitting elements emit light. The heat generated from the light-emitting elements is conducted mainly to the both side surfaces 21a and the back surface 21b of the housing 21 of the light-emitting module 2. Then, the heat transferred to the back surface 21b is conducted to the heat sink 3, and hence transferred to the number of thermal radiation fins 31 and radiated therefrom. The heat transferred to the number of thermal radiation fins 31 is conducted to the connecting member 7 which comes into contact with the thermal radiation fins 31, is radiated from a cylinder having a wide surface area, is conducted from the mounting strips 73 to the first luminous intensity distributing member 41, and is radiated from the front side.

[0048] In this manner, the heat generated by the light-emitting elements is effectively radiated from the front side and the back side of the light-emitting module 2, so that the temperature increase of the light-emitting elements may be inhibited. When radiating the heat from the front side, the luminous intensity distributing member 4 may be used effectively. In addition, the thermal radiation properties may be enhanced with the cylindrical connecting member 7 having a large surface area.

[0049] In addition, when being energized, air is distributed effectively through the gap G and is blasted from the blast mechanism 32 of the heat sink 3 toward the luminous intensity distributing member 4 in the direction indicated by arrows in FIG. 13 and hence the thermal radiation fins 31, the connecting member 7, and the first luminous intensity distributing member 41 are forcedly cooled down, so that inhabitation of the temperature increase of the light-emitting elements may be ensured.

[0050] Subsequently, a luminaire according to a fourth embodiment of the present invention will be described with reference to FIG. 16. The same or corresponding parts as in the third embodiment are designated by the same reference numerals and overlapped descriptions are omitted.

[0051] In the fourth embodiment, in addition to the configuration of the third embodiment, second connecting members 8 configured to connect the light-emitting module 2 and the cylindrical connecting member 7 so as to achieve heat conduction are provided.

[0052] The second connecting members 8 are formed of a material having the thermal conductivity, and is formed by bending a cold rolling steel plate, for example. The second connecting members 8 each include a mounting strip 8a mounted on the inner side of the cylindrical connecting member 7, and a mounting strip 8b mounted on the side of the light-emitting module 2.

[0053] A pair of the second connecting members 8 are provided. The second connecting members 8 are mounted in such a manner that the mounting strips 8a are mounted on the inner side of the cylindrical connecting member 7 by welding or the like and the mounting strips 8b are secured to the side surface 21a of the light-emitting module 2 with screws.

[0054] In such a configuration, the heat generated from the light-emitting elements is conducted mainly to the both side surfaces 21a and the back surface 21b of the housing 21 of the light-emitting module 2. Then, the heat conducted to the back surface 21b is conducted to the heat sink 3, and hence transferred to the number of thermal radiation fins 31 and radiated therefrom. The heat transferred to the number of thermal radiation fins 31 is conducted to the connecting member 7 which comes into contact with the thermal radiation fins 31, is radiated from the cylinder having a wide surface area, is conducted from the mounting strips 73 to the first luminous intensity distributing member 41, and is radiated from the front side.

[0055] Heat of the both side surfaces 21a of the housing 21 of the light-emitting module 2 is conducted to the second connecting members 8, and is conducted to the cylindrical connecting member 7 and is radiated therefrom. At the same time, the heat is conducted from the connecting member 7 to the thermal radiation fins 31 and the first luminous intensity distributing member 41, so that radiation is encouraged.

[0056] Therefore, a thermal radiation path is formed from the both side surfaces 21a and the back surface 21b of the housing 21 of the light-emitting module 2, so that improvement of the thermal radiation effect is achieved.

[0057] The present invention is not limited to the configuration of the above-described embodiments, and various modifications may be made without departing the scope of the invention. The light-emitting module and the heat sink are not specifically limited to the configuration of the above-described embodiments. For example, a housing of the light-emitting module formed into a parallelepiped shape or the cylindrical shape may also be applied.

[0058] Also, solid light-emitting elements such as LEDs or EL elements may be employed as the light-emitting elements to be provided on the light-emitting module.

[Reference Signs List]

[0059] 1... luminaire (down light), 2... light-emitting module, 3... heat sink, 4... luminous intensity distributing member, 5, 7... connecting member, 23... light outputting portion, 32... blast mechanism, 41... first light-distributing member, 41a... reflecting surface of first light-distributing member, 42... second light-distributing member, 42a... reflecting surface of second light-distributing member, 51... side walls, 52... back wall, 53... mounting strip

Claims

1. A luminaire **characterized by** comprising:

a light-emitting module having a light-emitting element as a light source, a light outputting portion configured to allow light from the light source to go out, and a housing at least part of which has thermal conductivity and is thermally coupled to the light-emitting element;
a heat sink provided on the back side of the light-emitting module and is thermally coupled to the part of the housing;
a thermally conductive luminous intensity distributing member surrounding the periphery of the light outputting portion of the light-emitting module and provided with a reflecting surface widening toward the direction of irradiation of light; and
a connecting member configured to connect the luminous intensity distributing member and the part of the housing to transfer heat from the housing to the luminous intensity distributing member.

2. The luminaire according to Claim 1, **characterized in that** the connecting member includes a pair of side walls and a back wall connecting the side walls, and includes mounting strips extending from the respective walls so as to come into surface contact with the luminous intensity distributing member.

3. The luminaire according to Claim 1, **characterized in that** the luminous intensity distributing member includes curved reflecting surfaces widening toward the direction of irradiation of light, the reflecting surfaces include a reflecting surface positioned on the side of the light outputting portion of the light-emitting module and a reflecting surface positioned on the side of the direction of irradiation of light having difference curvatures, and the curvature of the reflecting surface positioned on the side of the light outputting portion is set to be larger than the curvature of the reflecting surface positioned on the side of the direction of irradiation of light.

4. The luminaire according to Claim 1, **characterized in that** the heat sink includes a blast mechanism configured to blast air toward the luminous intensity distributing member.

5. A luminaire **characterized by** comprising:

a light-emitting module having a light-emitting element as a light source, a light outputting portion configured to allow light from the light source to go out, and a housing at least part of which has thermal conductivity and is thermally coupled to the light-emitting element;
a heat sink provided on the back side of the light-emitting module and is thermally coupled to the part of the housing;
a thermally conductive luminous intensity distributing member surrounding the periphery of the light outputting portion of the light-emitting module and provided with a reflecting surface widening toward the direction of irradiation of light; and
a connecting member configured to connect the luminous intensity distributing member and the heat sink and configured to transfer heat from the heat sink to the luminous intensity distributing member.

6. The luminaire according to Claim 5, **characterized in that** the luminous intensity distributing member includes curved reflecting surfaces widening toward the direction of irradiation of light, the reflecting surfaces include a reflecting surface positioned on the side of the light outputting portion of the light-emitting module and a reflecting surface positioned on the side of the direction of irradiation of light having difference curvatures, and the curvature of the reflecting surface positioned on the side of the light outputting portion is set to be larger than the curvature of the reflecting surface positioned on the side of the direction of irradiation of light.

7. The luminaire according to Claim 5, **characterized in that** the heat sink includes a blast mechanism configured to blast air toward the luminous intensity distributing member.

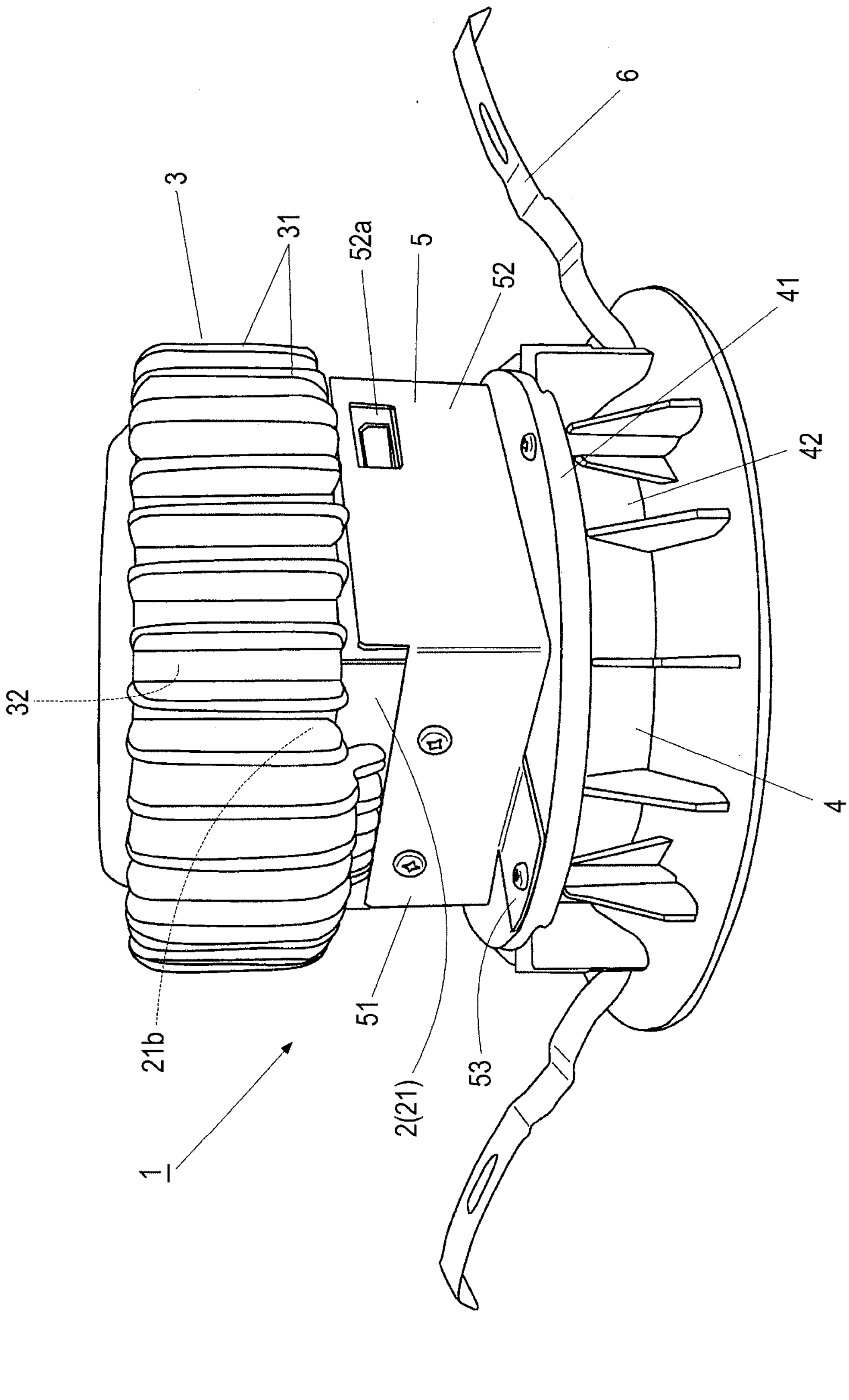


FIG. 1

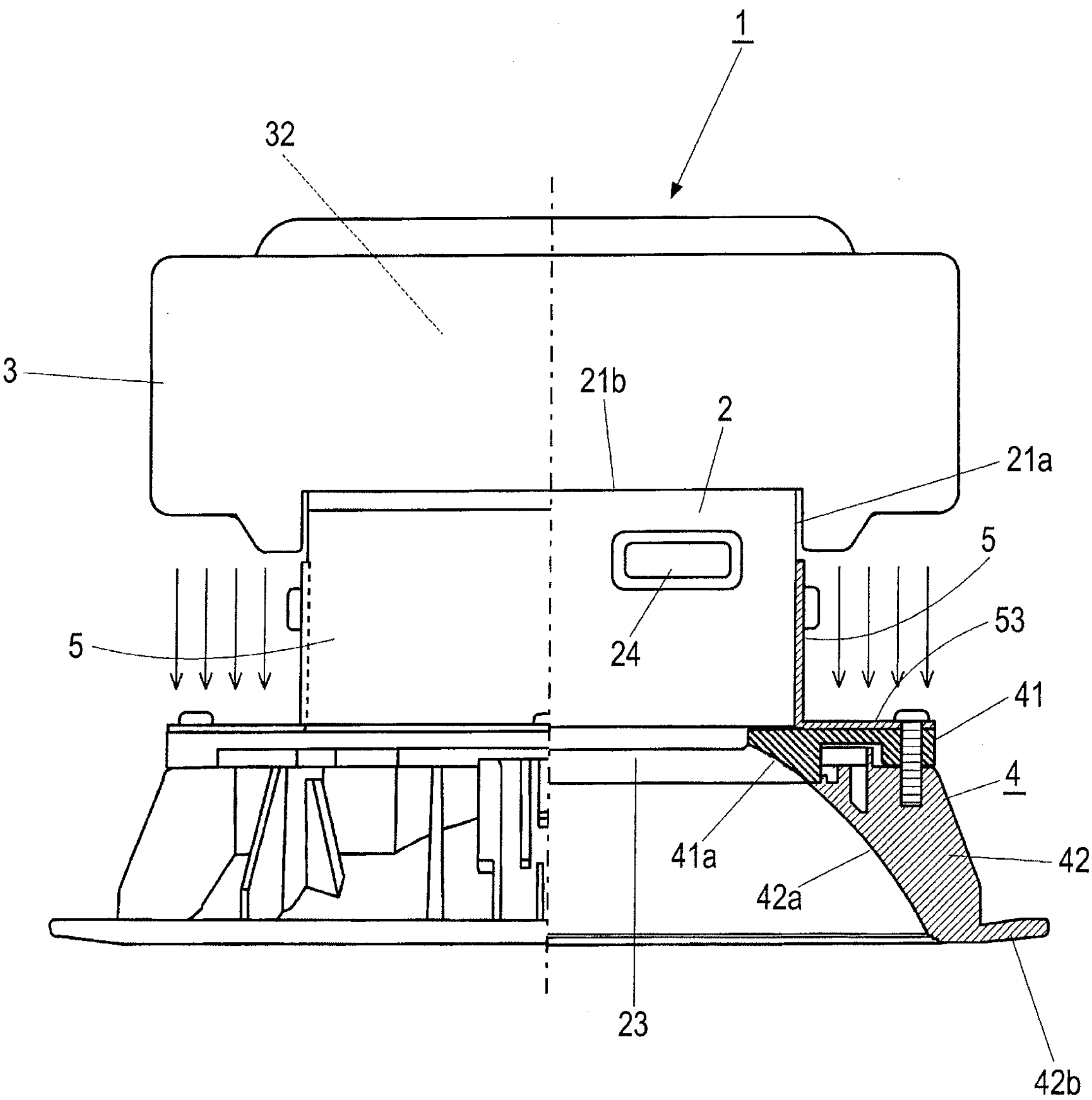


FIG. 2

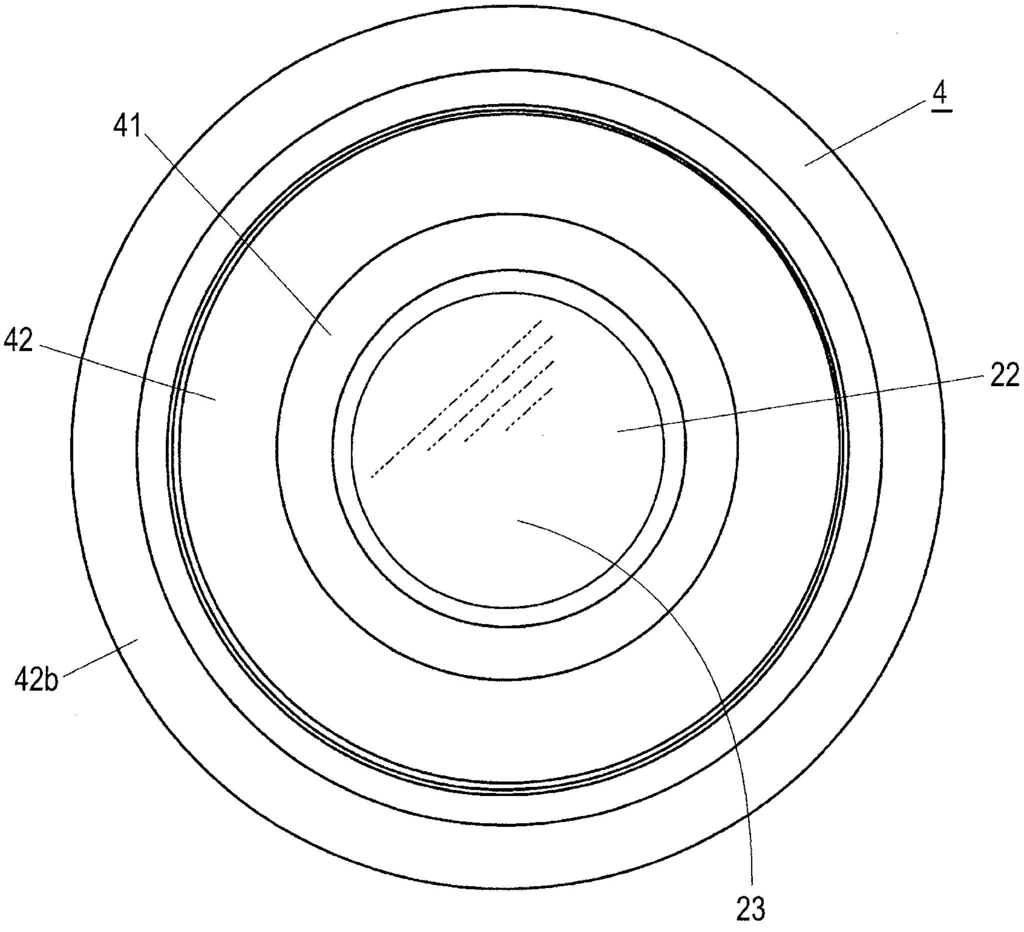


FIG. 3

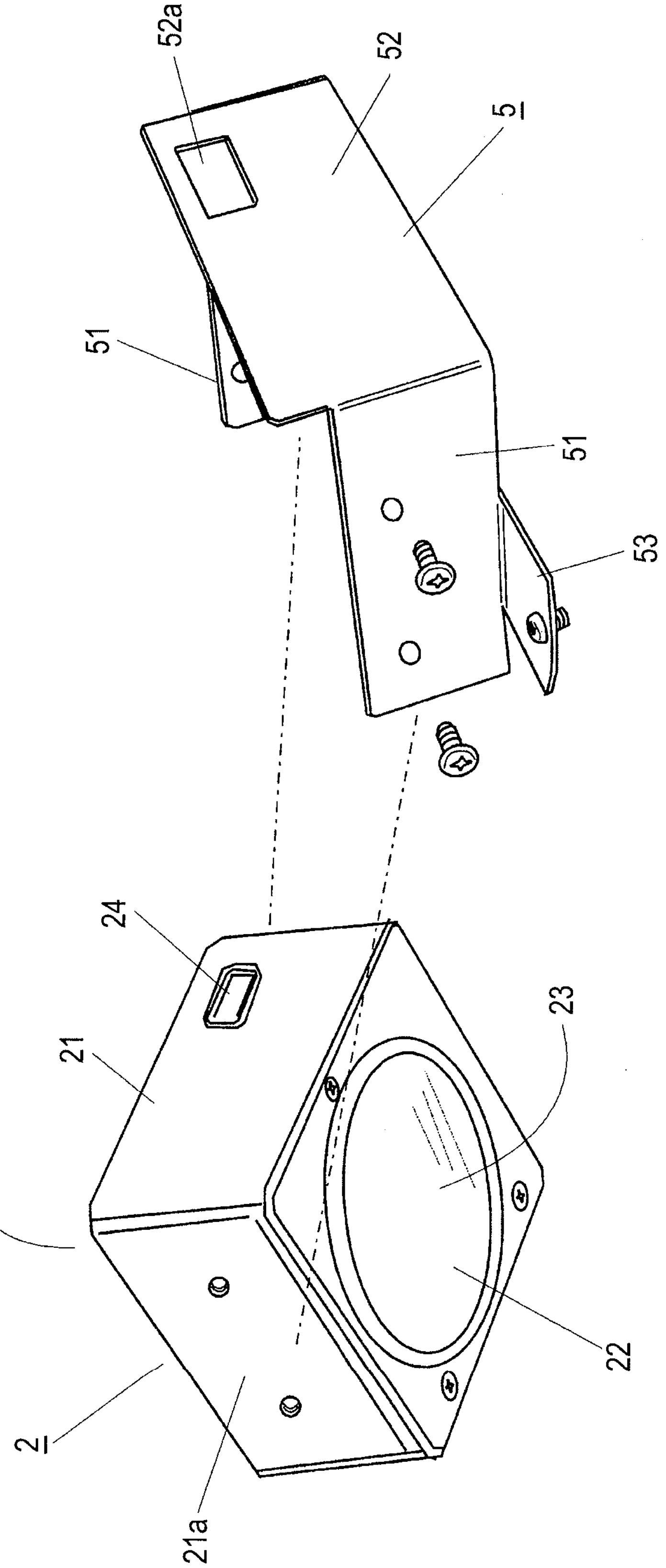
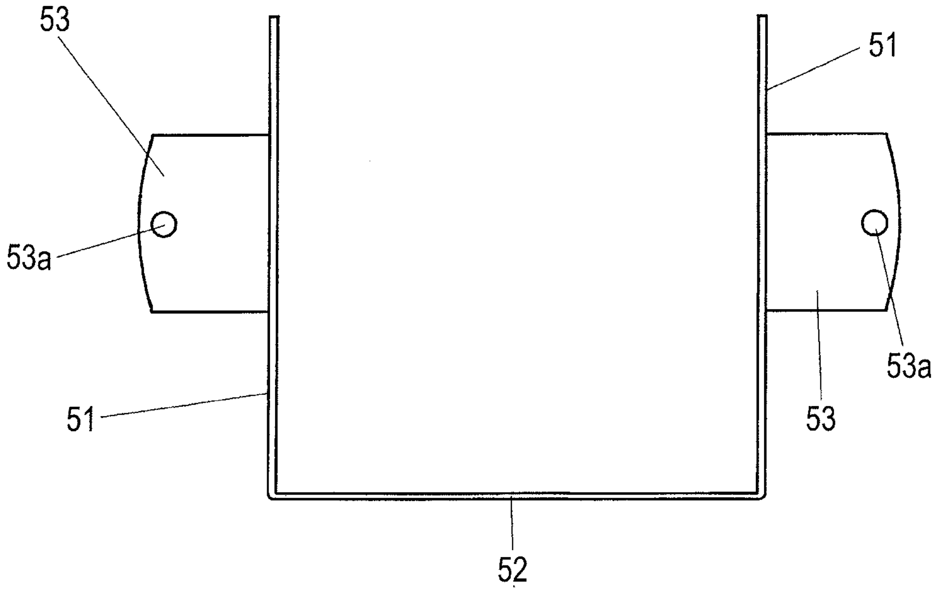
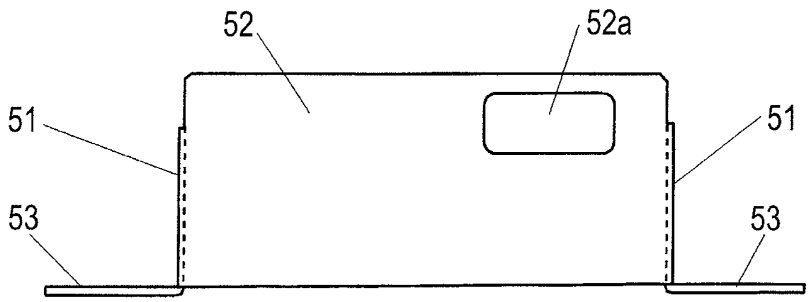


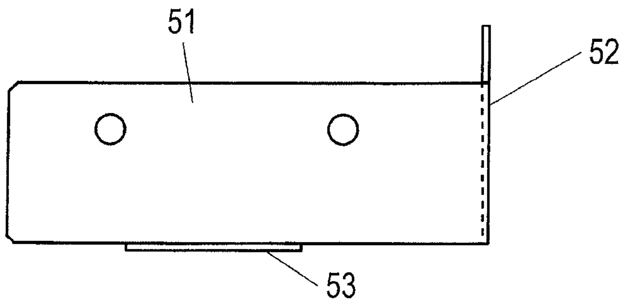
FIG. 4



F I G. 5



F I G. 6



F I G. 7

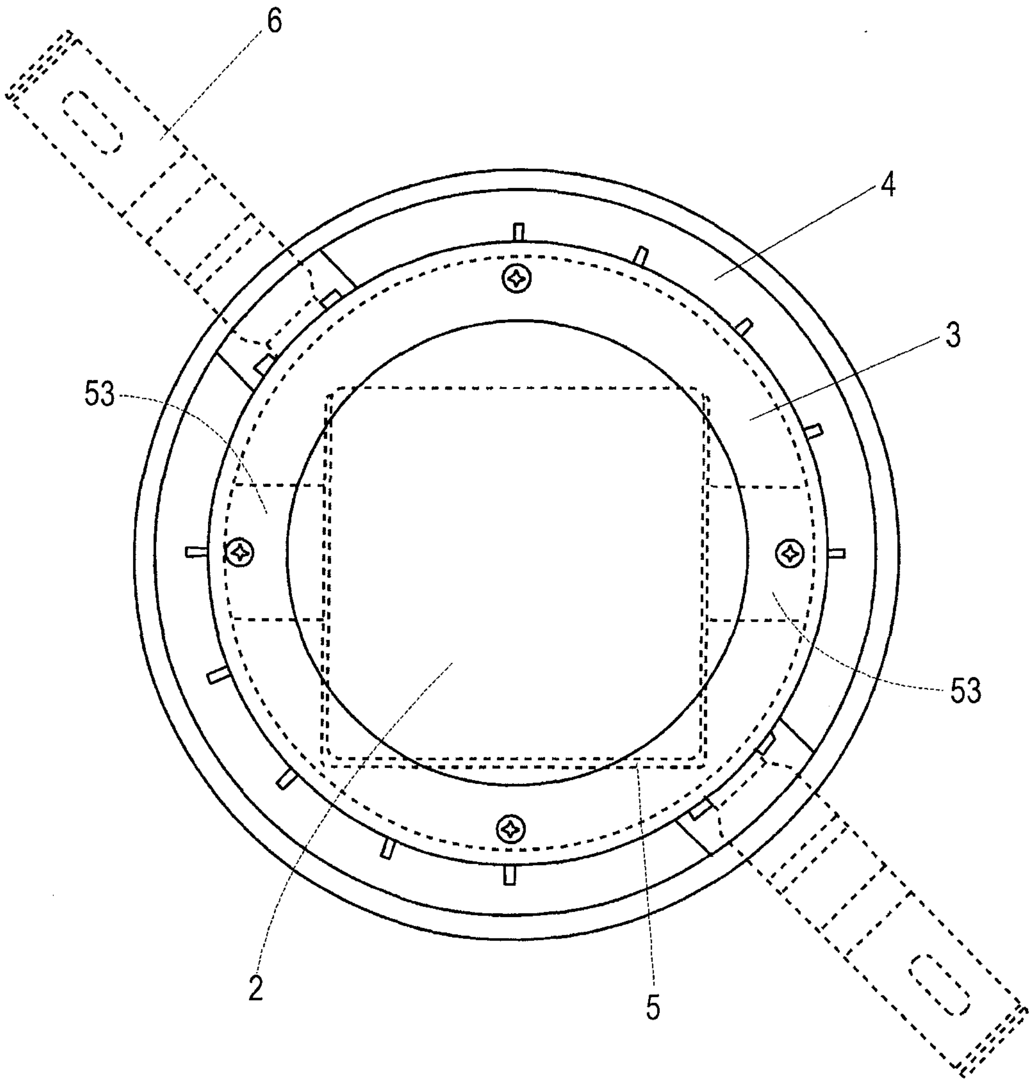


FIG. 8

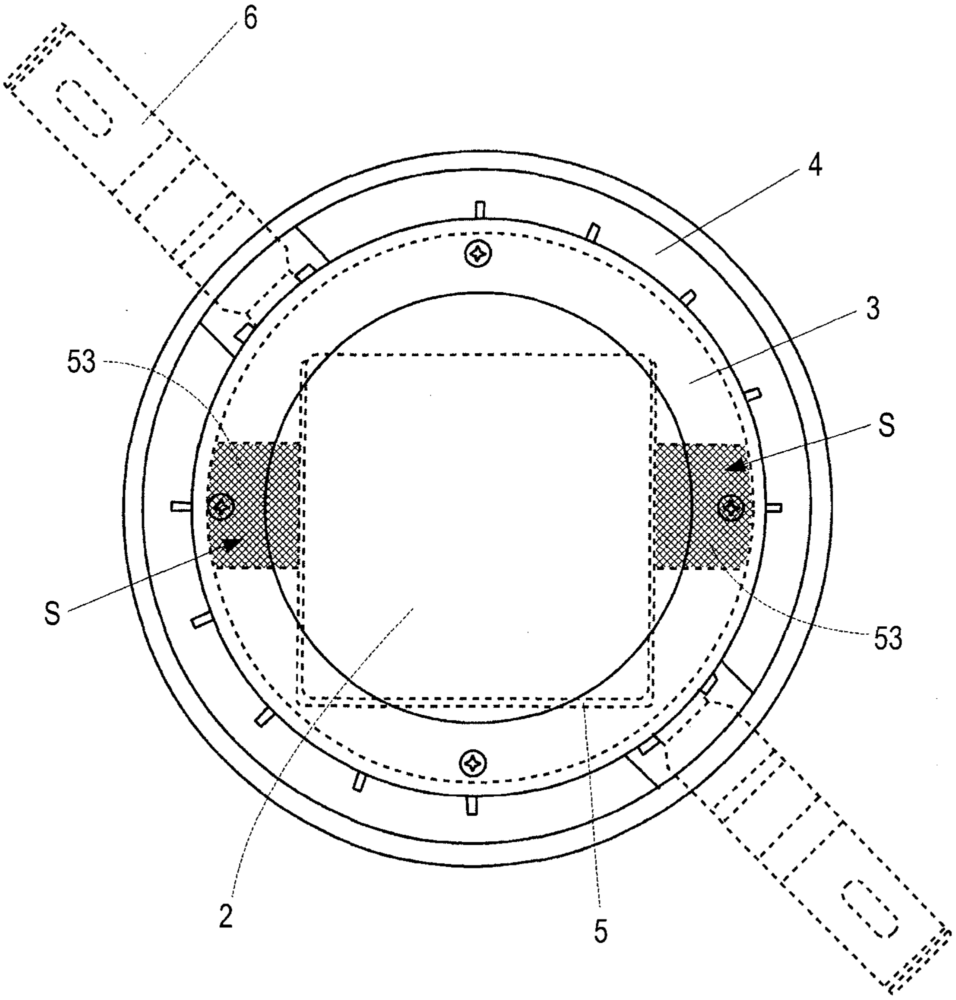


FIG. 9

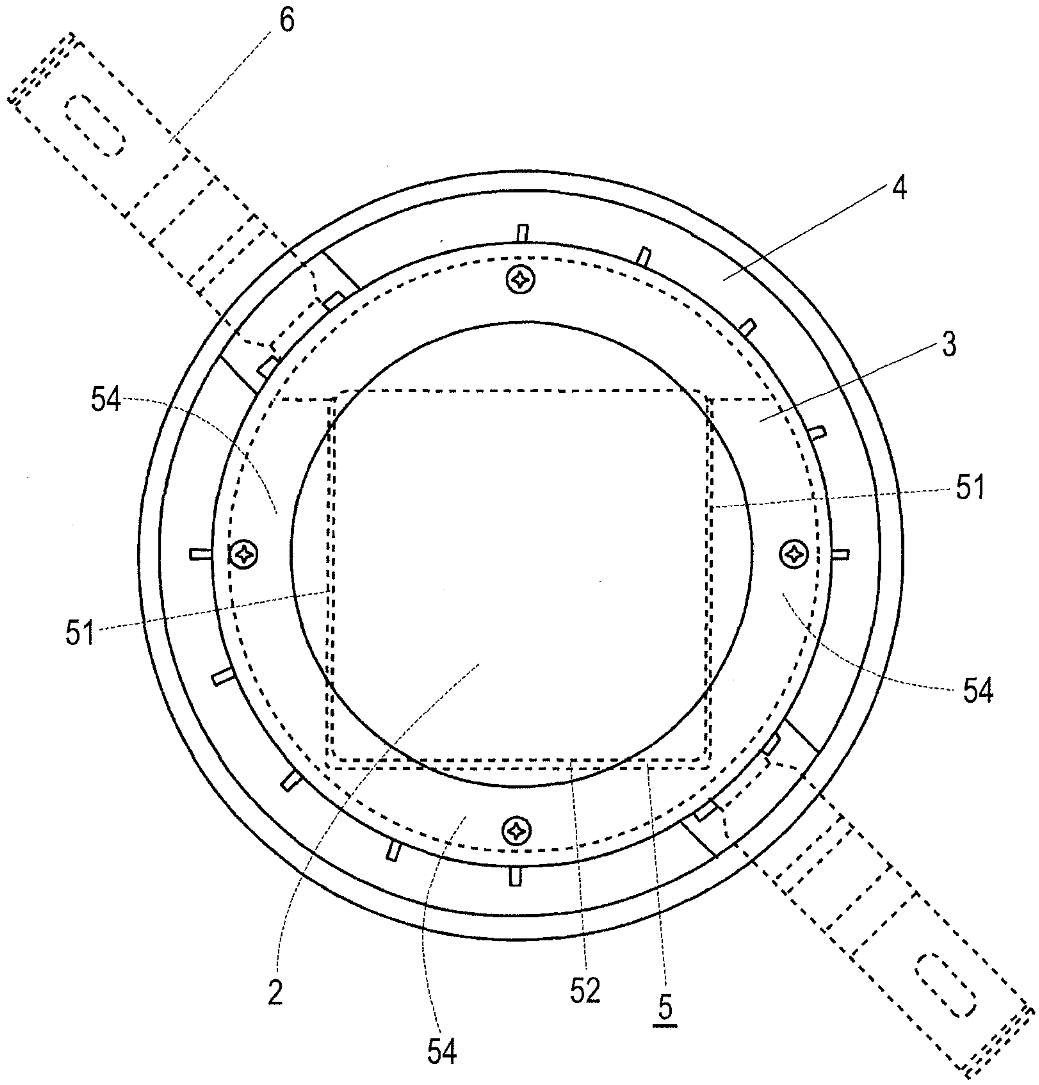


FIG. 10

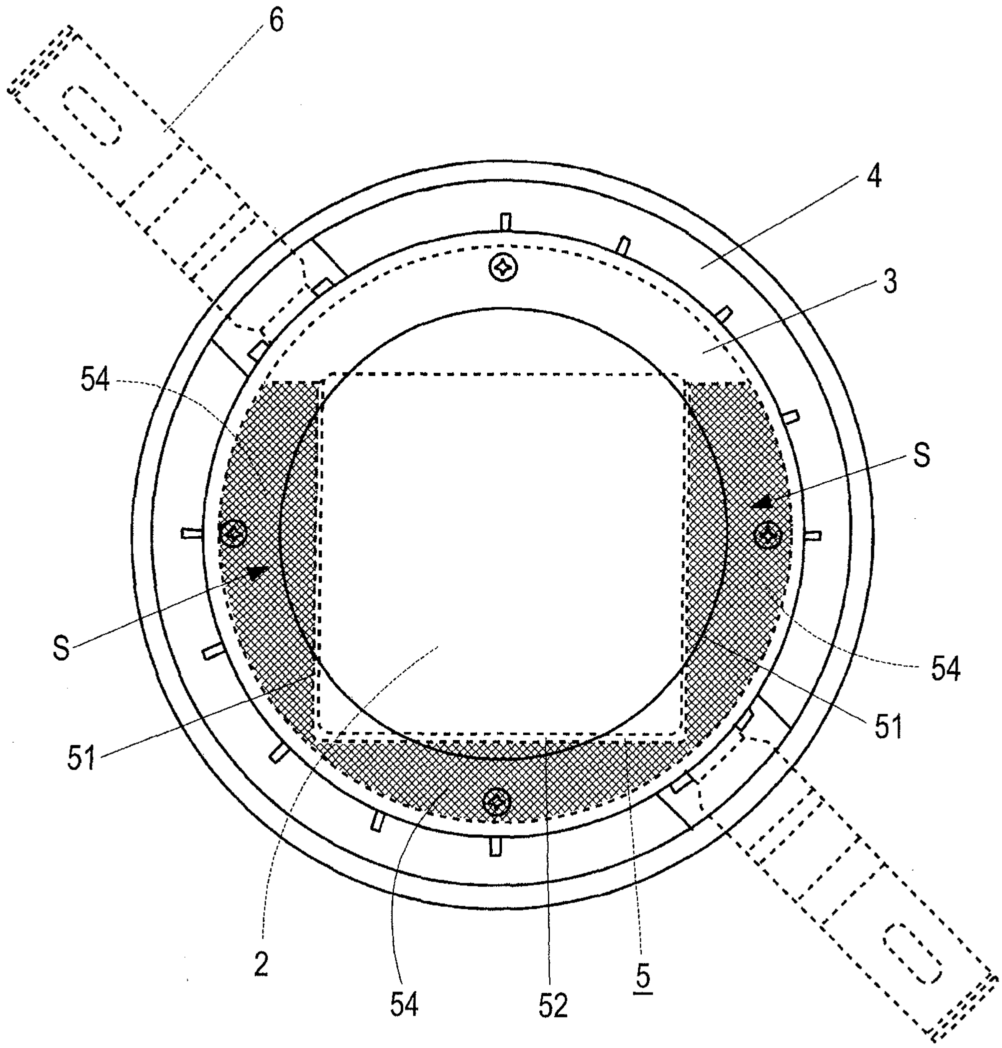
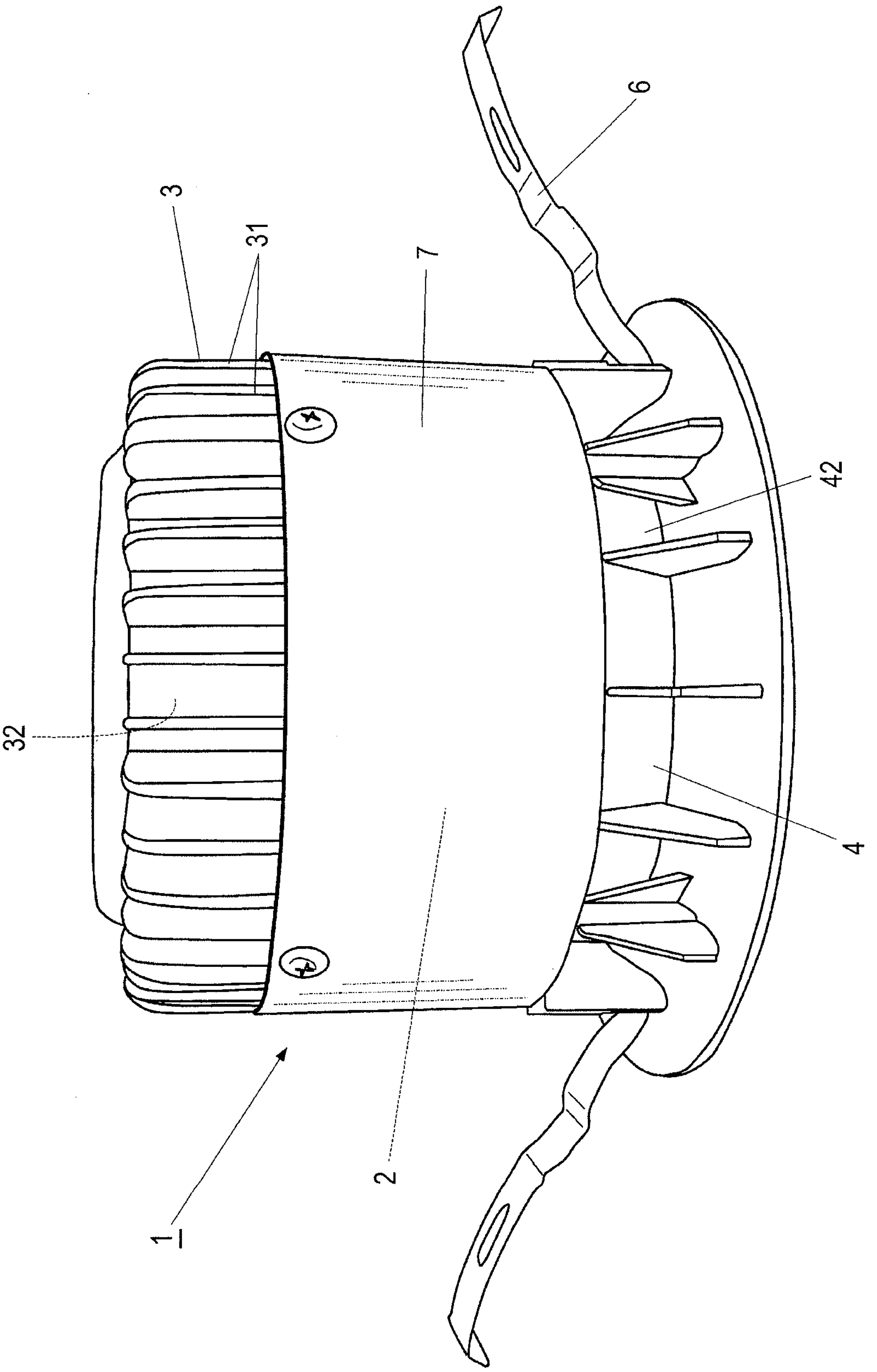
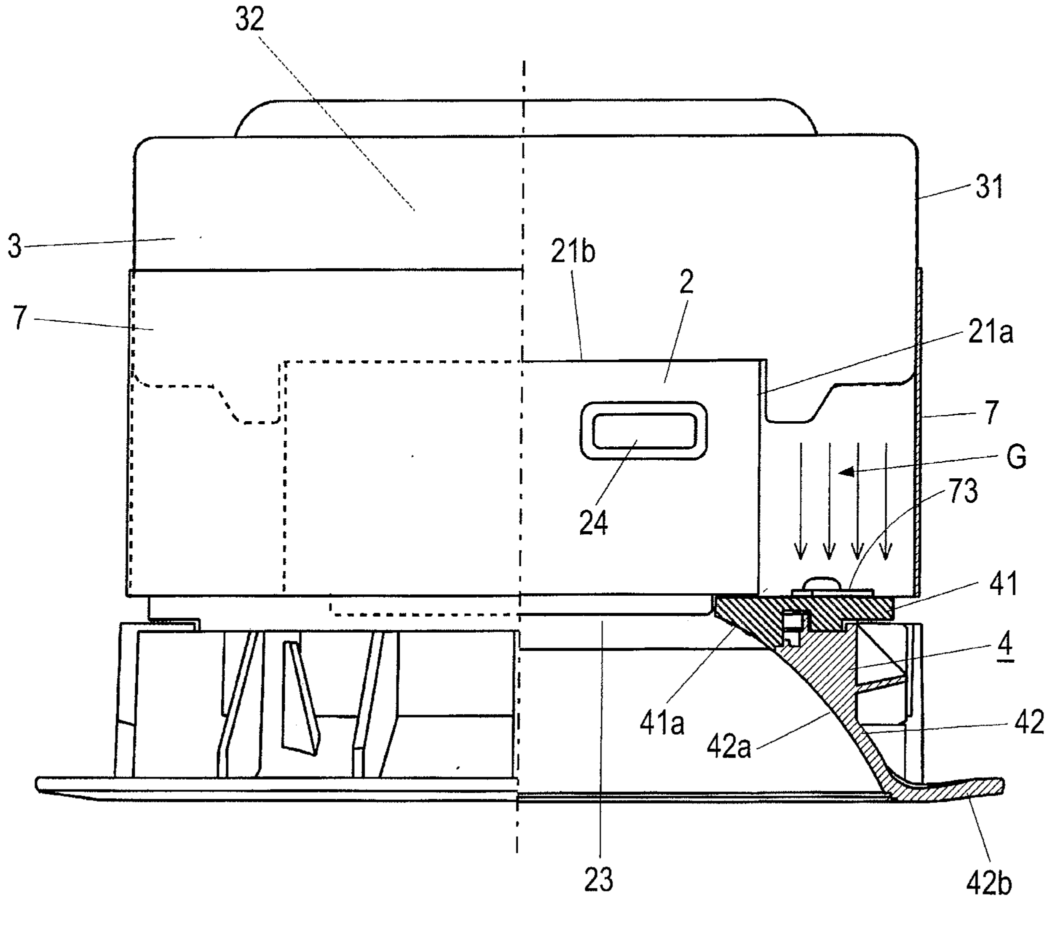


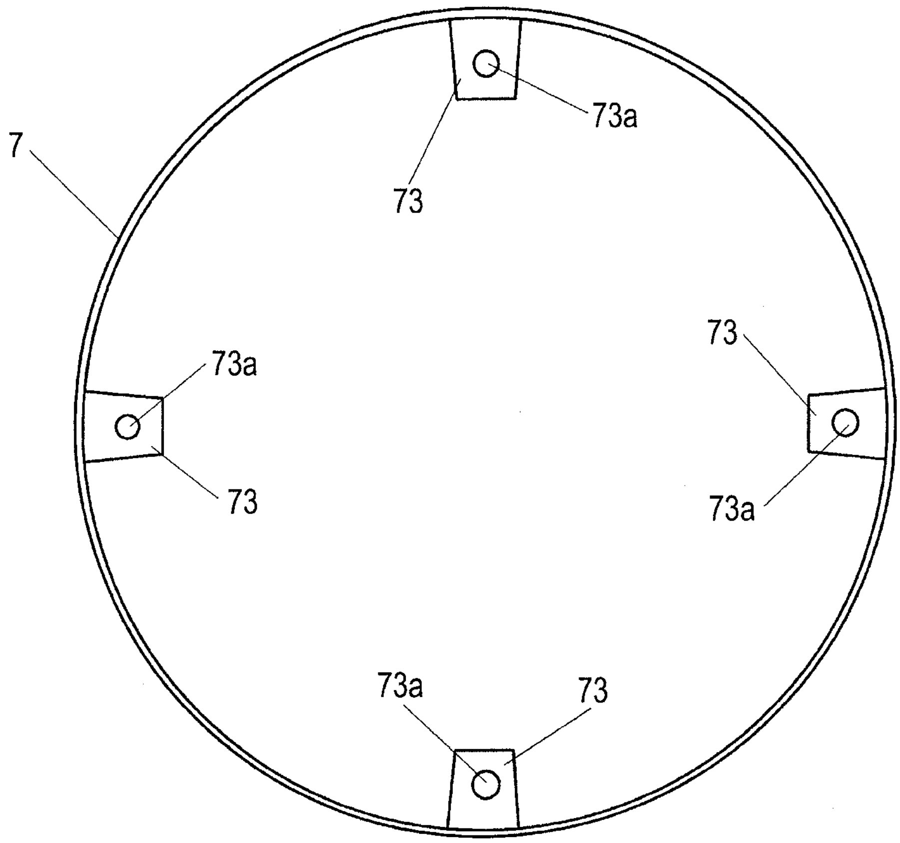
FIG. 11



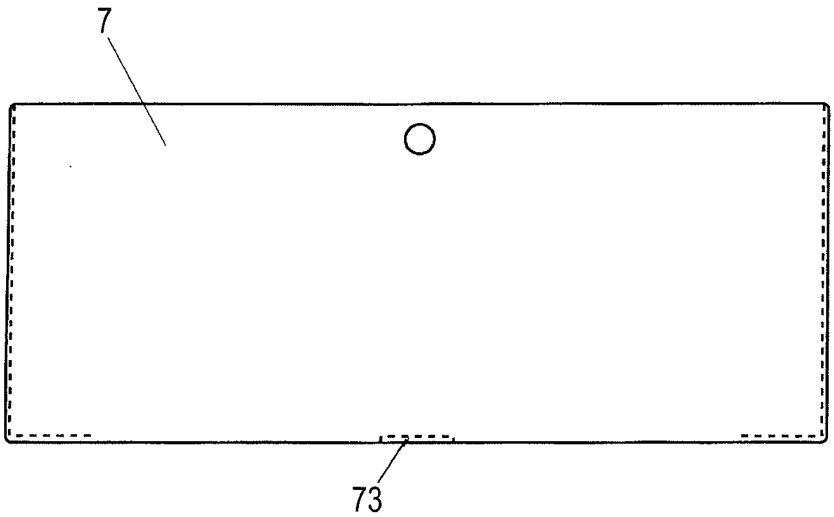
F I G. 12



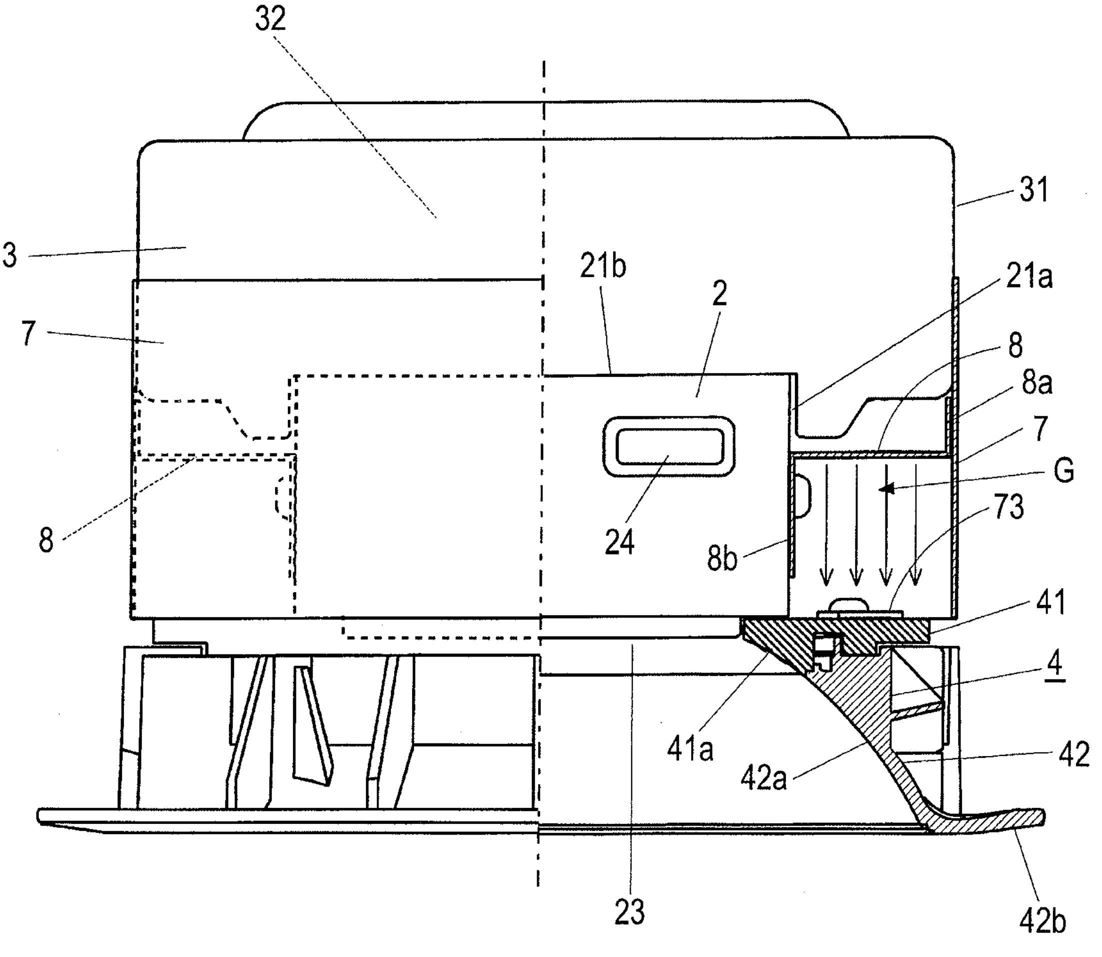
F I G. 13



F I G. 14



F I G. 15



F I G. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/067144

A. CLASSIFICATION OF SUBJECT MATTER
F21S8/02(2006.01)i, *F21V7/09*(2006.01)i, *F21V29/00*(2006.01)i, *F21V29/02*(2006.01)i, *F21Y101/02*(2006.01)n

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21S8/02, F21V7/09, F21V29/00, F21V29/02, F21Y101/02

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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.
Y	WO 2009/157370 A1 (Idemitsu Kosan Co., Ltd.), 30 December 2009 (30.12.2009), paragraphs [0017] to [0020]; fig. 2 & US 2011/0110107 A1 & EP 2299168 A1 & WO 2009/157370 A1	1-7
Y	JP 2010-161026 A (Toshiba Lighting & Technology Corp.), 22 July 2010 (22.07.2010), paragraphs [0021] to [0026]; fig. 1, 3 & US 2010/0165624 A1 & EP 2202446 A2	1-4
Y	JP 2007-5283 A (Hitachi Medical Corp.), 11 January 2007 (11.01.2007), paragraphs [0089] to [0091]; fig. 12 (Family: none)	1-4

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

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search	Date of mailing of the international search report
19 October, 2011 (19.10.11)	01 November, 2011 (01.11.11)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2011/067144

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 2003-132718 A (Matsushita Electric Works, Ltd.), 09 May 2003 (09.05.2003), paragraphs [0036] to [0041]; fig. 5, 6 (Family: none)	3,6
Y	JP 2009-152192 A (Foxsemicon Integrated Technology, Inc.), 09 July 2009 (09.07.2009), paragraph [0012]; fig. 1 & US 2009/0160344 A1	4,7
Y	JP 2008-108721 A (CCS Inc.), 08 May 2008 (08.05.2008), paragraphs [0019] to [0022], [0040] to [0041], [0048]; fig. 1, 6, 7 (Family: none)	5-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006172895 A **[0004]**
- JP 2008186776 A **[0004]**