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(54) ILLUMINATION DEVICE

(57) The present invention is an illumination device including light sources (20) using filaments (21), and in order to make it easy to control the light condensability and uniformity of light applied to an object, as well as to make it possible to protect connected parts such as sockets (20B), and to more flatten the intensity distribution of the light applied to the object, the illumination device is adapted to include: the multiple light sources (20) arrayed in one line or multiple lines; and a casing (10) that contains the light sources (20) and is formed with a light extraction opening X for extracting light from the light sources, in which the light sources (20) include: light emitting parts (20A) adapted to contain the filaments (21) in tubular containers (22); and the connected parts such as the sockets (20B) connected with the light emitting parts (20A), and are arranged in a posture in which light emitted from the outer circumferential surfaces (221) of the containers (22) is extracted through the light extraction opening X, and to further include shielding members (60) that cover at least parts of the sockets (20B) and shield light traveling toward the sockets (20B) after emission from the light emitting parts (20A).

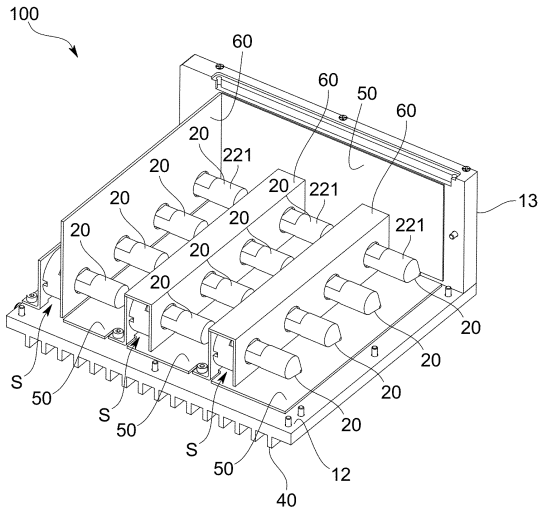

FIG. 2

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Description

Technical Field

[0001] The present invention relates to an illumination device.

Background Art

[0002] An illumination device including a light source using a filament, such as a halogen lamp, is superior to ones using LED light sources in emitting light having high intensity over a wide wavelength range up to an infrared range, and used for, for example, contamination inspection, appearance inspection, and the like together with an infrared camera.

[0003] As this sort of illumination device, as disclosed in Patent Literature 1, there is one in which multiple halogen lamps each adapted to contain a filament in a tubular container whose tip is sealed are arrayed in line. Specifically, this illumination device is configured to provide an ellipsoidal reflector at the back of each of the halogen lamps and also provide a reflective plate at the front to reflect light emitted from the halogen lamp toward an object while condensing the light.

[0004] However, in the case of the halogen lamp whose container tip is sealed, the light from the filament is refracted in an unexpected direction at the sealed part, thus making it difficult to control the light condensability of the light emitted from the halogen lamp and the uniformity of light applied to the object.

Citation List

Patent Literature

[0005] [Patent Literature 1]
Japanese Unexamined Utility Model Application Publication No. 56-60949

Summary of Invention

Technical Problem

[0006] Therefore, in the process of developing the present invention, the present inventor intermediately conceived a configuration in which tubular containers having sealed tips were arrayed in line in a state of being laid down and light emitted from the outer circumferential surfaces of the containers was guided to an object.

[0007] In such a configuration, light from filaments is emitted from the outer circumferential surfaces of the containers and guided to the object without being refracted in an unexpected direction, thus making it easy to control the light condensability and uniformity of light applied to the object.

[0008] Meanwhile, as described above, light sources using the filaments are configured to connect the containers containing the filaments to sockets and supply current to the filaments via the sockets, and therefore light over a wide wavelength range including infrared wavelengths produced by the light emission of the filaments is applied to the sockets.

[0009] As a result, there occur the problems that the sockets are damaged by heat and light having a specific wavelength among the light from the filaments is absorbed by the sockets to cause unevenness in the intensity distribution of the light applied to the object. Such problems are problems also occurring even when connecting the containers to connected parts such as electric cables and relay boards without the sockets.

[0010] Therefore, the present invention has been made in order to solve the above-described problems at once, and the main object thereof is to, in an illumination device including light sources using filaments, make it easy to control the light condensability and uniformity of light applied to an object, as well as make it possible to protect connected parts such as sockets from heat, and more flatten the intensity distribution of the light applied to the object.

Solution to Problem

[0011] That is, the illumination device according to the present invention is an illumination device including: multiple light sources arrayed in one line or multiple lines; and a casing that contains the light sources and is formed with a light extraction opening for extracting light from the light sources, in which the light sources include light emitting parts adapted to contain filaments in tubular containers and connected parts connected with the light emitting parts, and are arranged in a posture in which light emitted from the outer circumferential surfaces of the containers is extracted through the light extraction opening, and the illumination device further includes a shielding member that covers at least parts of the connected parts and shields light traveling toward the connected parts after emission from the light emitting parts. Note that the term "light traveling toward the connected parts" here includes not only light traveling toward the connected parts directly from the light emitting parts but also light traveling toward the connected part after reflection by surrounding members.

[0012] In the illumination device configured as described, since the light sources are arranged in the posture in which the light emitted from the outer circumferential surfaces of the containers is extracted through the light extraction opening, even when the tips of the containers are sealed, light from the filaments is emitted from the outer circumferential surfaces of the containers and guided to an object without being refracted in unexpected directions. This makes it easy to control the light condensability and uniformity of light applied to the object.

[0013] In addition, since the shielding member covers at least parts of the connected parts and shields the light traveling toward the connected parts from the light emit-

ting parts, the connected parts can be protected from heat, and light having a specific wavelength is not absorbed by the connected parts, making it possible to flatten the intensity distribution of the light applied to the object.

[0014] It is preferable that in a state where electric cables for supplying current to the filaments are connected to the connected parts, the shielding member covers at least parts of the electric cables and shields light traveling toward the electric cables after the emission from the light emitting parts. Note that the term "light traveling toward the electric cables" here includes not only light traveling toward the electric cables directly from the light emitting parts but also light traveling toward the electric cables after reflection by surrounding members.

[0015] In such a configuration, the electric cables can be protected from heat.

[0016] It is preferable that the shielding member is an elongated one extending along an array direction of the light sources, and covers the connected parts of the respective light sources included in the one line. In such a configuration, as compared with a configuration that, for example, provides shielding members to the respective light sources, the number of parts can be reduced, facilitating device assembly.

[0017] It is preferable that the shielding member is fixed to the casing, and the connected parts are attached to the shielding member.

[0018] In such a configuration, the need to separately provide members for fixing the connected parts can be eliminated to simplify a device configuration.

[0019] It is preferable that the shielding member forms a containing space that contains the connected parts and with respect to which air can flow in/out.

[0020] In such a configuration, air inside the casing and air outside the casing flow into the containing space, and therefore the air can cool the connected parts to surely protect the connected parts from heat.

[0021] It is preferable that the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which the outer circumferential surfaces of the containers are opposite to the light extraction opening.

[0022] In such a configuration, even if the light from the filaments is refracted in unexpected directions at sealed parts of the containers, the light extracted through the light extraction opening is hardly affected by this, and the light condensability and uniformity of the light extracted through the light extraction opening can be further improved.

[0023] Specific embodiments include a configuration in which the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which an array direction and axial directions of the containers are orthogonal to each other.

[0024] More specifically, it is preferable that the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which the tips of the containers face in mutually the same direction.

[0025] In such arrangement, the shielding member and the electric cables can be put together on one side, making it possible to simplify the overall configuration and facilitate wiring.

[0026] On the other hand, as described above, when the light sources are arranged in the posture in which the tips of the containers face in mutually the same direction, narrowing the interval between mutually adjacent light sources may cause the interference between the sockets of the light sources, and therefore it is necessary to keep the distance between the light sources to the extent that the sockets do not interfere. As a result, the unevenness of illumination intensity in the longer direction of linear light occurs.

[0027] For this reason, it is preferable that the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which the tips of containers of mutually adjacent light sources along an array direction face in mutually opposite directions.

[0028] In such arrangement, between mutually adjacent light sources arrayed facing in some direction, each of light sources arrayed facing in the opposite direction to that direction can be arranged, and therefore the arrangement interval between light sources can be narrowed, making it possible to reduce the unevenness of illumination intensity in the longer direction of linear light.

[0029] It is preferable that the light sources are ones that emit light including an infrared wavelength, and the shielding member is formed of material that reflects light having an infrared wavelength.

[0030] In such a configuration, the output power of the infrared light extracted through the light extraction opening can be improved.

Advantageous Effects of Invention

[0031] According to the present invention configured as described, in the illumination device including the light sources using filaments, it is achieved to make it easy to control the light condensability and uniformity of light applied to an object, as well as reduce heat damage to the connected parts such as the sockets, and make it possible to more flatten the intensity distribution of the light applied to the object.

Brief Description of Drawings

[0032]

[Fig. 1]
Fig. 1 a perspective view illustrating the configuration of an illumination device in the present embodiment.
[Fig. 2]
Fig. 2 is a perspective view illustrating the internal configuration of a casing of the illumination device in the present embodiment.
[Fig. 3]
Fig. 3 is a plan view illustrating the configuration and

arrangement of light sources in the present embodiment.

[Fig. 4]

Fig. 4 is a cross-sectional view illustrating the internal configuration of the casing of the illumination device in the present embodiment.

[Fig. 5]

Fig. 5 is a perspective view illustrating the internal configuration of the casing of the illumination device in the present embodiment.

[Fig. 6]

Fig. 6 is a plan view illustrating the configuration of a light source in another embodiment.

[Fig. 7]

Fig. 7 is a plan view illustrating the configuration of light sources in another embodiment.

[Fig. 8]

Fig. 8 is a cross-sectional view illustrating the internal configuration of a casing of an illumination device in one other embodiment.

[Fig. 9]

Fig. 9 is a perspective view illustrating the surrounding configuration of light sources in the one other embodiment. Description of Embodiments

[0033] In the following, one embodiment of the illumination device according to the present invention will be described with reference to drawings.

[0034] An illumination device 100 according to the present embodiment is one used to, for example, perform contamination inspection, appearance inspection, or the like using an infrared camera, and a surface light emitting device that applies light having infrared wavelengths (hereinafter referred to as infrared light) to an inspection object.

[0035] In addition, as the infrared camera, for example, a hyperspectral camera that includes a spectroscope to be able to acquire information over a wide wavelength range is preferable, but other various types of ones can be used.

[0036] Specifically, as illustrated in Fig. 1 and Fig. 2, the illumination device 100 includes: a casing 10 formed with a light extraction opening X; and multiple light sources 20 contained in the casing 10. In addition, Fig. 2 illustrates the internal configuration of the casing 10, but omits the illustration of the below-described electric cables EL.

[0037] The casing 10 is one that is formed in, for example, a substantially rectangular parallelepiped shape and whose one surface (upper plate 11) is formed with the light extraction opening X, and here the light extraction opening X is provided with a diffuser plate 30 having transparency. In addition, instead of the diffuser plate 30, the light extraction opening X may be provided with a light transmissive window allowing light to transmit without diffusing the light.

[0038] Also, the back surface (outer surface) of a bottom plate 12 on the opposite side to the light extraction opening X is provided with a heat radiating member 40 such as heat radiating fins for radiating heat from the light sources 20, and the front surface (inner surface) of the bottom plate 12 is provided with a reflective plate 50 that reflects infrared light. Further, in the present embodiment, at least part of the inner surfaces of side plates 13 of the casing 10 is provided with a reflective plate 50. In addition, a reflective plate 50 is not necessarily provided on the bottom plate 12 or the side plate 13.

[0039] As illustrated in Fig. 2, the light sources 20 are arranged in lines in the casing 10, and specifically, as illustrated in Fig. 3, are so-called halogen lamps each having: a light emitting part 20A adapted to contain a filament 21 in a tubular container 22 whose tip is sealed; and a socket 20B as a connected part connected with the light emitting part 20A.

[0040] Describing more specifically, the filament 21 is one that is adapted to wind a conductive wire and emits light while generating Joule heat when supplied with current. The filament 21 here extends in a direction perpendicular to an axial direction of the container 22, and from both ends thereof, lead-in wires 23 extend. The lead-in wires 23 are respectively connected to terminals 24 led out of the container 22, and by inserting the respective terminals 24 into the socket 20B, the light emitting part 20A and the socket 20B are connected.

[0041] The container 22 is one that is called a bulb made of glass and formed in a cylindrical and tapered shape, and the fore end thereof is provided with a tip 25 formed when a fore end opening was sealed by glass fusion or the like. Also, a back end opening is sealed by a flat sealing member 26.

[0042] The socket 20B is a blockish one formed with unillustrated insertion ports connected with the terminals 24, and here configured to be inserted with the light emitting part 20A along the axial direction of the container 22. Specifically, as viewed in the axial direction of the container 22, the socket 20B is formed in a cylindrical shape whose diameter is, for example, larger than the container 22 so that the socket 20B protrudes outward of the container 22, and a mounting surface 27 opposite to the light emitting part 20A is formed with the insertion ports. The socket 20B is connected with the electric cables EL for supplying current to the filament 21, and as illustrated in Fig. 1, the electric cables EL are led out of the casing through a through-hole 1h formed in a side plate 13 of the casing 10 in a state where, for example, multiple cables are bundled, and connected to an unillustrated power supply.

[0043] As illustrated in Fig. 2, the above-described light sources 20 are arrayed in mutually parallel multiple lines, and multiple light sources 20 arrayed in each of the lines are arranged in a posture in which the outer circumferential surfaces 221 of their containers 22 are opposite to the light extraction opening X. Describing in more detail, the respective light sources 20 are arranged in a posture in which the axial directions of the container 22 and a plane direction of the light extraction opening X (a direction perpendicular to the normal direction of the light ex-

traction window X) are parallel.

[0044] In addition, the axial directions of the container 22 are not necessarily required to be parallel to the plane direction of the light extraction opening X, but may be tilted with respect to the light extraction opening X.

[0045] In the present embodiment, the respective light sources 20 arrayed in lines are arranged in a posture in which an array direction and the axial directions of the containers 22 are orthogonal, i.e., arranged so that the filaments 21 of the respective light sources 20 extend along the array direction, and the axial directions of the respective containers 22 are mutually parallel. Also, the respective light sources 20 arrayed in lines are arranged in a posture in which the tips of the containers 22 face in mutually the same direction, i.e., in a posture in which the tips and back ends of the respective containers 22 are respectively positioned in straight lines along the array direction.

[0046] In addition, the filaments 21 are not necessarily required to extend along the array direction but may extend in a direction tilted with respect to the array direction. Also, the axial directions of the respective containers 22 are not necessarily required to be all mutually parallel.

[0047] In addition, as illustrated in Fig. 4, the illumination device 100 of the present embodiment is adapted to further include shielding members 60 that cover at least parts of the sockets 20B and shield light traveling toward the sockets 20B after emission from the light emitting parts 20A.

[0048] The shielding members 60 are made of material that reflects infrared light without transmitting it. In addition, the reflection includes specular reflection and diffuse reflection.

[0049] As illustrated in Fig. 2 and Fig. 4, the shielding members 60 of the present embodiment are ones whose at least parts interpose between the mounting surfaces 27 of the sockets 20B and the containers 22 to cover the mounting surfaces 27, and formed in an elongated shape extending along the array direction of the light sources 20. The shielding members 20 are provided for the respective lines of the light sources 20 arranged in lines, and each of the shielding members 60 is configured to cover sockets 20B of all light sources 20 included in a corresponding line.

[0050] The shielding members 60 are ones that form containing spaces S containing the sockets 20B and whose cross sections are formed in a rectangular shape opening downward. Specifically, as illustrated in Fig. 4, each of the shielding members 60 has: a front wall 61 that covers mounting surfaces 27 of corresponding sockets 20B; a back wall 62 that is opposite to the front wall 61 and provided at the back of the sockets 20B; and an upper wall 63 that interposes between the front wall 61 and the back wall 62 and is provided above the sockets 20B. In addition, the front wall 61, back wall 62, and upper wall 63 may be integrally formed or separate members; however, here, the front wall 61 and the upper wall 63 are integrally formed, and the back wall 62 is configured as a separate body from them. Also, the shielding member 60 is not necessarily required to have the front wall 61, the back wall 62, or the upper wall 63, but as long as it has at least the front wall 61, may be one not having, for example, the upper wall 63 as with a shielding member 60 illustrated in the last line in Fig. 2 and Fig. 4 or one not having the upper wall 63 and the back wall 62 although not illustrated.

[0051] The front wall 61 is a flat plate-like one formed with through-holes 6h inserted with corresponding light emitting parts 20A, and here the multiple through-holes 6h are formed along the longer direction, for example, at regular intervals. These through-holes 6h are formed at positions respectively corresponding to the light emitting parts 20A of the respective light sources 20 arrayed in line, and by inserting the light sources 20 into the respective through-holes 6h from the tips thereof, the front wall 61 is arranged in a state of being opposite to the mounting surfaces 27 of the sockets 20B.

[0052] In the present embodiment, as described above, since the upper wall 63 and the front wall 61 are integrally provided, by arranging the front wall 61 close to the mounting surfaces 27 of the sockets 20B, the upper wall 63 is arranged above the sockets 20B.

[0053] The back wall 62 is a flat plate-like one provided in parallel with the front wall 61, and the lower end part thereof is formed with a flange part that is bent along the bottom surface of the casing 10. In addition, by attaching the flange part on the bottom surface of the casing 10 using screws or the like, the shielding member 60 is fixed to the casing 10.

[0054] In the present embodiment, a surface of the back wall 62 opposite to the front wall 61 is attached with the sockets 20B via screws or the like, and the shielding member 60 is also used for fixing the sockets 20B and for positioning the sockets 20B.

[0055] A space surrounded by the above-described front wall 61, back wall 62, and upper wall 63 is a containing space S, and the containing space S here is configured to enable air to flow in/out without being sealed. Specifically, as illustrated in Fig. 2, one end or both ends of the shielding member 60 in its longer direction is opened without being blocked, and air inside the casing 10 is configured to flow in/out with respect to the containing space S through the one end opening or both end openings.

[0056] In the present embodiment, one ends of the shielding members 60 in their longer direction are opened, and the other ends are partially blocked by the above-described reflective plate 50. In addition, as illustrated in Fig. 5, the reflective plate 50 is formed with through-holes 5h for passing the electric cables EL, and the electric cables EL wired along between the reflective plate 50 and the inner surface of the casing 10 are configured to be insertable into the containing spaces S through the through-holes 5h. That is, the containing spaces S in the present embodiment contain at least parts of the electric cables EL, and the shielding members

60 are configured to cover at least parts of the electric cables EL and shield light traveling toward the electric cables EL after emission from the light emitting parts 20A.

[0057] According to the illumination device 100 of the present embodiment configured as described, the light sources 20 are arranged in a posture in which the light emitted from the outer circumferential surfaces 221 of the containers 22 are extracted through the light extraction opening X, and therefore the light from the filaments 21 is emitted from the outer circumferential surfaces 221 of the containers 22 and guided to the object without being refracted in unexpected directions. This makes it easy to control the light condensability and uniformity of light applied to the object.

[0058] In addition, since the shielding members 60 cover the sockets 20B to shield the light emitted from the light emitting parts 20A, the sockets 20B can be protected from heat, and light having a specific wavelength is not absorbed by the sockets 20B, making it possible to flatten the intensity distribution of the light applied to the object.

[0059] Also, since the shielding members 60 cover the electric cables EL to shield the light emitted from the light emitting parts 20A, the electric cables EL can be protected from heat.

[0060] Further, since the shielding members 60 are elongated ones extending along the array direction of the light sources 20 and the shielding members 60 are provided corresponding to the respective lines, as compared with a configuration that provides shielding members 60 to the respective light sources 20, the number of parts is small and device assembly is easy.

[0061] In addition, since the shielding members 60 are fixed to the casing 10 and the sockets 20B are attached to the shielding members 60, the need to separately provide members for fixing and positioning the sockets 20B can be eliminated to simplify a device configuration.

[0062] In further addition, since the containing spaces S are configured so that air can flow in/out, air inside the casing 10 and air outside the casing 10 flow into the containing spaces S. This makes it possible to cool the sockets 20B, and the sockets 20B can be surely protected from heat.

[0063] In addition, since the multiple light sources 20 arrayed in lines are arranged in the posture in which the outer circumferential surfaces 221 of the container 22 are opposite to the light extraction opening X, even if the light from the filaments 21 are refracted in unexpected directions at the sealed parts of the containers 22, the light extracted through the light extraction opening X are hardly affected by this, making it possible to further improve the light condensability and uniformity of the light extracted through the light extraction opening X.

[0064] Also, since the multiple light sources 20 arrayed in lines are arranged in the posture in which the tips of the containers 22 face in mutually the same direction, the shielding members 60 and the electric cables EL can be put together on one sides of the containers 22 in their axial directions, making it possible to simplify the overall configuration and facilitate wiring.

[0065] Further, since the shielding members 60 are formed of material that reflects light having infrared wavelengths, the output power of the infrared light extracted through the light extraction opening X can be improved.

[0066] Note that the present invention is not limited to the above-described embodiment.

[0067] For example, the illumination device is described in the above-described embodiment as a surface light emitting device in which the light sources are arrayed in multiple lines, but may be configured as a linear light illumination device in which light sources are arrayed in one line.

[0068] Also, in the above-described embodiment, the shielding members are elongated ones, and each of them is configured to cover sockets of all light sources included in one line; however, the shape and arrangement of the shielding members may be appropriately changed, such as providing one shielding member to one light source.

[0069] Further, the shielding members in the above-described embodiment are ones whose cross sections are of a rectangular shape opening downward; however, the cross sectional shape may be appropriately changed, such as a semicircular shape, elliptical shape, or triangular shape opening downward.

[0070] Also, the shielding members in the above-described embodiment are arranged so as to shield light traveling toward the sockets directly after emission from the light sources, but may be arranged so as to shield light traveling toward the sockets after reflection by surrounding members such as the diffuser plate provided to the light extraction opening.

[0071] In the above-described embodiment, the sockets are attached to the shielding members; however, for example, the sockets may be attached to the bottom surface of the casing or attached to members different from the shielding members.

[0072] Also, the sockets 20B in the above-described embodiment are configured to be inserted with the light emitting parts 20A along the axial directions of the containers 22; however, the insertion directions of the light emitting parts 20A do not have to be along the axial directions, but may be changed to have various configurations.

[0073] Further, the light sources in the above-described embodiment are described as ones whose filaments extend in directions perpendicular to the axial directions of the containers; however, as illustrated in Fig. 6, the filaments 21 may be ones extending along the axial directions of the containers 22.

[0074] Also, in the above-described embodiment, the respective light sources arrayed in lines are arranged in the posture in which the tips of the containers face in mutually the same direction; however, as illustrated in Fig. 7, the arrangement may be made in a posture in which the tips of containers 22 of mutually adjacent light sources 20 along the array direction face in mutually opposite directions.

[0075] In such a configuration, between mutually adjacent light sources 20 arrayed facing in some direction, each of light sources 20 arrayed in the opposite direction to that direction can be arranged, and therefore the arrangement interval between mutually adjacent light sources 20 can be narrowed without interference between corresponding sockets 20B, making it possible to reduce the unevenness of illumination intensity in the longer direction of linear light.

[0076] Also, as the illumination device 100 according to the present invention, as illustrated in Fig. 8 and Fig. 9, a reflective plate 50 as a reflective member provided opposite to the light extraction opening X may be provided integrally with a shielding member 60.

[0077] Describing more specifically, as in the above-described embodiment, the shielding member 60 includes a front wall 61, back wall 62, and upper wall 63, and here the back wall 62 is provided integrally with the reflective plate 50. In addition, the front wall 61 may be provided integrally with the reflective plate 50.

[0078] Further, the reflective plate 50 and the shielding member 60 are further integrated with the light sources 20. Specifically, sockets 20B constituting corresponding ones of the light sources 20 are connected to the shielding member 60 by screws or the like. In doing so, the light sources 20, the reflective plate 50, and the shielding member 60 constitute a unit structure Z in which they are unitized. Here, the multiple light sources 20 arrayed along a direction orthogonal to the light axes of the light sources 20, and the reflective plate 50 and shielding member 60 provided corresponding to the multiple light sources 20 constitute the unit structure Z.

[0079] As illustrated in Fig. 9, the unit structure Z is supported by support members 70. The support members 70 are ones that support the unit structure Z separately from a surface (bottom plate 12) opposite to the light extraction opening X of a casing toward the light extraction opening X side. The support members 70 here support the light sources 20, but may support the reflective plate 50 or the shielding member 60. Also, Fig. 9 illustrates the two support members 70; however, the number of the support members 70 is not limited to this, but may be one or three or more.

[0080] By arranging the unit structure Z separately from the bottom plate 12 as described, a second containing space S2 that contains, for example, a circuit board C, unillustrated electric cables, and the like is formed between the unit structure Z and the bottom plate 12. In addition, the circuit board C here is supported by the support members 70 and constitutes part of the unit structure Z.

[0081] Since in the illumination device 100 configured as described, the reflective plate 50 and the shielding member 60 are integrated, by attaching them to the light sources 20, the reflective plate 50 is arranged around the light sources 20 and also a structure in which the sockets 20B is shielded by the shielding member 60 can be obtained, improving assemblability. In addition, the unit structure Z is constituted in which the light sources 20, the reflective plate 50, the shielding member 60, and the circuit board C are unitized, thus making it possible to simplify a structure and further improve assemblability.

[0082] Describing further another embodiment, the light sources in the above-described embodiment are arranged in the posture in which the outer circumferential surfaces of the containers are opposite to the light extraction opening, and light emitted from each of the light sources is configured to directly travel toward the light extraction opening; however, the light emitted from each of the light sources may be configured to be made to travel toward the light extraction opening using, for example, a reflective mirror or the like.

[0083] In further addition, the illumination device of the present embodiment may be further provided with a relay board connected with multiple light sources arranged in line.

[0084] Specifically, the relay board is one electrically connected with electric cables connected to the sockets of the respective light sources, and for example, by providing the relay board in the containing space S, protection from heat can be provided.

[0085] Also, in the above-described embodiment, a configuration in which the light emitting parts are connected to the sockets is described; however, the light emitting parts may be connected with the electric cables without the sockets or the light emitting parts may be connected to relay boards. In such a case, the electric cables and the relay boards serve as the connected parts.

[0086] In addition, the illumination device in the above-described embodiment includes halogen lamps used for inspection applications; however, without limitation to the inspection applications, they may be used for a general purpose or the like, and besides the halogen lamps, Krypton lamps, incandescent lamps, UV lamps, or the like may be included.

[0087] Besides, the present invention is not limited to the above-described embodiments but can be variously modified without departing from the scope thereof.

Reference Signs List

[0088]

100 Illumination device
EL: Electric cables
10 Casing
X Light extraction opening
20 Light source
21 Filament
22 Container
221 Outer circumferential surface
20A Light emitting part
20B Socket
25 Tip
60 Shielding member
S Containing space

Industrial Applicability

[0089] According to the present invention, in the illumination device including the light sources using the filaments, it is possible to make it easy to control the light condensability and uniformity of light applied to an object, as well as to protect the connected parts such as the sockets from heat, and to more flatten the intensity distribution of the light applied to the object.

Claims

1. An illumination device comprising: multiple light sources arrayed in one line or multiple lines; and a casing that contains the light sources and is formed with a light extraction opening for extracting light from the light sources, wherein
the light sources include light emitting parts adapted to contain filaments in tubular containers and connected parts connected with the light emitting parts, and are arranged in a posture in which light emitted from outer circumferential surfaces of the containers is extracted through the light extraction opening,
the illumination device further comprising a shielding member that covers at least parts of the connected parts and shields light traveling toward the connected parts after emission from the light emitting parts.

2. The illumination device according to claim 1, wherein in a state where electric cables for supplying current to the filaments are connected to the connected parts, the shielding member covers at least parts of the electric cables and shields light traveling toward the electric cables after the emission from the light emitting parts.

3. The illumination device according to claim 1, wherein the shielding member is an elongated one extending along an array direction of the light sources, and covers the connected parts of the respective light sources included in the one line.

4. The illumination device according to claim 1, wherein the shielding member is fixed to the casing, and the connected parts are attached to the shielding member.

5. The illumination device according to claim 1, wherein the shielding member forms a containing space that contains the connected parts and with respect to which air can flow in/out.

6. The illumination device according to claim 1, wherein the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which the outer circumferential surfaces of the containers are opposite to the light extraction opening.

7. The illumination device according to claim 1, wherein the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which an array direction and axial directions of the containers are orthogonal to each other.

8. The illumination device according to claim 1, wherein the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which tips of the containers face in mutually a same direction.

9. The illumination device according to claim 1, wherein the multiple light sources arrayed in one line or multiple lines are arranged in a posture in which tips of containers of mutually adjacent light sources along an array direction face in mutually opposite directions.

10. The illumination device according to claim 1, wherein the light sources are ones that emit light including an infrared wavelength, and
the shielding member is formed of material that reflects light having an infrared wavelength.

11. The illumination device according to claim 1, further comprising
a reflective member that is provided opposite to the light extraction opening and reflects the light emitted from the light emitting parts, wherein
the reflective member is provided integrally with the shielding member.

12. The illumination device according to claim 11, wherein
the light sources, the reflective member, the shielding member, and a circuit board that controls the light sources constitute a unit structure in which they are integrated.

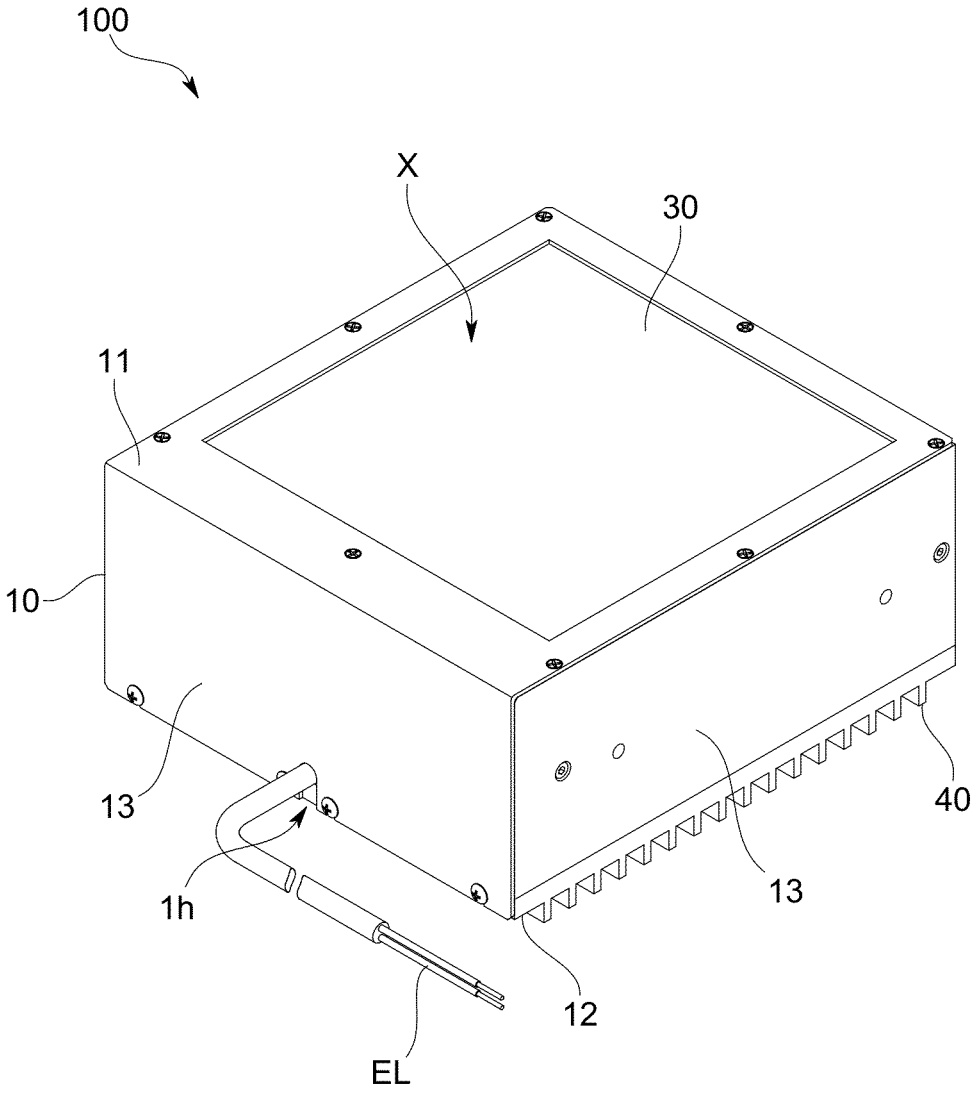

FIG. 1

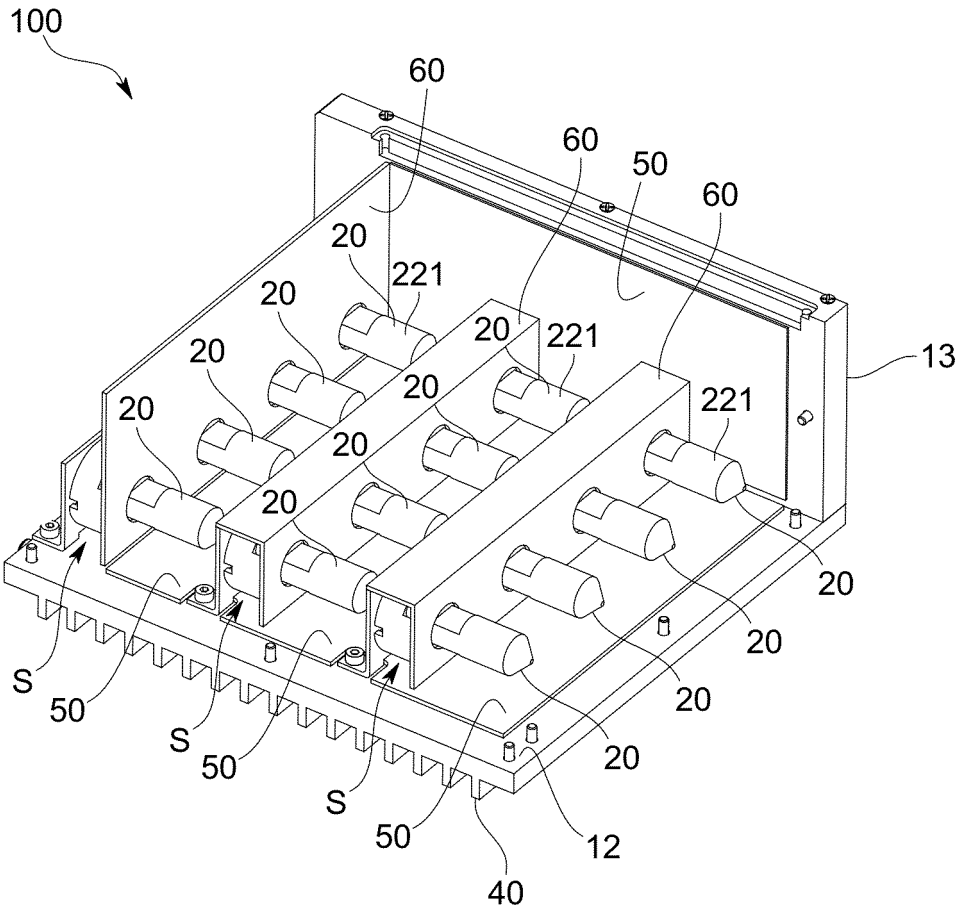
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FIG. 2

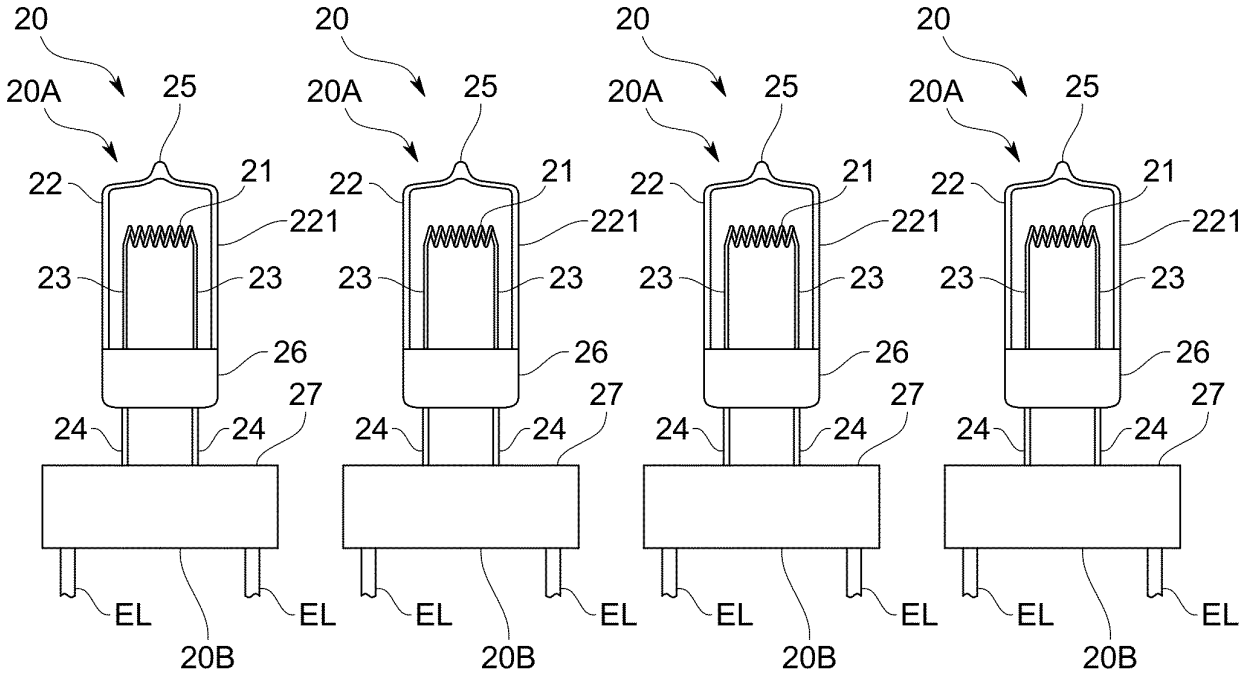
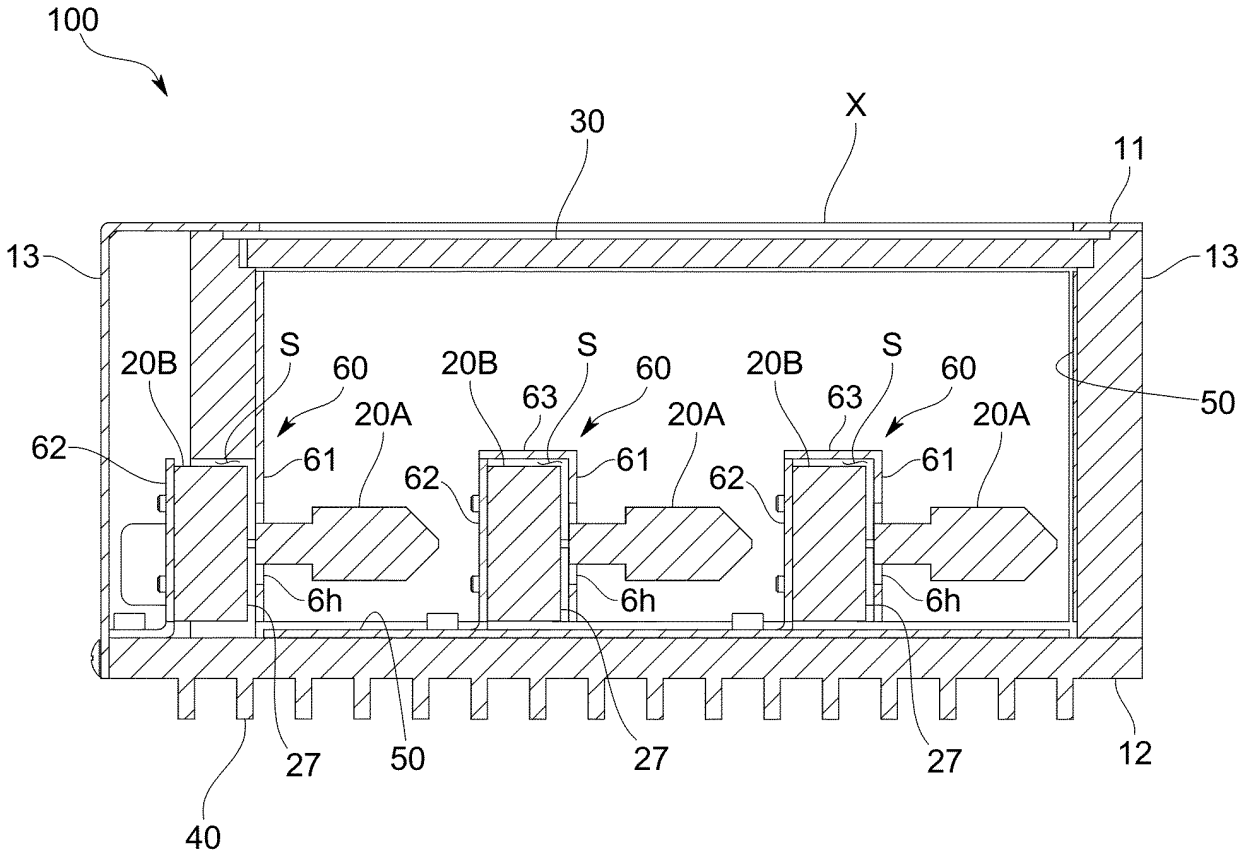


FIG. 3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12
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FIG. 4

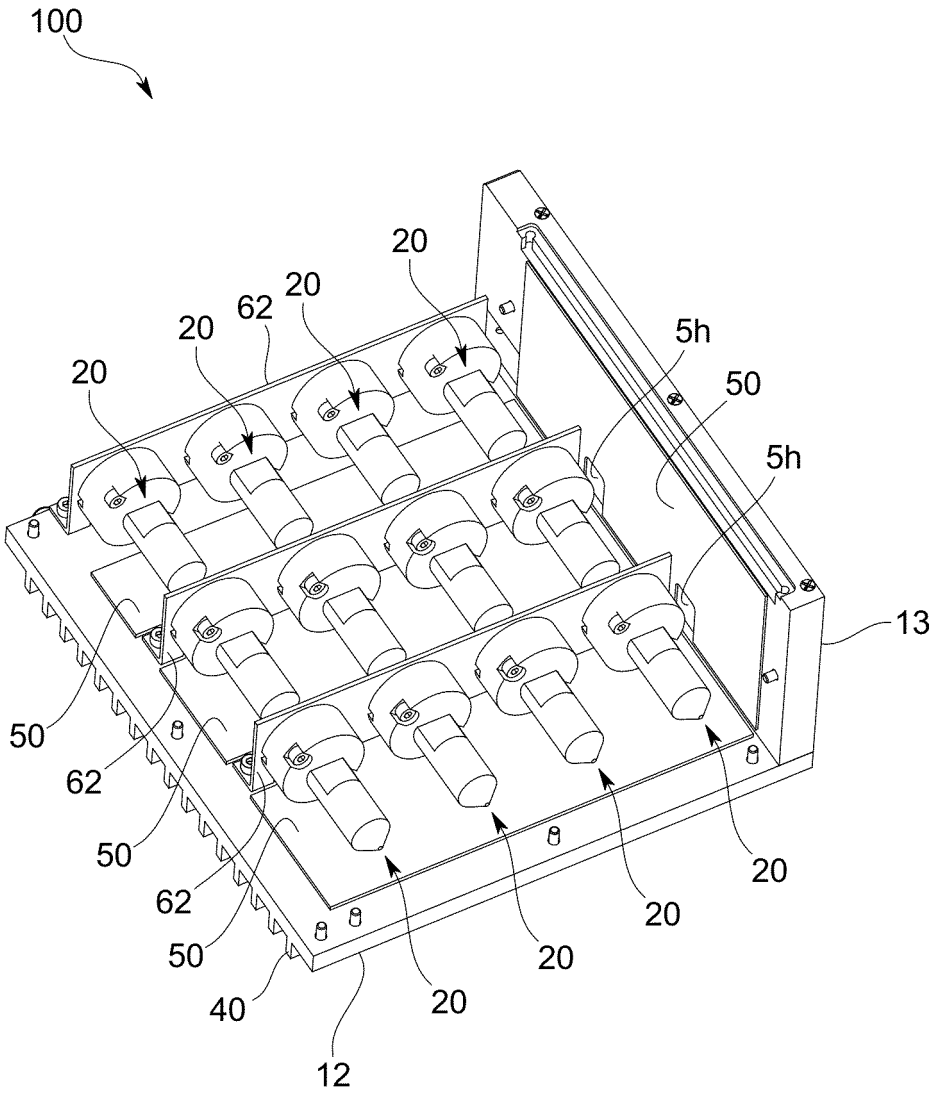

FIG. 5

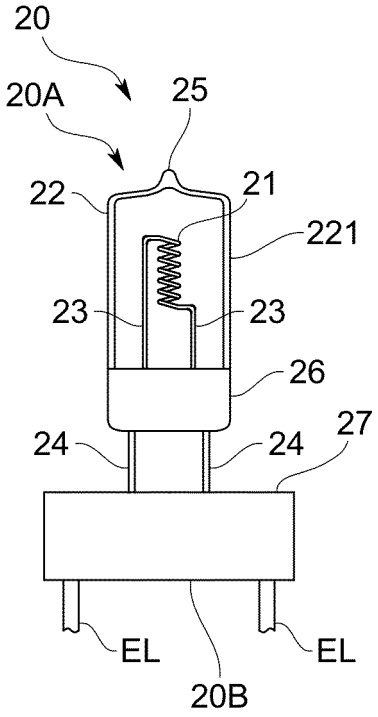

FIG. 6

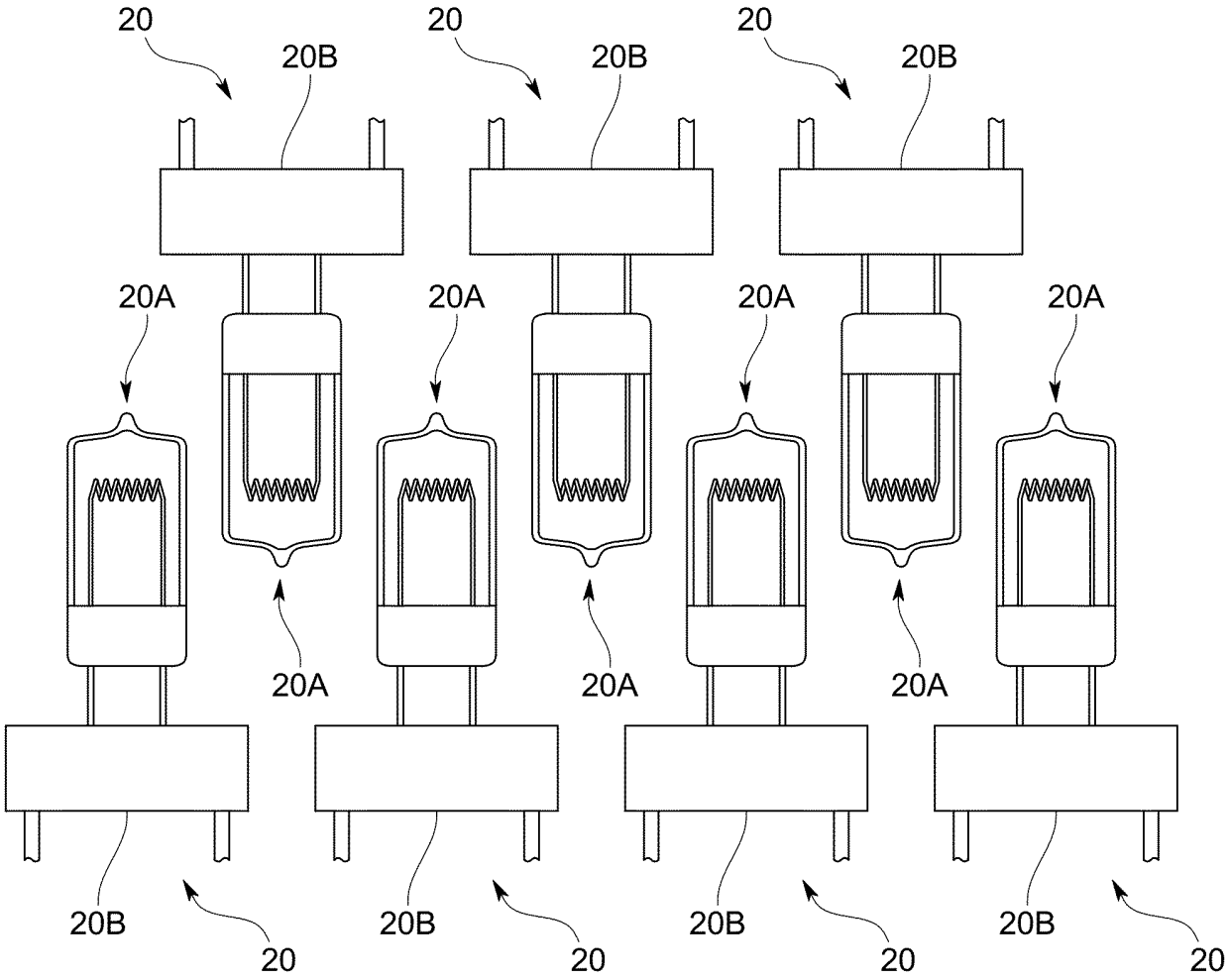
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FIG. 7

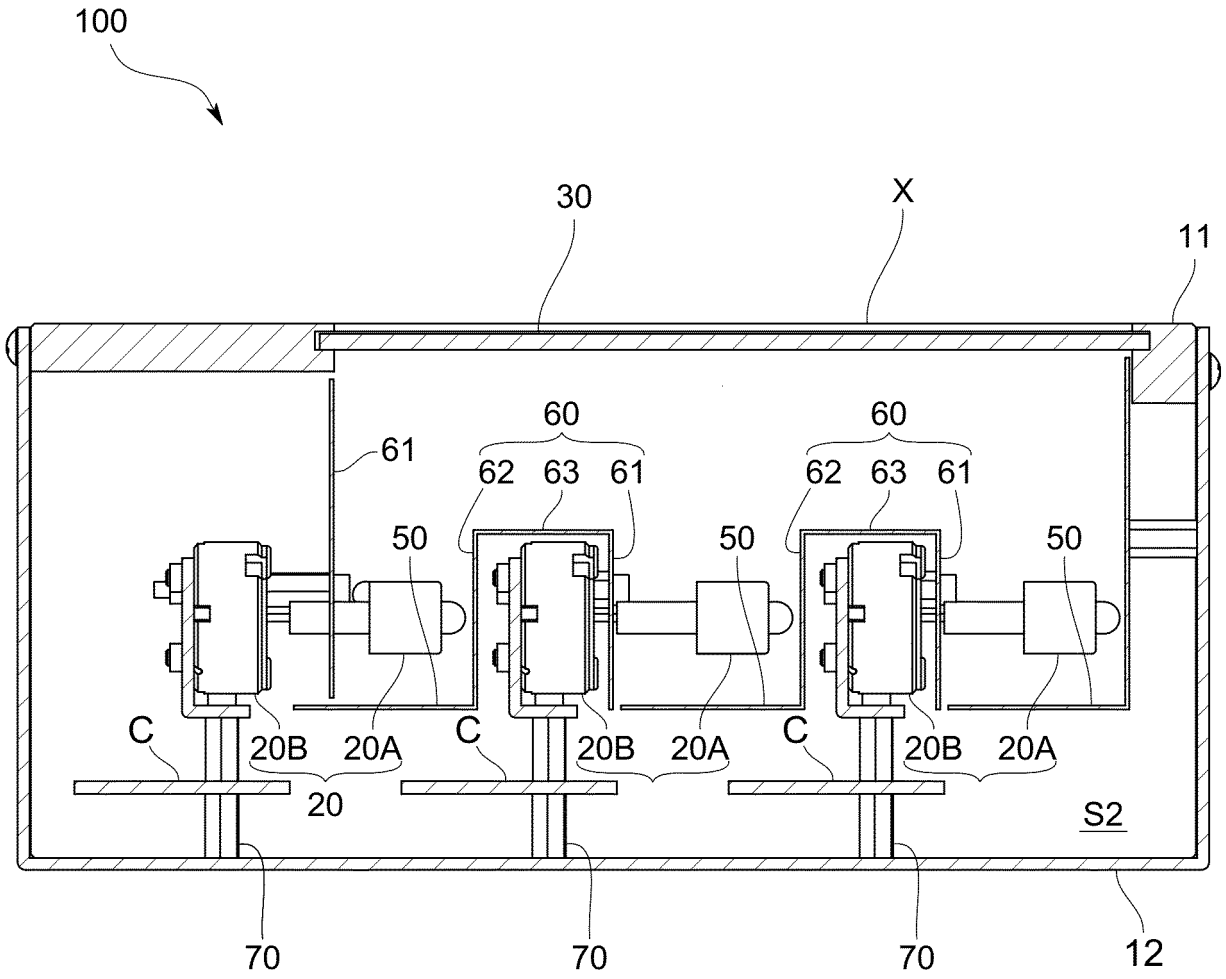
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FIG. 8

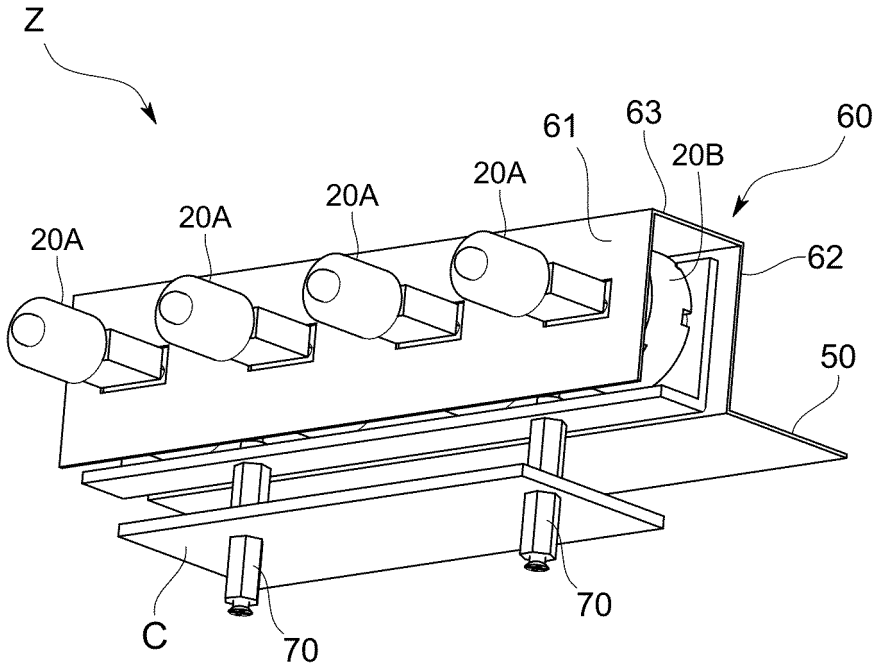

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/022336

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F21S2/00(2016.01)i, F21V7/00(2006.01)i, F21V7/24(2018.01)i, F21V9/04(2018.01)i, F21V23/00(2015.01)i, F21V29/15(2015.01)i, F21V29/83(2015.01)i, F21Y101/00(2016.01)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)
Int.Cl. F21S2/00, F21V7/00, F21V7/24, F21V9/04, F21V23/00, F21V29/15, F21V29/83, F21Y101/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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.
X Y A	JP 2006-147438 A (LEL KK) 08 June 2006, paragraphs [0016]-[0037], fig. 1-3 (Family: none)	1-6, 11 12 7-10
Y A	JP 2011-8979 A (IWASAKI ELECTRIC CO., LTD.) 13 January 2011, paragraphs [0012]-[0036], fig. 1-4 (Family: none)	12 1-11

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

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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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
"&" document member of the same patent family

Date of the actual completion of the international search 01 August 2018 (01.08.2018)	Date of mailing of the international search report 14 August 2018 (14.08.2018)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 56060949 A **[0005]**